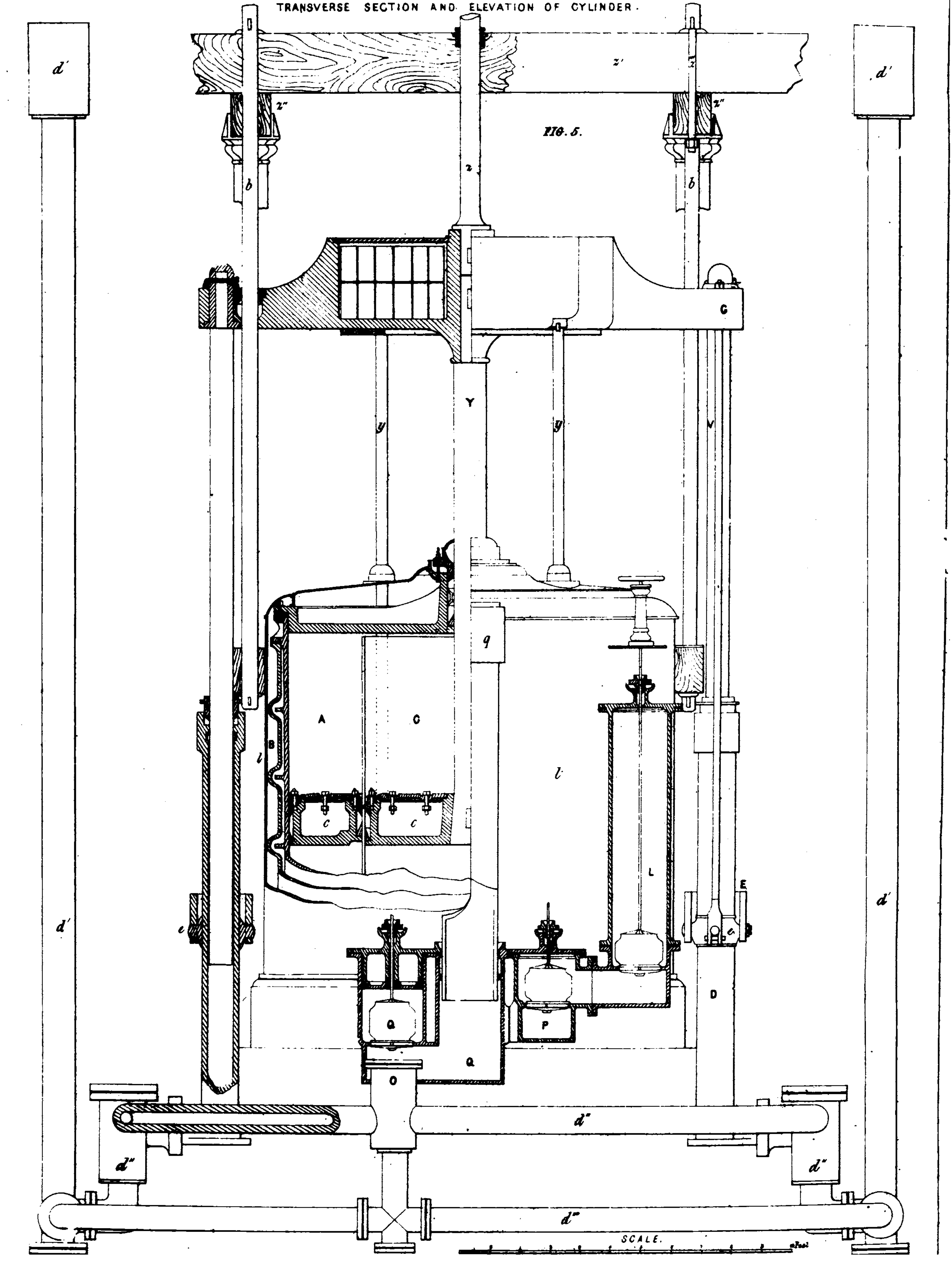
THE LEECHWATER ENGINE.

TRANSVERSE SECTION AND ELEVATION OF CYLINDER.



THE

CIVIL ENGINEER AND ARCHITECT'S

JOURNAL,

SCIENTIFIC AND RAILWAY GAZETTE.

VOLUME X.

1847

LONDON:

R. GROOMBRIDGE AND SONS, 5, PATERNOSTER ROW; J. WEALE, 59, HIGH HOLBORN; WILEY AND PUTNAM, NEW YORK; GALIGNANI, AND MATHIAS, PARIS.

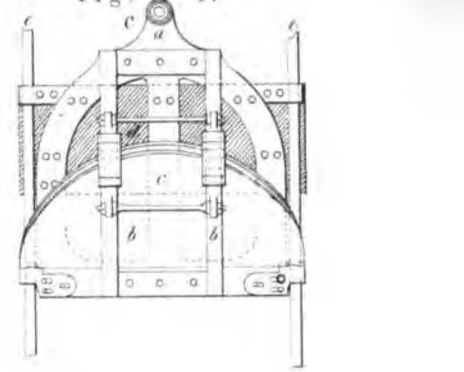
Printed and Published by WILLIAM LAXTON, the Proprietor, at No. 10, Fludyer Street, Whitehall.

HWATER ENGINE

oseph Gibbs & Arthur Dean, Engineers.

SCALE.

Fig. 4.



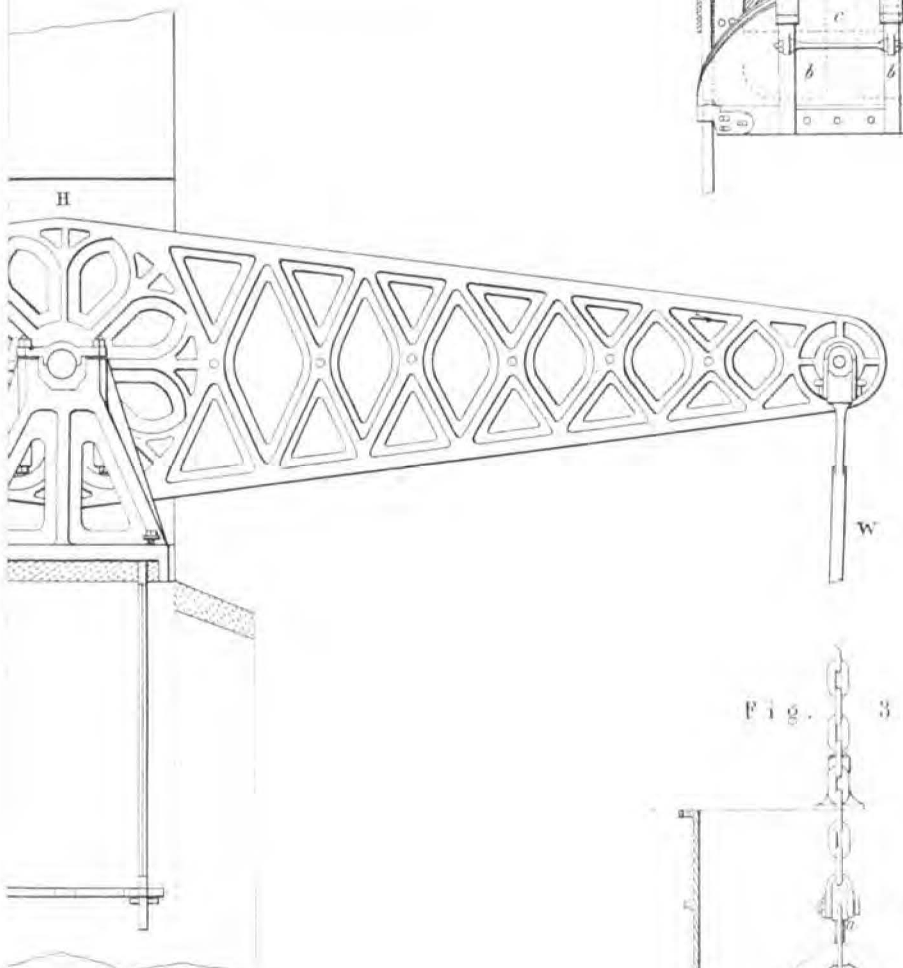
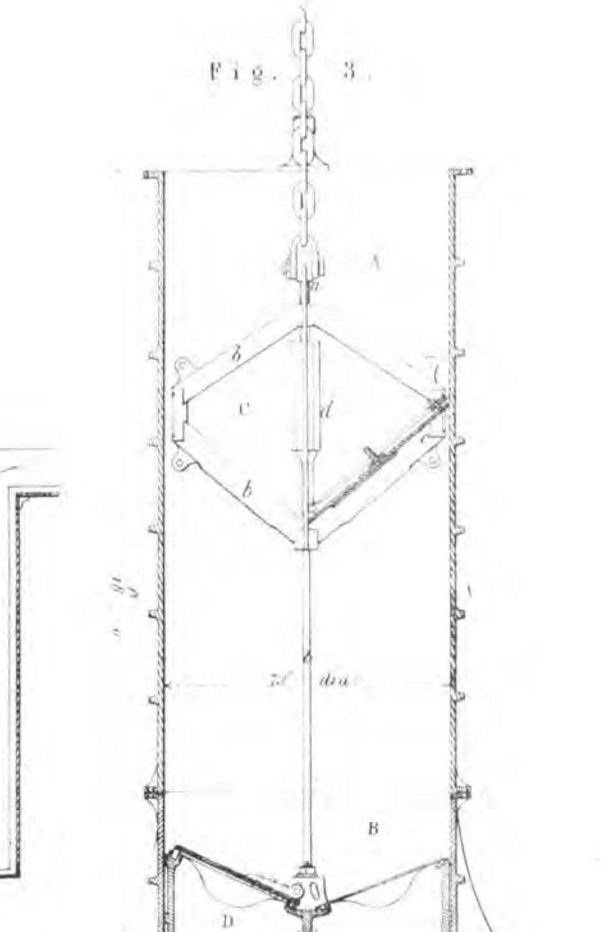
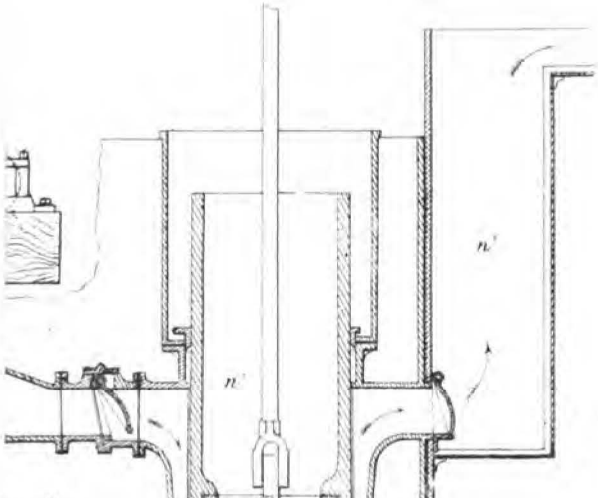


Fig. 3.





Section of Air Pump.

Section of Pump.

CIVIL ENGINEER AND ARCHITECT'S JOURNAL.

INDEX TO VOL. X.

A

B

Q

R

T

U

V

W

LIST OF ILLUSTRATIONS.

DIRECTIONS TO BINDER.

THE

CIVIL ENGINEER AND ARCHITECT'S JOURNAL.

THE LEEGHWATER STEAM ENGINE.

DRAINAGE OF THE HAARLEM LAKE, HOLLAND.—*Engineers:* Messrs. J. GIBBS and A. DEAN.

(With Two Engravings, Plates 1 *and* 2.*)*

The geographical changes which are produced near the embouchures of rivers by deposition of alluvial matter are in no part of the world exhibited in a more remarkable manner than in the delta of the Rhine. The natural operations of that river interest the antiquarian by the remoteness of their date, the geologist by their extent and physical character,* and the engineer by the grand artificial works undertaken to resist or modify their effects.

The Rhine on entering the Low Countries divides into several branches: the southernmost of these, the Whaal, reaches the sea near Kampen; the most northern branch is nearly at right angles to the former, and empties itself into the "rolling Zuyderzee," and another branch passes Rotterdam. The Rhine proper continues its enfeebled course to Leyden and Utrecht, and, nearly exhausted by the numerous canals which are connected with it, finally reaches the sea by a small artificial sluice. Its fate has been aptly compared to that of a dethroned monarch, who is deprived even of the satisfaction of attracting admiration and sympathy by the grandeur of his exit.

It is very interesting to observe how this delta has been altered even in the historic period. In the time of the Romans the Rhine had but two branches; Virgil calls it *bicornis*, and Tacitus says that the largest of these branches, that nearest to Gaul, is called *Vahalum*.† Even in the days of Charlemagne, the Rhine communicated with the Escaut, by a branch of the Meuse, which has since entirely disappeared. A great inundation, A.D. 860, destroyed the regularity of the mouths of the river. But perhaps the most remarkable alteration of all has been the conversion of the Zuyderzee from an inland fresh-water lake, such as it is described by Pomponius Mela, into a gulf of the sea. This change took place in the 13th century, and was the result of violent storms, during which the sea destroyed the barrier between itself and the lake. Traces of this barrier still exist in the islands and shoals between the Helder and Ter-shelling.

The natural division of the Rhine into two branches was first disturbed by the Roman legions under Drusus, who, in the 12th year before the Christian era, dug a canal from the Rhine to the small river *Sala*, as a military defence. This canal soon became enlarged by the force of the current into a third branch of the Rhine. A fourth branch, the Leck, was created subsequently, in a similar manner, during an insurrection under Claudius Civilis.

In our own times another important change is about to take place. The Lake of Haarlem is a large fresh water lake, between Leyden and Amsterdam, and communicates with the Zuyderzee. The project of draining this lake has been long entertained. The bottom consists of an alluvial deposit, well suited for agriculture. It was at the end of the last century, when steam engines began to be used for drainage, that the idea of employing them in draining the Lake of Haarlem was first entertained. The idea was but the extension of that which had already been practically exemplified in the drainage of the Beilm and Diem, in Holland. The longest side of the lake of Haarlem is parallel to the sea, and is separated from it by a very narrow strip of land. Moreover, the level of the lake is some twenty feet below that of the sea. When, therefore, the drained country is covered with villages and farms, it must be well protected by dikes, or the sea may some day perhaps pay the sober Dutchman a visit for which even their amphibious nature has not sufficiently prepared them.

In order to ascertain the most approved method, and at the same time the most economical manner, of draining the lake, the Dutch Government appointed a Commission of Engineers to report upon the best means and to examine the various plans of drainage adopted in England. After examining a great variety of schemes and proposals, it was determined to adopt the plan submitted by Mr. Joseph Gibbs and Mr. Arthur Dean—who have, by close attention to all the details, produced an engine which is working with great effect and astonishing economy of fuel. It is proposed to have three engines of the same power, and three sets of pumps.

The first of these engines is now in operation, and the engineers have furnished us with the following description, which is replete with valuable and interesting information, and is accompanied by ample illustrations of the details. The means taken to avoid shocks or impulses in an engine of this magnitude are especially worthy of attention.

---

* It is calculated (Ansted's Geology, I. 7), that seven or eight thousand millions of tons of alluvial mud are carried down by the stream annually. The greater part of this soil is deposited in Holland.

† The passage in Tacitus (Ann. II. 6,) seems somewhat inconsistent with another in Cæsar (De Bell. Gall IV. 10), where, after a sentence of which the text is evidently corrupt, and the meaning (to us at least), obscure, it is said, "Ubi Oceano appropinquat, in plures diffluit partes, multis, ingentibusque insulis effectis........multisque capitibus in Oceanum influit." It has been supposed, however, that Cæsar speaks merely of the subordinate streams and mouths near the coast.

DESCRIPTION OF THE ENGINES.

The Leeghwater Engine, as shown in Figs. 1, 2, and 5 of the accompanying Engravings, Plates 1 and 2, has two steam cylinders A and C, one within the other, united to the same bottom X, but the inner one is not attached at the top, a clear space of 1¼ inch existing between it and the cover, which serves for both cylinders. The large cylinder A, is 144·37 inches diameter and 1¼ inch thick, and C, the small cylinder, 84·25 inches diameter and 1¾ inch thick; both are truly bored out, and the small cylinder is also turned on its outer circumference. B is a steam jacket for the large cylinder, cast in 13 segments—which is again enveloped by a wooden casing *l*, having 4 inches of peat ashes between them.

Pistons.—The small cylinder C is fitted with a plain piston of 5474·81 square inches area, and the large cylinder A is occupied by an annular piston of 10,323·36 square inches area. The areas of the two cylinders, after deducting 472·8 square inches for the thickness of small cylinder, are as 1 to 2·85. The internal and external packings of the pistons consist of hard cast iron segments at bottom, with gasket above, pressed down by glands, also in segments; the open spaces in the pistons *c c* are filled with cast iron plates, and the tops of the pistons have moveable cast iron covers.

Cap or Crosshead.—The pistons are connected to the great cap or crosshead G by the main piston rod Y, of 12 inches diameter, and by four small rods *y* of 4½ inches diameter (figs. 1 and 5). The great cap G has a circular body 9 feet 6 inches diameter, divided into eight compartments, which can be filled with cast iron weights; from its centre a guide spindle *x* passes through a stuffing box placed in the centre of a great beam of timber 2 feet square, which passes across the engine-house, and is secured to its walls; there are two other guide rods, *b*, which pass through stuffing boxes in the arms of the great cap G, and are secured to the upper and lower spring beams.

Plungers.—Suspended from the arms of the great cap are two 9-in. plunger poles F, working in plunger cases D; attached to D are two valve nozzles *d''*, connected with stand pipes *d'*, by two branch pipes *d'''*; the valve nozzles are connected with each other and an hydrostatic equilibrium valve nozzle O, from the bottom of which a branch piece is connected with the stand pipes *d'* by the pipes *d''''*. The exterior surfaces of the plunger cases D, are turned truly, so as to allow the rings *e e* to slide up and down freely; the rings are suspended from the great crosshead by rods *v*, and are furnished with cross bearings, on which the jaws of the two air-pump balance beams E rest: the inner ends of these balance beams move in a perfectly vertical line, and the outer ends are furnished with rollers working between guides, to allow for the variation of the beams during the up or down stroke.

Air Pump.—From the centre of the air-pump balances, the two air-pump plunger pistons *n'* are suspended (fig. 2); diameter of plunger pistons 40 in., stroke 5 feet; the two air-pumps N are united by a branch piece with the bottom of the condenser M. The condenser has an intermittent injection by a valve 8-in. diameter, and a constant injection by another valve of 3-in. diameter. R is the condenser cistern.

Pipes and Valves.—L is the steam pipe (2 feet diameter) from the boilers; in it is placed a double-beat governor valve of 16-in. diameter.

P, the induction valve, 16-in. diameter and nozzle.
Q, Equilibrium valve, 20-in. diameter and nozzle.
S, Eduction valve, 26-in. diameter and nozzle.
q, Equilibrium steam pipe.

The induction and equilibrium nozzles are each connected to a separate port cast in the cylinder's bottom. The eduction nozzle is connected by a pipe M, 34-in. diameter, to the branch-pipe M of the condenser. The pipe M is also connected to the bottom of the cylinder, in which a port is cast, which communicates with the space under the annular piston; by this arrangement a constant vacuum is maintained beneath that piston.

The Hand Gear is connected to the weigh post K, and the plug rod is worked by a lever and shaft T, the outer end of which is slotted and worked by a pin on the sliding ring *e*.

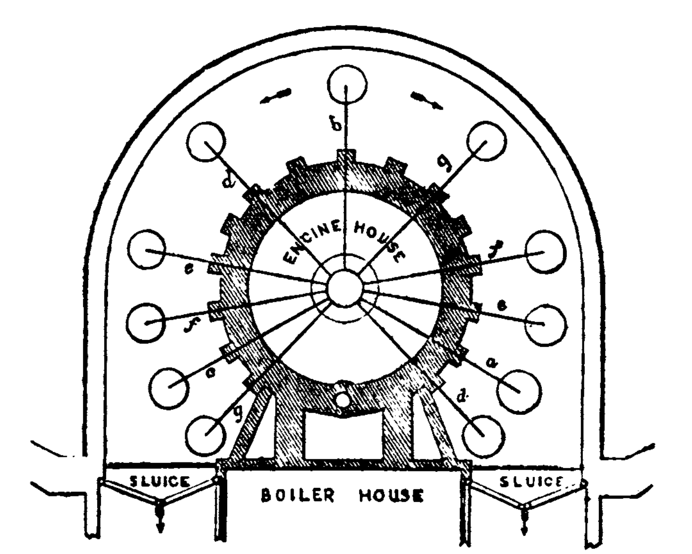
Pumps.—The engine works eleven pumps of 63-in. diameter; each pump is furnished with a cast iron balance beam H (fig. 1), which radiates from the centre of the piston rod; the inner and outer arms are of equal lengths from the centre gudgeon. The inner ends of the balance beams are furnished with cast iron rollers, working against a plate, fitted with guides for each roller, which is screwed up against the under-side of the great cap; each beam is connected to the cap by two slotted bridles, to ensure simultaneous upward motion during the up-stroke of the engine. From the outer end of the balance beam the pump piston is suspended by wrought iron rods, 3-in. diameter and 16 feet long, and an additional length of 14 feet of patent chain cable attached to the pump piston. Fig. 3 shows a section of one of the pumps, and fig. 4 an elevation of the piston. A, working barrel, 63-in. diameter; B, windbore and clack piece; C, the piston or bucket; D, bottom valve and seat.

The pump piston C is of a peculiar construction; it is composed of a wrought iron centre piece, 1 inch thick; firmly bolted to this piece are two double elbow frames of cast iron, called "the cradles;" the elbows are faced with gun-metal plates; the cradles serve to support two wrought iron semi-elliptic valves *c c*, which occupy the whole area of the pump when they fall out, and constitute in fact the piston. These valves are edged with wood, having a piece of leather on the upper side secured by a wrought iron gland; the valves are hung to the centre piece at about 3 inches from their lower edges, so that when they open during the down stroke, any dirt or sand which has lodged on the bottom may fall through. Attached to the centre piece are two plates of cast iron, which serve as ballast to sink the piston; these ends are cast with a jaw, in which pieces of wood are secured to prevent friction against the sides of the pump and to give steadiness to the piston. These pistons require a weight of 1·4 lb. per square inch of the area of the pump to sink them with the velocity required upon the down stroke. The pump pistons of the Leeghwater are not furnished with guides, as shown in figs. 3 and 4, and work very well without them: but the pistons for the pumps of the Cruquius and Van Lynden engines (now constructing for the drainage of the lake) will have guides, as shown in the drawings, in consequence of the diameter of the pumps being increased to 73 inches.

Pump Valves.—The bottom valves have cast iron seats secured to the windbore, the valve beats are of wood, and the valves are simply plates of wrought iron, 1 inch thick; the valves are not hung on fixed joints, but are each fixed to a bar, the ends of which are entered in cast iron slot pieces, allowing a rise of 1½ inch, so that the valve can rise altogether from its beat, and give a large water passage all round.

Power of Engines.—The steam and pump pistons both perform a stroke of 10 feet in length: each pump by calculation should deliver 6·02 tons of water per stroke, or 66·22 tons for the eleven pumps; but by actual admeasurement of the quantity delivered, it is found to be 63 tons. The loss might be reduced, but probably at the expense of increased friction.

The Engine House is a massive circular tower, concentric to the cylinders; on its walls are placed the eleven pump balances radiating from its centre, shown in the accompanying sketch. The pump



balances *a*, *b*, *c*, are placed at 120 degrees from each other; *d d*, *e e*, *f f* *g g*, are placed opposite each other: therefore, by this arrangement, the equilibrium of the great cap of the engine, under which the inner ends of all the balances are concentrated, is not in any way disturbed. If any of the pumps require repairs, the opposite pairs can be easily detached, without causing more than a trivial delay to the working of the engine.

The Action of the engine is very simple; the steam being admitted into the small cylinder, the whole of the dead weight and pump balance beams attached to the great crosshead are elevated with it, and the steam being cut off at such portion of the stroke as may be required, the remainder is effected by the momentum acquired by the dead weight and the pressure of the expanding steam upon the small piston (the pump pistons at the same time make their down stroke); at the end of the up stroke a pause of one or two seconds is requisite, to enable the valves of the pump pistons to fall out, so that upon the down stroke of the steam piston they may take their load of water without shock. During this time it is necessary to sustain the great crosshead and its load of dead weight at the point to which it was elevated by the up stroke, as otherwise it would fall back until the expanded steam under the small piston was compressed to a density equal to the pressure per square inch of the load lifted, or would cause a very violent shock upon the pump valves by suddenly throwing them out against the sides of the pumps. To avoid these evils, the hydraulic apparatus D F was devised.

Hydraulic Apparatus.—When the engine makes its up stroke, the plunger poles F (which form part of the dead weight) are lifted, and the water from the stand pipes and reservoirs d′ flows through the valves d″, and follows up the plunger poles as fast as they are elevated. At the end of the stroke the spherical valves instantly close, and the dead weight is suspended exactly at the point at which it had arrived—and, of course, if the valves are tight, could be maintained there for any given period; in consequence of all strain being thus removed, there is no pressure to close the valves of the pump pistons beyond their own weight; therefore, they fall out without the slightest shock. To make the down stroke, the equilibrium steam valve Q, and the hydraulic valve O are opened *simultaneously:* the water from beneath the plungers escapes to the stand pipes and reservoirs by the pipes d‴, and the steam from the small cylinder passes by the pipe q, round to the upper side of the small and annular pistons, puts the pressure on the small piston in equilibrium, and presses upon the annular piston (beneath which a constant vacuum is maintained), in aid of the dead weight now resting upon the inner ends of the pump balances: by the united effort, the pump pistons are elevated and the water discharged. Before the next stroke is made, the eduction valve is opened and a vacuum formed over both pistons.

So well does the hydraulic apparatus just described, effect the object for which it was designed, that the Haarlem-mer Meer Commissioners have decided to use only eight pumps, but of 73-in. diam., for the other engines; the chief reason for the adoption of the 63-inch pumps for the Leeghwater Engine having been the fear of the shocks to which such large pump pistons are ordinarily liable.

Boilers.—The Leeghwater Engine is furnished with five cylindrical boilers, each 30 feet long and 6 feet diameter, with a central fire tube, 4 feet diameter: a return flue passes under the boilers to the front, and then splits along the sides. Over the boilers is a steam chamber, 4 ft. 6 in. diameter and 42 feet in length, communicating with each boiler; from thence a steam pipe, of 2 feet diameter, conducts the steam to the engine. The steam space in the chamber, boilers, and pipe is nearly 1820 cubic feet, and as the engine draws its supplies from such an immense reservoir of steam, no "primage" takes place, and a very uniform pressure upon the piston is obtained until the induction valve closes. These boilers have produced steam enough to work the engine to the net power of 400 horses. The Cruquius and Van Lynden Engines will have boilers capable of working to 500 horses' power if required.

The Drainage.—Prior to the construction of the engine-house, &c. an earthern dam of a semi-circular form was thrown out into the lake, to enclose about 1¼ acres; after the water was pumped out from within the dam, a strong piled foundation was made, and the masonry commenced at the depth of 21 feet below the surface of the lake: a small steam engine was erected to evacuate the water from the dam. When the Leeghwater was completed, the Commissioners determined to test its merits fully before deciding on the construction of the other engines upon the same model; and as they had the means of evacuating the water within the dam to any level required, the Leeghwater could be tried and worked continuously under any circumstances, precisely similar to those which will occur during the drainage of the lake, if, instead of discharging the water from the pumps into the upper canal, it was allowed to fall back again to the level from whence it was derived.

The average depth of the lake is 13 feet below the general level of the surface water of the canal and watercourses conducting to the sea sluices; when the communications between those waters and the lake are closed, the engine will at first have only the head of water caused by the discharge from the pumps, and the friction of the machinery, to overcome; in this state, all the filling plates or ballast of the great cap and pistons will be taken out, and counter-balances added to the pump balance beams "out of doors," so as to take up as much of the dead weight attached to the great cap as may not be required for working the engine: as the lift becomes greater, the dead weight "in doors" will be gradually added. In this manner, the engine was worked for a considerable time, to get all the parts in good working order. A sub-committee of the Commission conducted a series of experiments, and satisfied themselves that the Leeghwater will perform a duty of 75 million pounds, lifted one foot high, by the consumption of 94 lb. of good Welsh coal, whilst exerting a net effective force of 350 horses' power. With a lift of 13 feet, the engine easily worked the eleven pumps simultaneously; the net load of water lifted being 81·7 tons, and the discharge 63 tons, per stroke.

When the bed of the lake is cultivated, the surface of the water in the drains will be kept at 18 inches below the general level of the bottom; but in time of winter floods, the waters of the upper level of the country will be raised above their ordinary height: in which case, to keep the bed of the lake drained to the regulated height, the lift and head may be increased to 17 feet. To test the power of the engine under these circumstances (and without regard to the consumption of fuel), the whole of the 11 pumps were worked simultaneously, and the extraordinary quantity of 109 tons net of water was raised per stroke to the height of 10 feet; but, in practice, it will be advisable to work a less number of pumps, and increase the number of strokes per minute.

After numerous and severe trials of the engine, the Commissioners were satisfied that it is capable of performing its work under the most difficult circumstances that can arise; and immediately determined on having two more engines constructed, of equal size, and on the same model—the only material alteration being in the arrangement of the pumps; the number being reduced to 8 for each engine, but of 73 in. diameter, placed in pairs opposite each other, and the ends of the balance beams projecting over the great cap of the engine (instead of under as in the Leeghwater), to which they will be connected by stout wrought-iron straps. The boilers also will be increased in number, and in power nearly 100 horses. All the feed-water will be filtered before passing into the boilers.

Advantages of Two Cylinders.—Many persons imagine that the engines are constructed with two cylinders to obtain a greater expansion of the steam than would be attainable in one cylinder; but such is not the case, as no greater economy of steam can be obtained by the use of two cylinders than by one, although greater steadiness of motion for rotatory engines, and less strain upon the pitwork of a mine-pumping engine, may result from the use of two cylinders. In the Haarlem engines two cylinders are used, because if one cylinder only were employed it would sometimes be necessary to use a dead weight of 125 tons to overcome the resistance of the water load and friction of the engine and pumps; such a mass of iron or other heavy material would be unmanageable, and no alteration in the force of the engine could be effected but by taking from or adding to the dead weight, which would be a source of great difficulty and inconvenience, when the varying character of the load, during the drainage of the lake, is considered; particularly as at times the water will be charged with so much foreign matter as greatly to add to the friction of the pumps. By the system adopted the maximum dead-weight elevated by the small piston will seldom exceed 85 tons; the additional power required being derived from the pressure of the return steam, at the down stroke, on the annular piston; by varying the expansion and pressure of the steam in the small cylinder, the engineman can add to, or diminish the pressure upon the annular piston, so as to meet any case of variable resistance without the inconvenience and delay attending an alteration of the dead weight; the load is therefore under perfect command at all times.

Quantity of Water.—The area of the Haarlem Lake is 45,230 acres, the estimated contents to be pumped out about 800 million tons, but should the quantity be increased by any unforeseen cause even to 1000 million tons, the whole amount could be evacuated by the three engines in about 400 days.

The bed of the lake when drained must be always kept dry by machinery, and observations continued during 91 years show that the greatest quantity of rain which fell upon the area of the lake in that period would give 36 million tons as the maximum quantity of water to be elevated by the engines in one month; to perform this work would require a force of 1084 horses' power to be exerted during that period; the average annual drainage is estimated at 54 million tons.

The cost of the Leeghwater, buildings, and machinery was 36,000*l.*; of this amount about 15,000*l.* are due to the buildings, and certain contingencies. For the foundations 1400 piles were driven to the depth of 40 feet into a bed of hard sand, and a strong platform laid thereon at the depth of 21 feet below the surface of the lake; upon this platform at the distance of 22 feet from the engine-house, a strong wall pierced with arches was constructed, and at 7 feet from the coping, a stout floor of oak was laid between the wall and the engine-house; the pumps rest upon the platform beneath and opposite the arches, and their heads come through the floor alluded to, and stand about 3 feet above its level: into the canal thus formed between the engine-house and the outer wall, the water from the pumps is discharged, and flows off on either side of the boiler house, through sluice gates, into the canals conducting to the sea sluices.

The great cost of the buildings for whatever description of machinery might have been employed, rendered it an object of considerable importance to lessen this expense by concentrating the power to drain the lake in three engines; in addition to which a considerable saving in the wages of enginemen, stokers, and others is effected, as these large engines require very little more attendance than an ordinary mine engine; this is an important feature in the economy of the charge for the permanent drainage of the "Polder," which will be formed by the bed of the lake.

The average consumption of the ordinary land-draining engines applied to scoop wheels and Archimedean screws, may be taken at 15 lb. of coal per *net horse power* per hour; this quantity will be greatly reduced if the horses power of the engines be calculated by the pressure of the steam on the pistons, and not by the net delivery of the water; in a case where the water delivered by a large steam engine working a scoop wheel, was measured during eight hours, the engine was found to exert a *net* force of 73 horses' power during the first hour, with a consumption of 15 lb. of coals per *net* horse power; as the lift increased the power diminished, and the consumption of fuel increased, until at the eighth hour it was found that the engine only exerted a *net* force of 33 horses' power, and consumed 24 lb. of coal per *net* horse power per hour. The consumption of fuel by the Leeghwater is 2½ lb. of coals per horse power per hour when working with a net effective power of 350 horses.

No *new principle* has been developed in the Leeghwater, but important facts have been demonstrated, which must have an immense influence on the progress of agricultural hydraulic engineering: it has proved that with proper attention to well-known principles, steam engines of the very largest class (the Leeghwater is believed to be the largest and most powerful land-engine ever constructed), may be employed to raise great bodies of water from low lifts for the drainage or irrigation of low lands with as great an economy of fuel as was hitherto generally supposed to be confined to the elevation of comparatively small quantities of water to great heights. To the Haarlem-mer Meer Commissioners belongs the merit of having ventured to carry out this bold experiment, and they will reap their reward by an economy of at least 100,000*l*. over the cost of draining the lake by the ordinary system of steam engines and hydraulic machinery employed to drain land; and of upwards of 170,000*l*. and three years time, over the cost of draining the lake by the windmill system hitherto generally employed in Holland.

Upon the cost of annual drainage an important saving will also be effected; by the system adopted it is estimated at 4500*l*., by windmills at 6100*l*., and by the ordinary steam engines at 10,000*l*. per annum, and if interest at 5 per cent. on the money saved in the original cost of draining the lake be taken into the account, the figures would stand thus, 4,500*l*., 14,600*l*., and 15,000*l*.

The Leeghwater is named in honour of a celebrated Dutch engineer, who, from his great success in draining numerous lakes in North Holland, was popularly known by the name of "Leeghwater," or "the drier-up of water," and with him the first proposal to drain the lake originated in 1623. The other two engines are called Cruquius and Van Lynden, after two celebrated men who have at various periods interested themselves in promoting the drainage of the Lake.

The engines and pumps are manufactured at the well-known establishment of Messrs. Harvey and Co., of Hayle, and Messrs. Fox and Co., of Perran, Cornwall; the pump balances and boilers by Messrs. Van Vlessingen and Van Heel, of Amsterdam.

TRABEATE AND ARCUATE ARCHITECTURE.

THIRD ARTICLE.

It is but a thankless office to demonstrate that an object of general admiration is unworthy of the homage paid to it: though the innovator may dethrone the idol, he cannot propitiate its worshippers. The advocate of heterodox opinions in architecture must not, therefore, even if he succeed in convincing his opponents, expect to win their applause. In these papers, of which the object has been to demonstrate the errors which have crept into our architectural system from an attempt to combine two irreconcileable means of construction—the arch and architrave—we have endeavoured to avoid the appearance of heterodoxy by confirming our opinions by the citation of acknowledged authorities. For the last three centuries it has been customary to consider architectural forms independently of their purpose; but though the effort to inculcate similar principles be comparatively recent, the labourers in this arduous undertaking are by no means few. We already reckon the names of Hope, Willis, Whewell, Cockerell, and Paley, among the advocates of architectural truth.

As an example of the effects of confounding trabeate and arcuate architecture, we have referred to the inconstructive arrangements of the dome and other parts of St. Paul's Cathedral—a bold illustration certainly, but one supported by the recorded opinion of Professor Cockerell, that this building exhibits a confusion of the principles of Classic and Christian Architecture. If, by way of contrast with the dome of St. Paul's, we examine the spires of Chichester or Salisbury Cathedrals, the difference between the principles of the mediæval architects and of those who succeeded them will be set in a very clear light. In the two mediæval spires there is no casing or outer covering to conceal the inner mechanical arrangements of the structure. Every course of stones used in the construction is visible, both from the outside and inside of those noble works. The visitor on ascending finds himself within a vast cone, formed of circular horizontal courses of masonry, diminishing in diameter from the base to the summit: he looks in vain for a single means of support not visible from the exterior of the cathedral. In St. Paul's, on the contrary, the *real* spire is, as has been shown, a concealed cone of bricks: the dome is merely a wooden frame-work fixed on to the cone after it was finished. Two ends are answered by this contrivance: the bricks are hidden, and an appearance of vaulting is given where it does not exist.

This and similar inconstructive arrangements are readily explained when we consider them the natural effects of an attempt to combine arch and architrave construction. It is time however to turn to another example of those effects; and the inference with respect to modern art being far more direct in the instance which we are about to select than in the former, the necessity of quoting authorities becomes greater.

"But of all the parts borrowed from Grecian Architecture," says Hope in the eighth chapter of his admirable Essay, "that which came to be applied in the way most different from, most inconsistent with, its nature and distinction in the original, was the fastigium, the part which we call the pediment.

"The pediment, which was only the termination of a roof slanting both ways from its central line or spine, of which, throughout its whole length, from end to end, the continuity was never broken, which was never seen in Grecian buildings, except on the straight line at the summit and the gable formed by the extremity of the roof, in Roman architecture frequently appeared as if cut off from all that belonged to it, and grew out of, and was stuck under, the entablature which it should have surmounted, against the upright wall, or a window, or a niche,—even as in the temple of Balbeck, placed within a projecting portico, a situation in which it could not be useful even to carry off the wet. . . . . In Grecian architecture the square pilaster only terminated the square pier or antæ; by the Romans it was carried in shallow slips or slices along the whole surface of the wall; and as the tyrant Maxentius tied together the living and the dead, so the architects of Rome everywhere attached the round, vigorous, and independent column to one of these flat, weak, and confined pilasters, for no other purpose that can be conjectured than that the effect of its tapering form might be destroyed by the straight lines of the pilaster."

These opinions respecting the use and abuse of pediments and columns are applied, in another part of the same work, to the Cathedral of St. Peter's, at Rome, in the following terms:—"One condemns in the church its front so much broken by partial projections, its pediment standing on a base too narrow, and an expanse too small, and *rendered evidently useless by the ponderous attic that rises behind it* and crushes the façade to which it was intended to give elevation.

"Contemplating those columns of nearly 9 feet in diameter, but which, formed of masonry of small stones, only look on a near approach like small turrets, one cannot help casting a lingering look back on the portico of the Pantheon, and thinking that elevation of insulated columns of granite of one single piece, though smaller in its dimensions, grander in its conception, and more striking in effect, than these clusters of large pillars, all reticulated with joints, and jammed up against a wall."

All these solecisms in the employment of pediments and columns may be easily traced to the attempts to retain the *forms* of Greek trabeate architecture, after the invention of the arch. By means of this invention the Romans were enabled to give to their edifices an extent and diversity of form before unknown. It was no longer necessary for the stability of a structure, that its roofs should be supported directly from the ground by vertical columns, placed so close that the intercolumniation might be spanned by a single block of stone. On the contrary, the buildings were raised to many stories in height, and both vertically and laterally were made up of that vast multiplicity of parts which, judging by the eye alone, we should pronounce the main *formal* distinction of Roman from simple Greek architecture. A natural consequence of the invention of the arch was the vaulting of roofs, which rendered the pediment generally unnecessary, and therefore adscititious.

It is by no means to be inferred that the introduction of the arch was prejudicial to the art. On the contrary, every new contrivance by which construction is facilitated ought to be looked upon as a direct benefit to architecture; for the most liberal and elevated views of an art are those which encourage its extension by every available means. The injurious effects complained of by Hope arose, not from the invention of the arch abstractedly considered, but from the injudicious application of it. It had rendered almost all the Greek forms unnecessary; they ought therefore to have been unreservedly abandoned in arcuate building, or at least those of them alone should have been retained which were necessarily common to the two modes of construction.

The pediment was appropriate and had meaning where what Hope aptly terms the *spine* of the roof (that is, the line formed by the two inclined planes intersecting at their vertical angle) was continued throughout the building from end to end. Where, however, the roof was flat, or surmounted by a horizontal entablature, as in Roman, and subsequently in Lombardic, architecture, or where the structure was crowned by a "ponderous attic," as in the case of St. Peter's, and numerous modern English buildings to which it is unnecessary to specify, it is clear that the pediment could have no real constructive use.

To the general reader we may appear unnecessarily minute in insisting upon these points, because he is not aware how much prejudice has to be surmounted in establishing them. A great change of opinion on architectural subjects is, however, happily taking place, and we trust that the day is not far distant when these observations will appear superfluous arguments in favour of self-evident propositions. For the present, however, we must be content to utter truisms, and to illustrate in every possible way their application and effect.

Flat-roofed buildings can never require pediments: let us apply this rule to the new show-front of the British Museum, now nearly completed. We will at once allow that there is something exceedingly attractive in the long range of numerous columns there presented to the eye. Columniation on an extensive scale has such peculiar magnificence that the difficulty is rather to produce an ungraceful, than a graceful, appearance by means of it. The architect of the British Museum has, however, surmounted this difficulty to a great extent. Still, much remains that will captivate the general eye, and we doubt not that those who prefer profusion of ornament to the right use of it, will greatly admire the new façade. But we are now addressing those who are willing to estimate architecture not by the eye alone, but by the judgment also.

It is to be observed then, in the first place, that the British Museum, though an isolated structure, in a position where it is seen from many points of view, has only one side decorated, the decorations being of course placed where they will be seen from the most frequented street.

"Purpureus, late qui splendeat, unus et alter
Assuitur pannus."

The pediment, consistently enough, is stuck on to the façade, just as the façade is stuck on to the building. The horizontal entablatures of the wings are either mere masks to conceal the real outline of the roofs, or else the roofs are flat. On the latter supposition, it is quite clear that the central pediment is placed where it does not define the outline of another roof; for a glance will convince us that there is not behind this pediment an inclined roof with its axis perpendicular to the front of the building, and its spine continued "throughout the whole length from end to end."

In point of fact, this pediment has no more connection with the building than the sign-boards frequently seen on the parapets of taverns have with walls to which they are attached. The comparison may be a homely one, but it exactly expresses the nature of the case Similar remarks might be applied to the Mansion House, Buckingham Palace, and numerous other buildings, in and out of London; but the general principle is so clear, that it is useless to provoke unnecessary opposition by pointing out all its consequences.

Had not custom familiarised us with the absurdity, there would appear something inexpressibly ludicrous in the fashion of uniting the front of a Greek temple to a modern secular square-built structure.

It is well known that a systematic and growing opposition to Classic architecture now exists in this country. Those who resist the novel tenets and express their indignation at the term "Pagan," do not consider that they themselves strengthen the arguments of their opponents by their adherence to debased Classic architecture. A barbarous confusion of different principles of construction can never be permanent, however obstinately it may be defended; and it certainly appears the most prudent course to give up a part of the contest at once, and return to pure and faithful Classic architecture, than, by blindly defending its most corrupt forms, to ensure the ultimate disuse of every form of it.

The attempt to combine the forms of trabeate and arcuate construction has produced, as all will admit who are not interested in the denial, a strange mongrel style, in which members, which had originally significance and utility, are distorted and disarranged in every conceivable manner. Such architecture resembles a mere *hortus siccus*, or herbal filled with botanical specimens; for its relation to true architecture is that of withered leaves to a living flora. Or is it not, rather, an architectural Frankenstein, endued with vitality indeed—but vitality of that monstrous kind which renders it only the more hideous by adapting its individual members to strange, unnatural uses?

REMOVAL OF WESTMINSTER BRIDGE.

Many arguments have been urged in favour of the existing site of Westminster Bridge; those in favour of a new site have not yet been communicated to the public. There can be no doubt that the Commissioners of Woods and Forests have wise and cogent reasons for giving notice of their intention to apply for "an act to alter, amend and repeal, several acts of Parliament passed during the reigns of George II. and III., relative to Westminster Bridge, &c." And as we give the Commissioners credit for the best and most prudent motives, it cannot but be regretted that the public have of late years fallen into the unhappy habit of judging for themselves on matters of public interest. It has been argued (indiscreetly, no doubt) that the collective opinion of the inhabitants of Westminster and Lambeth as to the relative advantages of the new and old sites, is as valuable as that of a Government commission. The idea that the latter possess exclusive information on the subject, and are therefore the most competent to decide, is summarily rejected by the contending party, who reply (and it is difficult to detect a flaw in their reasoning) that the nature of the subject precludes the existence of exclusive information—that whatever knowledge of the facts may be possessed by the Commissioners is shared with the inhabitants of the districts affected—that the convenience of any particular thoroughfare is to the latter a matter of daily observation, and that in the ordinary intercourse of trade they would be certain to learn whether traffic was obstructed by difficulties in the route chosen for it. Finally, it is argued that if the Commission *have* any exclusive knowledge on the subject, it is the very kind of a knowledge which they ought not to have; for though private information may be very important in carrying on business of high diplomatic importance, the existence of private information on such a very matter-of-fact topic as the alteration of a thoroughfare gives colour, at least, to a charge of undue regard for private interests.

At a crowded meeting of the inhabitants of Westminster, held during the last month, the chairman, Mr. B. Hawes, the member for Lambeth, in opening the proceedings, said—

"There had been no manifestation of public feeling in favour of the proposed new bridge to Charing-cross, although the money for erecting it, amounting to upwards of £2,000,000, would be taken from the public purse. The new bridge had not been sanctioned by the goverment, further than that a public department had consented to give certain notices prior to the introduction of the bill. He hardly thought any member for Lambeth, Westminster, or Surrey would be found to support such a measure; and it might reasonably be asked what public reason was to be assigned for it? He understood the architect of the new Houses of Parliament thought the present bridge an eye-sore; but could it not be repaired and beautified, or rebuilt on the existing site? There were many reasons for retaining it: first of all, on the ground of economy. All the approaches to the present bridge were the property of the bridge commissioners. In the next place, a bridge lower down, as was proposed, must be longer and larger, and all the approaches would have to be bought. But was it just to existing interests to build a bridge elsewhere? There were at present two private bridges close to the site of the new bridge—Waterloo and Hungerford bridges—the first of which did not pay a farthing to the subscribers, and the other paid but very badly. From the proposed bridge to Waterloo-bridge there would be a distance of only about 200 feet, whilst the Hungerford-bridge would be close to it; and Westminster-bridge being taken down, there would be no accommodation for the public from the Charing-cross bridge to Vauxhall bridge—a distance of about a mile. When the present bridge was built, the site was a matter of considerable discussion; it was, moreover, selected as the most beneficial for the public at large; and he believed, that from the corner of York-road over the new bridge to Charing-cross, would not be 20 yards nearer than by the present route. Besides this, there was a great traffic westward over Westminster Bridge to Belgrave-square, Pimlico, Knightsbridge, &c., and access to the Houses of Parliament, and the law courts. He pledged himself to oppose the bill in every stage, and he did not believe that five gentlemen would be found in parliament to sanction such an unnecessary waste of public money."

It was also asserted at the meeting, that the Commissioners themselves were not very strongly persuaded of the necessity of altering the situation of the bridge, but had merely *allowed* their solicitor to prepare the notices: another suggestion was, that Hungerford Bridge had been already conditionally sold to the Southampton Railway Company, who intended to use it as an approach to their new terminus in Lambeth. If this important information be correct, it may reasonably be feared that the promoters of the removal of Westminster Bridge to Charing-cross will incur the charge of over anxiety to facilitate the conversion of Hungerford Bridge to the purposes of the Southampton Railway Company. This bridge and the new Westminster Bridge would so nearly adjoin at their Lambeth ends, that the former would be rendered nearly useless to the public at large; and its conversion would therefore be greatly facilitated.

The metropolitan bridges are at present nearly equidistant. This arrangement secures the greatest amount of benefit from each of them: but by removing Westminster Bridge to Whitehall-place, a large and densely-populated district, extending from that point to Vauxhall Bridge, will have no intermediate communication with the opposite bank of the river. There can be no doubt but that after a time, this evil will be so seriously felt, that another bridge must be built above the new Houses of Parliament—that is, the public will be put to the expense of building two bridges instead of one. Moreover, may we not justly complain of the inconsistency of pronouncing Hungerford Bridge by one legislative act a useful, by another a useless, structure? The only just ground for sanctioning its erection was public convenience. If it were not of public utility it ought not to have been erected: if it were of public utility it ought not to be rendered useless, by the erection of another bridge almost close to it. In every point of view, the proposed measures present the same appearance of being anticipatory of a purchase of Hungerford Bridge for private purposes. For no one would be mad enough to propose two contiguous bridges, unless one of them were about to be closed against the public.

We have said little of the injury to existing and justly acquired interests consequent on the alteration, because we wish to view the question on general grounds. But it certainly seems a matter of injustice, almost of robbery, to ruin the property adjacent to the present line of traffic. Many of the houses in the roads leading to Westminster Bridge have, doubtless, frequently changed hands during the last century, and the price of purchase must have been materially influenced by the consideration of the present facilities of communication. The purchaser, who has bought on faith of the permanence of those facilities, finds suddenly that the amount of his purchase-money was twice too much. On the other hand, the owner of mean tenements in Lambeth, adjacent to the new site of the bridge, finds himself in possession of valuable property, at a most inadequate cost. The injustice is double. The latter class of purchasers have no moral right to a treble or quadruple value of their property—the former class are deprived of the value of investments honestly and legally acquired.

To the lover of architecture, it will appear no small argument against the removal of Westminster Bridge, that by that act the only convenient point for viewing the Houses of Parliament is lost to the great body of the inhabitants of London. This consideration has gained additional force since the repairs of the old bridge have been in progress. Recently, the footway has been lowered, and a light parapet of wood, breast high, has been substituted for the former lofty balustrade, by which the view was almost entirely obstructed. The river facade of the New Palace, consequently, presents itself to the eye with a distinctness and unity never before exhibited. It is really curious to observe how much the appearance of the edifice has been improved by the alteration of the bridge. Of course, this advantage would be sacrificed by removing the bridge to Whitehall-place; in fact, the public generally would then have *no* means of viewing the Palace of Westminster except from a considerable distance. That Mr. Barry has nothing to do with the proposition for altering the site of the bridge, but is, on the contrary, desirous that it should remain unaltered, may be announced on the authority of a statement made by Mr. Grissell at the meeting referred to above.

THE WELLINGTON STATUE,

AND THE ROYAL INSTITUTE OF BRITISH ARCHITECTS.

Little has been hitherto said in these pages respecting the position of the equestrian statue on the Triumphal Arch in Piccadilly. Our contemporaries have entered upon the discussion so copiously, that room scarcely seems left for new opinions. Besides, when many speakers harangue simultaneously, they are apt to drown each other's voices, and the heat of a debate is but a poor compensation for the lack of judgment and perspicuity. At the present moment, however, as the storm of discussion is somewhat lulled, we may as well profit by the momentary silence to express the few remarks which we have to offer on the subject.

There are many persons of good taste who, without hypercriticism, would condemn a colossal statue in which the natural proportions are greatly exceeded, as a gross unwieldy object, evincing an utter disregard of the modesty of nature. Without, however, allowing the objection to apply with full force in the present instance, we may still concede that an equestrian figure, exaggerated to gigantic (or more than heroic) dimensions, must require more than ordinary skill in its artistic treatment, and more than ordinary care to render the unnatural magnitude inoffensive. Our visual ideas are all relative. The giants of Brobdignag appeared to Gulliver hideous, and his own size seemed horrible to the Lilliputians.

The Wellington statue will, it is said, be removed to the space between the Horse Guards and the Enclosure in St. James's Park. This removal is on many accounts commendable. A colossal figure, to appear even tolerable, must be placed where the disparity of surrounding objects is not offensively observable. Such a contrast is by every means to be avoided, and the eye must be attracted by the absolute, not by the comparative magnitude of the work of art. Colossal figures have generally appeared best when standing on a wide open plain, isolated from all other artificial objects. The Lion on the field of Waterloo is so placed, standing apart from human habitation, on a broad expanse of country, over which it is visible for miles round. The appearance of the figure in such a situation is, we imagine—for we have never seen it except at a great distance—very effective. The size of the object accords well with its solitude and its simple character.

By analogy, we may presume that this new memorial of the Waterloo conflict should be similarly isolated. To find in London a situation which would perfectly fulfil the conditions here suggested, is of course impracticable, but the position in St. James's Park sufficiently satisfies them. Elevated on a simple plinth or base of steps, at a considerable distance from the nearest building, the statue would no longer look a heavy lump of metal; its size would, we may hope, appear magnificent —at present it seems merely unnatural.

The circumstance of the statue being initially placed in its present ridiculous position will prove by no means prejudicial to the interests of art. On the contrary, the discussion which has arisen produces this net result—the English people will no longer tolerate the absurdity of statues elevated out of sight. The condemnation of the present position of the Wellington Statue, and the ridicule heaped on the Nelson Monument, will render the renewal of this kind of barbarism practically impossible. One great step has therefore been taken in the progress of the doctrine of truth and fidelity in art. The grand objection to the position of the Nelson and Wellington statues is, that their merits or defects as works of art are inappreciable to the ordinary powers of vision. The whole matter may be reduced to a dilemma: if the statues be worth seeing, they should be put where they can be examined; if the statues be not worth seeing, they ought not to be erected as public monuments.

As far as can be at present judged of the Wellington Statue, it is not unworthy of being publicly exhibited. It would be unwise to anticipate the opinion which will be formed of the statue when situated more conveniently for examination; but to judge from the outline (which is almost all that is now discernible), the composition, if not possessed of extraordinary merit, is free from gross defects: and it is stated that the work has been carefully finished and will bear a near inspection. The new pedestal ought to be very simple and of ample breadth, and its elevation ought to be regulated by this plain rule—the best height to which a statue can be raised is that at which it can be most conveniently examined. We have strong hopes that on such a pedestal, and in such a commanding situation, the monument will not prove unworthy of the events commemorated.

The opinion of the Institute of British Architects respecting the elevation of the statue on the arch, corroborates the judgment already formed by the public. The Report of the Institute is already before our readers, and is worth a brief analysis; it consists of six paragraphs, of which three are argumentative. The three reasons for which the Institute condemns the position of the statue are these—first, because Mr. Burton does not like it; secondly, because it injures the architecture of the adjacent buildings (among which are Apsley House and the "elegant" screen next to it); thirdly, because it is an innovation.

We should like to know which of these arguments satisfies the reader: neither has much weight with ourselves. We do not fear that the merits of Mr. Burton's arch will be destroyed, because we are unable to perceive their existence: and the same consideration removes all apprehension respecting Apsley House and the row of stone columns adjacent to it. In the first place, the triumphal arch displays eminently the fault of all its tribe—forms without purpose. If the arch be *real*, its object must be to support a superstructure of proportional size; a vault so enormous as this would never have been erected without such a superstructure, had the least idea of constructive propriety entered the mind of the architect. The vast arches which form the portico beneath the Victoria Tower of the Houses of Parliament are about as large as that in Piccadilly, but then they are of a size corresponding to their purpose;—were it not intended to support a vast tower upon them, they must appear ridiculous. It seems to be forgotten that an arch is not an integral building, but only a part of one, just as a single limb is only one of the component parts of the animal body. Again, if Mr. Burton's arch were real, it would have buttresses; for we know by ordinary mechanical principles that an arch cannot exist without lateral pressures, and that a buttress diminishing in breadth from its base upwards is the proper form for resisting those pressures. The fact, then, of the buttresses being dispensed with, proves that this arch is applied to no purpose, or to a wrong purpose. Lastly, if the arch were real, what is the purpose of the Corinthian columns and horizontal entablature? An arch properly built requires neither. If the weight be supported on a single beam of stone laid on vertical props (as the columns and entablature suggest), then the arch is superfluous. Or if the construction be altogether different—if the space be spanned by numerous wedge-shaped stones, arranged in the form of a vault—then the columns are superfluous. The arch and the entablature cannot *both* be wanted; one at least of them is inconstructive: we believe that both are.

Neither is Apsley House much likely to be injured. In our view, the columns, stuck in front of the walls of the first floor for show, effectually put the building beyond the pale of criticism. We should have thought the same of the adjacent screen of columns, had not the Institute of British Architects pronounced it "elegant." Where is the elegance? We can see the beauty of the periptery of a Greek temple, for there the columns have meaning and purpose. But surely the row of columns at the entrance of the Hyde Park are *un*-meaning. They sustain no weight but that of the small horizontal course of stones laid athwart them. Judging from their dimensions, you would say that the architect had intended to build a large solid edifice, but had been compelled to relinquish his work when only just commenced: or it might be thought that the substructure was begun by one architect; and that another, who did not know for what superstructure it was intended, had finished it in the readiest way he could.

Amphora cœpit
Institui: currente rota cur urceus exit?

In the second paragraph of the Report, the Institute speak of the triumphal arch as "a successful work:" in the concluding paragraph it is recommended that it should be enriched with "accessorial and subordinate" decorations, as "it would then no longer be subject to the severe criticism of artists, foreign visitors, and persons of acknowledged taste." When the writer of the Report praises the arch as successful, he contradicts the laws of good architecture and common sense; but when he suggests means of avoiding the severe and general criticism of it, he does something totally different—he contradicts himself. We are told, first, that the arch is successful; secondly, that it should be decorated in a very different way to what it has ever yet been, in order to be "no longer subject" to universal condemnation. Clearly then, its success has been of a very different kind to that which the Institute set out by assigning to it.

These strictures upon the Report of the Institute are dictated by a sincere conviction that the formal opinion of so distinguished a body ought to possess far greater weight and authority than will be assigned to this document. The Institute is comprised of those whose learning and position command general respect, and whose zeal in the cause of architecture, and success in the practise of it, indisputably entitle them to the support of the profession which they represent. But dissatisfaction at the acts of the collective body is not inconsistent with a most ample acknowledgment of the talents of the individual members.

Considering that the leading architectural doctrine of this Journal is the dependance of decoration on construction, it is natural enough that when the Institute applaud structures in which this great principle is grossly violated, we at least should examine the grounds of their judgment. How has it been arrived at? Certainly not in ignorance of the principle of architectural truth. Neither, we suppose, in defiance of it, for this—to put the question on its lowest basis—would indicate opposition to the doctrines advocated by the most learned architectural writers of our own day, and exemplified by the noblest monuments of ancient architecture. No other supposition remains but that the Institute recognise the principle, but are literally afraid of its consequences. Much opposition, doubtless, must be overcome before what may be called *nonsense architecture* is consigned to its deserved destiny. But the Institute carry their complaisance and caution too far when, to avoid offending individual prejudices, they advocate an irrational system which is fast growing obsolete. It lies in their power to contribute most effectually to the emancipation of art from the artifice and conventionalism which have too long enthralled it. They may direct the reform, and beneficially modify its operations; but it is beyond their power to restrain its progress.

Every paper read before this learned body, or sanctioned by it, is retrospective—none prospective. The progression, the improvement of art is scarcely ever heard of. The past—the past only, claims all attention; and this among those who are best qualified to make provision for the future. The Institute owe it to themselves, and owe it to the public, to take a far more elevated and independent position than they have yet assumed: when they have shown their determination to lead the public taste, instead of following it, we doubt not that their title to do so will be universally recognised.

A statement has been made that Mr. Weale offered to the Institute to publish illustrations of the works of the members, and that his offer was rejected. We are in no way concerned in this statement, and know nothing whatever of it but that it appears in the *Westminster Review*, and has been contradicted at a meeting of the Institute. But the very existence of the rumour, and the earnestness of the denial, indicate its importance. The difficulties of procuring information respecting the progress of architecture are, as we know by experience, almost insuperable. Have we not a right to complain that this information is not voluntarily offered? Our applications to individual architects have been met with uniform courtesy and liberality. But we still feel that the *greatest possible* benefit which the Institute could confer on their art would be by calling on the members to detail, from time to time, the progress of their works*—not to read dissertations on Roman remains in London, or the *scamilli impares* of Vitruvius. We are also perfectly certain that this feeling is strongly participated in by the architectural profession at large and the whole body of the lovers of architecture. Surely an opinion so universal ought to claim some respect from the Institute.

To the remarks made at the meeting just referred to respecting the impropriety of authors reviewing their own writings, we fully assent. All public confidence in reviews must cease when the slightest objection or even suspicion of partiality attaches to them. It has been an invariable rule of this Journal that every paper should be rejected, whatever might be the subject of it, if it seemed written with a covert purpose of furthering individual interests. We are quite willing, or rather, we are most solicitous, that if cases should occur in which our subscribers think that this rule has not been applied with sufficient stringency, the particulars should be publicly communicated in our own pages. These observations have somewhat of personal interest; but the occasion seemed to demand them.

* As at the Institution of Civil Engineers.

ON THE INFLUENCE OF HEAT UPON THE COHESION OF LIQUIDS.

By C. Brumner, Jun.

(*Translated in an abridged form by M. Rosenthal, M.D.*)

Laplace and Poisson have established it as a law, that at various temperatures the height of the capillary column is in a direct ratio with its density. In asserting this, however, they were solely guided by theoretical views on the "force moléculaire." Guy-Lussac's experiments bearing on the above are too insufficient in number to settle the question; and, notwithstanding many valuable publications being since communicated by several authors, Brumner deemed it worthy his consideration to undertake a fresh investigation of the matter. M. Hagen having lately stated that in the case of water, a change of temperature, amounting to a certain number of degrees, has no influence on the phenomena of its capillarity, the author was the more attentive to this point in his researches. M. Hagen in his experiments employed brass plates, brought together in a parallel direction, but Brumner operated with capillary tubes.

These experiments were conducted in the following manner:—The liquid to be examined was introduced into a cylindrical jar, and the latter put in an oil-bath; care being taken that the portion of liquid contained in the capillary tube should be of the same temperature as that observed in the external liquid. To measure the height of the liquid column raised, a glass mass was first immersed in the external liquid, in order to raise the liquid surface until it reached the point of a steel needle fixed for this purpose. The observer, by means of a cathetometer, having noticed the uppermost point of the liquid column raised in the capillary tube, removed again the glass mass immersed as above; the water thus lowered ceased to touch the steel point, and the cathetometer was directed towards the steel point.

The distance between the highest point of the capillary column and the steel point, obtained by means of the cathetometer, indicated the amount of elevation occurring in the capillary tube above the natural level.

These experiments were made with water, ether, and olive oil. In all these liquids, it appeared, the height of the capillary column was considerably diminished by an increase of temperature, in a ratio far greater than would answer to Laplace or Poisson's law relative to the proportionality of density; water, for instance, its temperature being raised from 32° to 158° F., had its density lowered by $\frac{1}{50}$, whereas its capillary height decreased to almost $\frac{1}{6}$. It seems in general that the diminution of the capillary height, caused by elevation of temperature, is *not proportional to density*, but that it is rather corresponding with the *increase of temperature*.

Founded on this assertion, Brumner calculated his experiments agreeably to the method of the "least squares." In this manner he had this law fully confirmed; and the height (h) at which a column of liquid in a capillary tube of one milimeter radius, at a given temperature, is raised, may be determined by means of the following most simple formulæ:—

For water, $h = 15{\cdot}58215 - 0{\cdot}028639\,t$.
For ether, $h = 5{\cdot}3536 - 0{\cdot}028012\,t$.
For olive oil, $h = 7{\cdot}4640 - 0{\cdot}010486\,t$.

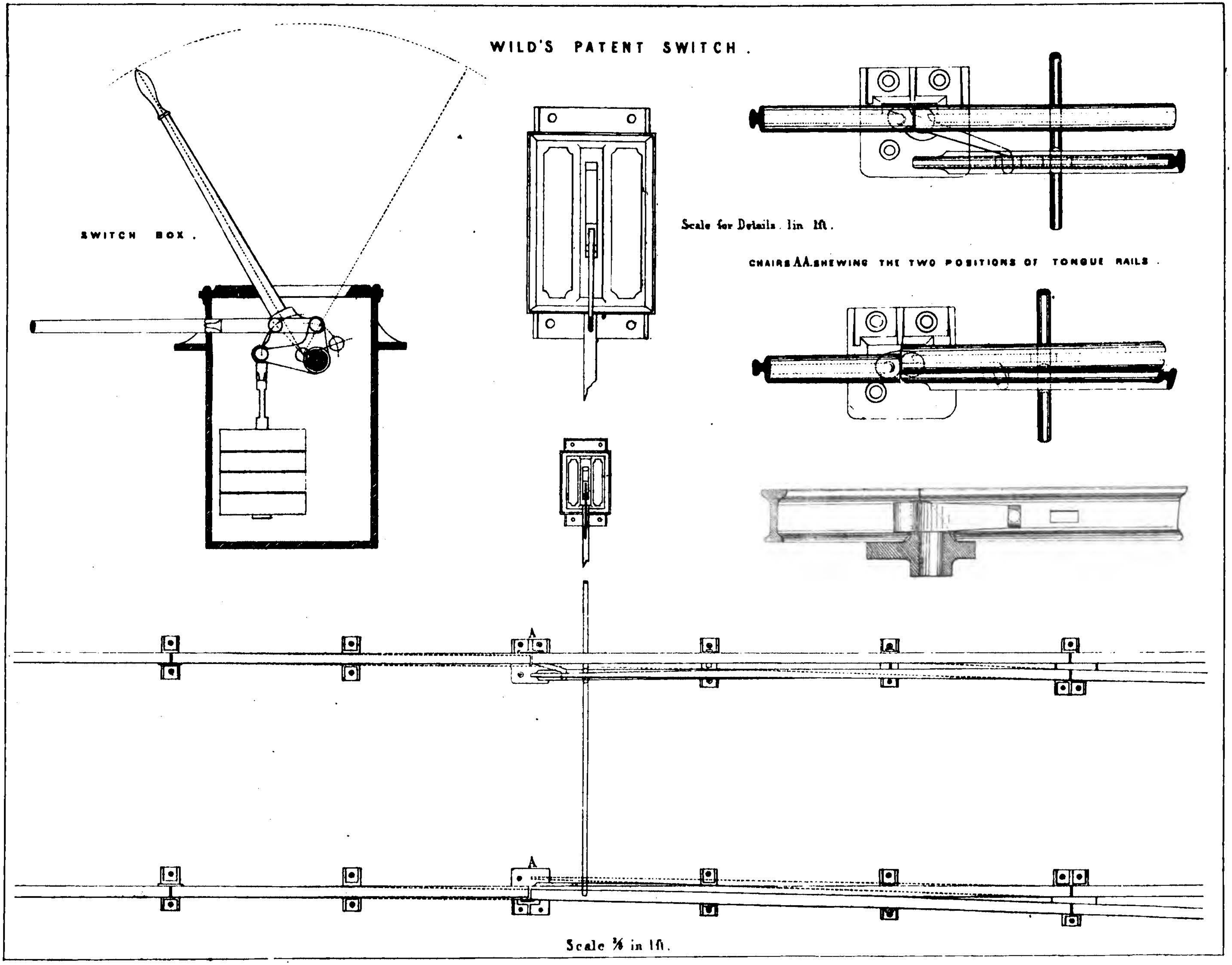
In these formulæ, t expresses the temperature in degrees of the centigrade scale.

The law, that capillarity is not a direct ratio with density, but that it is inversely proportional to the elevation of temperature, becomes most evidently corroborated by observations made with water at low temperatures. About 200 experiments, instituted with water at temperatures varying from 0° to 8° centigrade, or 32° to 46·4° Fahr., showed that the well-known anomaly occurring in the density of water, from 32° to 39·2° F., had no influence whatever on its cohesion; and starting from 32° F. cohesion, diminished in a ratio proportional to the increase of temperature.

We may, therefore, consider it as established that heat has another influence on cohesion than that caused by mere change of density.

PLATE III.

WILD'S PATENT SWITCH.



WILD'S RAILWAY SWITCH.

(With an Engraving, Plate III.)

In the present number we give an engraving of a new railway switch. There have been since the first introduction of railways, several arrangements proposed for passing trains from one line of rails to another; the whole of these, however, which have been adopted may be classed under two heads: those in which, in order to effect a change from one line of rails to another, the apparatus had to be moved by hand; and those in which an engine can pass from either of the two diverging lines on to the single line without such aid, clearing the way for itself, should the switch be in the wrong position. These are termed, and are, to a certain extent, self-acting.

The former possessed the advantage of making the guage perfect for either line, but was deficient in the more essential quality of safety; while the latter, to attain this quality, sacrificed the parallelism of guage. In the improved switch the advantages of both are united, the self-acting principle being accompanied with perfect uniformity of guage.

In order to describe the working of the new apparatus, it will be first advisable to refer to the one now mostly employed, in which either tongue rail is embedded in the ordinary rail according to the position of the switch; in this arrangement the guage is always imperfect, as the notch occupied by the end of the tongue rail is, when this is withdrawn, left exposed: this defect is partially provided against by the introduction of a check rail.

In the improved switch, the end of the tongue, when in contact with the rail, is also embedded in a notch, which however ceases to exist when it is no longer required. This motion is effected by causing the rail abutting against the end of the tongue to move in connection with it, but in the opposite direction, so that when the tongue is withdrawn, the protruding rail which formed the notch is withdrawn also.

In all inventions of this class, however ingenious they may appear on paper, practice is the main test of their utility, and we are informed that the invention which we have now noticed, has been for some time in successful operation upon several railways; among which we may mention the Grand Junction, the Manchester and Leeds, the Chester and Birkenhead, and the South Eastern Railways.

THE PLANET BEYOND URANUS.

The memoir of the discovery of the planet beyond Uranus, read by the Astronomer-Royal at the November meeting of the Royal Astronomical Society, has been printed on account of its importance before the remainder of the usual monthly notice was completed. Extracts of Professor Airy's memoir are given below, but for the sake of brevity several parts are omitted, for which we have substituted the paragraphs in brackets.

We wish to direct the reader's attention chiefly to the papers marked 11 and 12, and to the remarks following them. It will be seen from these, that a few days after Mr. Adams had communicated to the Astronomer-Royal *all* the elements of the planet, M. Le Verrier published, in the *Comptes Rendus*, a paper on the perturbations of Uranus, in which he says nothing of their being caused by an exterior planet: we may, therefore, suppose that he had not, at that time, made any discoveries respecting it. Seven months after, M. Le Verrier publishes another paper, in which he, for the first time, speaks of the new planet. The Astronomer-Royal says that he received this paper with "a feeling of delight and satisfaction," because it confirmed the conclusions of Mr. Adams respecting the position of the planet, which he "had perused seven months earlier." It is important to observe that this second paper by M. Le Verrier gave only the position—not the mass and orbit—of the planet, which had been however ascertained by Mr. Adams. The eccentricity of the planet was not discovered by M. Le Verrier till August, 1846—that is, ten months after the Astronomer-Royal received Mr. Adams's determination of it.

It appears that neither the Astronomer-Royal nor Professor Challis thought it worth while to take the trouble of looking for the planet until Le Verrier's paper confirmed that of Mr. Adams. The self-exculpatory tone adopted by the superintendents of the two principal English observatories, does not seem altogether needless. The fact of their both offering apologies, seems to indicate that apologies were necessary. The Astronomer-Royal had "always considered the correctness of a distant mathematical result to be a subject rather of moral than of mathematical evidence." Professor Challis says, in a paper following that by Professor Airy, that his motive for undertaking the search for the predicted planet, was the agreement of M. Le Verrier's "deductions with those of Mr. Adams, together with the recommendation of the Astronomer-Royal." He tells us, also, that he was deterred from commencing the work sooner, because it was "*so novel a thing* to undertake observations in reliance upon merely theoretical deductions."

We have no desire to depreciate M. Le Verrier's labours. On the contrary, they entitle him to high renown. His first paper alone, investigating the perturbations of Uranus without assigning a new cause for them, is a work of the utmost scientific value. But the chief peculiarity of this event in the history of science is the *predictive* evidence and application of the laws of gravitation. Hitherto, the evidence of the truth of those laws, wonderfully minute and varied as it has been, was restricted to the explanation of observed facts; but the most overwhelming evidence of a theory is its capability of anticipating the result of experimental observations before they are actually made. This kind of evidence is furnished in an unexampled degree, by the anticipatory calculation of the mass, &c., of the unseen planet. Regarding, therefore, the prediction of the planet as an event altogether unparalleled, and as the feature of the discovery most important with respect to the evidences of science, we cannot over-estimate the value of the fact established by the Astronomer-Royal, that Mr. Adams was the first *predicter* of the position, mass, and orbit of the new planet.

When the Astronomer-Royal speaks of the discovery as "a consequence of what may properly be called a movement of the age," we must take this as a rhetorical expression, not intended to have any specific meaning. In fact, the utmost that can be made of the sentence is this, that there has for some time existed a general suspicion of the existence of a planet beyond Uranus. The numerical determination of the longitude of the planet (328 34), &c., by an elaborate mathematical investigation, required something a *little* more tangible and definite than a "movement of the age."

It has not been usual to admit into the *Memoirs* of this Society mere historical statements of circumstances which have occurred in our own times. I am not aware that this is a matter of positive regulation: it is, I believe, merely a rule of practice, of which the application in every particular instance has been determined by the discretion of those Officers of the Society with whom the arrangement of our *Memoirs* has principally rested. And there can be no doubt that the ordinary rule must be a rule for the exclusion of papers of this character; and that if a positive regulation is to be made, it must absolutely forbid the presentation of such histories. Yet it is conceivable that events may occur in which this rule ought to be relaxed; and such, I am persuaded, are the circumstances attending the discovery of the planet exterior to *Uranus*. In the whole history of astronomy, I had almost said in the whole history of science, there is nothing comparable to this. The history of the discoveries of new planets in the latter part of the last century, and in the present century, offers nothing analogous to it. *Uranus*, *Ceres*, and *Pallas*, were discovered in the course of researches which did not contemplate the possible discovery of planets. *Juno* and *Vesta* were discovered in following up a series of observations suggested by a theory which, fruitful as it has been, we may almost venture to call fanciful. *Astræa* was found in the course of a well-conducted re-examination of the heavens, apparently contemplating the discovery of a new planet as only one of many possible results. But the motions of *Uranus*, examined by philosophers who were fully impressed with the universality of the law of gravitation, have long exhibited the effects of some disturbing body: mathematicians have at length ventured on the task of ascertaining where such a body could be; they have pointed out that the supposition of a disturbing body moving in a certain orbit, precisely indicated by them, would entirely explain the observed disturbances of *Uranus*: they have expressed their conviction, with a firmness which I must characterise as wonderful, that the disturbing planet would be found exactly in a certain spot, and presenting exactly a certain appearance; and in that spot, and with that appearance, the planet has been found. Nothing in the whole history of astronomy can be compared with this.

The principal steps in the theoretical investigations have been made by one individual, and the published discovery of the planet was necessarily made by one individual. To these persons the public attention has been principally directed; and well do they deserve the honours which they have received, and which they will continue to receive. Yet we should do wrong if we considered that these two persons alone are to be regarded as the authors of the discovery of this planet. I am confident that it will be found that the discovery is a consequence of what may properly be called a movement of the age; that it has been urged by the feeling of the scientific world in general, and has been nearly perfected by the collateral, but independent labours, of various persons possessing the talents or powers best suited to the different parts of the researches.

With this conviction, it has appeared to me very desirable that the authentic history of this discovery should be published as soon as possible; not only because it will prove a valuable contribution to the history of science, but also because it may tend to do justice to some persons who otherwise would not receive in future times the credit which they deserve. And as a portion of the history, I venture to offer to this Society a statement of the circumstances which have come to my own knowledge. I have thought that I could with propriety do this: not because I can pretend to know all the history of the discovery, but because I know a considerable part of it; and because I can lay claim to the character of impartiality to this extent, that, though partaking of the general movement of the age, I have not directly contributed either to the theoretical or to the observing parts of the discovery. In a matter of this delicacy I have thought it best to act on my own judgment, without consulting any other person; I have, however, solicited the permission of my English correspondents for the publication of letters.

Without pretending to fix upon a time when the conviction of the irreconcilability of the motions of *Uranus* with the law of gravitation first fixed itself in the minds of some individuals, we may without hesitation date the general belief in this irreconcilability from the publication of M. Alexis Bouvard's *Tables of Uranus* in 1821. It was fully shown in the introduction to the tables, that, when every correction for perturbation indicated by the best existing theories was applied, it was still impossible to reconcile the observations of Flamsteed, Lemonnier, Bradley, and Mayer, with the orbit required by the observations made after 1781: and the elements of the orbit were adopted from the latter observations, leaving the discordances with the former (amounting sometimes to three minutes of arc) for future explanation.

The orbit thus adopted represented pretty well the observations made in the years immediately following the publication of the tables. But in five or six years the discordance again growing up became so great, that it could not escape notice. A small error was shown by the Kremsmünster Observations of 1825 and 1826: but, perhaps, I am not in error in stating that the discordance was first prominently exhibited in the Cambrige Observations, the publication of which from 1828 was conducted under my superintendence.

[Here intervene letters from Mr. Hussey (1834) and M. Bouvard (1837), surmising that the perturbations might be produced by an unseen body.]

I have departed from a strictly chronological order for the sake of keeping in connexion the papers which relate to the same trains of investigation. Several months before the date of the last letter quoted, I had received the first intimation of those calculations which have led to a distinct indication of the place where the disturbing planet ought to be sought. The date of the following letter is Feb. 13, 1844:—

No. 6.—Professor Challis to G. B. Airy.

[extract.]

"*Cambridge Observatory, Feb.* 13, 1844.

"A young friend of mine, Mr. Adams, of St. John's College, is working at the theory of *Uranus*, and is desirous of obtaining errors of the tabular geocentric longitudes of this planet, when near opposition, in the years 1818-1826, with the factors for reducing them to errors of heliocentric longitude. Are your reductions of the planetary observations so far advanced that you could furnish these data? and is the request one which you have any objection to comply with? If Mr. Adams may be favoured in this respect, he is further desirous of knowing, whether in the calculation of the tabular errors any alterations have been made in Bouvard's *Tables of Uranus* besides that of *Jupiter's* mass."

No. 7.—G. B. Airy to Professor Challis.

[extract.]

"*Royal Observatory, Greenwich*, 1844, *Feb.* 15.

"I send all the results of the observations of *Uranus* made with both instruments [that is, the heliocentric errors of *Uranus* in longitude and latitude from 1754 to 1830, for all those days on which there were observations, both of right ascension and of polar distance]. No alteration is made in Bouvard's *Tables of Uranus*, except increasing the two equations which depend on *Jupiter* by $\frac{1}{50}$ part. As constants have been added (in the printed tables) to make the equations positive, and as $\frac{1}{50}$ part of the numbers in the tables has been added, $\frac{1}{50}$ part of the constants has been subtracted from the final results."

No. 8.—Professor Challis to G. B. Airy.

[extract.]

"*Cambridge Observatory, Feb.* 16, 1844.

"I am exceedingly obliged by your sending so complete a series of tabular errors of *Uranus*. * * * The list you have sent will give Mr. Adams the means of carrying on in the most effective manner the inquiry in which he is engaged.

No. 9.—Professor Challis to G. B. Airy.

"*Cambridge Observatory Sept.* 22, 1845

"My friend Mr. Adams (who will probably deliver this note to you) has completed his calculations respecting the perturbation of the orbit of *Uranus* by a supposed ulterior planet, and has arrived at results which he would be glad to communicate to you personally, if you could spare him a few moments of your valuable time. His calculations are founded on the observations you were so good as to furnish him with some time ago; and from his character as a mathematician, and his practice in calculation, I should consider the deductions from his premises to be made in a trustworthy manner. If he should not have the good fortune to see you at Greenwich, he hopes to be allowed to write to you on this subject."

No. 10.—G. B. Airy to Professor Challis.

"*Royal Observatory, Greenwich*, 1845, *Sept.* 29.

"I was, I suppose, on my way from France, when Mr. Adams called here: at all events, I had not reached home, and therefore, to my regret, I have not seen him. Would you mention to Mr. Adams that I am very much interested with the subject of his investigations, and that I should be delighted to hear of them by letter from him?"

On one of the last days of October, 1845, Mr. Adams called at the Royal Observatory, Greenwich, in my absence, and left the following important paper:—

No. 11.—J. C. Adams, Esq. to G. B. Airy.

"According to my calculations, the observed irregularities in the motion of *Uranus* may be accounted for by supposing the existence of an exterior planet, the mass and orbit of which are as follows:—

Mean Distance (assumed nearly in accordance with Bode's law)	38·4
Mean Sidereal Motion in 365·25 days . .	1°30′·9
Mean Longitude, 1st October, 1845 . . .	323 34
Longitude of Perihelion.	315 55
Eccentricity	0·1610.
Mass (that of the Sun being unity), . . .	0·0001656.

For the modern observations I have used the method of normal places, taking the mean of the tabular errors, as given by observations near three consecutive oppositions, to correspond with the mean of the times; and the Greenwich observations have been used down to 1830: since which, the Cambridge and Greenwich observations, and those given in the *Astronomische Nachrichten*, have been made use of. The following are the remaining errors of mean longitude:—

Observation—Theory.

1780	+0″·27	1801	−0″·04	1822	+0″·30
1783	−0 ·23	1804	+1 ·76	1825	+1 ·92
1786	−0 ·96	1807	−0 ·21	1828	+2 ·25
1789	+1 ·82	1810	+0 ·56	1831	−1 ·06
1792	−0 ·91	1813	−0 ·94	1834	−1 ·44
1795	+0 ·09	1816	−0 ·31	1837	−1 ·62
1798	−0 ·99	1819	−2 ·00	1840	+1 ·73

The error for 1780 is concluded from that for 1781 given by observation, compared with those of four or five following years, and also with Lemonnier's observations in 1769 and 1771.

"For the ancient observations, the following are the remaining errors:—

Observation—Theory.

1690	+44′·4	1750	− 1″·6	1763	− 5″·1
1712	+ 6 ·7	1753	+ 5 ·7	1769	+ 0 ·6
1715	− 6 ·8	1756	− 4 ·0	1771	+11 ·8

The errors are small, except for Flamsteed's observation of 1690. This being an isolated observation, very distant from the rest, I thought it best not to use it in forming the equations of condition. It is not improbable, however, that this error might be destroyed by a small change in the assumed mean motion of the planet."

I acknowledged the receipt of this paper in the following terms:—

No. 12.—G. B. Airy to J. C. Adams, Esq.

"*Royal Observatory, Greenwich*, 1845, *Nov.* 5.

"I am very much obliged by the paper of results which you left here a few days since, showing the perturbations on the place of *Uranus* produced by a planet with certain assumed elements. The latter numbers are all extremely satisfactory: I am not enough acquainted with Flamsteed's observations about 1690 to say whether they bear such an error, but I think it extremely probable.

"But I should be very glad to know whether this assumed perturbation will explain the error of the radius vector of *Uranus*. This error is now very considerable, as you will be able to ascertain by comparing the normal equations, given in the Greenwich observations for each year, for the times *before* opposition with the times *after* opposition."

I have before stated, that I consider the establishment of this error of the radius vector of *Uranus* to be a very important determination. I therefore considered that the trial, whether the error of the radius vector would be explained by the same theory which explained the error of longitude would be truly an *experimentum crucis*. And I waited with much anxiety for Mr. Adams's answer to my query. Had it been in the affirmative, I should at once have exerted all the influence which I might possess, either directly, or indirectly through my friend Professor Challis, to procure the publication of Mr. Adams's theory.*

From some cause with which I am unacquainted, probably an accidental one, I received no immediate answer to this inquiry. I regret this deeply, for many reasons.

While I was expecting more complete information on Mr. Adams's theory, the results of a new and most important investigation reached me from another quarter. In the *Compte Rendu* of the French Academy for the 10th Nov., 1845, which arrived in this country in December, there is a paper by M. Le Verrier on the perturbations of *Uranus* produced by *Jupiter* and *Saturn*, and on the errors in the elliptic elements of *Uranus*, consequent on the use of erroneous perturbations in the treatment of the observations. It is impossible for me here to enter into details as to the conclusions of this valuable memoir; I shall only say that, while the correctness of the former theories, as far as they went, was generally established, many small terms were added; that the accuracy of the calculations was established by duplicate investigations, following different courses, and executed with extraordinary labour; that the corrections to the elements, produced by treating the former observations with these corrected perturbations, were obtained; and that the correction to the ephemeris for the present time, produced by the introduction of the new perturbations and the new elements, was investigated and found to be incapable of explaining the observed irregularity of *Uranus*. Perhaps it may be truly said that the theory of *Uranus* was now, for the first time, placed on a satisfactory foundation. This important labour, as M. Le Verrier states, was undertaken at the urgent request of M. Arago.

In the *Compte Rendu* for June 1, 1846, M. Le Verrier gave his second memoir on the theory of *Uranus*. The first part contains the results of a new reduction of nearly all the existing observations of *Uranus*, and their treatment with reference to the theory of perturbations, as amended in the former memoir. After concluding from this reduction that the observations are absolutely irreconcilable with the theory, M. Le Verrier considers in the second part all the possible explanations of the discordance, and concludes that none is admissible, except that of a disturbing planet exterior to *Uranus*. He then proceeds to investigate the elements of the orbit of such a planet, assuming that its mean distance is double that of *Uranus*, and that its orbit is in the plane of the ecliptic. The value of the mean distance, it is to be remarked, is not fixed entirely by Bode's law, although suggested by it; several considerations are stated which compel us to take a mean distance, not very greatly differing from that suggested by the law, but which nevertheless, without the suggestion of that law, would leave the mean distance in a most troublesome uncertainty. The peculiarity of the form which the investigation takes is then explained. Finally, M. Le Verrier gives as the most probable result of his investigations, that the true longitude of the disturbing planet for the beginning of 1847 must be about 325°, and that an error of 10° in this place is not probable. No elements of the orbit or mass of the planet are given.

This memoir reached me about the 23rd or 24th of June. I cannot sufficiently express the feeling of delight and satisfaction which I received from it. The place which it assigned to the disturbing planet was the same, to one degree, as that given by Mr. Adams's calculations, which I had perused seven months earlier. To this time I had considered that there was still room for doubt of the accuracy of Mr. Adams's investigations; for I think that the results of algebraic and numerical computations, so long and so complicated as those of an inverse problem of perturbations, are liable to many risks of error in the details of the process: I know that there are important numerical errors in the *Mécanique Céleste* of Laplace; in the *Théorie de la Lune* of Plana; above all, in Bouvard's first tables of *Jupiter* and *Saturn*; and to express it in a word, I have always considered the correctness of a distant mathematical result to be a subject rather of moral than of mathematical evidence. But now I felt no doubt of the accuracy of both calculations, as applied to the perturbation in longitude. I was, however, still desirous, as before, of learning whether the perturbation in radius vector was fully explained. I therefore addressed to M. Le Verrier the following letter:—

No. 13.—G. B. AIRY to M. LE VERRIER.

"*Royal Observatory, Greenwich*, 1846, *June* 26.

"I have read, with very great interest, the account of your investigations on the probable place of a planet disturbing the motions of *Uranus*, which is contained in the *Compte Rendu de l' Académie* of June 1; and I now beg leave to trouble you with the following question. It appears, from all the later observations of *Uranus* made at Greenwich (which are most completely reduced in the *Greenwich Observations* of each year, so as to exhibit the effect of an error either in the tabular heliocentric longitude, or the tabular radius vector), that the tabular radius vector is considerably too small. And I wish to inquire of you whether this would be a consequence of the disturbance produced by an exterior planet, now in the position which you have indicated?

"I imagine that it would not be so, because the principal term of the inequality would probably be analogous to the moon's variation, or would depend on sin $2(v-v')$; and in that case the perturbation in radius vector would have the sign—for the present relative position of the planet and *Uranus*. But this analogy is worth little, until it is supported by proper symbolical computations.

"By the earliest opportunity I shall have the honour of transmitting to you a copy of the *Planetary Reductions*, in which you will find all the observations made at Greenwich to 1830 carefully reduced and compared with the tables."

Before I could receive M. Le Verrier's answer, a transaction occurred which had some influence on the conduct of English astronomers.

On the 29th of June, a meeting of the Board of Visitors of the Royal Observatory of Greenwich was held, for the consideration of special business. At this meeting, Sir J. Herschel and Professor Challis (among other members of the Board) were present; I was also present, by invitation of the Board. The discussion led, incidentally, to the general question of the advantage of distributing subjects of observation among different observatories. I spoke strongly in favour of such distribution; and I produced, as an instance, the extreme probability of now discovering a new planet in a very short time, provided the powers of one observatory could be directed to the search for it. I gave, as the reason upon which this probability was based, the very close coincidence between the results of Mr. Adams's and M. Le Verrier's investigations of the place of the supposed planet disturbing *Uranus*. I am authorised by Sir J. Herschel's printed statement in the *Athenæum* of October 3, to ascribe to the strong expressions which I then used the remarkable sentence in Sir J. Herschel's address, on September 10, to the British Association assembled at Southampton. "We see it [the probable new planet] as Columbus saw America from the shores of Spain. Its movements have been felt, trembling along the far-reaching line of our analysis, with a certainty hardly inferior to that of ocular demonstration."* And I am authorised by Professor Challis, in oral conversation, to state that the same expressions of mine induced him to contemplate the search for the suspected planet.

[M. Le Verrier's reply follows, in which he says that M. Bouvard calculated incorrectly the orbit of Uranus, in ignorance of the exterior planet, and that the error of the radius vector of Uranus arises from errors of its eccentricity and longitude of perihelion.

The following letter is from Professor Airy to Professor Challis, requesting the latter to undertake the search at Cambridge, with the Northumberland equatorial telescope, as the only instrument in England large enough for the purpose.]

In explanation of this letter, it may be necessary to state that, in common I believe with other astronomers at that time, I thought it likely that the planet would be visible only in large telescopes. I knew that the Observatory of Cambridge was at this time oppressed with work, and I thought that the undertaking—a survey of such an extent as this seemed likely to prove—would be entirely beyond the powers of its personal establishment. Had Professor Challis assented to my proposal of assistance, I was prepared immediately to place at his disposal the services of an efficient assistant; and for approval of such a step, and for liquidation of the expense which must thus be thrown on the Royal Observatory, I should have referred to a Government which I have never known to be illiberal when demands for the benefit of science were made by persons whose character and position offered a guarantee, that the assistance was fairly asked for science, and that the money would be managed with fair frugality. In the very improbable event of the Government refusing such indemnity, I was prepared to take all consequences on myself.

On the 13th of July, I transmitted to Professor Challis "Suggestions for the Examination of a Portion of the Heavens in search of the external Planet which is presumed to exist and to produce disturbance in the motion of *Uranus*," and I accompanied them with the following letter:—

No. 16.—G. B. AIRY to Professor CHALLIS.

"*Royal Observatory, Greenwich*, 1846, *July* 13.

"I have drawn up the enclosed paper, in order to give you a notion of the extent of work incidental to a sweep for the possible planet.

"I only add at present that, in my opinion, the importance of this inquiry exceeds that of any current work, which is of such a nature as not to be totally lost by delay."

My "Suggestions" contemplated the examination of a part of the heavens 30° long, in the direction of the ecliptic, and 10° broad. They entered into considerable details as to the method which I proposed; details which were necessary, in order to form an estimate of the number of hours' work likely to be employed in the sweep.

I received, in a few days, the following answer:—

No. 17.—Professor CHALLIS to G. B. AIRY.

[EXTRACTS.]

"*Cambridge Observatory, July* 18, 1846.

"I have only just returned from my excursion. * * * I have determined on sweeping for this hypothetical planet. * * * With respect to your proposal of supplying an assistant I need not say anything, as I understand it to be made on the supposition that I decline undertaking the search myself. * * * I purpose to carry the sweep to the extent you recommend."

* Here the Astronomer Royal explained to the meeting, by means of a diagram, the nature of the errors of the tabular radius vector.

* This sentence is copied from the written draft of the speech. Sir J. Herschel appeared to suppose that the sentence had not been reported in the public journals as spoken. I did, however, see it so reported in an English newspaper, to which I had access on the Continent.

The remainder of the letter was principally occupied with the details of a plan of observing different from mine, and of which the advantage was fully proved in the practical observation.

On August 7, Professor Challis, writing to my confidential assistant (Mr. Main) in my supposed absence, said,—

No. 18.—Professor CHALLIS to the Rev. R. MAIN.

[EXTRACT.]

"*Cambridge Observatory, August* 7, 1846.

"I have undertaken to search for the supposed new planet more distant than *Uranus*. Already I have made trial of two different methods of observing. In one method, recommended by Mr. Airy * * * I met with a difficulty which I had anticipated. * * * I adopted a second method."

From a subsequent letter (to be cited hereafter), it appears that Professor Challis had commenced the search on July 29, and had actually observed the planet on August 4, 1846.

Mr. Main's answer to the other parts of this letter, written by my direction, is dated August 8.

At Wiesbaden (which place I left on September 7), I received the following letter from Professor Challis :—

No. 19.—Professor CHALLIS to G. B. AIRY.

[EXTRACT.]

"*Cambridge Observatory, Sept.* 2, 1846.

"I have lost no opportunity of searching for the planet; and the nights having been generally pretty good, I have taken a considerable number of observations: but I get over the ground very slowly, thinking it right to include all stars to 10-11 magnitude; and I find, that to scrutinise, thoroughly, in this way the proposed portion of the heavens, will require many more observations than I can take this year."

On the same day on which Professor Challis wrote this letter, Mr. Adams, who was not aware of my absence from England, addressed the following very important letter to Greenwich :—

No. 20.—J. C. ADAMS, Esq., to G. B. AIRY.

"*St. John's College, Cambridge, Sept.* 2, 1846.

"In the investigation, the results of which I communicated to you last October, the mean distance of the supposed disturbing planet is assumed to be twice that of *Uranus*. Some assumption is necessary in the first instance, and Bode's law renders it probable that the above distance is not very remote from the truth: but the investigation could scarcely be considered satisfactory while based on any thing arbitrary; and I therefore determined to repeat the calculation, making a different hypothesis as to the mean distance. The eccentricity also resulting from my former calculations was far too large to be probable; and I found that, although the agreement between theory and observation continued very satisfactory down to 1840, the difference in subsequent years was becoming very sensible, and I hoped that these errors, as well as the eccentricity, might be diminished by taking a different mean distance. Not to make too violent a change, I assumed this distance to be less than the former value by about $\frac{1}{30}$th part of the whole. The result is very satisfactory, and appears to show that, by still further diminishing the distance, the agreement between the theory and the later observations may be rendered complete, and the eccentricity reduced at the same time to a very small quantity. The mass and the elements of the orbit of the supposed planet, which result from the two hypotheses, are as follows :—

	Hypothesis I. $\left(\frac{a}{a^1}=0{\cdot}5\right)$	Hypothesis II. $\left(\frac{a}{{}^1}=0.515\right)$
Mean Longitude of Planet, 1st Oct. 1846	325° 8′	323° 2′
Longitude of Perihelion ..	315 57	299 11
Eccentricity	0·16103	0·12062
Mass (that of Sun being 1) ..	0·00016563	0·00015003

"This investigation has been conducted in the same manner in both cases, so that the differences between the two sets of elements may be considered as wholly due to the variation of the fundamental hypothesis. The following table exhibits the differences between the theory and the observations which were used as the basis of calculation. The quantities given are the errors of *mean* longitude, which I found it more convenient to employ in my investigations than those of the true longitude.

Ancient Observations.

Date.	(Obs. — Theory.) Hypoth. I.	Hypoth. II.	Date.	(Obs. — Theory.) Hypoth. I.	Hypoth. II.
1712	+6″·7	+6″·3	1756	— 4″·0	— 4″·9
1715	—6 ·8	—6 ·6	1764	— 5 ·1	— 4 ·1
1750	—1 ·6	—2 ·6	1769	+ 0 ·6	+ 1 ·8
1753	+5 ·7	+5 ·2	1771	+11 ·8	+12 ·8

Modern Observations.

1780	+0″·27	+0″·54	1810	+0″·56	+0″·61
1783	—0 ·23	—0 ·21	1813	—0 ·94	—1 ·00
1786	—0 ·36	—1 ·00	1816	—0 ·31	—0 ·46
1789	+1 ·82	+1 ·63	1819	—2 ·00	—2 ·19
1792	—0 ·91	—1 ·06	1822	+0 ·30	+0 ·14
1795	+0 ·09	+0 ·04	1825	+1 ·92	+1 ·87
1798	—0 ·99	—0 ·93	1828	+2 ·25	+2 ·35
1801	—0 ·04	+0 ·11	1831	—1 ·06	—0 ·82
1804	+1 ·76	+1 ·94	1834	—1 ·44	—1 ·17
1807	—0 ·21	—0 ·08	1837	—1 ·62	—1 ·53
1810	+0 ·56	+0 ·61	1840	+1 ·73	+1 ·31

"The greatest difference in the above table, viz. that for 1771, is deduced from a single observation, whereas the difference immediately preceding, which is deduced from the mean of several observations, is much smaller. The error of the tables for 1780 is found by interpolating between the errors given by the observations of 1781, 1782, and 1783, and those of 1769 and 1771. The differences between the results of the two hypotheses are exceedingly small till we come to the last years of the series, and become sensible precisely at the point where both sets of results begin to diverge from the observations; the errors corresponding to the second hypothesis being, however, uniformly smaller. The errors given by the *Greenwich Observations* of 1843 are very sensible, being for the first hypothesis + 6″·84, and for the second + 5″·50. By comparing these errors, it may be inferred that the agreement of theory and observation would be rendered very close by assuming $\frac{a}{a^1}=0{\cdot}57$, and the corresponding mean longitude on the 1st October, 1846, would be about 315° 20′, which I am inclined to think is not far from the truth. It is plain also that the eccentricity corresponding to this value $\frac{a}{a^1}$, would be very small. In consequence of the divergence of the results of the two hypotheses, still later observations would be most valuable for correcting the distances, and I should feel exceedingly obliged if you would kindly communicate to me two normal places near the oppositions of 1844 and 1845.

"As Flamsteed's first observation of *Uranus* (in 1690) is a single one, and the interval between it and the rest is so large, I thought it unsafe to employ this observation in forming the equations of condition. On comparing it with the theory, I find the difference to be rather large, and greater for the second hypothesis than for the first, the errors being + 44″·5 and + 50″·0 respectively. If the error be supposed to change in proportion to the change of mean distance, its value corresponding to $\frac{a}{a^1}=0{\cdot}57$, will be about + 70″, and the error in the time of transit will be between 4′ and 5′. It would be desirable to ascertain whether Flamsteed's manuscripts throw any light on this point.

"The corrections of the tabular radius vector of *Uranus*, given by the theory for some late years, are as follows :—

Date.	Hypoth. I.	Hypoth. II.
1834	+0·005051	+0·004923
1840	+0·007219	+0·006962
1846	+0·008676	+0·008250

"The correction for 1834 is very nearly the same as that which you have deduced from observation, in the *Astronomische Nachrichten*; but the increase in later years is more rapid than the observations appear to give it: the second hypothesis, however, still having the advantage.

"I am at present employed in discussing the errors in latitude, with the view of obtaining an approximate value of the inclination and position of the node of the new planet's orbit; but the perturbations in latitude are so very small that I am afraid the result will not have great weight. According to a rough calculation made some time since, the inclination appeared to be rather large, and the longitude of the ascending node to be about 300°; but I am now treating the subject much more completely, and hope to obtain the result in a few days.

"I have been thinking of drawing up a brief account of my investigation to present to the British Association."

Mr. Main, acting for the Astronomer Royal in his absence, answered this letter as follows :—

No. 21.—The Rev. R. MAIN to J. C. ADAMS, Esq.

"*Royal Observatory, Greenwich*, 1846, *Sept.* 5.

"The Astronomer Royal is not at home, and he will be absent for some time; but it appears to me of so much importance that you should have immediately the normal errors of *Uranus* for 1844 and 1845, that I herewith send you the former (the volume for 1844 has been published for some time), and I shall probably be able to send you those for 1845 on Tuesday next, as I have given directions to have the computations finished immediately. If a place (geocentric) for the present year should be of value to you, I could probably send one in a few days."

In acknowledging this letter, Mr. Adams used the following expression:

No. 22.—J. C. ADAMS, Esq. to the Rev. R. MAIN.

[EXTRACT.]

"*St. John's College, Cambridge, 7th Sept.* 1846.

"I hope by to-morrow to have obtained approximate values of the inclination and longitude of the node."

On the same day, Sept. 7, Mr. Main transmitted to Mr. Adams the normal places for 1845, to which allusion was made in the letter of September 5.

On the 31st of August, M. Le Verrier's second paper on the place of the disturbing planet (the third paper on the motion of *Uranus*) was communicated to the French Academy. I place the notice of this paper after those of September 2, &c. because, in the usual course of transmission to this country, the number of the *Comptes Rendus* containing this paper would not arrive here, at the earliest, before the third or fourth week in September; and it does not appear that any earlier notice of its contents was received in England.

It is not my design here to give a complete analysis of this remarkable paper; but I may advert to some of its principal points. M. Le Verrier states that, considering the extreme difficulty of attempting to solve the problem in all its generality, and considering that the mean distance and the epoch of the disturbing planet were determined approximately by his former investigations, he adopted the corrections to these elements as two of the unknown quantities to be investigated. Besides these, there are the planet's mass, and two quantities from which the eccentricity and the longitude of perihelion may be inferred; making, in all, five unknown quantities depending solely on the orbit and mass of the disturbing planet. Then there are the possible corrections to the mean distance of *Uranus*, to its epoch of longitude, to its longitude of perihelion, and to its eccentricity; making, in all, nine unknown quantities. To obtain these, M. Le Verrier groups all the observations into thirty-three equations. He then explains the peculiar method by which he derives the values of the unknown quantities from these equations. The elements obtained are,—

Semi-axis Major	.	36·154 $\left(\text{or } \frac{a}{a'} = 0{\cdot}531\right)$
Periodic Time	.	217y·387
Eccentricity	.	0·10761
Longitude of Perihelion		284° 45′
Mean Longitude, 1 Jan. 1847		318 47

Mass $\frac{1}{9300} = 0{\cdot}0001075$

True Heliocentric Longitude, 1 Jan. 1847 326° 32′

Distance from the Sun . . 33·06

It is interesting to compare these elements with those obtained by Mr. Adams. The difference between each of these and the corresponding element obtained by Mr. Adams in his second hypothesis is, in every instance, of that kind which corresponds to the further change in the assumed mean distance recommended by Mr. Adams. The agreement with observations does not appear to be better than that obtained from Mr. Adams's elements, with the exception of Flamsteed's first observation of 1690, for which (contrary to Mr. Adams's expectation) the discordance is considerably diminished.

M. Le Verrier then enters into a most ingenious computation of the limits between which the planet must be sought. The principle is this: assuming a time of revolution, all the other unknown quantities may be varied in such a manner, that though the observations will not be so well represented as before, yet the errors of observation will be tolerable. At last, on continuing the variation of elements, one error of observation will be intolerably great. Then, by varying the elements in another way, we may at length make another error of observation intolerably great; and so on. If we compute, for all these different varieties of elements, the place of the planet for 1847, its *locus* will evidently be a discontinuous curve or curvilinear polygon. If we do the same thing with different periodic times, we shall get different polygons; and the extreme periodic times that can be allowed will be indicated by the polygons becoming points. These extreme periodic times are 207 and 233 years. If now we draw one grand curve, circumscribing all the polygons, it is certain that the planet must be within that curve. In one direction, M. Le Verrier found no difficulty in assigning a limit; in the other he was obliged to restrict it, by assuming a limit to the eccentricity. Thus he found that the longitude of the planet was certainly not less than 321°, and not greater than 335° or 345°, according as we limit the eccentricity to 0·125 or 0·2. And if we adopt 0·125 as the limit, then the mass will be included between the limits 0·00007 and 0·00021; either of which exceeds that of *Uranus*. From this circumstance, combined with a probable hypothesis as to the density, M. Le Verrier concluded that the planet would have a visible disk, and sufficient light to make it conspicuous in ordinary telescopes.

M. Le Verrier then remarks, as one of the strong proofs of the correctness of the general theory, that the error of radius vector is explained as accurately as the error of longitude. And finally, he gives his opinion that the latitude of the disturbing planet must be small.

My analysis of this paper has necessarily been exceedingly imperfect, as regards the astronomical and mathematical parts of it; but I am sensible that, in regard to another part, it fails totally. I cannot attempt to convey to you the impression which was made on me by the author's undoubting confidence in the general truth of his theory, by the calmness and clearness with which he limited the field of observation, and by the firmness with which he proclaimed to observing astronomers, "Look in the place which I have indicated, and you will see the planet well." Since Copernicus* declared that, when means should be discovered for improving the vision, it would be found that *Venus* had phases like the moon, nothing (in my opinion) so bold, and so justifiably bold, has been uttered in astronomical prediction. It is here, if I mistake not, that we see a character far superior to that of the able, or enterprising, or industrious mathematician; it is here that we see the philosopher. The mathematical investigations will doubtless be published in detail; and they will, as mathematical studies, be highly instructive: but no details published after the planet's discovery can ever have for me the charm which I have found in this abstract which preceded the discovery.

I understand that M. Le Verrier communicated his principal conclusions to the astronomers of the Berlin Observatory on September 23, and that, guided by them, and comparing their observations with a star-map, they found the planet on the same evening. And I am warranted by the verbal assurances of Professor Challis in stating that, having received the paper on September 29, he was so much impressed with the sagacity and clearness of M. Le Verrier's limitations of the field of observation, that he instantly changed his plan of observing, and noted the planet, as an object having a visible disk, on the evening of the same day.

My account, as a documentary history, supported by letters written during the events, is properly terminated; but I think it advisable, for the sake of clearness, to annex extracts from a letter which I have received from Professor Challis since the beginning of October, when I returned to England.

[In this letter Professor Challis details his labours in search for the planet, and states that on September 29, he singled out one star of 300 observed that evening, for which he noted, "seems to have a disk." This turned out to be the planet.]

Before terminating this account, I beg leave to present the following remarks:—

First. It would not be just to institute a comparison between papers which at this time exist only in manuscript, and papers which have been printed by their authors; the latter being in all cases more complete and more elaborately worked out than the former.

Second. I trust that I am amply supported, by the documentary history which I have produced, in the view which I first took, namely, that the discovery of this new planet is the effect of a movement of the age. It is shown, not merely by the circumstance that different mathematicians have simultaneously but independently been carrying on the same investigations, and that different astronomers, acting without concert, have at the same time been looking for the planet in the same part of the heavens; but also by the circumstance that the minds of these philosophers, and of the persons about them, had long been influenced by the knowledge of what had been done by others, and of what had yet been left untried; and that in all parts of the work the mathematician and the astronomer were supported by the exhortations and the sympathy of those whose opinions they valued most. I do not consider this as detracting in the smallest degree from the merits of the persons who have been actually engaged in these investigations.

Third. This history presents a remarkable instance of the importance, in doubtful cases, of using any received theory as far as it will go, even if that theory can claim no higher merit than that of being plausible. If the mathematicians whose labours I have described had not adopted Bode's law of distances (a law for which no physical theory of the rudest kind has ever been suggested), they would never have arrived at the elements of the orbit. At the same time, this assumption of the law is only an aid to calculation, and does not at all compel the computer to confine himself perpetually to the condition assigned by this law, as will have been remarked in the ultimate change of mean distance made by both the mathematicians, who have used Bode's law to give the first approximation to mean distance.

Fourth. The history of this discovery shows that, in certain cases, it is advantageous for the progress of science that the publication of theories, when so far matured as to leave no doubt of their general accuracy, should not be delayed till they are worked to the highest imaginable perfection. It appears to be quite within probability, that a publication of the elements obtained in October 1845 might have led to the discovery of the planet in November 1845.

I have now only to request the indulgence of my hearers for the apparently egotistical character of the account which I have here given; a character which it is extremely difficult to remove from a history that is almost strictly confined to transactions with which I have myself been concerned.

THE GOVERNMENT SCHOOL OF DESIGN.

Though a considerable time has elapsed since the following report on the French Schools was presented by Mr. Poynter to the Council of this Institution, it has remained unpublished. The Council have since sanctioned its publication, and as the subject of the document is not of temporary interest, it is well worthy of perusal.

"My Lords and Gentlemen,—Previously to entering upon the exercise of the office to which the Council have done me the honour to appoint me, I considered that a more intimate knowledge of the system of instruction adopted in the French Schools, and its results, would enable me to judge more advantageously of the condition and prospects of our own. I have, therefore, visited Paris with a special view to this subject; and would willingly have extended my journey to Lyons, had time permitted. But,

* I borrow this history from Smith's Optics, sect. 1050. Since reading this Memoir, I have, however, been informed by Professor De Morgan, that the printed works of Copernicus do not at all support this history, and that Copernicus appears to have believed that the planets are self-luminous.—G. B. A

although it was out of my power actually to inspect any other School than that of Paris, I have had the advantage of obtaining an intimate acquaintance with the Schools of Lyons and Toulouse, through the Reports lately made by M. Charles Texier, commissioned by the Government to inspect the Schools of Art, which were very obligingly placed in my hands for perusal.

"The Report laid last year before the Council by Mr. Townsend, will render superfluous any detailed account of the views entertained with regard to industrial art, and the system upon which they are carried out, in the School of Paris; I shall therefore notice merely such points as it occurred to me might be of importance with reference to our own Schools, and which may be mentioned without needless repetition.

"The course of instruction at Paris is divided into three main branches: 1. The Figure; 2. Ornament; 3. Architecture and Geometry. These three courses of study (subdivided and classified) are taught on alternate days, in the order named, a day being devoted to each; but the limited space to which the School premises are confined has caused a most inconvenient system of taking the classes in relays, greatly to their disadvantage. The students are admitted free of charge, and no pledge is required from them of their exclusive devotion to any branch of industrial art; many, it is well known, pass from the elementary classes of the *Ecole de Dessin* to the *Ecole des Beaux Arts*, in order to follow the higher branches of painting and sculpture; but this is not considered to militate in any way against the usefulness of the School, as a nursery of art applied to manufactures. To extend a sound knowledge of art in general is held to be the best mode of securing a supply of artists for industrial purposes. The only condition to which the pupils are bound is, that if they remain in the School they must follow up the whole course of study prescribed by the regulations. Exceptions are made in favour of artisans who wish to take advantage of the means afforded by the School to increase their knowledge and improve their taste. This class of students, however, have recourse more generally to the *Ecole Communale*,—for an account of which I must refer to Mr. Townsend's Report.

"There is one branch of instruction in the Paris School which I beg leave to offer to the special notice of the Council—a course of lectures on the History of Ornament, illustrated by examples drawn by the Professor in the absence of the pupils. These examples he sketches to a working scale, on large canvas covered with paper. They consist of a chronological series of every class of ornament, beginning with the Greek, and followed throughout all styles and all ages, explaining their origin, their connexion with each other, and the peculiar characteristics by which they are to be discriminated. Each lecture is a continuation of the subject from that which precedes it; and the Professor is bound by his engagement to vary the examples during the period of three years. This professorship is held by a pupil of M. Constant Dufeux, the Architect to the School; and the first requisite toward the establishment of a similar class elsewhere would be, to find an artist with the knowledge of ornament possessed by this gentleman united to the handicraft skill with which he expresses its forms, and brings them out in the truest effects of chiar'-oscuro by the most simple manipulation in black and white. It would be very desirable to possess some of this gentleman's sketches in our School, as examples of masterly execution in this branch of art. I mentioned this to the Director, M. Belloc, and have no doubt they might be obtained if the Council thought proper.

"An excellent plan is adopted in the Mathematical Class to secure to all the pupils the full benefit of the instructions given by the Professor. It is not to be expected that mathematical demonstrations will be comprehended by a whole class the first time of explanation; those pupils, therefore, who have understood the lesson, are charged with repeating it to those of slower apprehension, until it is made clear to every individual.

"I beg leave to enter somewhat more particularly upon a subject which has ever been regarded with great interest in our own establishment, namely, the Female School. This branch is placed, at Paris, under the superintendence of two *Dames Directrices*, who divide the labour of teaching. There are two classes in the day, each of about fifty pupils, a division rendered necessary by want of room for a better arrangement. The Female School has been established with a double purpose: it is calculated not only for the improvement of the arts usually practised by females, but some prominence is given to the object of extending as much as possible the resources, hitherto too narrowly limited, for the exercise of female industry. It is considered that the employments open to females, and for which they may be qualified by instruction in the arts of design, may comprise designing and working in embroidery of every description, lace, gimp, fringe, and every sort of worsted work; designs for everything relating to jewellery, engraving, and enamelling in gold, setting stones, false jewellery (which is manufactured in Paris to an immense extent, with great taste and ingenuity), small articles in or-molu, and the burnishing and colouring of metals; fancy works in card and paper, and patterns for the papers employed in them; pictorial toys for children, dissected puzzles, &c.; porcelain painting, in all its branches; lithography, and engraving on copper and wood. And it is to be observed that the *Ecole Communale* is much frequented by females already occupied in such pursuits, who devote their leisure hours to improving themselves in drawing; those engaged in jewellery, artificial flowers, and engraving in gold, resort there in numbers. In order to carry out the intentions of the Government in this respect, the course of instruction in the Female School includes the figure, landscape, animals, flowers, and ornaments. It has been noticed that many of the pupils take up especially the study of the head, the figure, and landscape, with a view to become teachers of drawing; but the course of study followed in the school is not considered to be of a nature to qualify them for this position, which requires that the elementary studies common to all classes of art should be followed up by those peculiar to the higher branches.

"It must be observed, that in this branch of the School at Paris the objects proposed are not yet carried out to their full extent. There are several deficiencies to be supplied; and lithography has not hitherto been taught at all.

"The Provincial Schools in France are not necessarily regulated by that of Paris; and a view of the system pursued at Lyons, where the first of the Provincial Schools has been carried out to its utmost capabilities, with the most successful result in effect upon the peculiar manufactures of the place, cannot fail to be regarded with interest. But the success which has attended the School of Lyons is mainly owing to the appreciation of its importance by the authorities and inhabitants of the city itself, to the energy, with which they have promoted it, and the liberality with which they have contributed to the funds for its support. And I may here notice in evidence of the zeal and intelligence of the manufacturers of Lyons in the pursuit of their commercial interest through the means of industrial art, a memorial lately addressed to the Mayor of Lyons, that, with reference to the new vent for manufactures opened in the East, he should call upon the Minister of Commerce to procure for the manufacturers, by means of the Consuls and other commercial agents, patterns of the oriental stuffs of silk, wool, and cotton, which can be imitated at Lyons; and it is significantly pressed upon the Minister '*that this proceeding should not be left to other nations.*'

"It is a fact worthy of attention, that at the foundation of the School of Lyons the mistake was committed of drawing too distinct a line of demarcation between the elements of *fine art* and those of art as applied to industry and manufactures; and the first course of instruction established in the School was applied to the technical process of the *mise en carte;* this was shortly superseded by a class for '*drawing applicable to manufactures,*' that is to say, to silk manufactures; but as the pupils who attended this class proved to be already advanced in flower painting, the professor found the basis of instruction to which he was confined too narrow to enable him to effect anything essential for their improvement: the course of instruction was therefore made general, by the adoption of a methodic course of ornament, applicable not only to that style of drawing, but to sculpture in wood, metal, and stone. From this period important modifications have been made from time to time in the system of instruction, so that scarcely anything is now left of the original organization of the school. Into these changes no theories have been suffered to intrude—they have all been effected as experience has dictated their necessity, and the result, as is well known, is eminently practical.

"The present course of study pursued in the school is as follows:—the elementary study of the figure, drawing the figure from the round, and from the living model. Hence the pupils enter the classes for drawing and painting flowers, and after passing through the class of architectural ornament (combined with geometry and perspective), finish the course of study obligatory on all who remain in the school by a class of composition applied to manufactures. Thus it will be seen that to *perfect the taste* of designers and manufacturers, for that is the great point to be attained, a sort of inversion of principle is adopted, beginning with the figure, thence passing to flowers, thence to ornament in general, so as to prepare the student with a sound artistical education for finishing with the course of composition peculiar to the silk manufacture. To give instruction in this course, there are ten professors, including one for anatomy, one for etching, one for geometry and perspective, and one especially for flower painting. The annual expense of the establishment amounts to about 40,000 francs, of which 30,000 are supplied by the city, and 10,000 by the Government; but the citizens of Lyons consider all their literary and scientific establishments as intimately connected with their school, and that its success is greatly promoted by the general knowledge diffused among all classes by means of their library, their museums of antiquities and natural history, and other public institutions.

"The school is open five hours every day,—the professors attending from nine o'clock till two in the winter, and from eight to one in the summer. The pupils enter at the age of fourteen. They must be able to read and write, and to do the four rules of arithmetic, and are compelled to follow the whole course of instruction if they remain in the school. They are removed from one class to another on the recommendation of the Professor of their class to the *Council of Professors*. During the first month the pupils draw for the purpose of ascertaining the class in which they are to be placed. Two years' trial are allowed before they are dismissed for incapacity.

"The Director has abolished the use of heads in lithography as studies for the pupils, finding them from their general mediocrity, unfit for the purpose. The frequent competitions at the *Ecole des Beaux Arts*, at Paris for '*têtes d'expression*,' has enabled him to collect a sufficient number of valuable drawings of this class, mostly prize works, from which the pupils now study to the exclusion of engravings. This example is strongly recommended to be adopted in all schools, not only as regards chalk drawings, but also for models, and all other objects of study. The Director greatly desires that casts of the Parthenon marbles may be added to the collection.

"The object of the Government in supporting the Provincial Schools, is to develop art in such a manner as to enable the pupils in quitting them to exercise a profession, each town directing the final studies of the pupils more particularly to its predominant manufacture, and the system upon which the schools are worked is calculated to direct not only the hand and eye of the pupils, but also their taste. For this result, the study of the figure is found by practical experience to be the most instructive. Geometrical forms alone, though useful to exercise the fingers, are insufficient to give a perception of beauty, and harmony of outline—a fact fully proved by the practice of the School at Toulouse, where the latter mode of study has been substituted for the former. Cold and unmeaning lines convey no intelligence to the pupils, and excite no interest. Hence the pupils who at Toulouse pass from the elementary to the higher classes, are found to be strikingly inferior to those of the same standing at Paris and Lyons. When they come to draw other objects from the round, they are altogether deficient in the knowledge of light and shade, and relief, and even facility of hand. The error which has been experienced at Somerset House seems to have been committed at Toulouse, of confining the study of the figure to a small and select class, the master of which has another class to attend to; so that, to use M. Texier's words, 'the figure has only *half* a Professor allotted to it.' It is therefore proposed, as an improvement of the utmost necessity, that the School of Toulouse should be assimilated, in this respect, to those of Paris and Lyons. A pupil who has followed the elementary study of the figure, with the management of the chalk and stump, is found to possess a knowledge of shadows and reflections, which open to him a thorough understanding of every work in relief before which he may be placed. The School is also deficient in other particulars: the classes sit for two hours only even for the study of the figure—a space of time totally insufficient. There is no class for plants, and the class for demonstrating the composition of ornaments of all dates and styles, described under the Paris School, is much to be desired, not only at Toulouse but at Lyons. There seems to be some difficulty in finding a competent Professor. The Council of Toulouse wish for the establishment of a course of chemistry applicable to manufactures.

"I could have wished to take such a view of the manufactures of Paris as might have enabled me to draw some comparison with those of our own country; but as the time at my disposal did not admit of any general inquiry, I confined myself to the subject of stained glass, of which a great quantity has lately been executed in France. The church of St. Denis has been completely fitted up with modern coloured glass, in a style which it is impossible to commend. Part of this glass is designed on the imbecile principle unhappily too prevalent in England, of imitating the wretched drawing and composition of the middle ages, under the notion that this perversion of art is essential to the character of the work. But the glass of this order at St. Denis is destitute of the archæological knowledge and taste in the arrangement of colour, which are the redeeming quality of many English performances of this class. Other portions of the glass at St. Denis are designed on the still more mistaken system of assimilating glass painting to painting on canvas.

"At the royal manufactory of Sèvres, great pains have been bestowed on the improvement of stained glass. Being, however, doubtful of the impression to be produced by the view of mere specimens, I did not visit Sèvres, but performed a journey to Dreux, about sixty miles from Paris, where a magnificent chapel, designed by the present king as a mausoleum for his family, has been completely fitted up with Sèvres glass. There is much good art in this glass. There are figures and groups, of which the drawing, composition, and expression are extremely fine, but the colouring is in some portions crude, and in others vapid. There is an insufficiency of the detail essential to the proper effect of stained glass. The draperies are too plain. There is an attempt at diaper-work upon some of the backgrounds, but it is feeble and inefficient, and the general effect of the whole is poor. The artists, with all their merit, and it is great, have evidently been hampered by the principles and practice of painting on canvas, and the mechanical process of joining the glass has been so ill understood that all the subjects are cut up into squares by the ironwork. The same observations will apply to the glass in the chapel erected at Paris to the memory of the late Duke of Orleans, also from the Sèvres manufactory.

"The modern glass displayed in the new church of St. Vincent de Paul is of extraordinary quality. In this the artist has solved the problem of uniting high art with the conditions required for the due effect of painting on glass. Fine design, drawing, and expression, combined with a perfect conception of the distribution and collocation of colour, and a profusion of detail in the draperies, background, and borders, render it an example of rare perfection in stained glass, not inferior to the ancient in brilliancy and harmony, and immeasureably beyond it as a work of art. Each window contains a figure, or two, on a blue background, richly diapered, within a border of small figures in compartments, formed by green arabesque. This glass is the work of M. Maréchal, of Metz, an artist also greatly distinguished as a crayon painter. I should consider a fine specimen of his work an important acquisition to our School, if it could be obtained at any price.

"It is probable that some of the facts and observations which I have now had the honour to submit to the Council, may bear upon circumstances connected with our own establishments, and it is not impossible that comparisons may offer themselves during my approaching visit to the Provincial Schools. I have therefore hastened to submit these remarks to the Council whilst they were fresh in my mind, and unbiassed by anything arising in the course of my tour of inspection.

7th Oct. 1845. "AMBROSE POYNTER."

REVIEWS.

Turning and Manipulation. By CHARLES HOLTZAPFFEL, Vol. II. Illustrated by upwards of 700 woodcuts. Holtzapffel. London: 1846. 8vo.

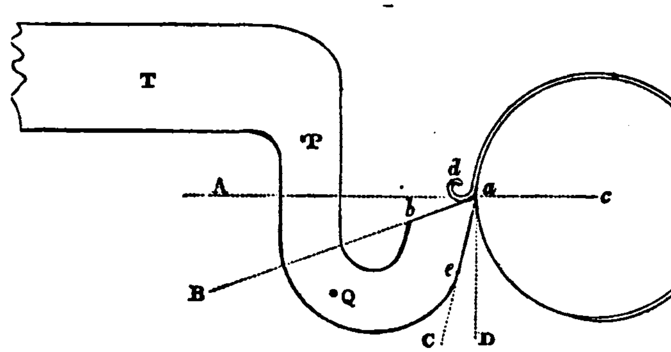
[SECOND NOTICE.]

In the former notice of this interesting work we gave a brief outline of its contents. The volume concludes with an appendix containing papers by several contributors, and additional notices of new processes and inventions which have come to the author's knowledge while the work was passing through the press. The author has directed our attention to the following remarks, which we accidentally overlooked when alluding to the contributions by Prof. Willis.

"The formation of the tools used for turning and planing the metals is a subject of very great importance to the practical engineer, as it is indeed only when the mathematical principles upon which such tools act, are closely followed by the workman, that they produce their best effects. With a full conviction of the advantages which result when theory and practice are thus associated, the author has to congratulate himself on being able to present to his readers, two original papers, respectively written on the subject of the principles of tools for turning and planing metals, by Charles Babbage, Esq., F.R.S., &c., and Professor Willis, A.M., F.R.S., &c., both distinguished by their high mathematical attainments, and their intimate practical experience in the use of tools."

The first paper by Mr. Babbage treats of the nature of the resistance to be overcome in the cutting a revolving substance by means of a fixed tool, and is an admirable instance of the importance of applying general inferences from the theory to the practice of mechanics. Of course it would be impossible to calculate with perfect accuracy the amount of resistance to the progress of the tool, as the material will never be perfectly homogeneous, nor the thickness of the shaving separated from it perfectly uniform. Still in this, as in other instances of the application of theory to practical cases, though the *numerical* results may not be depended upon, the *general* conclusions are of the utmost value. The principles here laid down, by Mr. Babbage, would tend to a considerable modification to the forms of tools, and would probably have this advantage—that the construction of cutting instruments would be made to depend not upon uncertain arbitrary rules, but upon fixed and reasonable laws.

"Steel of various degrees of temper and under various forms, is almost universally employed for cutting metals. Before deciding on the forms of the different tools it is desirable to inquire into the principles on which their cutting edges act, and to assign special names to certain angles on the relations of which to each other, and to the metals upon which they are used, their perfection mainly depends.



In the engraving c is a cylinder of steel or other metal, and T is a planing or turning tool acting upon it at the point a. A c is a horizontal line through the center c, and the cutting point a. B a, is a line passing through the cutting point a and along the upper plane b a, of the cutting tool T. C a, is a line passing through the cutting point a and along the front plane e a, of the cutting tool. D a, is a line from the cutting point a, at right angles to the radius c a. The angle D a C, may be called the *angle of relief*, because by increasing it, the friction of that face of the tool upon the work is diminished. The angle C a b, may be called the *angle of the tool*. The angle B a A, may be called the *angle of escape*, because the matter cut away by the tool escapes along it.

The forces to be overcome in cutting a thin shaving of metal from a cylinder or from a flat surface are of two kinds,

1st. It is necessary to tear along the whole line of section each atom from the opposite one to which it was attached. The force required for this purpose will obviously be proportioned to the length of the cutting edge of the tool, and dependent on the nature of the metal acted upon. But it will be quite independent of the thickness of the part removed.

2nd. The shaving cut off by the tool must, in order to get out of its way, be bent or even curled round into a spiral. This second force is often considerable, and when thick cuts are taken, is usually far larger than the former force. If the bending were of small extent, then the force to be exerted would vary as the square of the thickness of the shaving multiplied by some constant, dependent on the nature of the metal operated upon. But the bending very frequently proceeds to such an extent that the shaving itself is broken at very short intervals, and some shavings of iron and steel present a continued series of fractures not quite running through, but yet so complete, that it is impossible even with the most careful annealing to unwind the spiral. This partial severance of the atoms in the shaving itself, will require for its accomplishment a considerable exertion of force. The law by which this force increases with the thickness most probably embraces higher powers than the first and second, and may be assumed thus

$$\text{force} = a + b\,t + c\,t^2 + d\,t^3 +$$

For the present illustration it is unnecessary to consider more terms than those already more particularly explained, namely the constant force, and that which varies as the square of the thickness of the shaving. If therefore t be the thickness of the shaving, and A and B two constants, we shall find amongst the forces required for the separation of the shaving the two terms

$$A + Bt^2$$

where A, and B, depend upon the nature of the metal acted upon. We may learn from this expression, even without being acquainted with the values of the constants A and B, that the force required to remove the same thickness of metal, may vary considerably according to the manner in which it is effected. For example,—if a layer of metal of the thickness of $2\,t$, is to be removed, it may be done at two successive cuts, and the force required will be equal to

$$2\,A + 2\,Bt^2$$

But the same might have been accomplished at one cut, when the force expended would have been

$$A + 4\,Bt^2."$$

The latter quantity always exceeds the former when t^2 exceeds $\frac{A}{2B}$ as the writer shows algebraically. Consequently, when the square of the thickness exceeds half the ratio of A to B, less force is required to effect the operation by two cuts, than by one. And in the same way it may be shown that any number of slices (n) require less force than a single slice of n times the thickness if t^2 exceed $\frac{A}{n\,B}$.

"The angle of relief should always be very small, because the point a will in that case have its support nearly in a line directly opposed to that force acting upon it.

If a tool either for planing or for turning is defectively formed, or if it is presented to its work in such a manner that it has a tendency to dig into it, then a very small angle of relief, in addition to a long back $a\,e$, will in some measure counteract the defect.

The smaller the angle of the tool, the less will be the force necessary for its use. But this advantage of a small angle is counterbalanced by the weakness which it produces in the support of the cutting point. There is also another disadvantage in making the angle of the tool smaller than the escape of the shaving requires; for the point of the tool being in immediate connection with a smaller mass of metal, will not so quickly get rid of the heat it acquires from the operation of cutting, as it would if it formed part of a larger mass.

The angle of escape A a B is of great importance and it varies with the nature of the material to be acted upon. If this angle is very small the action of the tool is that of scraping rather than of cutting, and the matter removed approaches the form of a powder. If however the material is very flexible and cohesive, in that case shavings may be removed. The angle I have found best for cutting steel is about 27°, but a series of experiments upon this subject is much required.

After the form of the cutting tool is decided upon, the next important point to be considered is the manner of its application. The principle which is usually stated for turning tools is, that the point of the tool should be nearly on a level with the axis of the matter to be turned, or rather that it should be very slightly below it. This rule when applied to the greater number of tools and tool-holders is calculated to mislead. Before applying the correct rule it is necessary to consider in each tool or tool-holder, what is the situation of that point around which the cutting point of the tool will turn when any force is put upon the tool. Let this point be called the center of flexure. Then the correct rule is, that the center of flexure should always be *above* the line joining the center of the work and the cutting point.

On looking at fig. 983, A c is the line joining the cutting point a and the center of the work c. By making the tool weak about Q that point becomes the center on which the point a will bend when any unusual force occurs. On the occurrence of any such unusual force arising from any pin or point of unequal density in the matter cut, the point of the tool a, by bending around the center Q will dig deeper into the work and cause some part of the apparatus to give way or break.

If on the other hand the point P is that around which the point of the tool when resisted tends to turn, then since this point is above the line joining the cutting point and the center of the work, the tendency of the additional strain on the point is to make it sink less deeply into the work, and consequently to relieve itself from the force opposed to it.

Fortunately the position of this point can always be commanded, for it is always possible, by cutting away matter, to make one particular part weak. This is indeed a circumstance too frequently neglected in the construction of machinery. Every piece of mechanism exposed to considerable force is liable to fracture, and it is always desirable to direct it to break at some one particular point if any unexpected strain occurs. In many cases where danger may arise from the interference of the broken part with the rest of the machinery this arrangement is essential. In all cases it is economical, because by making the breaking, if it occur, at a selected spot, provision may be made of duplicate parts and the delay arising from stopping the machine be avoided.

The results of the preceding inquiry would lead to considerable changes in the forms of tools generally used in cutting metals, and as the time employed in taking a cut is usually equal whether the shaving be thick or thin, the saving in power by taking thin cuts separately would be accompanied by a considerable expense of time. This however need not be the case if proper tool holders are employed, in conformity with the following several conditions: thus

The tool-holders should be so contrived as to have several cutters successively removing equal cuts.—The cutting edges should be easily adjusted to the work.—The steel of which the cutters are formed should be of the best kind, and after it is once hardened should never again be submitted to that process.—The form and position of the cutter should be such that it may, when broken or blunted, be easily ground, having but one or at the utmost but two faces requiring grinding.—It is desirable that when being ground it should be fixed into some temporary handle, in order that it may always be ground to the same cutting angles.—The cutters should be very securely, but also very simply tightened in their places.—The center of flexure of the cutter should, in turning, be *above* the line joining the center of the work and the cutting point;—whilst in planing the center of flexure should be in *advance* of a line perpendicular at the cutting point to the surface of the work planed. Examples of some tool-holders of this kind will be given subsequently.

The effects of such improved tools would be to diminish greatly the strain put upon lathes and planing machines, and consequently to enable them to turn out better work in the same time and at a less expense of power: whilst the machines themselves so used would retain their adjustments much longer without reparation."

The next paper contains an account of various tool-holders invented by Mr. Babbage. Prof. Willis's papers relate not so much to the mechanical as to the geometrical theory of cutting tools or the relations of their sides and angles, the inclination of the edges required for different metals being assumed to be known. Prof. Willis also describes a new tool-holder invented by him, which Mr. Holtzapffel states to be now generally used in his manufactory.

Among the papers in this appendix one of the most useful is that on the diversity of gauges of wires and sheet metals, &c. Our author compares the different scales of measurement of rod iron, nail rod, rifle tubes, wire, sheet iron, zinc plates, crown-glass, &c.: he shows that the greatest inconvenience arises from the numerous scales, which are perfectly arbitrary, and vary in different manufactories. He has given a table of the values of several of the principal gauges to three places of decimals of an inch, the measures being ascertained by an exceedingly accurate sliding gauge, constructed by himself, and indicating by a vernier the thousandths of an inch. In the following extracts the advantage of a general application of decimal notation to small quantities is admirably illustrated.

Decimal Gages.

"*The remedy proposed to remove the arbitrary incongruous system of gages now used*, is simply and in every one of the cases above referred to, and also in all other requiring minute measures, *to employ the decimal divisions of the inch, and those under their true appellations.*

Thus for most purposes the division of the inch into one hundred parts would be sufficiently minute, and the measures 1. 2. 5. 10. 15 or 100 hundredths, would be also sufficiently impressive to the mind; their quantities might be written down as 1. 2. 5. 10. 15 or 100 hundredths, as the decimal mode of expression might if preferred be safely abandoned. and the method would be abundantly distinct for common use if the word "*Hundredths*" were stamped upon the gage, to show that its numerals denoted hundredths of an inch, quantities which could be easily verified by all.

In practice no difficulty could be seriously felt even without this precaution of marking the gages respectively with the word *Hundredths* or *Thousandths;* as we should not more readily mistake 5 thousandths for 5 hundredths, than we should 5 tenths or half an inch for 5 whole inches, or 5 entire inches for as many feet.

Neither is it to be admitted that no such gages are attainable as may be read of in hundredths or thousandths. The demand would immediately create the supply, and there could be no more difficulty in constructing the gages of the customary forms, with notches made to systematic and *definite* measures, *that may be easily arrived at or tested*, than with their present unsystematic and *arbitrary* measures, *which do not admit of verification.*

Besides, for those who desire to possess them, several very correct decimal gages already exist, amongst which may be cited the decimal sector gages long since recommended, and published by the Society of Arts, Edinburgh, and various sliding gages with verniers some to read off in hundredths, and finer ones in thousandths, of the inch, all of which have been long and constantly used in the author's manufactory.

To these may be added—La Rivière's gage, modified and enlarged from that used for the balance springs of watches amongst the Geneva watchmakers.—Chater and Hayward's gage for sheet metals and glass.—Walker's gage for sheet iron.—Whitworth's micrometer gage and others—which may be severally read off to the thousandth of the inch, and even more minute quantities, and amongst which kinds sufficient choice exists for almost every purpose.

The proposed decimal scheme would introduce one universality of system, intelligible alike to all, instead of the numerous and irregular measures now used, which are but partially and indifferently known and lead to frequent mistakes.

It would give a superior idea of particular magnitude, and enable the theoretical and practical man to proceed with so much more decision in their respective communications.

In conveying verbal or written instructions, the system would be in every way superior to the usual methods, as being almost free from the chance of misunderstanding; more especially as some of the decimal sliding gages are so small as hardly to take up more room in the pocket than an ordinary penknife, and might be therefore continually within reach for reference.

When certain objects are required to be so proportioned as to constitute a series; the intervals between the decimal measures would be far more easily arranged and appreciated, than those of vulgar fractions; and if calculation were referred to, the decimal figures, especially when divested of the decimal point, and the zeros to the right of the same, would be immediately intelligible to the least informed, from being then no more in fact than simple numerals.

Quantities expressed decimally would be more easily written down, and more exactly defined than the compound fractions, such as $\frac{3}{8}$ and $\frac{1}{16}$ of an inch—or than the still more obscure method of $\frac{5}{8}$ of an inch *full* or *bare*, as the case might be; which latter nearly sets all attempts at exactness at defiance.

The smaller aliquot fractions of the inch, such as the $\frac{1}{20}$ $\frac{1}{32}$ $\frac{1}{24}$ $\frac{1}{36}$ $\frac{1}{40}$ $\frac{1}{50}$ &c. of an inch, although in themselves very precise, do not from their nature so readily admit of definition or comparison, as the quantities 2. 3. 4. 5. 6. 7. 8. 9. or 10 hundredths of an inch; because, in the vulgar fractions every one has a *specific* relation to the inch, whereas the decimal terms have one *general* relation, decimals being sometimes considered as the numerators of fractions, all having the constant denominator unity, or 100, 1000, & : and therefore the latter, or the decimal terms, constitute a simple arithmetical series, or one in which the intervals are alike, but this is not the case with vulgar fractions.

The decimal scheme would allow the exact weight in every superficial foot of sheet metals and other substances to be readily arrived at.—Thus, as a cubic foot of water weighs 1000 ounces troy, the specific gravities of lead, copper, silver, &c., denote at the same time how many troy ounces are severally contained in one cubic foot of the same. The specific gravity divided by 1200, gives the weight of a plate or film, the one hundredth of an inch thick, and thence a table may be readily computed, *by addition alone*, to show the weight of plates of any thickness in *troy* ounces.

How confusing would it be, if the measures by which broad cloths, linens, cottons, silks, velvets, carpets, and other textile fabrics, are manufactured and sold, were all different, instead of being uniformly the yard measure; and yet this incongruity fully applies to the various articles whose measurements are described under the mystical names of *number*, *size*, *gage*, and other appellations, which assume *different* values in *different* branches of manufacturing art; as for example, in the various kinds of sheet metals, various kinds of wires, in tubes, joiners' screws, and vast numbers of small manufactured articles, the various sizes of which are arbitrarily designated as Nos. 1. 2. 3. 4. &c.

Why not in all these branches of trade, describe every thing measuring $\frac{1}{10}$th of an inch, as No. 10; those of $\frac{3}{10}$ths inch, as No. 30? and then in sets of objects required to be nearly alike, the succeeding numbers could be 31. 32. 33. 34. 35. 36. &c.; or if fewer and wider variations were wanted, the series might be 32. 34. 36. 38. 40. &c.; or else, 35. 40. 45. 50. 55. Every trade could select any portion of the series it might require, both as regards general magnitude, and the greater or less intervals between the sizes, and with the power of adding to, or subtracting from, the scale first selected, as circumstances might suggest.

But there should be one common understanding that the *commercial* numbers or sizes, when different from the measures of the foot-rule, should be always understood to be hundredths of the inch, (in some rare instances thousandths,) as then from the unity of system no confusion or difficulty could possibly arise.

It may be true that some of the proposals having reference to the weights of materials in the superficial foot, the correspondences with foreign measures, and some of the projects principally intended for the purposes of science, may not be required in every-day practice; but still much remains in the system, that in the opinion of the author, would admit of very easy introduction, and most general and satisfactory employment.

In respect to the practical application of the method of decimal divisions, as regards mechanical construction, the author can speak most satisfactorily from some years' experience in his own manufactory, as he has found it to be most readily followed by his workpeople, and also that it has avoided frequent and vexatious misunderstandings, to which, before its adoption he was frequently subjected, from the want of a more minute and specific system of measure, than is afforded by the common foot-rule and wire gages.

Therefore, from conviction of the usefulness and practicability of the decimal system of measures for small quantities, he would most strongly urge its general, or indeed universal, adoption, as above proposed; the more especially as it is a change that would be attended with very little temporary inconvenience or expense, circumstances which greatly retard all attempts at generalization."

We cannot conclude our notice without renewing the expression of approbation of the work. As far as we are aware, the plan of Mr. Holtzapffel's labours is unique: no other similar book has been published, and this is so comprehensive and perspicuous that no other similar book need be desired.

Ancient Architecture described and demonstrated by its Monuments.—L'Architettura antica descritta e dimonstrata coi monumenti. By L. Canina. Rome, 1834-1844. 9 vols. 8vo. text, and 3 vols. gr. fol. Plates. Price £24.

M. Canina divides the history of ancient architecture into three epochs and classes—the Egyptian, Greek, and Roman—and symbolises this idea by the juxta-position of the pyramids and obelisks of Thebes, the Acropolis of Athens, and the Roman Capitol, represented in the title-page of his splendid atlas. As the personal representatives of these art-periods, the busts of Rameses III. or Sesostris, and those of Pericles and Augustus are depicted. Since the great discoveries of Champoillon and his disciples, never has Egyptian architecture been treated in that deep and consequential detail as in M. Canina's fine work; and he has also the merit of giving the first *chronological account* of Egyptian architectural monuments. The author further assigns the times of the resorting to the different architectural organic improvements; for instance, the *vault*, derived from the very inscriptions of the monuments—which implies, besides the knowledge of the architect, that of the hieroglyphist and philologist. The next new feature of this excellent work is, that M. Canina considers the architecture of Egypt, and its limitrophs, as the generic and prototype—of which that of the Jews, Assyrians, and Phœnicians is merely derivative and co-generic. To that common source, also, those very ancient monuments of Asia Minor, only lately discovered, are ascribed, whence Greek and Roman art have taken their origin. Going still further, M. Canina unites to Egyptian architecture that of Persia, India, China, and South America, being *all* only the diverse modification of the same prototype, modified according to climateric, national, and social reasons and incitives. This system of uniting art here introduced, is rich in pregnant ideas and views; still, it must be confessed, one difficult to be carried out, both in its technical and historical bearings.

In the portion of the work treating of the structures of Hellas, many most tasteful restorations of those now vanished erections are represented in all their original symmetry. Still, some weighty critics have taken umbrage at the hypæthral form which has been given to some of the finest temples of Greece—for instance, to that of Zeus Parhellenius at Aegina, the Parthenon, the Temple of Jupiter at Olympia, that of Apollo Epicurios at Bessä, of Neptune at Pæstum, &c. This controversial point has occupied much of the attention of architects, and been also dilated upon in the transactions of the Archæological Society of Athens. The opinion that the Greeks left the middle part of the cella—where the figure of the god-image stood, surrounded by valuable votations,—unroofed, or partly so, has been generally received, and M. Canina also adheres to it. Quatremère de Quincy and Wilkins first combated it, and C. Ross* has, of late, again brought it before the public. The main question hinges on the passage of Vitruvius, III. —"Hypoethros vero decastylos est in pronao et postico—*medium* autem sub divo est *sini tecto*, aditusque valvarum ex utraque parte in pronao et portico. Hujus autem exemplar Romae non est, sed Athenis octastylos est in templo Olympio."—This passage is construed by German critics against M. Canina. It is scarcely to be supposed, that the Greeks could leave such beauteous and surprising colossal sculptures as Pallas Athæna of the Parthenon, or the Jupiter Olympius, to be merely illumined by the dim light from the entrance of a cella, without any windows running down the whole length of the walls.

Among the Greek temples, which our author has so beautifully pictured, some omissions have occurred,—unavoidable, perhaps, in so large a work. Amongst these, we may mention that Ionic show-

* Hellenika. 1846. p. 1-39.

temple of Jupiter Parhellenius at Aizani, described by Texier. The department of Roman architecture, as M. Canina's more immediate and autoptic province, is treated with a detail descending into the slightest minutiæ of theory and practice. The great number of 256 plates is devoted to this portion of the work.

Narrative of the Recovery of H. M. S. Gorgon. By ASTLEY COOPER KEY, Commander, R.N. London: Smith, Elder, and Co. 1847. 8vo., pp. 113.

During the military operations of the Buenos Ayrean army against Monte Video, in 1843, a violent gale occurred, by which H. M. steam-ship *Gorgon*, part of the British squadron stationed in the River Plate, was driven ashore. The present work contains a clear, interesting, and most minute account of the mechanical means by which the vessel was rescued from her perilous position. The difficulties contended against were so formidable, and the ingenuity and energy displayed in overcoming them so great, that the account given by an officer of the vessel, who appears to have had an important share in the work, possesses a general interest. To the naval officer and engineer, however, the narrative will appear of much more importance than an interesting story: the accurate and detailed explanation of all the operations and apparratus, and the record of their comparative efficiency, brings this work into that class of circumstantial publications which the two professions have learned to consider invaluable. It may be added that the present moment seems happily chosen for publishing this book, when general attention is attracted to the fate of the *Great Britain*.

Before analysing the part of the work referring to the recovery of the ship, we may be doing some service by calling attention to certain defects of construction, which Lieut. Key assigns as contributing causes of the stranding of the *Gorgon*; they are these—1st, insufficiency of engine-power for extraordinary emergencies; 2nd, the want of anchors and cables in number and size proportioned to those of sailing vessels; 3rd, the absence of a mizen-mast. Under the first head, our author well remarks that a steam ship ought to have power sufficient for extraordinary as well as ordinary occasions. The *Gorgon* had not during the gale sufficient power to steam into deep water, and barely gained steerage way. Again, the sails could not be used to bring the vessel to the wind, for from the position of the mainmast, the effect of the main trysail was neutralised by the action of the wind on the paddle-boxes, which were as much before the centre of the ship as the trysail was abaft it: had there been a mizen-mast, its sail would have had leverage to turn the vessel.

In order to understand the subsequent operations, we must consider the position of the vessel after stranding. She was found on examination after the storm, to have run *head foremost* into a sand bank, 13 feet high. A few feet of her stern were still in the water, but by far the greater part of the ship rested on—and, forward, was imbedded in—the sand. The idea of getting the ship from such a position, without taking her engines out, when first expressed by her commanding officer, Capt. Hotham, subjected him to the pleasant suspicion of labouring under a fit of insanity.

The means of the recovery were mainly these: the formation of a dock, by the excavation of the sand for a distance of twenty feet from the vessel; the application of large screws on the beach, partly to raise her vertically and partly to start her forward; the lashing of buoyant caissons to the ship's bottom to lighten her; the haulage by cables attached to the vessel worked by capstans on the beach; and by other cables attached to anchors in deep water, and worked by the ship's engines.

The first of these operations was by far the most arduous, and was continued almost incessantly during the whole time occupied in recovering the vessel—upwards of five months. From the loose nature of the sand and effect of the tides, the banks of the dock frequently gave way, and the labour of a month was undone in a few hours. A great part of the excavations were effected manually, but an ingenious machine, constructed upon the spot, was also used for the same purpose. To a fulcrum on either side of a barge was fixed a long lever, with a capacious mud-bag at the end of it; the mouth of the bag being kept open by a hoop, to which chains were attached to drag it through the sand: the chains were worked by winches in the extremity of the barge. By these simple means, 4½ tons were cleared away in an hour, and the apparatus was sometimes kept in use night and day for several weeks together. The great difficulty however was not to get the mud out, but to keep it out. A resident civil engineer undertook the construction of a dam of piles of three-inch plank, driven *four or five feet* into the sand;—the first high tide carried them all away. Another dam, however, constructed on the starboard side of the vessel, where the water had little force, answered its purpose tolerably well, the piles forming it being driven deeply into the sand. A complete bulwark against incursions of the sand was subsequently constructed by mooring alongside the vessel three large iron boats, which together formed a breakwater 120 feet in length.

The application of pressure by means of large screws to force the vessel forward seems to have been a novel one. The employment of vertical screws in transporting and launching vessels had been already practised, but here for the first time screws were used to propel the ship as well as raise it. Only a limited number of cables could be obtained for hauling, and the aggregate strain which these would bear without breaking was totally inadequate to move the ponderous mass to which they were attached. The application of the screws therefore effected that which without them would have been impracticable. The great difficulty was to obtain a firm purchase for them, as the abutments on the loose foundation, against which they acted, were liable to give way. This difficulty was overcome by imbedding enormous blocks of wood deep in the sand, so as to distribute the back-pressure of the screws over a large surface.

Our author calculates that a force of about 550 tons was applied to start the ship forward—300 tons from the pressure of screws, and the remainder from the tension of cables. The screws were all inclined to the horizontal, so that their force was partly vertical, partly horizontal. The pressure resolved in the former direction was about 130 tons; in addition to this upward force there were 470 tons arising from the buoyancy of large camels, caissons, boilers, tanks, and barrels attached to the ship's bottom; so that the total force tending to raise the ship was about 600 tons. We cannot pursue the narrative further than to state that by these means, after nearly half a year of forethought and invention on the part of the officers, and unceasing industry on the part of the men (nearly 300 in all), the vessel was restored to her native element, without any injury, unless we except the following very trivial one, which we allude to merely because it arose from a cause worthy of the attention of the practical engineer:—

"At one of our previous attempts to move the ship, when no impression could be made on her, beyond giving her a lift to port of about 10°, the sudden heel had fractured the waste water and injection pipes, thereby showing that the ship must be slightly strained somewhere; but, as these pipes are of cast iron and are rigidly bolted to the ship's side, a very slight jerk would be sufficient to break them; soon afterwards, however, when the ship was brought upright by the camels, the broken parts resumed their original position, and so exactly, that the fracture could not be discovered without very minute inspection, and in that state were easily and efficiently repaired; this showed what a trifling strain was sufficient to break these pipes, and it would appear that in the event of a steamer taking the ground under any circumstances, should she not be so strongly built as the *Gorgon*, these vital parts of the engine would be liable to serious injury—surely a remedy for this might readily be found, by fitting these pipes with a sliding joint, and also, instead of bolting the extremities to the ship's side, less liability to fracture would be incurred, by fitting it with a slide and flange, giving the extremity of the pipe free motion in every direction, and making the diameter of the hole in the ship's side, something less than that of the pipe."

The principal practical value of this book arises from the minuteness with which the information is given. There are eighteen lithographic plates, and every piece of apparatus of any importance is carefully delineated and described in a detailed manner. The information respecting admeasurements also is generally complete, and the author seems to possess considerable knowledge of theoretical mechanics.

The Colosseum, St. Peter's, The Pantheon, The Forum; drawn and engraved by DOMENICHO AMICI, Membro d'Onore della Congregazione de Virtuosi al Pantheon. Size 22 inches by 19 inches.

These splendid engravings, illustrative of Rome, have just been imported into this country from Rome, by Messrs. Groombridge and Sons; they are admirably drawn and engraved in the line manner, by Domenicho Amici, an Italian engraver of considerable merit; they are the commencement of a series. The above four prints are well suited to the studio of the architect.

A Practical Treatise on Perspective Simplified. By GEORGE PYNE. Weale, 1846. 12mo. pp. 109. Lithographic plates.

This treatise is addressed to those who wish to acquire only a limited knowledge of perspective, but to acquire that little correctly. The object of the author has been to render the work as concise as possible, and to omit every superfluous line: he has attained this object, without sacrificing brevity. To those who merely wish to sketch from nature in correct perspective, without attaining the geometrical precision of the architectural draughtsman, this little Manual will be an excellent guide.

The Literary and Scientific Register and Almanack for 1847. By J. W. G. Gutch. This annual is replete with highly useful scientific information.

SIR JOHN SOANE.

For the following memoir we are indebted to the labours of Mr. George Bailey, the able Curator of the Soanean Museum; it was published some time since as an Appendix to a Memoir of Sir John Soane, by Mr. Donaldson, and has now received some trifling corrections to render it more perfect.

1753. September 10, born near Reading.

1768. Entered the office of Mr. George Dance.

1772. Exhibited his first drawing at the fourth exhibition of the Royal Academy, "Front of a nobleman's town-house."

1772. Obtained the silver medal at the R. A. for the best drawing of the front of the Banqueting House at Whitehall.

1774. An unsuccessful competitor for the gold medal at the R. A.

1776. Gained the gold medal for the best design for a triumphal bridge.

1777. Left London for Italy.

1778. His first publication, entitled, "Designs in Architecture," appeared.

1780. Elected member of the Academy of Fine Arts at Parma, and returned to London from Italy in June.

1784. Designed and executed extensive alterations and additions to Mulgrave Hall, near Whitby, Yorkshire, for the Earl of Mulgrave—and to Ryston Hall; designed a house for the Rev. G. Gooch, Norfolk; Tendering Hall, Suffolk, for Admiral Sir Joshua Rowley.

1785-8. Designed a house at Shottisham, near Norwich, for Robert Fellowes, Esq.; Letton Hall, for B. G. Dillingham, Esq.

1788, October 16. Appointed architect and surveyor to the Bank of England.

1788-1794. Designed alterations and additions to Norwich Castle.

1789-90. Rebuilt Blackfriars Bridge, at Norwich; designed and executed extensive additions to Chillington, the seat of Mr. Gifford; designed a house for the Rev. Charles Collyer, Gunthorpe; designed extensive alterations and additions to Bentley Priory, near Stanmore, for the Marquis of Abercorn.

1790-4. Buckingham House, in Pall Mall, for the Marquis of Buckingham, and a town mansion for the Duke of Leeds, in St. James's-square.

1790-9. Designed alterations and additions to Moggerhanger House, Bedfordshire, the seat of Godfrey Thornton, Esq.

1791. Designed extensive alterations and additions to Skelton Castle, for John Wharton, Esq.

1791. Appointed Clerk of the Works to St. James's Palace, the two Houses of Parliament, and other public buildings in Westminster.

1791-2. Designed and executed alterations and additions to Barons Court, in Ireland, a seat of the Marquis of Abercorn.

1791-3. Designed and executed alterations and additions to Wimpole, the seat of the Earl of Hardwicke.

1792. Designed and built his own house, No. 12, Lincoln's-inn-fields.

1792. Designed and executed alterations and additions to Sulby Lodge, Northamptonshire, the seat of René Payne, Esq.

1793. Published a work, entitled, "Sketches in Architecture."

1793-6. Designed and executed Tyringham Hall, near Newport Pagnel, for Wm. Praed, Esq.

1794-1802. Designed and executed a house at Reading, for W. B. Simmonds, Esq.

1794. Designed and executed the entrance gates and lodge in Hyde-park, opposite Great Cumberland-street (since taken down); a house for the Hon. Mrs. Yorke, near Southampton.

1795. Became a member of the Society of Antiquaries; elected Associate of the Royal Academy; appointed architect for new buildings and repairs in the royal parks, woods, and forests, July; designed and executed extensive alterations and additions at Bagden House, for the Earl of Ailesbury.

1796. Designed and executed extensive alterations and additions at Hinton St. George, for Earl Paulett; designed and executed a house at Reading, for L. Austwick, Esq.

1797-9. Designed and executed alterations and additions to Holwood House, the seat of the Right Hon. W. Pitt.

1797-8. Erected a house in Stratton-street, Piccadilly, for Col. Graham; designed and executed alterations and additions to a house for the Countess of Pembroke, Grosvenor-square.

1799. Offered himself candidate for the surveyorship of the East India Company; published a letter to the Earl Spencer, K.G.

1799-1808. Designed and executed extensive alterations and additions to a house in St. James's-square, for Samuel Thornton, Esq.

1800-1. Designed and executed extensive alterations and additions to Aynho, Bucks, the seat of W. R. Cartwright, Esq.

1801. Designed and executed the banking-house in Fleet-street, for Messrs. Praeds and Co.

1802. Elected Royal Academician; designed and executed alterations and additions at Albury Park, the seat of Samuel Thornton, Esq.; ditto, at Cricket Lodge, near Chard, the seat of the Viscount Bridport.

1804. Designed and executed the obelisk in the market-place at Reading, erected at the expense of E. Simeon, Esq.; built a large house, counting-houses, warehouses, &c., in Fountain-court, Aldermanbury, for W. A. Jackson, Esq.; a villa, for himself, at Ealing; designed and executed alterations and additions to Port Eliot, St. Germans, Cornwall, the seat of Lord Eliot, afterwards Earl of St. Germans.

1804-1807. Designed and executed alterations and additions at Ramsey Abbey, Huntingdonshire, the seat of W. H. Fellowes, Esq.

1804-1806. Designed and executed alterations and additions to a house at Roehampton, for John Thomson, Esq.

1805-1819. Designed and executed alterations and additions to a house in St. James's-square, for Lord Eliot, and the Earl of St. Germans.

1805-1806. Designed and executed the Gothic Library, at Stowe House, Bucks.

1806-1807. Alterations and additions to Macartney House, Blackheath, the seat of the Hon. G. F. Lyttleton.

1806. Elected professor of architecture, in the Royal Academy.

1806-1811. Erected a mansion at Moggerhanger, in Bedfordshire, for Stephen Thornton, Esq.

1807. Erected a monumental tomb, in the church-yard, at Leytonstone, in Essex, for Samuel Bosanquet, Esq.; appointed clerk of the works of the Royal Hospital, at Chelsea.

1808. Made designs for the completion of Taymouth Castle, the seat of the Earl of Breadalbane; for the Royal Academical Institution, at Belfast; designed and executed a mausoleum, adjoining the house of Mr. Desenfans, in Charlotte-street, Portland-place.

1808-1810. Designed and executed the five new houses in Princes-street, forming "New Bank Buildings."

1809. Designed and executed the new infirmary, at Chelsea Hospital; 27th March, read the first lecture, Royal Academy.

1810. Repeated the first lecture, Royal Academy, January 8; lectures stopped, at the fourth lecture, on January 29; designed and executed alterations and additions to Whitley Abbey, near Coventry, the seat of the Right Hon. Lord Hood.

1811. Designed and executed the entrance to the London Dock Company House, and to the counting-house of Messrs. Thellusson and Co., in Meeting-house-court, Old Jewry.

1812. January 9, Lectures resumed, Royal Academy; designed and executed a house in Park-lane, for Mr. Robins; alterations and additions to Everton-house, Bedfordshire, the seat of William Astell, Esq.; designed and built his own house, 13, Lincoln's-inn-fields; the New Gallery, at Dulwich College, to receive the collection of pictures, bequeathed by Sir Francis Bourgeois, and a mausoleum, wherein are deposited the remains of Sir F. Bourgeois and Mr. and Mrs. Desenfans.

1813. Elected Grand Superintendent of Works to the United Fraternity of Freemasons.

1813-1815. Designed and built a house for the Rev. G. Monins, at Ringwould, near Deal.

1815. Designed and executed additions to the Earl of Hardwicke's house in St. James's-square; appointed one of the attached architects to the Office of Works.

1816-1817. Designed and built a farm-house, for Thomas Swinnerton, Esq., at Butterton, in Staffordshire.

1818. Designed and executed extensive alterations and additions to the banking-house of Messrs. Grote, Prescott, and Co., in Threadneedle-street.

1818. Alterations and additions to Marden Hall, near Hertford, the seat of George Thornton, Esq.

1818-1819. Designed and built the National Debt Redemption and Life Annuities Office, in the Old Jewry.

1820-1821. Designed and built houses in Regent-street, for Mr. Robins, and others.

1820-22. Designed and superintended the re-building of Wotton House, in Buckinghamshire, the seat of the Marquis of Chandos.

1820-1827. Designed and built the new law courts, at Westminster.

1821. Chosen a Fellow of the Royal Society; designed and executed Pelwall House, near Market Drayton, for Purney Sillitoe, Esq.

1822. Designed and executed a new church at Walworth, in the parish of St. Mary, Newington.

1822-1824. Designed and executed the new Scala Regia, Royal Gallery, and Library, in the House of Lords.

1824. Designed and executed Trinity church, St. Marylebone; a new chapel in the parish of St. Matthew, Bethnal-green.

1824-7. Designed and erected the new offices for the Board of Trade, and the Privy Council offices.

1825. Designed and erected additional committee-rooms, House of Lords.

1826. Designed and erected additional committee-rooms and a new library for the House of Commons; the new grand Masonic Hall, adjoining Freemason's Hall, in Great Queen-street.

1827. Printed for private distribution, "Designs for public and private buildings."

1828. Published "a brief statement of the proceedings respecting the new law courts, at Westminster."

1829-1833. Designed and executed the New State Paper Office in Duke-street, Westminster.

1831. Designed and executed the ante-room to the Sculpture Gallery of Sir Francis Chantry, R.A.; September 21, received the honour of Knighthood from his Majesty King William IV.

1832. Printed for private distribution, a "Description of the house and museum on the north side of Lincoln's-inn-fields."

1833. Oct. 16. Resigned the appointment of Architect to the Bank.

1833. April 20. Procured an Act of Parliament for settling his museum, library, and works of art in Lincoln's-inn-fields, for the benefit of the public.

1835. March. Presented with impressions in bronze, silver, and gold, of a medal, struck in his honour by the architects of England; received a medal from the Société libre des Beaux Arts at Paris; elected member of the Academy of Fine Arts at Vienna.

1836. Elected consigliere corrispondente of the Academy of Fine Arts at Parma; elected honorary member of the Société libre des Beaux Arts, at Paris, December 9.

1837. January 20. Expired at his house in Lincoln's-inn-fields.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

HARBOUR OF OSTIA.

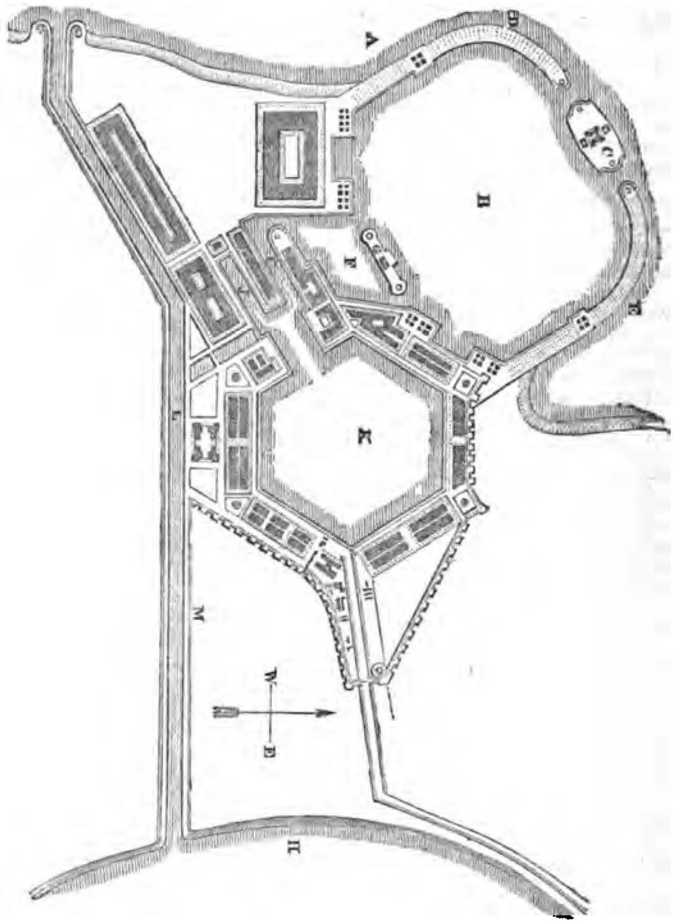
On the Ancient Harbour of Ostia. Paper read at the Institution of Civil Engineers, by Sir John Rennie, *President.*

New Harbour of Ostia.—The river Tiber appears to have been used exclusively as the port of Rome until the reign of the Emperor Claudius, who, conceiving it to be utterly hopeless to improve it against the obstacles of nature, conceived the bold and original idea of making an entirely new port altogether independent of the Tiber. Having once come to this determination, he communicated his views to his engineers, and asked their opinion as to the sum which would be required to carry it into effect; they replied that the sum would be so great that if he knew the amount he would never think of undertaking it. Not at all discouraged by this answer, which, on the contrary, only served to confirm Claudius in his resolution, he ordered the necessary preparations to be made for commencing the work. The situation selected for the new harbour, was a little to the northward of the then mouth of the Tiber, with the entrance pointing N.W., by which means it would be better protected against the southerly and westerly gales, and farther removed from the deposit of alluvial matter brought down by the Tiber; still, however, it was too near to be effectual, for the projection of the new works only served as jetties to check the current along the shore, and thus to occasion the accumulation of a deposit as great as that occurring at the mouth of the Tiber itself. It could hardly, however, be expected that the knowledge of the day was sufficient to enable the engineers to predict all the consequences of this state of things. The effects of the Tiber were evident, and it was naturally concluded, that by abandoning that river, all danger from deposit would be avoided, and it was only by experience that their error was discovered. Accordingly, the Emperor Claudius determined to construct an entirely new harbour, independent of the Tiber, but at the same time having a connexion with it, to be used according to circumstances.

The ancient writers agree generally as to the principles of the design, construction, and extent of the celebrated port of Claudius. The general plan of the harbour is shown in fig. 1. It consisted of an extensive low-water outer harbour, B, and a small inner harbour, F, The outer harbour, B, was formed by two artificial moles, D E, of 1900 feet in length, projecting nearly at right angles from the shore; each mole consisted of two parts or arms; the one nearest to the shore was perfectly straight for about 950 feet, the remainder formed a quadrant of a circle 1800 feet long, the breadth, which was equal throughout the whole length, being 180 feet. Between the outer extremities of the two piers or moles was a distance, C, of about 1100 feet. Immediately in the centre of the entrance, or opening between the two moles, was an isolated or detached mole, 780 feet long and 400 feet wide, forming as it were an island, and leaving an opening at each extremity between it and the opposite pier, or mole, of about 140 feet, thus giving a double entrance to the harbour. The distance between the two piers at the shore, or the total length of the harbour, was about 3000 feet, the width 2330 feet, and the surface extending over about 130 acres; about one-third of this space, however, was excavated out of the main land. Immediately in front of the outer entrance, there was a small inner harbour, F, 1200 feet long and 520 feet wide, covering an area of about 7 acres; this inner harbour was divided from the outer harbour by another isolated or detached mole, G, of the same length as the outer one, with an entrance at each end 120 feet wide.

Immediately behind the harbour were two parallel cuts or canals, H J, communicating both with the Tiber and Mediterrranean. The one nearest to the harbour communicated with it at each end of the inner harbour, so that the vessels could proceed either up the Tiber to Rome, or they might go to sea, or in fact might make use of it either for entrance or departure as the wind and other circumstances might be favourable. The other canal was quite independent of the harbour and of the first canal. It was probably used for vessels going direct to Rome, or proceeding to sea without stopping at the harbour. Across both canals there were communicating bridges and probably stop gates, particularly on the one next to the harbour, so that the waters of the Tiber might be turned into the harbour,

Fig. 1.



or be prevented from communicating with it, according as circumstances might render such steps advisable. The lock does not appear to have been then known. The circular part of the northern outer mole was open, or constructed upon arches, so as to give free access to the current, but was at the same time built sufficiently solid to break the sea and produce tranquility within. The circular part of the southern outer mole was solid, to prevent the deposit of the Tiber from entering the harbour. At the extremities of the detached mole, and also of the outer and inner moles, were towers for the purpose of defence, and for drawing strong chains across the entrances, in order to prevent the access and egress of vessels when necessary; thus converting the port into a close harbour (λιμην κλειστοσ), as used by the Phœnicians at Tyre, and subsequently adopted by the Greeks and Romans. The upper part of the moles was covered with sheds or colonnades, which were used probably for landing goods and for promenades; the interior harbour was surrounded with magazines and warehouses. In the centre of the detached mole, at the entrance to the outer harbour, was placed the great lighthouse, described by Suetonius; the base of which rested upon piles, and was founded by a caisson, formed out of the vessel which brought the great obelisk from Egypt. The depth of this harbour does not appear, but judging from the nature of the coast and the extent to which the piers were carried out into the sea, it could not have been less than from 15 feet to 20 feet, at low water, and that of the inner harbour not less than 8 feet to 10 feet, to have enabled it to accommodate the vessels used at the time.

After the reign of Cladius, the inner harbour was found too small and inconvenient; Trajan therefore enlarged it by making an entirely new inner harbour or basin, K. This was of an hexagonal form, each side being 1160 feet, the diameter being about 1800 feet, and the superficial area being about 70 acres. The entrance between it and the outer harbour was 120 feet in width, and was formed by part of the inner canal made by Claudius to communicate both with his harbour and the Tiber. The remainder of this canal and of the other one by Claudius, was filled up, and a new one, L, nearly parallel to them, was made about 400 feet to 500 feet nearer to the Tiber, communicating with the hexagonal basin, and was no doubt used for the same purpose as the canals of Claudius before mentioned. The inner harbour was also surrounded with quays and storehouses upon an extensive scale, containing all the requisites for carrying on a considerable trade for the supply of Rome, and for the construction and maintenance of the fleets, which were stationed in this quarter for the protection of the capital, as well as for the purpose of sending expeditions to the various departments of the widely extended Roman Empire. The whole of the harbour was surrounded by an extensive and lofty fortified wall, flanked with towers, quite independent of the town of Ostia, which was also surrounded by a wall.

Old Port filled up.—The port of Claudius Cæsar has now become completely filled up by the alluvial matter brought in by the littoral currents, as well as by the deposit of the Tiber, and is now about a mile from the shore. We cannot be surprised at this result, but at the same time we must admire the great skill, ingenuity, and perseverance by which it was attempted at that early period, to overcome by means of art the obstacles interposed by nature.

Dredging.—It is a question well worthy of serious consideration how far this principle may be carried with advantage, or where the obstacles interposed by natural causes become too powerful for the comparatively feeble resources of art. The Clyde at Glasgow, and the Liffey at Dublin, are extraordinary examples of what may be effected by this system. The harbours also of Boulogne, Calais, Dunkerque, and Ostend have all been materially improved in this manner; it still, however, remains to be proved how much further this system can be carried with advantage at these ports. It is doubtful whether the ancients were acquainted with, or had applied the modern system of penning up water in large reservoirs, and then discharging it with increased velocity by means of sluices, so as to enable it to act with more effect in scouring and deepening navigable channels: it must, however, be recollected that this system can only be practised with advantage when there is a considerable rise of tide (which does not take place in the Mediterranean), for otherwise it is difficult to obtain sufficient head or fall to discharge the water from the reservoirs with the required velocity.

In the second place, as regards the harbour of Claudius, there was clearly a great effect, accompanied by considerable boldness, as well as ingenuity, both in the design and execution. He must have foreseen, judging from past experience, that it was in vain to contend farther with the difficulties of the Tiber, and determined at once to get rid of them by making an entirely new harbour, which he anticipated would be entirely free from similar objections, and yet, at the same time, would be sufficiently near to communicate with the Tiber, and to take advantage of its navigation to Rome. The works were designed and constructed upon a magnificent scale, comprising almost every principle, both in design and construction, adopted at the present time, with the exception of the open or arched mole, which was peculiar to the ancients. This principle is certainly ingenious, and is well designed to obviate one of the most serious difficulties in maintaining a harbour upon a flat alluvial coast like that of Ostia. It might be applied with advantage to many cases in modern times, and it is singular that it has not been more studied, although it must be admitted, that the great rise of tide and the stormy nature of the northern seas (circumstances which do not exist in the Mediterranean) interpose practical difficulties in carrying the system into effect. It has been tried with advantage upon a small scale in the outer harbour of Ramsgate, and there are many cases where it might prove equally applicable. The double entrance, when circumstances admit of its being tried, is very valuable, and where it cannot be used, such a particular form of entrance is desirable as would enable vessels under sail to enter and depart at all times; and at the same time would prevent too great an increase of sea. Such a principle was adopted by the late Mr. Rennie at Donaghadee, and was also proposed by him at Kingstown.

The curved form of the outer piers, although well calculated to facilitate the passage of the current, was ill adapted to break the waves; on the contrary, it tended rather to increase their force, particularly at the entrance, where tranquility was much required: the angular form would therefore have answered this purpose better.

Construction.—As regards construction in Ostia, there is an illustration of almost every principle in use at the present time; the rubble thrown promiscuously into the sea to form its own slope, according to specific gravity of the materials and the action of the waves upon them; the solid vertical wall of masonry with arches resting upon piers, founded by means of pozzolano and rubble mixed in caissons; and the caisson and piled foundation for the light-house on the outer detached mole. There is no account of the diving-bell having been applied to the purpose of building under water, but the use of the material pozzolano, which abounds in Italy, was well understood and generally adopted. The mode employed in using it was to mix the pozzolano in a moist state with certain proportions of lime and small pieces of stone, then to throw the whole mass into a dam or caisson, constructed in the form required, and there to leave it until it had set sufficiently hard; the caisson might then be removed, and the mass of concrete left standing, and which became more solid the longer it remained, as the ruins of Caligula's Bridge bear ample testimony. The same system is pursued in many of the ports of Italy at the present day. The French at their new moles at Algiers and Cherbourg, are said to have extended this system with advantage; yet its merits, as compared with masses of natural stone, still require the test of time to prove its superiority.* Vitruvius, in his Chapter on Harbours, especially describes the different modes of operation before mentioned, with repect to rubble, and pozzolano walls, coffer-dams, piling, &c.

From the above account of the ancient port of Ostia, the following general conclusions may be drawn:—

First. That the ancients were well acquainted with the general principles of design and construction of harbours.

Secondly. That as regards the mouth of the Tiber, they carried the improvements as far as was practicable, and that having arrived at that point, their only resource was to construct an entirely new port elsewhere, free from the difficulties by which the Tiber was surrounded.

Thirdly. That in flat alluvial and deeply embayed coasts like those adjacent to the Tiber, it is a matter of the first consequence to ascertain by practical experience, the extent to which the coast line may be expected to advance, from the construction of works at the mouth of a river. This point being first decided, if further improvements be required, then the question of a new harbour free from the difficulties of the old river port may be entertained; and its construction should be so designed as to give the required protection, without incurring the risk of an injurious accumulation of deposit. The port of Claudius, although it was well designed and constructed in itself, was too near the mouth of the Tiber to be effectual, and in fact it acted like a great jetty or continuation of the old works at the mouth of the Tiber; thereby obstructing the free action of the current and producing stagnation on both sides, and by thus, to a certain extent, facilitating the deposit of alluvial matter, which it was intended to obviate, it became overwhelmed and destroyed.

Fourthly. The fate of the port of Claudius and Trajan demonstrated the impracticability of making an effectual harbour near the mouth of the Tiber. Trajan therefore determined to select an entirely new site free from the difficulties of the old, and, with that view, constructed the well known port of Civita Vecchia, anciently called Centum Cellæ, which has been preserved to the present time, a monument of skill and ingenuity in this department of construction. Upon the whole, therefore, the history of the port of Ostia is replete with instruction, as we at once see exemplified nearly all the various departments of harbour construction, both theoretical and practical, together with their usual results, and it is only by a careful study of this and similar examples, combined with a correct knowledge of the various local circumstances, that we can obtain a complete knowledge of this difficult but highly useful and important branch of Civil Engineering.

THE CASTLE OF OSTIA.

[From a Sketch by Mr. Riplngille in 1844.]

Remarks.—After the paper was read, the following observations were made:—

Mr. F. Giles had listened with much interest to the excellent paper which had been read; it was full of instructive, practical facts. He had been forcibly struck with the similarity of the results described, to the effects which were daily under the observation of engineers, in the harbours of the south coast of England. Rye, Dover, and Shoreham, might be quoted as examples. Of the ancient harbour of Rye, scarcely any traces remained. Mr. Giles was sent to Dover by the late Mr. Rennie, during the last year of the Pitt administration, in 1805, with instructions to make a survey, for the purpose of forming an extensive harbour of refuge for the Channel fleet. The design was not proceeded with, but certain improvements were commenced, with the view of removing the mass of shingle on the bar, and preventing a further accumulation. Mr. Walker had since done much for the further improvement of the harbour, by extending the backwater, and affording greater power of scouring by sluices. There was still great room for improvement; and, although there was at present rarely such an accumulation of shingle across the entrance, after a storm, as to close it up, which frequently occurred in former times: yet it was evident, that wherever piers or other obstacles were projected directly from the shore, the shingle would accumulate against them, and turning the point, would be thrown, in the form of a bar, across the entrance. This had become so evident, that the

* Qy Is not Caligula's Bridge a sufficient test of time?—Ed. C. E. & A. Journal.

attention of engineers was now directed to the formation of a harbour of refuge, which must, in his opinion, be detached from the shore, in order to permit the free run of the shingle. Such a harbour, or even a good breakwater, behind which steamers could take shelter, would be extremely useful, particularly in case of war, as from the proximity to the French coast, Dover would require special protection. There were several harbours where, in the course of his practice, Mr. Giles had seen these views exemplied. Bridport harbour consisted of two small piers and open timber jetties, through which the shingle was carried, and was deposited in the entrance. When he was called upon to devise methods of improvement, he directed the open jetties to be filled up with rubble work, and by establishing a system of scouring by sluices, the accumulation was carried away. Shoreham harbour was much in the same state, and in spite of all that had been done, it still remained a bar harbour. The harbour of Sunderland was liable to be choked up with sand, and but for the scour of the river Wear, it could with difficulty be kept open. It, however, was still a bar harbour, and neither in it, nor in any other of the ports that had been mentioned, could vessels be received at low water; in fact, only during the time the tide was up. It would always be observed, that upon coasts which were subject to the shifting of shingle, sand, or mud, any solid projection would inevitably cause effects analogous to those which had been mentioned; and to which might be added, the instances of the works of the harbour of Courtown, County Wexford, commenced by Mr. Nimmo, and continued by Mr. Giles.

Sir John Rennie, President, said, that the chief object he had in view, in bringing the history of the ancient port of Ostia before the Institution was, independently of the interest which attached to such extensive works, which had failed so entirely from natural causes, to direct the attention of the members to the important question of the effect of the action of tides, and of rivers, in the formation of deltas, shoals, and bars, at the entrances of harbours. Some instances had been given of a few of the English harbours, but the opposite coasts of France and Holland exhibited, in a more marked degree, the effects of this action, not only in the bars of the harbours, but in the formation of banks parallel with the shore. The ports of Dunkerque, Calais, Boulogne, and Havre, might be especially mentioned. In all of them, in spite of continued extension of the jetties, and constant attention to the works, the accumulation of matter at the entrance extended with the new works. Havre was, perhaps, the most extraordinary instance. The current, at the entrance, was at times so strong, that a powerful steam vessel, such as the "Phœnix," had found much difficulty in entering the harbour.

The formation of the Goodwin Sands was a subject of interesting observation. There could not be any doubt of these sands being formed by the action of the eddies of the tide and the river Thames; an attentive study of the position, with respect to the headlands near, the currents of the river and the tidal waters, bearing in mind the direction of the prevailing winds, enabled a reasonable solution of the problem to be arrived at.

Dover harbour was a curious example of the effects of the motion of shingle, which was produced from the débris of the fallen chalk cliff, the flints of which formed the pebbles, and the chalk and earth composed the silt. In the time of Henry VIII., Dover bay was instanced as being very fine, and having very deep water. The prevailing winds caused the shingle and silt to be carried to and fro freely along the shore. As soon as an obstruction was offered by piers, the shingle, having no longer a free and unrestricted course, accumulated across the ends of the piers, forming an embankment enclosing one side of the lake, which was replenished at each tide, until it became so extensive as to burst through the bank, and scoured everything before it. Constant endeavours had been made, and in some instances successfully, to improve the harbour by extending the piers, but, as had been stated, very much yet remained to be done, to form a good harbour at Dover.

It should be remarked particularly in the paper, that one of the leading features in the works at Ostia, was the construction of the moles upon arches, below the line of the low-water mark, so that the moles afforded still water for the vessels, while the arches permitted the alluvial matter to be carried through by the current. The same system had been adopted at Pozzolana, in the mole called Caligula's Bridge, in which concrete was used for the building. Sir John Rennie was of opinion, that this system of construction might be very advantageously adopted in many situations, and he had frequently proposed it. At Carrickfergus he designed two solid breakwaters to keep off the run of the sea on the most exposed side, while from the shore at right angles to it, and pointing to the centre of the breakwater, an arched mole would have been built, besides which vessels would lie, at all times of tide; the run of the shingle along the shore, would thus have been very slightly impeded.

The Italian harbours deserved very particularly the study of engineers. The port of Genoa had been badly designed, and was constantly embarrassed by the deposit in it. Ancona being situated on a promontory had less deposit. At Ravenna the harbour had been nearly destroyed. The port of Venice was almost entirely kept open by dredging by manual labour, assisted by the moderate rise of tide at particular seasons. In the Lagunes, the accumulation of alluvial matter was immense. A canal was constructed entirely round the Lagunes, with locks and sluices, to admit the fresh water when clear, by which means a power for scouring was obtained, and the channel was kept open. Civita Vecchia was principally indebted to its position for being preserved from the alluvial deposit, which was felt so severely all along the coast.

Mr. Thorold was struck with the apparent similarity between the harbour of Sandwich and that of ancient Ostia, both of which had failed from the same causes; whereas Ramsgate was, like Civita Vecchia, an instance of the advantage of a proper selection of a site for a harbour. The port of Dublin might be also instanced as another example of comparative failure; while that at Kingstown was altogether as successful, as he believed it was almost entirely free from sand. The system of scouring away accumulations of sand and silt from harbours, by means of large reservoirs, did not appear to be sufficiently resorted to. Mr. Therold was of opinion, that in some cases, great advantage would result from the application of the steam engine and the flash wheel, for raising water into the scouring reservoirs. In the fens of Lincolnshire, and near Yarmouth, he had found that arrangement of machinery very economical for draining. It had been applied in the river cutting of the Yarmouth and Norwich railway, after it had been partially filled by a storm. The cutting was about half-a-mile in length, 100 feet wide at the top, and 20 feet in width at the bottom, and was 10 feet in depth. It was completely drained in 36 hours, with an expenditure of only 5 tons of coals. A reservoir of those dimensions would be found a great assistance for scouring a harbour, when any extra accumulation had occurred.

ANCIENT DECORATIVE ART.

At the Archæological Institute was read the following interesting paper on *the various Ancient Decorative Arts and Process of Working in Metals, such as Chasing, Embossing, Niello, Filagree, &c.* By Mr. Hudson Turner.

The paper contained rather a general view of the subject than details respecting the several processes in metallurgy anciently used. The writer observed that in the majority of instances we can now show scarcely more than the names whereby numerous artificial processes connected with working in metals during the mediæval period were designated, in evidence of their having been practised. The variety, however, of these distinctive appellations rendered it desirable that a catalogue of the descriptions whereby they were distinguished in commercial traffic should be formed, in order that distinctive names, as yet unintelligible, may be appropriated to the several objects of curious workmanship exhibited from time to time. To the British antiquary it would be an attainment of great interest if his researches enabled him to identify the method of working in gold or silver practised at an early period in this country, and known by reputation in other parts of Europe as the work of England, *opus Anglicum*, and a variety of it familiarly designated as the work of Durham, *opus Dunolmense*. It would be equally desirable to be enabled to classify such examples of foreign workmanship as may be found in our island by their proper designations; as the work of the Saracens, *opus Saracenorum*,—or the *opus Græcum*,—the *opus Veneticum*, work of Venice,—the work of Tours, *opus Turonense*,—or of Cyprus, *opus Cypresse*. Any attempt towards such a classification would possess more than a merely curious antiquarian interest; since it could not fail to throw important light on the history of commerce and international relations in early times. Moreover, the extent to which objects of personal ornament and productions of a costly character were used in a country afforded valuable collateral evidence of the actual state of society. It is obvious that any considerable introduction of foreign luxuries during the infancy of commerce must have been the result of some influential circumstances by which the taste of the time was fixed or modified; and therefore the prevalent esteem for any particular objects of foreign production may be taken as evidence of commercial and friendly relation at that period. The elevation of an ecclesiastic of Greek origin, Theodorus, to the see of Canterbury, in the seventh century, must have tended to the introduction of the arts and choicer productions of Greece or Asia, as well as of the dogmas or ceremonial peculiarities of the Eastern Church: and it was in sacred ornaments that the most costly processes of art were lavishly displayed. The practice of performing pilgrimages to Rome, the Holy Sepulchre, and other remote places—where the rich produce of various countries was displayed to view, and an emporium opened for the supply of the most remote regions of Christian Europe,—doubtless led to the introduction of numerous works of foreign artificers into this country. By such pilgrimages, even more perhaps than by commercial traffic, were the productions of Italy, Greece, or the East, imported into our country in earlier times.

Mr. Turner observed that we have scarcely any data in regard to the actual practising of the more curious processes of metallurgy, either by foreigners or natives, in England, in very early times. It may be reasonably surmised that the most precious existing example of goldsmiths' work—the Alfred Jewel, preserved at Oxford—was fabricated in this country; though some antiquaries consider its enamel as of oriental work, while the gold setting, richly elaborated in filagree, may doubtless be English. However, it was to be remembered that, whilst the art was chiefly subservient to ecclesiastical purposes, it was also chiefly practised by ecclesiastics; and that through their communication with their foreign brethren, the knowledge of curious artistic processes would be diffused throughout their order, and carefully preserved. Thus, the arrival of some Greek acolyte with Archbishop Theodorus affords a reasonable ground for explaining the introduction of arts into our country which are undoubtedly of oriental character. It was scarcely needful to remind the archæologist that ecclesiastics of the highest grade did not account themselves demeaned by practising the crafts in which they had attained to eminent skill as simple brethren of the convent. St. Dunstan in England, and St. Eloi, bishop of Noyon, in France, who lived at the close of the sixth century, are instances of prelates celebrated for their skill in working the precious metals.

Mr. Turner next adverted to the undoubted practice in Ireland, from a very early period, of the various arts of working in metals. His observations applied not only to productions in gold and silver, but to castings in bronze or mixed metals, presenting the united characteristics of very early fabrication with peculiarities of most skilful workmanship; and he alluded to the superior advantages enjoyed by Irish antiquaries for the prosecution of such an inquiry in the existence of a national collection. The nature and extent of the collection formed by the Royal Irish Academy was known to many members of the Institute, by the series of faithful drawings of the numerous objects preserved in their museum, which, by favour of the Council and the kind intervention of Dr. Todd, were exhibited at the last year's meeting of the Institute at Winchester. It was observable that some of the Irish specimens exhibited a remarkable skill in the use of the metallic compound technically called *niello*, at a period long antecedent to that at which writers have usually accounted that curious art to have been practised. That art, indeed, is of far earlier date than the times of Finiguerra and the Florentine *orfèvres* of the fifteenth century, as is shown by the researches of Count Cicognara, who has given examples of it earlier than the eighth century. In the possession of the Society of Antiquaries there is a Stylus, or pointel, for writing on waxed tablets, the head of which is beautifully ornamented, apparently with *niello*. This little work is of early Norman, or possibly Saxon, date. After some remarks on the art of engraving as applied to the enrichment of sepulchral memorial familiarly termed "Brasses,"—which, independently of their value as family memorials, evidences of costume, &c., possess additional interest as examples of design, and of a peculiar kind of artistic method in the working of metals, viz., the combination of the work of the burin with the use of enamel, and of a coarse assimilation to the process of the use of *niello*,—Mr. Turner observed, he regretted that it was at present impracticable to offer any definitions of a precise nature in regard to many of the mediæval terms to which he had occasion to advert. As respected the distinctive term *opus Anglicum*, by which the works of the early metallurgists of England were known abroad, he ventured to express an opinion that the phrase was not applied to denote any particular process of art, but was rather used to describe the general character and design of the objects fabricated in the precious metals in this country at an early period. And it might possibly have reference to the two peculiar patterns generally worked on the surface of such objects,—which may be broadly distinguished as the ribbon and the lacertine or dragon pattern. The *opus Dunelmense* he was inclined to consider as a peculiar decorative process which the monks of Durham, to whose skill it must be attributed, derived from their predecessors who came from Lindisfarne; and the characteristics of this style were probably analogous to those of the early Irish works to which previous reference had been made. The want of any national Museum of Mediæval Art in this country was a serious obstacle to the prosecution of researches of this nature; as it was only by actual and careful comparison of examples that any satisfactory knowledge of their date or origin could be obtained. In many instances, doubtless, these terms were confounded; as, for example, works of oriental character may have been called without strict regard to their proper designations. But unquestionably these were appellations denoting objects of perfectly distinct style, in their true signification: and, Mr. Turner remarked, that in formal documents some attempt seemed to be made to distinguish the country of objects of price with precision. Thus, in a list of presents (xenia) given to Henry the Third by the Master of the Temple beyond Sea, we find, among other productions of oriental skill—"two *Turkish* bows with strings of leather," and "two iron maces of *Saracenic* work." The discrimination between Turkish and Saracenic work is curious in more respects than one; and, besides its indicating a knowledge of the difference between the races, it would appear to mark some distinction fully recognised in the thirteenth century in the character of eastern productions. By the writers of romance these terms were doubtless used in a more vague or general sense; as in the "Tale of Gawayn," written in the times of Richard the Second, in which the battle-axe of the Green Knight is minutely described, with its handle strengthened with iron wound around it,—

> ——and all bigraven with grene in
> Grecous werkes.

At the same time, the frequent allusion to Greece as the source whence such decorations were derived, is fully consistent with the fact that the chief source of a great variety of artistic processes, of every kind, prevalent during the Middle Ages, may be traced to Constantinople.

In illustration of the goldsmiths' work of the 13th and 14th centuries, Mr. Turner read numerous extracts from the unpublished accounts of the native artists employed by Henry the Third and Edward the First, which shewed the variety and elaborate character of the objects executed by them in the precious metals, during those times. In the course of some concluding, and necessarily hasty, remarks on early iron-work, Mr Turner called especial attention to a beautiful cast, exhibited by Mr. Willement, of the wrought iron screen which formerly enclosed the monument of Eleanor, consort of Edward the First, in Westminster Abbey. This beautiful specimen of the iron work of the 14th century was removed but a few years since, and is now rusting in the vaults or crypts of the Abbey. In Mr. Willement's opinion, it is scarcely inferior in beauty to the celebrated work at Notre Dame: and Mr. Turner observed, it should possess great interest in the eyes of English archæologists, as he had discovered that it was the undoubted work of an English smith, one Adam de Leighton, of Leighton Buzzard, in Bedfordshire; who received 12*l.* for the entire fabric—equal to 180*l.* of the present currency. It is to be hoped that under the auspices of the present Dean this remarkable specimen of the excellent craft of a provincial smith in the old time may be either restored to its original position, or preserved from further possible mutilation or decay.

DECORATION OF THEATRES.

At a meeting of the Decorative Society, a paper "*On the Decoration of Theatres*," by Mr. Dwyer, was read. It was illustrated by sketches from the interiors of the Metropolitan Theatres.

The subject was introduced by observations upon the influence which dramatic art and its literature have had for good purposes when judiciously conveyed. The just appreciation of the beautiful in scenic effects, now frequently displayed in our theatres, was adverted to. Mr. Dwyer considered that the best means of increasing the importance of theatres, and raising them in the public estimation, is to render them *magnificently* worthy, in every way, for the dissemination of moral truths and refinements. He noticed the construction of theatres; and admitting that accommodation for the greatest number in the least possible space, with subdivisions for various classes of visitors, formed an important requirement, he argued that the form generally adopted (that of the horse-shoe) is not the most suitable. He maintained that the idea of making the audience feel as comfortably seated in a theatre as in a drawing room had been imperfectly contemplated; and that, however much a curved side might with propriety be admired, *utility* should have the first attention, so as not to restrict the view in any case to merely a portion of the opposite boxes. The circular and semi-circular forms employed by the ancients, Mr. Dwyer said, suggested a useful modification, somewhat approached in the plan of Drury Lane Theatre, and contrasting favourably with the straight-sided horse-shoe form in Covent Garden.

An ignorance of acoustics was said to be evident in the construction of our theatres. Mr. Dwyer referred to several well-known forms, such as tunnels, archways, and long curved spaces; as also to the stone-canopied seats on Westminster Bridge,—where the slightest whisper in one could be heard in the opposite,—as so suggestive that he could not but feel the greatest surprise at such repeated blunders. The proscenium to each of the London theatres was said to be different in arrangement; no two being alike, and none exhibiting an approach to any principle which the laws affecting sound would dictate. Some censure followed on the prevailing use of massive Greek entablatures, with Corinthian columns in unusual proportions (at Astley's very lofty, at the Haymarket very short), exhibiting a disregard of harmony in form and proportion, from the entire absence of a medium for combining the gigantic massiveness in the one with the subdivision of parts throughout the interior of the house. The theatre at Versailles was referred to as an instance where Corinthian columns being placed on the stage, Ionic columns support the superstructure; and which, together with some other arrangements, render this theatre particularly worthy of observation. Nevertheless, the proscenium there is imperfectly constructed for the distribution of sound. Mr. Dwyer considered the upper portion of the proscenium at Covent Garden the least objectionable of any in the metropolitan theatres; and awarded praise to the picturesque and agreeable manner in which it blends with the interior, and also as being in that part better calculated for the distribution of sound. A form of construction was then explained, which, it was said, would obviate the necessity for extraordinary exertions on the part of the performers in attempting to produce an audible and satisfactory effect throughout the house. Mr. Dwyer propounded a theory which, he said, comprehended the principles embodied in two familiar instruments of sound;—viz., the bell and the violin. He said he would construct two bold bell-shaped curves, diverging over not less than eight feet on the stage to the sides of the theatre; each composed of two thicknesses of wood placed about six inches apart. The front one should be perforated ornamentally; thus serving to receive and distribute equally within itself the sounds given forth near to it. The elevation should assume the form of an arch, with spandrels also perforated—thereby distributing with distinct resonance the words or music to all parts of the house.—In a subsequent part of the paper Mr. Dwyer offered some remarks upon the construction of ceilings; which we report now, as having more immediate connexion with the acoustic theory last described. He proposed the use of a spherical or a spheroidal roof, supported by iron ribs, which might be ornamented; the spaces between each rib to be enriched with elaborate perforations (or otherwise, according to the general style of the house), in a manner similar to the doorway in the circle at Astley's. The additional height thus given to the interior would enable the chandelier to be placed above the line of sight from the upper part of the theatre to the stage; and the objections that might be made to this position of the chandelier were met by the fact that a concave surface reflects much more than a flat one. Another important advantage arising from this form of ceiling was the facility afforded for a powerful system of ventilation. The painting-room would be raised some nine feet; and the absence of the rolls of canvas, scenery, and other properties, from the top of the ceiling, would add considerably to the reverberation of sounds—besides contributing greatly to the comfort and health of the artists employed in the theatre. Mr. Dwyer elucidated his ideas by sketches. Adverting to the general principles of construction exhibited in the theatres of the metropolis, Mr. Dwyer considered that the Surrey Theatre embraces more than any other the best arrangements for seeing and hearing; the proscenium being formed on a bold level, judiciously diminishing the width of the stage.

The disregard of unity in the construction of theatres generally was pointed out; and, among other instances the St. James's was named—where light flowing ornaments, in the French style, are in juxta-position with a massive Classic style; and the ceiling of the Princess's was deemed an instance of discordant arrangement. The application of various decorative materials, such as distemper paintings, paper-hangings, composition, papier maché, to the fittings, &c., received attention: and it was asserted that the Princess's was conspicuous for elaborate richness and diversity of ornament,—but that it was questionable whether the Herculean expression therein, rather than the grace and delicacy of Apollo, may be deemed appropriate. Mr. Dwyer said, that as a specimen of decoration it merited warm praise; owing to the characteristic vigour throughout every part (*up to the ceiling*), as well as for a suitable strength and richness of colour. The usual enrichment on the fronts of boxes was commented on; and the use of bas relief, or raised ornament, recommended in preference to the most elaborate surface-painting on panels,—as exhibited at the Italian Opera House, where the effect partakes of the weakness peculiar to paper-hangings and similar media. The second tier in the Princess's was alluded to as a good specimen of this manner; being decided in character, with the details effective but subordinate, and the terminal figures between the compartments skilfully devised. The velvet valances to the boxes in this theatre were commended; but the practice of having them, as in several theatres, to extend only above the private boxes was deprecated. When it is not wished to have ornament in relief upon the fronts of the boxes, valances of this kind suspended from the cushion were suggested as imparting a peculiar and good effect. Ornamental iron-work, is was said, may be introduced with great diversity of design, for balconies, open fronts to the boxes, fret-work and ornaments in relief for various parts of a theatre. Some remarks were added on the usual method of supporting the boxes by series of columns; and others condemnatory of the manner in which the tiers of stage boxes are generally placed *between large Corinthian columns.* Sculpture was mentioned as offering an important adjunct in producing a higher class of decorations,—and encaustic painting as facilitating cleanliness and durability.

At the following meeting some observations on the paper were made by Mr. COOPER; in which, referring to the remarks on a plan of a theatre, he suggested that another form offered considerable, and probably greater, advantages. This he described as the oval; which he would have divided by its longer diameter, one half apportioned to the audience, and the other to the stage, &c. He alluded to several continental theatres, approaching to this form in construction—the Circus Franconi, Napoleon's grand amphitheatre at Milan, the Roman Circus at Verona, and the Colosseum. As painted or shifting scenery was not employed with the Greek Drama, the proscenium was richly decorated with ranges of marble columns, statues, gilding, and bronze. The advantages of the semi-circular and semi elliptical over those of the horse-shoe form were enlarged upon; and the Olympic Theatre at Vicenza, built by Palladio, was said to exhibit them in a perfect manner. This theatre may be considered the *chef-d'œuvre* of Palladio; and was erected, by order of the Olympic Academy of Vicenza—whose members directed him to build it in accordance with the ancient plan, that they might afford their compatriots an idea of the magnificence of ancient theatrical exhibitions. Various plans, as well as the proscenium, which is a remarkably elaborate architectural composition, were exhibited in an old work upon the public and palatial buildings of Vicenza. Mr. Cooper then noticed the remarks by Mr. Dwyer on decorations: several of which met with his concurrence—and others he extended by additional descriptions and suggestions; referring especially to the decorations of the *Théâtre Comédie* at Paris, as of a chaste and appropriate kind. The details were said to be very light, and in the Renaissance style.—The discussion was supported by Messrs. Parris, Seddon, Crabb and others: and the following observations are selected from others of interest. A spheroidal form of ceiling, it was admitted, offered several advantages; influencing ventilation and lighting, as well as contributing much towards a picturesque and pleasing effect.—The decorations of the ceiling in the Italian Opera House, it was observed, had been copied from one in the Ducal Palace at Mantua (a coloured plate was exhibited from Gruner's work), but they had not been successfully adapted. It was considered questionable if the example was suitable for such an extensive surface; if, admitting the propriety of selection, the figures hold their just proportions. The great distance at which they are required to be seen had not been sufficiently regarded in the colouring; and the peculiar haze to the atmosphere in a large theatre, as well as some other general principles in colouring, demanded a different treatment. The use of bright colours, such as vermillion, it was remarked, ought to be restricted to a very limited application.—Mr. Parris supported this opinion by references to works by Raffaelle and Rembrandt; and recommended Indian red and Venetian red, when supported by a bold mass of shadow, as producing a more powerful effect. He also objected to the prevalent use of bright colours for interior decorations—from their harsh and, owing to the general absence of green, fatiguing impression. It was remarked that the decorations of the Italian Opera House appear most satisfactory when the seats are vacant; and consequently, that the design does not embrace some essential principles. The box tiers on the rising of the curtain were compared to bands of white ribbon figured with certain dark spots, oddly associating with the rich scenery and dresses on the stage. Encaustic painting was alluded to; and its durability and effect were said to have been proved equal to fresco when subject to the influence of gas and vitiated atmospheres. Coloured decorations when composed of sprawling cupids or allegories were slightingly mentioned. Some suggestions were made stating that rich fabrics, coloured as Persian carpets, cloth of gold, &c., when thrown over the fronts of the boxes, would conduce to a rich and gay appearance quite distinct from any obtainable by painting.—The *Opéra Comique* at Paris was described by way of contrast to the decorations of our Opera House. A satisfactory, quiet, yet rich effect, it was said, is there displayed, together with some important matters in construction. The ornaments are composed of stamped brass.—A description was given of Covent Garden Theatre as it was when first opened. It was designed by Smirke, and painted under his directions. The drop-scene was painted by William Dixon in subdued colours; with sienna columns and statuary, with broad masses of shadow, conducing to a forcible impression by powerfully enhancing the effect of colours in scenery and dresses on the stage. The repose conveyed on the fall of the curtain was said to have been agreeable, although splendour was not aimed at.

SOCIETY OF ARTS, LONDON.

Dec. 16.—Dr. ROGET, Sec. R.S., V.P., in the Chair.

The Secretary read an address from the Council, which gave a retrospect of the proceedings of the past year, and the proposals of the Council for the future. It stated that formerly the Society, as is well known, stood alone as the great active scientific, mechanical, and artistic society of London, the Royal Society being the only other in any analogous position. That now, however, that great field is happily full of co-operating Societies, each labouring on some one subject formerly a mere dependant on its vast territory. That this removal from the parent Society of so many branches, has necessarily stripped it of many of its bright ornaments; but it appears to the Council, that far from being regarded as an evil, this multiplication of useful Societies is a subject for congratulation, and should be regarded as one strong proof of its past usefulness.

The Council consider that the field on which the Society might with best effect concentrate its future labours, as well as that which most properly belongs to it, is a department of the Fine Arts hitherto much neglected in this country, and which has been strongly approved of by H.R.H. Prince Albert, President of this Society,—namely, that of promoting high art in connection with the mechanical, for which our manufacturers are so justly celebrated.

The Address then proceeded to state the various alterations and improvements which had been effected on the Society's premises during the recess, and concluded with a list of the various pecuniary and honorary rewards about to be offered for competition during the current session.

The first paper read was "*On the principles employed in the recent Decorations of the Society's Great Room.*" By D. R. HAY, Esq.

The paper commenced by stating that the decorator who has been intrusted with the embellishment of the hall of a Society which has for its object the advancement of the ornamental and useful arts, naturally felt much anxiety as to the result of his labours; and this anxiety was increased by the reflection, that his work must necessarily be of a nature calculated to accompany one of the greatest efforts in high art of which this country can boast. His first object, therefore, has been to adopt such a style of decoration as should not only embellish the hall, but at the same time give additional effect to those great works of art which it contains, connecting the whole in one general harmony of form and colour.

This has been effected by surrounding the pictures, by Barry, with cloth of a deep purple hue, which colour is the most effectual in giving clearness to works of high art. The spaces of wall which surround the pictures thus have the effect of being in shade, while the pictures themselves will appear in full light.

Having in some measure separated the pictures from the ceiling, the next consideration of the decorator was the general effect of the hall itself. It is requisite that all apartments, in which great works of art are exhibited, should possess a certain degree of grandeur. This is sometimes imparted by architectural decoration alone; but in the Society's hall scarcely anything of the kind exists. The wall terminates by a narrow and lightly enriched cornice, surmounted by a plain cove of 8 ft. 4 in. wide—this cove is terminated by a narrow border of stucco work, between which and the aperture for the cupola light there is a flat space also quite plain. The aperture towards the cupola light is thrown into eight panels by a plain narrow moulding, and this completes the architectural decoration.

It, therefore, appeared to the decorator that whatever grandeur was to be imparted to the hall must depend upon the embellishment of the plain surfaces, and that the architectural decorations could only be made to appear as bands dividing those surfaces. It became, however, requisite to unite in some measure the cornice with the walls, and this has been effected by painting it of an Etruscan brown, or deep *terra cotta* hue, which hue forms a natural harmony with the colour of the cloth upon the walls. The plain surface of the cove which surmounts the cornice, afforded the decorator the first field upon which he could exhibit a style of decoration, and this he has confined to a simple combination of geometric with chromatic harmony; and that it might have a *rationale*, he has made this combination to represent mosaic work composed of *giallo antico*, *rosso antico*, *lapis lazuli*, and inlaid gold. This selection of material has a double advantage, for while it gives meaning it also affords an opportunity of using what artists term broken colours, the *giallo antico* being yellow intermixed with tints of purple, the *rosso antico* being a low tone of red, broken up by tints of grey and white, and the *lapis lazuli* being intense blue, likewise broken with tints of gold colour and grey; thus preventing the crude effect of plain patches of colour, and giving the qualities of unity and continuity amongst the parts. The band of stucco work which divides this cove from the flat part of the ceiling is painted pure white, to represent statuary marble, as are also the mouldings round and upon the aperture that leads to the cupola light. This was adopted in preference to the *terra cotta* colour of the cornice, as being equally appropriate and more light in effect. The flat part of the ceiling is also enriched by a mosaic work of a similar chromatic harmony of the same marbles, but of a different harmony of form from that of the cove, and without gold. The panels in the space leading to the cupola are similarly enriched by a mosaic work, composed of *lapis lazuli* and *siena* combined with inlaid gold.

The figures forming the design in the cove are produced by the combination of elliptic bands round central points, so that they are all perfectly curvilinear, and formed by arcs of the same ellipse, the size of which was proportional to that of the principal figures in the pictures. As a contrast to this arrangement of curvilinear forms in the cove, the decorator has introduced a rectilinear design upon the flat part of the ceiling which divides the cove from the cupola. This design arises out of a combination of equilateral triangles producing hexagonal and rhomboid figures, into the former of which the national emblems—the rose, the thistle, and the shamrock—are introduced as if inlaid in *rosso antico* marble. In the panels above this, and forming the sides and spandrils of the space below the cupola-light, the design is produced by the combination of an equilateral triangle and a circle; thus uniting the curve with the straight line, as an appropriate winding up of the linear harmony.

In the centre of each of the four side panels, a shield has been inserted. The one over the chair is blazoned with the royal arms. The shield opposite to the chair is blazoned with the family arms of H.R.H. the President of the Society. The shield on the right of the chair, is emblazoned with the arms of Barry the painter, and that on the left, with the badge of the Society.

The second paper read was "*On the first principles of Symmetrical Beauty, and their application in certain branches of the Art of Design.*" By D. R. Hay, Esq.

This paper commenced by stating that the first principles of symmetrical beauty originate in the power of numbers, and that a means of applying the principle of numbers in the formation of plane figures is afforded by the division of the circumference of the circle into 360 degrees, which degrees are again divisible and subdivisible by 60 into minutes, seconds, &c. Thus, the abstract principle of harmony and proportion in the relations of certain numbers to each other, becomes apparent and visible in their application to the structure of geometrical figures by means of the division of the circle. It then proceeds to show, that to apply these degrees to rectilinear plane figures, each figure must be reduced to its primary element; that the triangle, which is half of the square, is the first and most simple of its class, and is the representative of the No. 2; that the scalene triangle, which is half of the equilateral triangle, is in like manner the representative of No. 3; that the next scalene triangle which arises naturally in the series is that which is half of one of the five isosceles triangle which form the pentagon, and is the representative of No. 5.

We have, therefore, in the square, the equilateral triangle and the pentagon, the primary elements of all symmetrical beauty, as represented by plane figures, and evolving the operation of the harmonic numbers of 2, 3, and 5. Out of the primary rectilinear figures already referred to, arises a second class, as, when an equilateral triange is divided into two scalene triangles by a line drawn through one of its angles and bisecting the opposite side, these scalene triangles, if reunited by their hypothenuses instead of their longest sides, will form an oblong rectangle—every rectilinear figure having its corresponding curvilinear figure.

The paper concluded by showing the operation of the principles of harmonic ratio in the formation of the mouldings of Grecian architecture, ornamental vases, household utensils, &c.

Dec. 23.—W. H. Bodkin, Esq., M.P., V.P., in the Chair.

The first communication read was by Dr. Roget, Sec. R.S., "*On his Economical Chess-Board,*" the object of which is to give the chess-players a board of sufficiently small dimensions to admit of being put into the pocket, when folded, at any part of the game, without deranging the position of the men on the board, so that when it is reopened they will be found in the same place as before, and the game or problem can be resumed where it had been left off.

The second communication read was "*On the effects of Heavy Discharges of Atmospheric Electricity, as exemplified in the Storms of* 1846 *(including an Account of the Destruction of St. George's Church, at Leicester, on the* 1st *of August); with Remarks on the Use and Application of Lightning Conductors.*" By E. Highton, Esq., C.E., Telegraphic Engineer to the North Western Railway. Fragments of the roof of St. George's Church, and the apparatus used for getting rid of the injurious effects of lightning on electric telegraphs were exhibited in illustration of the subject. The author commenced by stating that the frequent occurrence of thunder storms during the past summer had afforded almost unequalled opportunities of investigating the effects of atmospheric electricity in the concentrated form of lightning. He then proceeded to give a description of the effects produced on St. George's Church, Leicester, by a discharge of lightning. The church, which was a new and handsome building, was entirely destroyed by the effects of the thunder storm of the 1st of August; the steeple having been burst asunder, parts of it were blown to a distance of 30 feet in every direction, while the vane rod and top part of the spire fell perpendicularly down, carrying with it every floor in the tower, the bells, and the works of the clock. The falling mass was not arrested until it arrived on the ground, under which was a strong brick arch, and this also was broken by the blow. The gutters and ridge covering were torn up, and the pipes used to convey the water from the roof were blown to pieces. The author next proceeded to compare the power developed in the discharge of the lightning which destroyed St. George's Church with some known mechanical force. He stated that 100 tons of stone were blown down a distance of 30 feet in three seconds, and consequently a 12,220 horse-power engine would have been required to resist the effects of this single flash. In the course of the paper the author exhibited the effects of a new battery, constructed by himself, and which was less than the $\frac{1}{40}$ of a cubic inch in size. This battery, he had found, would for a month together ring a telegraphic bell 10 miles off. He also exhibited a second battery, which, although so small that it would pass through the eye of a needle, is of power sufficient to work a telegraph. Having detailed the course of several discharges of atmospheric electricity, he then proceeded to show the effects produced on the electric telegraphs, and the means which have since been adopted to prevent injury to them in future.

M. Highton further stated that since the occurrence of the above storms he had examined the cathedral of St. Paul's, in London, to ascertain how far this noble pile of building is protected from the effects of lightning. He found that the two small turrets have lightning conductors erected, but the central dome has none. He found, however, that the position of the spouts and other metallic connections is such, that he considers if the same are preserved as they now are, the building will, for years to come, be free from damage by lightning; but should they be removed at any time, and glass or porcelain be employed in their stead, then the main part of that noble building would be in constant danger from every storm that passes over the city.

He then concluded by urging the importance of a correct and systematic principle being acted on in the new Houses of Parliament, with a view to securing them from the disastrous effects of lightning.

ROYAL SCOTTISH SOCIETY OF ARTS.

Nov. 23, 1846.—David Maclagan, M.D., F.R.S.E., President, in the Chair.

The following communications were made:—

1. *On producing White, or Neutral Light, by means of ordinary artificial light.* By George Tait, Esq., Advocate, Vice-President.

The white light, or artificial day-light, was exhibited, in contrast with ordinary artificial light, upon the primary and the secondary colours, and upon a coloured sketch.

In this communication Mr. Tait shows, that, while the white light of the sun is composed of rays producing orange and of those producing blue, in equal parts, in ordinary artificial light the rays producing orange exceed by many times those producing blue; the consequence of which is, that the latter lignt resolves into an orange light a little modified by blue, which affects very much the appearance of the colours of objects exposed to it. In order to produce white light, he incloses the ordinary light in a lantern, or otherwise, and transmits it through coloured glass, or painted glass, of the proper depth of blue, so as to absorb the excess of orange; by which means it is produced at five or six times the expense of the same quantity of the ordinary light employed, which, by using a gas argand lamp, is about a half of the expense of ordinary light from tallow candles. He ascertains the proper tint for the glass by colouring it so that white paper receiving the light transmitted through it may be in unison with similar paper receiving the white light of the sun. He exhibited in a simple and striking manner the great contrast of the effect of ordinary light and of that of white light, or artificial day-light, thus produced by him (by means of glass which he had painted with "French blue") upon white, the primary and the secondary colours, and also upon coloured landscape sketches.

2. Description of a *Patent Safety-Rein*. By Mr. Alexander Miller, saddler, Edinburgh.—By this rein, which has been a considerable time in use, and severely tested, Mr. Miller states that all possibility of a horse running off is effectually prevented. Its effect when drawn is to compress the horse's windpipe, and thus render him powerless. A vicious horse once or twice checked by this rein is completely under command and learns obedience.

3. Description of a very cheap and convenient *Coil-Electrical Machine*. By Mr. Alexander Brown. Communicated by George Wilson, M.D. Dr. Wilson, in bringing forward this machine, did so not as claiming a different arrangement from the coil-electrical machines already in use, but he considered Mr. Brown had great merit in making his machine not only convenient in size and handsome in appearance, but very moderate in price. It can be sold at 1*l.* 15*s.*, and is fitted for all medical purposes. The shock can be graduated from the slightest to the strongest, by withdrawing and again gradually introducing the bundle of wire into the centre of the coil.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

Dec. 14.—S. Angell, V.P., in the Chair.

M. Lesueur, of Paris, was elected an honorary member.

Drawings were exhibited to illustrate the description of the mode adopted by Mr. J. B. Gardiner to warm the Synagogue of the Spanish and Portuguese Jews, in Bevis Marks; that object having been successfully attained by the admission of warm air from a chamber beneath the building.

Mr. D. Mocatta read a paper descriptive of a distillery and its appurtenances recently erected from his designs in London; with some observations on the principles of distillation, heating furnaces, and general ventilation.

Mr. E. J. Anson described a modification of the "Polmaise" system of warming, applied to a vinery near London. A discussion arose on the ill effects of the system if applied to general purposes, in consequence of the vitiated air being reheated.

Remarks were made on the consumption of smoke, and also on the necessity of providing means of ventilation wherever warm air is introduced.

RAFFAELLE.

The following is the *Breve* of Pope Leo X., by which he conceded to Raffaelle the license to purchase all stone and marbles required for the construction of St. Peter's, and to prevent the destruction of ancient monuments and inscriptions by the masons and builders of Rome.*

"To Raffaelle Urbinate.

"As it is most necessary for the construction of the Roman temple of the Prince of Apostles, that stone and marble, of which we ought to have an abundant supply, should be rather procured at home, than be conveyed from abroad; and as it has been ascertained, that the ruins of Rome contain a great quantity of these materials, and that all persons who, either in Rome or even in the neighbourhood, intend to build, do appropriate the same to their own use; I make you, whom I use as the master of this said temple, the overseer of all the marbles and stones which, henceforth, may come to light at Rome, or at a distance of ten thousand paces therefrom—for this reason, that you shall purchase for me those which may be proper for the edification of this temple. Therefore, I command all people, middle, highest, lowest, that wherever they shall, hereafter, dig out marbles or other stones, of any kind, within the space assigned by me, that they shall acquaint you, the overseer, forthwith, of the nature or kind of every thing so discovered or excavated. And also, that whoever shall not do so within three days from the time of such discovery, he be fined from 100 to 300 gold coins, as shall appear to you fit. And, moreover, as I have been informed, that much of ancient marble and stone, engraven with inscriptions and other monuments—which monuments often bear some exquisite stamp of art, and ought to be preserved for the cultivation of literature and the improvement of the Roman tongue—are vilely cut up by the marble-workers as building material, and that thus the inscriptions are destroyed, I command all persons who exercise the trade of cutting marble and other stones, that, without your orders or permission, they may not dare to cut or work any inscribed stone,—applying the same fine, as aforesaid, to all who may act otherwise than I command.—Given this sixt Cal. of September. Year three. Rome."

J. L——y.

* Petri Bembi epistol. Leonis X., P. M. Lugdun. 1538. 8vo. p. 246.

REGISTER OF NEW PATENTS.

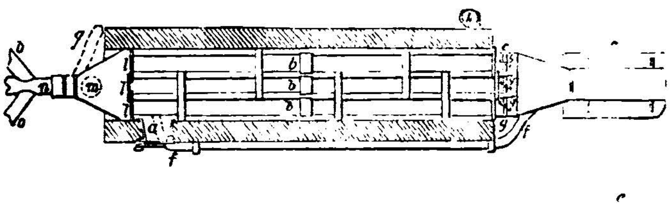
HEATING APARTMENTS AND BUILDINGS.

Anthony Nathan de Rothschild, of London, merchant, for "*Improvements in heating apartments and buildings.*"—Granted April 28; Enrolled October 28, 1846.

This invention relates to heating any desired space, by forcing heated air by mechanical means to the space to be heated; or to heat or dry various manufacturing articles in the same manner, and also to lead heated air for any desired purpose, whether perfectly dry or containing the moisture required for various purposes, to any situation that may be required, and is well adapted to warm churches, hospitals, theatres, saloons, bathing establishments, barracks, manufactories, prisons, horticultural establishments powder mills, breweries, &c., &c., as well as for other purposes where a high and regular degree of heat is required.

The apparatus is shown in the annexed engravings. *a* is a fur-

Fig. 1. Plan.



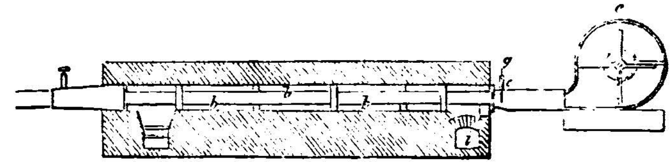


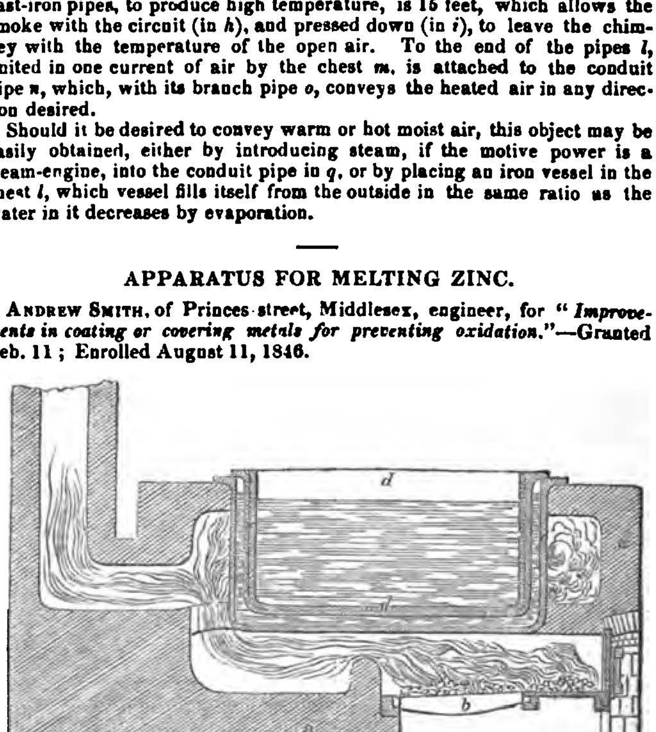
Fig. 2. Section.

nace, in which are placed cast-iron pipes *b b b*, the number of which may be increased if much heat be required; pipes of an oval form have been found most convenient. The pipes are heated by the fire *a*. The entrance of the pipes is connected at *c*, with a ventilator *e*, set in motion by mechanical force, which forces pure atmospheric air into the pipes *b*. The same ventilator forces also a strong current of air through the pipe *f*, to the fire. All the pipes have valves, *g g g*, to increase or decrease the current of air. By being driven through the heated pipes, beginning with the lowest and ending with the highest temperature, the air acquires a very intense heat. It has been found that the most convenient length of the cast-iron pipes, to produce high temperature, is 15 feet, which allows the smoke with the circuit (in *h*), and pressed down (in *i*), to leave the chimney with the temperature of the open air. To the end of the pipes *l*, united in one current of air by the chest *m*, is attached to the conduit pipe *n*, which, with its branch pipe *o*, conveys the heated air in any direction desired.

Should it be desired to convey warm or hot moist air, this object may be easily obtained, either by introducing steam, if the motive power is a steam-engine, into the conduit pipe in *q*, or by placing an iron vessel in the chest *l*, which vessel fills itself from the outside in the same ratio as the water in it decreases by evaporation.

APPARATUS FOR MELTING ZINC.

Andrew Smith, of Princes-street, Middlesex, engineer, for "*Improvements in coating or covering metals for preventing oxidation.*"—Granted Feb. 11; Enrolled August 11, 1846.



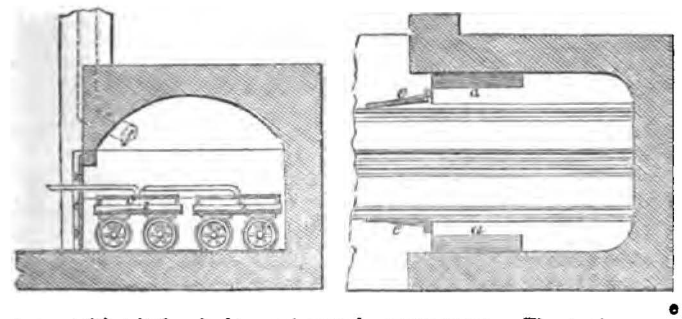
The improvements relate to coating metals with zinc, melted in a bath of lead or tin, or any suitable medium that melts at a lower heat than zinc, which is effected in the manner shown in the annexed engraving, representing a vertical section of the apparatus, which consists of a wrought or cast iron pan or vessel *d*, for holding the zinc, placed within another wrought or cast iron pan *c*, with a span of about 1½ inch all round and under the upper pan; this lower pan is set in brickwork *a*, over a furnace *b*, and surrounded by the flue, and contains molten lead, or lead combined with tin, through which the heat is transmitted to the upper pan, containing the zinc; the upper pan is lined on the inner face with fire-clay or fire-brick, to prevent any galvanic effect by the action of the zinc on the iron. By this method the zinc is kept in the bath at an even temperature of about 800° Fahrenheit.

IMPROVEMENTS IN GLASS.

James Timmins Chance, of Handsworth, Staffordshire, glass manufacturer, and Henry Badger, of West Bromwich, glass stainer, for "*Improvements in the manufacture of glass.*"—Granted April 28; Enrolled October 28, 1846.

The improvements relate, first, to the application of heat to sheets, panes, or plates, or other articles of glass, when they require to be reheated for any purpose, such as the producing stained, painted, enammelled, or other glass, which has been hitherto effected either by placing the glass upon metallic shelves within a muffle, and applying the fire externally, or by placing the glass in a kind of reverberatory kiln, upon a bed of stone or burned clay, and then applying the fire internally and directly upon the glass. By the former method there is a difficulty in preventing plates of glass from becoming bent or cockled, and in heating the glass uniformly; and, by the latter plan, the direct action of the fire upon the glass is injurious.

The improvements consist in so applying heat that the advantages of the two methods above mentioned are united, and, at the same time, their respective peculiar defects are avoided. In carrying out this part of the invention, the glass is laid upon a suitable bed (stone is preferred), and the glass covered by suitable covers, so as to enclose the glass in a chamber, by which the direct action of the fire on the glass is prevented, the inverted pans, for the time being, producing close chambers within the kiln. In the top of each cover there is a small aperture, communicating, by means of a pipe, with the outside of the front of the kiln, this contrivance being intended to allow of the escape of any vapour. In order to facilitate the practical operation of enclosing the glass in covers, moveable beds are preferred, placed upon an iron carriage running upon rails, the kiln being properly constructed for receiving such carriages. The annexed engravings show a plan and longitudinal section. *a a* are the fire-places; *b b* carriages, with a bed or beds; *c c* inverted pans or covers. The carriages are introduced into the kiln at the doors *e e*; the doors are then closed, and the flame and heat will be reverberated within the arch, and then pass off up the chimney *f*, which is to have a damper to regulate the draft. The process of heating and cooling the glass is then conducted in the ordinary way. And for the purpose of still further securing the glass from being injured by the fire or smoke, the edges of the covers are fitted into grooves cut into beds, there being powdered chalk, or other suitable substance, to close the joints.



The second part of the improvements relate to the mode of applying heat to sheets, panes, or plates of glass, when it is desired to alter their shape, whether to render them more flat, or to give them any required curvature. According to the methods generally adopted, the kiln has to be cooled considerably before a second charge of glass can be introduced into it. Now, the improvements consist of so employing moveable beds and covers, as described, that the cooling down of the kiln is rendered unnecessary, and the glass, when enclosed in the chambers formed on the beds, can be safely introduced into the flattening or bending kiln, without necessarily reducing the temperature of the kiln. The moveable beds aforesaid, previously to their being charged with glass, are to be heated to a temperature approximating to that of the kiln itself: this is done by means of a small kiln, similar to the main kiln. When the glass has remained sufficiently long in the flattening or bending kiln, it is withdrawn along a lear or long arch opening into the kiln, similar to that described in the specification of a patent granted to the said James Timmins Chance, July 7th, 1842. This lear or arch, however, is not an essential appendage to the present system of the patentees, because the beds and the covers above mentioned may be of such a thickness as to allow the glass to be withdrawn from the kiln without the intervention of a lear or long arch.

GLAZING CAST IRON.

Timothy Kenrick, of West Bromwich, Staffordshire, ironfounder, for "*Improvements in glazing and enamelling the surfaces of Cast Iron.*"—Granted May 26; Enrolled Nov. 26, 1846.

The improvements relate to coating and glazing articles of cast iron, with two separate coats, one to give it a body, and the other the glaze, in the following manner:—The cast iron articles are first to be thoroughly cleaned, and then to be coated with a composition, consisting of 100lb. of calcined flints and 75lb. of borax, both ground fine and fused; when cooled, 40lb. of this mixture is to be added to 5lb. of potters' clay, ground in water till of such a consistency, that when the article is dipped, it will retain a coating 1-16th inch thick. It is then allowed to set, and while moist, the glazed composition is carefully sifted over the surface, consisting of 100lb. of cornish stone, ground fine, 117lb. borax, ground fine, 35lb. soda ash, 35lb. saltpetre, 35lb. slaked lime, 13lb. white sand, and 50lb. white glass, well pounded; the whole are mixed, and well vitrified: when cool they are ground to a fine powder, washed, and dried; 45lb. of this mixture to be added to 11lb. of soda ash, in hot water, and well stirred, and then dried in a stove. When the article has received the glazing it is placed in a stove, and kept at a temperature of 212° Fahr. Afterwards it is fired in a kiln or muffle, raised to a heat sufficient to fuse the glaze; then removed and examined, and if the glazing be not perfect, the mixture is sifted over it, and it is again subjected to the action of the kiln or muffle.

For coating the interior of iron pipes, the first mixture, or body coating, is poured through the tube, at the same time turning it round so as to insure its contact with every part throughout its entire length, and whilst moist the glazing powder is passed through in the same way; after which the tube is to be treated as above described.

The patentee does not claim glazing the *interior surfaces of vessels of capacity*, but only for enamelling the external surface of such articles, and the enamelling and glazing of cast-iron Italian irons, box irons, knobs for door handles, and such like articles, and the inside of cast iron pipes, and ornamental surfaces of cast iron ornaments.

IMPROVEMENTS IN SMITHS' WATER TUE-IRONS.

By W. Noton.

(Reported in the Franklin Journal.)

The smiths' water tue-iron as fitted up on the ordinary construction, is bad in principle, lasts a very short time before it is destroyed, and is eminently calculated for being an expensive item in the economy of the smith's workshop. Much inconvenience and hindrance results from the frequent stoppage occasioned by the failure of this useful appendage to the smithy fire.

My attention was directed to the circumstance, eight or nine years ago, with the intention of finding a remedy for, or at least an amelioration of the evil. Upon examination of the disabled tue-iron, I found the inside, more especially the end nearest the fire, generally filled up with a substance sufficiently solid to prevent any water getting to that part—the place where it is most required to carry away undue temperature; thus the tue-iron is not fairly worn, but burnt out before its time.

What is meant by the ordinary construction may be understood by reference to figs. 1 and 2, of the prefixed sketch:—

Fig. 1.

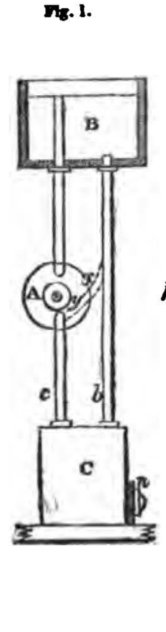
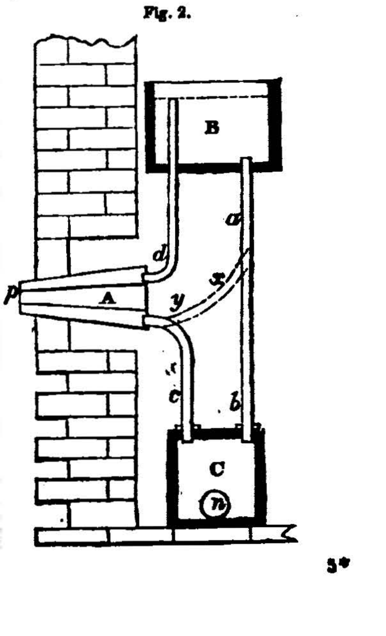


Fig. 2.



A, water tue-iron. B, cistern for water, at a convenient height above A. *a x y*, wrought-iron pipe, connecting the lower part of the cistern, B, with the lower part of the tue-iron, A. *d*, another pipe, connected with the upper part of A, and passing either through the bottom of the cistern B, or by one side, and over the top with a bend. Water poured into B will descend by the pipe, *a x y*, into the tue-iron, A, driving the air before it up the pipe, *d*, and if sufficient water be supplied till it stands at the height shown by the line in the cistern, the whole of the pipes and tue-iron will be full of water.

In actual working, the nose, *p*, is covered with burning coal; the water soon attains a boiling temperature, and steam being formed, a portion of the water is driven out of the tue-iron up the pipe *d*, into the cistern B, when a fresh supply descends by *a x y*, to be in its turn heated and driven out as before.

If distilled water could always be supplied to the cistern B, and that kept clean, the tue-iron would have a fair chance of doing its duty to the end; but as it is not so, and as there is a great probability that other substances get into the cistern, and ultimately find a settlement in the tue-iron, some contrivance was desirable for preventing the accidental, or perhaps, in some instances, wilful choking of the tue-iron. The means adopted for this purpose will be readily understood by again referring to the two figures. Instead of the water descending by the curved pipe *a x y*, it is conveyed by the straight pipe *a b*, into the cast-iron box C, which is fixed considerably below the tue-iron, and must first be filled before any can rise up the pipe *c*, into the tue-iron. Should any sand or ashes get into the cistern B, it will settle in the box C, and not in the tue-iron, which will be supplied with water containing no heavy particles. A mud-hole door *n*, is provided, by which the box may be cleaned out at any time when the work is not going on. This additional apparatus, if attended to, will ensure a satisfactory working and add a considerable period to the existence of the water tue-iron. The box C, I have made, is of the capacity of one cubic foot to each fire, and I would recommend that the mud-hole door be opened every two or three weeks according to circumstances.

ST. PAUL'S CHURCH, ALNWICK.

Sir,—In your notice on new churches in the last number of the Journal, you have made some remarks on the seats in the chancel of St. Paul's Church, Alnwick, and on the Duke of Northumberland, which I am sure you would not have done had you written from actual observation and knowledge of the case. I therefore beg leave to lay before you the facts. You are correct in denying the name of stalls to the seats in the chancel; they are not stalls, neither are they pews—but *open seats*, two rows on each side, and the end of one row on the south side prepared so that the duke can wheel his chair into it. In the aisles of the chancel are seats fitted up and reserved for the boys of his grace's school.

The castle not being in the district of St. Paul's, the family, with few exceptions, never go there. And I may say (from having been well acquainted with the feelings under which the duke has acted throughout this munificent work), that the only privilege he desired, was to be able, when he did go to that church, to get to his place—seat I cannot call it—as quietly and unobtrusively as was possible, considering the affliction he labours under.

I am, Sir,
Your obedient servant,

21, Savile-row, Dec. 4, 1846. A. Salvin.

*** The explanation given by Mr. Salvin is perfectly satisfactory as far as it refers to the Duke of Northumberland, and we readily believe that his munificence has been characterised by its usual unobtrusiveness, and that the architect has executed his task with his usual ability. But we cannot regret having insisted that a church is not the place for mundane distinctions, and ought not to contain privileged seats for privileged worshippers. The remark is intended to be perfectly general, and this protest against a specific application of it is an admission of its abstract correctness.

The question respecting the propriety of setting apart a large portion of the church for liturgical purposes has been learnedly discussed on both sides. It is not within our province to consider it except with reference to architecture; we certainly believe that the architecture of a church may be faultless where the distinction of nave and chancel is not maintained, and that the services may be conveniently performed in such a building in strictest conformity with the rubric. The Temple Church in London is an eminent instance. Where there are distinct chancels, it may also be objected that no one portion of the laity ought to be admitted in preference to the rest—the exception made in favour of singing men and choristers has no more valid excuse than the paid attendance and musical ability of this portion of the congregation. Besides, the rubric expressly directs that the whole "people," not a selected few, are to engage in this service.

Architects who view the question in this common-sense way incur a certain amount of vituperation, to which the slightest exercise of moral courage would render them perfectly indifferent. It is certainly to be regretted that the controversy has not been *authoritatively* settled. On one point connected with it there can, however, be no dispute. If, in a new church, a chancel be built at all, it ought to be set apart exclusively and strictly for its professed purpose. To build a chancel, and then suffer the laity to occupy it, or to erect stalls (as at St. Giles's, Camberwell,) which are merely superior seats to be had for paying,—is an idle, ostentatious retention of forms, after their significance and purpose have ceased.

BURNETTIZING TIMBER.

Sir,—In looking over your Journal for December, I meet in the "Notes of the Month" with an account on "Burnettizing Timber and Marine Worm," which statement I beg you to correct, it being replete with errors. I am the person by whom the experiments were made for Sir William Burnett; having given the subject of marine worm attention for many years past. Your correspondent is totally unacquainted with the subject he handles, and asserts the specimens were "duly immersed in his (Sir William's) solution;"—they were not immersed in the solution known to the public as Sir William Burnett's far-famed solution. When the pieces of wood (about six in number) arrived from him, I received them understanding them to be pieces immersed in order to try the effect of *a* preparation—which preparation is very different to the former, which stains the wood considerably; but in this instance the wood was not in the least discoloured. The far-famed I am perfectly acquainted with, seeing the use of it every day.

Sheerness, Naval Yard, Dec. 12, 1846. James Mitchell, *Civil Engineer.*

*** The paragraph was taken from the Naval Intelligence in the daily papers. With all due deference to Mr. Mitchell, we should have been much better pleased if he had stated what preparation had been used by Sir W. Burnett for *the* six pieces of wood, which it is not denied had failed, and we should be glad if Mr. Mitchell would state whether Burnettised timber, or any other prepared timber, had generally withstood the ravages of the marine worm at Sheerness.

SETTING OUT RAILWAY CURVES.

Sir,—I have seen, in your Journal for December, Mr. Tait's notice of my letter to you, inserted in your October number, and I have read his description of an instrument invented by him for setting out railway curves.

The objection which appears to his instrument seems to be obvious: it clearly is that the principle is liable to much perplexity and error, because it is founded on a system of what surveyors call "building"—that is, making the accuracy of the whole work depend upon the nicest accuracy of a great number of minute parts, consisting of arithmetical calculations in trigonometry, accurate measurement of small distances, exactness of instruments, straightness and uprightness of boxing rods, &c. &c. This machinery appears to me to be too complex for practice.

It is objected by Mr. Tait to my proposal, that it may be possible a surveyor may not be able to *see* the two extreme points of a curve. In answer to this, I need only say that surveyors, employed to set out curves, would always be in possession of means to find out, without any great trouble, and without trigonometrical calculations by means of arithmetic—but merely by the aid of a common theodolite—the *direction* of the chord line: having once determined this, he must be a poor surveyor who does not see his way clear in laying down a curve, the radius of which is given. The method follows from the system of chords mentioned in my former letter, and is obvious to any tyro in geometry.

The system suggested by me deduces particulars from generals; in other words, it proceeds upon the plan of ascertaining fundamental or general points, and producing the minor points by means of them. The plan of Mr. Tait proceeds by "building" a great number of minute triangles, one upon another; which is not, amongst surveyors, accounted orthodox.

Your's,

Oswestry, Dec. 5, 1846. An Engineer out of Employment.

ENGINEERING LITERATURE.

Sir—In your reply to Correspondents in the December number, I noticed your answer to a six years subscriber, respecting the best published account of the details of the Steam Engine; and, notwithstanding you referred him to the treatise of the Artizan Club, yet your opinion was, "that a satisfactory work on the Steam Engine remains among the desiderata of Engineering Literature." I am so much gratified that you have given expression and publicity to an idea which I believe very many persons have long thought most desirable, that I cannot forbear asking if it would not be possible to form a society for the purpose of publishing some valuable works on the "Steam Engine and Engineering in General," on the same plan as the Camden and Shakspeare Societies have already done so successfully, and which, it appears is to be followed by another, to be called the Hackluyt Society.

For myself, I shall be happy to contribute towards any subscription which may be made to carry out such a measure; and I have no doubt I could, among my friends, obtain several names and subscriptions, in addition to my own. I am, Sir, your obedient servant,

A Reader of your Journal from the Commencement.

Lewes, Dec. 24, 1846.

P.S.—If my suggestion is considered practicable, I will communicate with you again. I have the first volume of "Farey on the Steam Engine:" can you inform me if the second volume is likely soon to be published?

*** We may probably reply to this letter hereafter.

NOTES ON FOREIGN WORKS.

Transactions of the Archæological Institute of Rome.—The volume o the proceedings of this Society, just published, again proves the richness of antiquarian relics, and likewise an increased activity of the Society, under the auspices of the present Pope. The first memoir contains Professor Ulrich's travels in Greece, from Athens to Chalkis, Anthedon, Aulis, and Oropos—places scarcely yet explored by any antiquarian. Amongst the monuments discovered is a bronze tablet, with a marsian inscription, found at Rapino, and, most probably, the only relic of the kind extant. Another tablet of lead, with a Grecian imprecation, is interesting to the searchers of linguistic and religious antiquity.—The celebrated architect, L. Canina, has contributed a paper on a round pedestal in the Lateran, with emblems of Vulcan upon it.—The most attractive paper, however, is that of M. Welker, on the portrait of Sophocles. M. W. has compared the splendid statue in the Lateran, found at Terracina, where the poet is represented in a proud, nay triumphing attitude—with that of the Mosaic pavement lately found at Köln.—Two double entaglios of Sophocles and Euripides, from the collection of M. Torlonia at Rome, were exhibited. The configuration of the two heads is very characteristic,—Sophocles handsomer, quieter, of great regularity and harmony of form of head, approaching the ideal ascribed by the ancients to Jupiter; while that of Euripides is more shrewd, active, and bustling.

The great picture of Garofolo, at Rome, representing the descent from the cross, a huge canvas, comprising seven figures of life-size, has been bitherto in a very precarious condition, on account of the wood, on which it was stretched, having become rotten, if not decomposed. M. Radice, its present owner, knowing the great artistic value ot this historical picture, engaged the famous restorer, M. Bunosi, to transfer the canvas to another substratum. This has been done so successfully, that M. Overbeck has expressed his perfect coincidence and approbation.

Railway from Naples to the Roman Frontier.—The Neapolitan government have granted to M. Falcon de Cimier the concession to construct a railway from either Capua, Ceprano, or Fondi, direct to the Roman frontiers; but under this condition—that the newly discovered system of Jouffroy be tried on the line. This system, which is said to afford greater security to travellers, and a saving of expense, will first be tried on a space of two miles; a commission is then to decide whether it be advisable to employ it on the entire line.

Railways and Coal Mines in Bohemia.—Austria boasts of having constructed the first railway on the continent of Europe, namely, the Budweis and Linz line, commenced in 1825, although merely worked by horse power. Another from Prague to the coal mines of Lahna, a length of 30,240 cubits, was begun in 1826. It was at first intended that this line should extend to Pilsen, and thus form a junction with the Bavarian States' lines. The Lahna coal mines now supply fifteen manufactories with 15,000 tons of coal monthly; but as this coal yields a superior kind of coke, which could be advantageously used on the Great North Line (whose engines have hitherto burnt wood), these new branch lines will be of great commercial value to the whole country.

The Erection of the Terminus of the Paris and Lyons Railway, at the former city, excites much controversy among our French contemporaries. The right bank of the Seine was originally fixed upon, but the subsequent underhand doings of certain land proprietors, who desired it near the Boulevard Mazas, seems to have balanced the decision in their favour. Now, the Place de la Bastille seems likely to suit all requirements. The interests of the whole line, and the immense capital which has to flow through it, demands that the terminus should be as near as possible to the centre of the commercial and banking activity of Paris.

The New Opera House at Vienna.—The present building near the Kärtnerthor, is one of those insignificant edifices erected under the late Emperor. This having become too palpable, the plan for a new one has been devised. The two gates of Carinthia will be pulled down, and replaced by one in a monumental style; the ramparts on this side of the city demolished, and the limits of the city extended; by which alterations, sufficient space for a splendid new Opera House will be gained. As the lease of the present theatre, however, does not expire for two years, the operations will not commence until that time.

Irrigation of Algeria.—The French Minister of woods and public works has nominated a commission, chosen from among the general staff of surveyors of roads and bridges, to examine the plans and projects sent to Paris from Africa, for the barrage of the rivers of Africa. These plans have been made on the spot, by another commission, which is surveying Algeria for that purpose. The first plans of irrigation will be executed on the waters of the plain of Mitidja.

The Guildhall, Louvain, Belgium.—By a curious accident, the name of the builder (hitherto unknown) of this splendid structure has been discovered, by one of the keepers of the archives at the Guildhall. His name was Matheeus de Layens, master mason of the city of Louvain. While occupied on this task, for thirty years, he received four sols (half-pence) per day in summer, and three sols in winter; and when this immortal work was completed, the municipality gave him a *recompense* of five Peters and ten sols!

City Embellishments in Austria.—The imperial building court councillor, M. Springer, has undertaken the rebuilding of the façade of the Altstadt guildhall, at Prague, which will be adorned by six bronze statues of Bohemian monarchs, sculptured by M. Marx. The corporation have voted a sum of 80,000 florins (equivalent to £20,000 English) for that purpose.

Restoration of the Ulm Minster.—Amongst the most important monuments which the grandeous art-taste and generous piety of a great age has left to its not always grateful successors, the Ulm Minster occupies a considerable place. It covers an area of 58,000 square feet, and is not surpassed by any mediæval cathedral, Cöln and Speyer excepted. Its naves, complete as they are, are of gigantic proportions, the principal one being 141 feet in height, and the four lateral ones 70½ feet; the choir 90 feet. The spire, had it been completed according to the plans of the original architect, Mathew Boblinger, would have overlooked even that of Cöln, as it was planned at a height of 475 feet (Rhenish), while the latter was to be 474 feet. The spires of Freyburg, St. Stephen at Vienna, and even Strasburg, are all of a lesser height. Thus, what is related by tradition may well be true—namely, that the Ulm burghers, at whose expense this edifice was raised, said then, that they wanted to erect a *case* for the Strasburg Minster. This gigantic building was begun in 1377, the names of the architects being Heinrich and Michel (most probably only their Christian names). When Mathias Boblinger took charge of it, from 1480 to about 1490, the building had proceeded as far as the platform. A subsidence of this stupendous mass was subsequently apprehended, and Boblinger was compelled to fly from Ulm; Bunkhard and Engelberger de Hornberg being then appointed architects. They underran the spire with such tremendous walls, that professional men say *any height* can be raised thereon. The building was not subsequently proceeded with, if we except those graceful columns erected by Lienhart Aeltlin (1502-1507), by which the lateral naves are divided. Want of funds—and still more, the approach of the Reformation, prevented every further endeavour to complete it. Thus it remained until 1844, when the tendency to restore the mediæval monuments of Germany—already manifested in that of the dome of Cöln—reached also the inhabitants of Ulm. The completion of the spire is certainly, up to the present time, a subject of mere wish and desire; but that of the central nave (only inferior to that of Cöln by 20 feet) is more easily to be achieved. The projected lateral pillars, which support the central nave and the still unfinished turrets, are yet wanting. The completion of the two easterly turrets would at once impart to the whole a more perfect appearance. If all this be done—as it has already been begun—then the huge spire could be attempted, the expense of which, albeit large, would be only one-third of the cost of the completion of the dome of Cöln, calculated at five millions of dollars (at four shillings). The works are under the sole direction of the city architect, M. Thrän, whose energy is generally praised and appreciated.

Great New's Hall at Berlin.—M. G. Julius has just completed the erection of the above establishment, in which the periodicals of all nations and countries, and of every branch of human knowledge and on every subject, are to be met with. Situated in the very centre of the town, its success is almost sure. [A similar place does *not* exist in London.]

Raffaelle an Architectural Author.—If some persons are astonished to hear that Raffaelle, whom they supposed hitherto the painter of Cartoons and Madonnas, was also the completor of St. Peter's dome, at Rome, they will be still more surprised to understand that he was also an author, and this on a professional subject. His "Report to Leo X. on the preservation of the antiquities of Rome," is a jewel of delicate yet deep thought; but it is the only thing which the divine painter ever put to paper, his mind manifesting itself in a different sphere.

The Boldest Enterprise of the Age is, certainly, the draining of the Zuider-Zee in Holland, the expense of which is calculated at 61 millions of florins (10 millions sterling). The plan is ready, and embraces a gigantic dyke to protect the new land against the force of the Baltic Sea—a maritime canal, accessible at all times of the tide, to connect the sea with Amsterdam. No plan, except to form a railway over one of the passes of the St. Gothard, can be compared with the above.

Acoustics of Theatres and other Public Auditory Buildings.—It has been tried in some of the recent constructions of theatres in France, to provide spaces in the body of the walls and pilasters, for increasing the acoustic character of the building. The rationale of this scheme is quite correct—it agrees with the theory of sound, lately brought before the French Institute, that it is *not* a vibration of air, but a substance—a material body, like electricity, magnetism, heat, &c. It is obvious that walls, and other solid work, cannot and will not propagate the *rays* of sound dynamically, as well and accurately as air does, which is its appropriate menstruum and vehicle. Of what shape these spaces are to be, and where they are to be placed—both according to the shape and size of the building—is a subject open to the investigation of architects. It is curious, indeed, to know that Aristotle says (Problem II. sec. 11) that the ancients placed empty vases or pots in the walls of theatres, forums, &c., for increasing the vibration and power of sound.

Fall of a Building on the French Northern Line.—On Friday, the 20th Nov., the large wooden building at Lille, in which the company gave the grand banquet to the French princes and the company invited to the inauguration of the line, and which was recently being prepared for a waiting-room for passengers, fell with a frightful crash. Not one of the supporting timbers resisted. The excavation of the earth around the supports was the cause of the accident.

Belgium.—The Luxembourg company contemplate building eight streets in the London style next spring around the station to be erected in the Quartier Leopold, Brussels, for the occupation of opulent English families It is well known that the English establishing their residences at Brussels have always chosen the upper part of the city for the benefit of the air of the park and neighbourhoood.

Tunnelling the Alps—The *Moniteur Belge* announces that experiments have been made in order to test the efficacy of a machine just invented for the purpose of effecting a new and speedy method of boring tunnels. It is proposed to apply this machine to the construction of the great tunnel about to be commenced in connection with one of the Italian lines. The machine was placed in front of the web, and effected a bore to the depth of 18½ centimeteres (7 inches) in thirty-five minutes. At this rate, the new invention will complete upwards of 5 metres (16ft. 6in.) of bore per day, and the proposed tunnel through Mount Cenis will be finished in the space of three years. The experiments have been repeated twice before several of the first engineers of France, and with the most complete success.

NOTES OF THE MONTH.

Electrical Telegraph—At the Paris Academy of Sciences, M. Brégue exhibited a new electro-magnetic battery, intended for the line of electrica telegraph of the Paris and St. Germain railroad. A prepared magnet of steel is fixed perpendicularly upon a strong board. Above and very near the poles a rectangular plate of soft iron is fixed upon an axis, which bears a pinion commanded by a large copper wheel. Upon the plane are engraved the letters of the alphabet, and opposite each letter there is a hole. The axis of the wheel has a handle, to which is fixed a steel point, capable of entering the holes of the wheel. The handle has a hinge, in order that it may be raised or lowered, and is free at the centre of the wheel, so that when the point is out of a hole the handle may turn in either sense to find the letter and transmit it. Very near the edge of the wheel is a lever, the small arm of which is above its centre of motion, with a larger one under, which serves to work a second lever: they are combined in such a way that a slight motion of the small arm of the first may describe an arch to the extremity of the large arm of the second. The upper arm of the first lever serves as the point of arrest of the handle, at the same time that the large arm of the other stops the movement of rotation. The apparatus is so contrived as to engage and disengage itself in the finding and transmission of the letters, without any effort on the part of the person working the battery.

Steamers for the Ganges.—On the 21st Nov. a number of scientific gentlemen connected with India and steam navigation, met at the iron steam ship works of Messrs. H., O., and A. Robinson, Mill Wall, Poplar, to inspect a large iron steamer, intended for the navigation of the river Ganges, between Mirzapore and Calcutta, and named (by the spirited Company who ordered her) the "Mirzapore." She is the third of a line of steamers for the Ganges designed and constructed by the same firm, and is the largest river steamer ever built, with one or two exceptions in America, her length being 250 feet and her breadth inside the paddles 38 feet. The vessel is an admirable combination of strength and lightness, and embraces some novelties in iron ship-building to attain this desideratum in the navigation of shallow rapid rivers. The engines are of the collective power of 250 horses; are horizontal and perfectly unconnected; their valves are on the equilibrium principle; are acted upon by cambs, and are well geared for the easy manipulation of the engines. The first of these steamers, named the "Patna," has proved to be admirably adapted to the navigation and traffic of the Ganges, and the company have in consequence given orders for the immediate preparation of additional steamers.

Restoration of Llandaff Cathedral.—The Dean has just issued a statement of the progress of this work. The eastern chapel has been completely restored; the windows and open parapet work at the east end of the south aisle are in progress. Active operations have been commenced in the choir, and a noble arch of Bishop Urban's work, with elaborate mouldings, has been opened. Beneath this a beautiful screen of Bishop Marshall's, A.D. 1048, has been exposed; as also a beautiful recessed monument in he south-east wall of the choir.

All Saints, St. John's-Wood.—Two stained glass windows have been presented by Mr. Fairs.

Holyhead Harbour.—The Admiralty have given notice of their intention to deepen and dredge this harbour, and to construct retaining walls and wooden jetties.

South Staffordshire Mines.—A weekly paper says—"We have been informed, on the best authority, that the Government have appointed an experienced engineer, thoroughly versed in the system of mining, who will immediately proceed to visit the iron and coal mines in South Staffordshire."

Cleopatra's Needle has, it is stated, been offered by the Bey of Tunis to Louis Philippe and accepted, and is to be placed in the Carousel at Paris.

New Act on Steam Navigation.—On the 1st January an important Act "For the regulation of Steam Navigation, and for requiring sea-going vessels to carry boats," comes into operation. Every vessel of upwards of 100 tons is to be provided with hose for extinguishing fire. Every steam-vessel passing another steam vessel is to pass as far as may be safe on the port-side. No compensation is to be recovered for injury by vessels not exhibiting lights at night. In rivers steam vessels are to pass as near as practicable to that side of the mid channel which lies on the vessel's starboard. Owners are to transmit to the Board of Trade twice a year certificates of the efficiency of the engines, and are to report the supposed loss of any vessel, &c.

At Latheney Abbey, Gloucestershire, five ancient Norman pillars have been dug up.

Long Acre Improvements—All the houses belonging to the Mercer's Company, in Long Acre, opposite the end of Bow-street, have been demolished, and a direct communication is thus established with Waterloo-bridge. The new street at the end of St. Martin's-lane is rapidly progressing; it is one of the widest thoroughfares in London, its breadth being 110 feet.

The Fortifications at Sheerness.—Dec. 21.—These works continue to progress rapidly. The large and formidable battery opposite the dockyard gate, facing seaward, is now complete, with the exception of the curtain or parapet wall, which will shortly be proceeded with, after which the beds for the traversing platforms of from 40 to 50 guns will be laid down. The musketry walls connecting this battery, on the one hand to the fortifications at Garrison Point, and on the other to the land defences, are also complete, and present a fine appearance, being excellent specimens of substantial workmanship. These land defences, which extend continuously from the Thames to the Medway, interrupted only by the drawbridge to Mile Town, are now in course of being repaired and heightened, by the mud procured in the deepening of the moat which protects them. The excavations for the moat which surrounds the new battery, and which have been continued northward, as far as the second angle of the old works at Garrison Point, and southward into the moat surrounding the land defences, are nearly completed, and workmen are now engaged in several parts banking it up with rubble stone. The greatest number of men are, however, engaged in the construction of a ravelin, capable of containing 3,000 men, on the Mile Town side of the drawbridge. The moat is to be conducted round the ravelin, and a second drawbridge thrown over it. The repairs and alterations of the old works at Garrison Point are completed. The magazines are in course of being filled. New barracks, capable of containing 1,000 men, are to be immediately erected, and three Martello towers on the Isle of Grain shore, should the foundation prove satisfactory. A party of Sappers and Miners are at present engaged there making the necessary borings and examinations.

Analysis of a Peruvian Alloy, by Mr. Henry How.—This was a small plate of a yellow metal, which was taken from a band of similar plates surrounding a human shull: it consisted of—

Gold	38·98
Silver	54·82
Copper	5·86
	99·66

It is a question whether the metal is an artificial alloy or the crude product of a metallurgic process. The author was inclined to the latter opinion.—*Chemical Society*.

King's Well, Bath. Analysis of the Water, by Messrs. MERCK and GALLOWAY.—The whole method of analysis pursued in this investigation is given in detail in a paper to the Chemical Society, and the authors sum up with the following results in the imperial gallon:

Carbonate of lime	8·820
Carbonate of magnes'a	0·829
Carbonate of iron	1·064
Sulphate of lime	80·052
Sulphate of potash	4·641
Sulphate of soda .. .. —	19·229
Chloride of sodium	12·642
Chloride of magnesium	14·581
Silica	2·982
With traces of iodine and oxide of manganese	
	144·340

Its specific gravity is 1·0025 and its temperature 115°, the atmospheric being 68° at the time.

The Largest Merchant Vessel in the World.—This magnificent ship arrived in the Mersey last month on her first trip across the Atlantic. She is intended to take her station as one of the packet-ships between that port and New York. She is 188 feet long between perpendiculars, 190 feet from the stem to the taffrail, 42 feet extreme breadth of beam, 28 feet deep, and is 1,818 15·95ths tons, carpenter's measurement, or 1,511 31·95ths, Government measurement. It is estimated that she will stow 5,000 bales of cotton, or 3,000 tons of measurement goods. She has three decks, the same as a frigate, the upper one being as substantial, in proportion, as either of the others.—*Liverpool Mercury.*

Dublin.—The success of the School of Engineering, established by the University in 1842, has exceeded the expectations of its founders. Seventy students at present are attending its classes. The course of instruction lasts for three years. At the end of each year the students pass an examination previous to their being admitted into a higher class, and a final examination for the University diploma; the whole is under the control of Sir John Macneill, L.L.D., Professor of Engineering in the University.

Drainage of the Zuyderzee.—The works in operation for draining the Lake of Haarlem, seemed to have stimulated the ingenuity of the projectors of a still more gigantic undertaking—the drainage of the Zuyderzee, which according to a plan published at the Hague, is proposed to be effected by the construction of an immense dike, cutting off the communication with the North Sea, and by forming a canal between Amsterdam and the coast, into which are to be diverted the rivers which at present empty themselves into the Zuyderzee.

Demolition of Trinity Church, Edinburgh.—The North British Railway Company have projected the destruction of this ancient building, erected in 1462 by Mary of Gueldres, wife of James II. of Scotland, and containing her tomb. The conduct of the Commissioners of Woods and Forests in appealing to the magistrates for the preservation of this edifice, affords an admirable contrast to the cold, money-loving spirit which instigated its demolition.

A Gallery of Art at Calcutta has been projected. The Government offer to contribute 5000 rupees (£500).

Button, the Archæologist.—An entertainment in honour of this veteran supporter of the cause of English architecture was recently given at the Freemasons' Tavern. We regret to say that he himself was prevented by indisposition from attending.

Buckingham Palace.—The demolition of the colonnade in front of the south wing has been commenced.

Trinity Church, Paddington.—The foundations of this church have partially failed: the cause is stated to be as follows: The roads round the site of the church had been raised 16 feet above the natural level, the building was therefore supported on brickwork 16 ft. 6 in. high, that its base might be on the ground line. The embankments of the surrounding roads having sloping sides, and the foundation of the church having vertical sides, there was of course an intervening space to be filled in: the earth used for this purpose has pressed against the brickwork and caused it to yield.

Submarine Telegraph.—The South Eastern Railway Company have exhibited their confidence in this invention by making preparations to lay down an electric telegraph from Folkstone to Boulogne.

New Docks at Wisbeach, covering 13 acres, are about to be erected by the Eastern Counties and Great Northern Railway Companies conjointly.

Maddington Church has been restored. The stone work has undergone extensive reparation, and a new pulpit of stone has been erected.

St. Germain L'Auxerrois.—At this church, one of the most interesting Paris, a chapel painted by M. Amaury Duval, has just been exposed to view, and four others by different artists at Notre Dame, de Lorrette, and St. Sulpice, will soon be completed.

Holy Trinity Church, Liverpool, is nearly completed. The style is the Decorated, and the material red freestone. The church has a spire and transepts. The benches are fitted up with Honduras mahogany, and polychrome decorations are used as borders to the windows. Mr. John May, of Liverpool, is the architect.

DREDGE'S SUSPENSION BRIDGES IN INDIA.

For the following particulars of another failure of these bridges in India, taken from the *Calcutta Star*, October 5th, 1846, we are indebted to the attention of a correspondent in Calcutta, who states that the bridge at Jingurutchy was erected by military engineers, but that the iron work was sent to order from England.

"It is with deep regret we announce a melancholy and most fatal accident which has happened at Jingurutchy, nine miles this side of Jessore. The bridge there, recently completed by Captain Duncan, of the Engineers, has fallen. The chains gave way when the bridge was crowded with people, and at the moment three boats were passing under it, which were sunk with all their crews. Our informant says the loss of life had not been ascertained when a messenger was sent off to Captain D. with the report of the disaster; but he computes it at 100. We earnestly hope this may prove over the mark. We believe it was only the other day the bridge was examined by Major Sage and two other engineers, and favourably reported on."

The following paragraph appeared in a second edition of the same paper:—

"We have since learnt from Captain Goodwin, of the Engineers, that this bridge was constructed in England by Mr. Dredge, the patentee, and that Captain Goodwin reported unfavourably upon it on its arrival here; and also the committee, who examined it after its erection, decided that the structure was only fit to endure the weight which would be placed on it by ordinary traffic. On the occasion of the sad accident in question, some five or six hundred persons were on the bridge for the purpose of witnessing a poojah, and the accident was mainly owing to a sudden rush of the whole crowd to one side of the bridge, which our readers may remember was the case in the Yarmouth catastrophe, which happened about a twelvemonth ago. There is no doubt but that on such an occasion there should have been police stationed to prevent the structure from being overloaded."

THE GREAT BRITAIN STEAM SHIP.

Mr. Brunel has addressed to the proprietors of this vessel a report, dated December 14th, of which the following is a brief analysis:—

The ship is at present comparatively little injured. The strains and damage sustained are entirely local, and not communicated to the whole hull, as would have been the case in a wooden vessel, under similar circumstances. All the injuries done to the Great Britain might be repaired if she could be got into dock.

To this object all attention ought to be turned, as the ship would scarce pay the expense of breaking up; and if she were brought into port exactly in her present condition, she would be worth from £40,000 to £60,000. It would require, at least, three months to complete the means of floating her, and in the interim it is necessary that she should be protected against the effects of the sea. To this end, Mr. Brunel proposes to erect—not a fixed breakwater, which has been already proved impracticable—but a mass of fagots, used as in the protection of sea-banks in Holland. The strongest conviction of the cheapness and efficacy of this plan is expressed, though "few persons who have not seen the effect of a sea beating against fagots will share in it." The fagots are to be packed closely against the ship's exposed side for a considerable thickness and up to the level of the deck. The whole is to be bound into a compact mass by rods, driven through the fagots vertically, and is to be attached tightly to the ship by iron chains. About 10,000 fagots would be required.

So much for the means of protecting the vessel—next, as to the mode of subsequently raising her. Mr. Brunel is of opinion that this cannot be well effected by flotation. There are only 10 feet of water at ordinary high tide, and she has worked herself 5 or 6 feet into the rock and sand. The weight to be raised is 2000 tons, and therefore if the buoyancy of floating camels were resorted to, the apparatus would have to be of enormous magnitude.

It is recommended that, instead of hydrostatic, mechanical power should be employed, and that when the ship is raised sufficiently to allow the repairing of her bottom, she should be rendered water-tight, and then be towed to Liverpool or Bristol.

MENAI TUBULAR BRIDGE.

EXPERIMENTS AT BLACKWALL.

We have on one or two recent occasions witnessed experiments made on the huge model of the proposed tubular bridges of the Chester and Holyhead Railway, under the able direction of Messrs. Hodgkinson and Fairbairn, when several other eminent engineers were present. The principal object of the present experiments has been to ascertain the proper proportions of the sectional areas of the top and bottom of the tube. Great additional strength has been obtained by stiffening the side plates with vertical ribs of T iron, attached at equal intervals throughout the whole length of the tube.

In the first experiments, the sectional area of the bottom plate being 22½ square inches, of the top 24 square inches, and the sides 10 inches, a weight of 58 tons produced a deflection of 3·2 inches. This weight was allowed to remain till the following morning, and the increase of deflection was found to be inconsiderable. The tube being subsequently laid on its side, in order to test its lateral strength, it was found that 9 tons produced 2 inches deflection, and 12 tons, the last load laid on the tube in that position, produced 3½ inches total deflection, including that due to the weight of the beam itself.

In the concluding experiments, Dec. 23, it was determined to load the model bridge till it was broken. The following table exhibits the deflection corresponding to each load :—

Experiments.	Load.	Deflection.
No. 1	31,612 lb.	0·70 inches
2	57,947	1·21
3	83,310	1·91
4	105,362	2·38
5	117,826	2·77
6	125,927	2·96
7	135,255	3·17
8	Same weight after remaining 9 days	3·22
9	139,567	3·38
10	144,352	3·48
11	149,684	3·70
12	151,772	3·81

With the last load, equal to 67¾ tons, the beam broke.

In order to a right apprehension of the manner in which the fracture took place, it must be understood that the thickness of the bottom plate had been greatly increased near the middle point of the model by additional plates, which were continued for 20 feet on each side the centre; and it was where the thin part, or single thickness of the bottom plate, commenced that fracture took place. The bottom plate was torn asunder with a very irregular line of fracture, not contiguous to the rivets. The vertical or side plates also gave way, but in them the rivets (24 on each side, of $\frac{7}{16}$ iron) were actually cut or sheared asunder, the rivet-holes being perfectly uninjured. The top or cellular plate remained perfect.

These experiments have suggested several improvements of details in the bridges to be constructed over the Menai and Conway: but at present the modifications are not defined sufficiently to be laid before the public. The utmost precautions have been taken to secure the strength and stability of the proposed structures. The greatest credit is due to the skill and perseverance displayed by Messrs. Fairbairn and Hodgkinson, and other gentlemen called in by Mr. Stephenson to carry on the investigation, and also to the liberality with which expensive models have been provided.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM NOVEMBER 25, 1846, TO DECEMBER 21, 1846.

Six Months allowed for Enrolment, unless otherwise expressed.

Henry Robert Ramsbotham, of Bradford, York, worsted-spinner, for "Improvements in combing wool."—Sealed Nov. 25.

James Bullough, of Blackburn, Lancaster, and Adam Bullough, of the same place, for "certain Improvements in looms for weaving."—Dec. 1.

Henry Bridges, of Croydon, Surrey, coach-builder, for "certain Improvements in railway-wheels."—Dec. 1.

William Thomas, of Cheapside, city, merchant, for "Improvements in machinery for sewing or stitching various fabrics."—Dec. 1.

William Johnson, of Grosvenor Wharf, Millbank, gentleman, for "certain Improvements in machinery for raising or lifting and lowering weights or ponderous bodies."—Dec. 1.

George Ellins, of Droitwich, Worcester, salt-manufacturer, for "certain Improvements in apparatus for manufacturing salt."—Dec. 1.

Richard Love, of Coleman-street, City, merchant, for "certain Improvements in paving streets, roads, yards, and other surfaces, over which carriages and beasts of burden have to pass."—Dec. 1.

Jacques Francois Pinel, of Lyons, France, chemist, for "Improvements in grinding wheat and other grain."—Dec. 1.

Samuel Cunliffe Lister, of Manningham, near Bradford, manufacturer, for "Improvements in combing wool."—Dec. 1.

William Mayo, of Silver-street, City, manufacturer, for "Improvements in the manufacture of aerated liquids, and in apparatus used for such manufactures, and when pumping the liquids, and also in bottling fluids."—Dec. 1.

George Fergusson Wilson, of Belmont, Vauxhall, Surrey, gentleman, and John Jackson, of Southville, Wandsworth-road, for "Improvements in the process of and apparatus for treating fatty and oily matters, and manufacturing candles and night-lights."—Dec. 1.

William Johnson, of Grosvenor Wharf, Millbank, Westminster, gentleman, for "certain Improvements in propelling carriages on railways."—Dec. 2.

Joseph Bancroft Reade, of Stone Vicarage, Aylesbury, Buckingham, clerk, for "certain Improvements in inks, and in the process by which the same are manufactured, and the application of some of these processes to the production of certain salts."—Dec. 3.

Thomas Craddock, of Birmingham, engineer, for "Improvements in steam engines and boilers, and in machinery connected therewith."—Dec. 3.

William H. Fox Talbot, of Lacock Abbey, Wilts, Esq., for "Improvements in obtaining and applying motive power."—Dec. 3.

Edmund Morewood, of Thornbridge, Derby, merchant, and George Rogers, of Stearndale, Derby, merchant, for "Improvements in the manufacture of iron into sheets, plates, and other forms in coating iron, and in preparing iron for coating and other purposes."—Dec. 7.

Eugene Basile, of Rouen, France, manufacturer, for "Improvements in obtaining heat during the manufacture of coke, and applying such heat to various purposes." (A communication.)—Dec. 7.

John Dacie, of Foxley, Kennington, Surrey, gentleman, for "an improved apparatus to be attached to boots and shoes, for the purpose of protecting the wearer from splashes of mud in walking."—Dec. 7.

Samuel Clift, of West Bromwich, Stafford, gentleman, for "certain Improvements in the distillation of tar and pitch."—Dec. 8.

Alexander Bain, of Hanover-street, Edinburgh, electrical engineer, for "certain Improvements in transmitting and receiving electrical telegraph communications, and in apparatus connected therewith."—Dec. 12.

Moses Poole, of the Patent Bill Office, London, gentleman, for "Improvements in the construction and working of electric telegraphs, and in apparatus connected therewith, partly applicable to other purposes." (A communication.)—Dec. 14.

James Yates, of Masborough, in the parish of Rotherham, York, engineer, for "Improvements in the construction of blast furnaces."—Dec. 14.

John Keeley, junior, of Nottingham, dyer, for "Improvements in dressing or finishing lace, and other fabrics."—Dec. 14.

William Longmaid, of St. Helen's, Lancaster, gentleman, for "Improvements in the manufacture of alkali and chlorine."—Dec. 14.

Elijah Galloway, of Buckingham-street, Strand, Middlesex, civil engineer, for "Improvements in rotatory engines, and in locomotive carriages and railways."—Dec. 14.

John Shaw, of Blackburn, Lancaster, for "certain Improvements in machinery or apparatus for carding, drawing, slubbing, and roving cotton wool and other fibrous substances."—Dec. 14.

James Carter, of Oldham, Lancaster, painter, for "an Improved lubricator."—Dec. 14.

Charles Ford, of Shelton, Stafford, engineer, for "Improvements in the manufacture of pottery or earthenware, and in the tools, instruments, or apparatus employed therein, part or parts of which improvements are applicable to other similar purposes."—Dec. 14.

Henry Bleasdale, of Chipping, Lancaster, roller-maker, and William Ryder, of Bolton, in the same county, roller-maker, for "certain Improvements in machinery or apparatus to be employed in the manufacture of rollers used in machinery for preparing and spinning cotton and other fibrous substances."—Dec. 14.

John Todd, of Glasgow, engineer, and William Johnson, of Birmingham, engineer, for "Improvements in arranging the rails on certain parts of railways."—Dec. 14.

John Chubb, of St. Paul's Churchyard, City, for "Improvements in locks and latches to be used for fastenings."—Dec. 14.

Benjamin Vickers, of Sheffield, Yorkshire, merchant, for "an invention called the mechanical chirographer, or machine for delineating letters, figures, and other characters." (A communication.)—Dec. 14.

Jeremiah Campion, of Somers-place, Hyde-park, Middlesex, gentleman, for "Improvements in soldiers' belts, and improvements to facilitate the carrying of knapsacks."—Dec. 15.

Thomas Friend Dickinson, of Newcastle-upon-Tyne, sharebroker, and John Falirous, of the same place, gas engineer, for "certain Improvements in gas metres."—Dec. 15.

Mark Bingley, of Cannon-street, London, stationer, for "Improvements in bookbinding, and in weaving materials used in bookbinding, applicable also to other weavings, and in preparing for, and making alphabets for account and other books, and in inking type therefor and other purposes, and in preparing sprinkled, granulated, or mottled paper for bookbinders and others, applicable also to the edges of books, and in graining or chequering Russia or other leathers."—Dec. 15.

Richard Turner, of Hammersmith Works, Dublin, and Bath-place, New-road, Middlesex, for "Improvements in the construction of roofs of railway stations, and roofs and floors of other buildings."—Dec. 15.

Walter Smart, junior, of Leather lane, Middlesex, lithographic printer, for "a new or improved lithographic printing press."—Dec. 21.

John Watson, of Glasgow, manager to Messrs. Gilmour and Kerr, power-loom cloth manufacturer, for "Improvements in weaving by Jacquard looms by power."—Dec. 21.

Peter Borrie, of the Crescent, Minories, City, engineer, for "Improvements in the construction of piers and harbours."—Dec. 21.

John Jennings, of Ollerton, Chester, farmer, for "certain Improvements in machinery or apparatus for threshing."—Dec. 21.

Richard Boyce Osborne, of Limerick, Ireland, civil engineer, for "certain Improvements in bridges, roofing, and flooring." (A communication.)—Dec. 21.

Louis Sylvian Gonin, of Paris, manufacturer, for "Improvements in printing stuffs, paper, and other matters."—Dec. 21.

Moses Poole, London, gentleman, for "means and apparatus for administering certain matter to the lungs for medical or surgical purposes." (A communication.)—Dec. 21.

Joseph Whitworth, of Manchester, engineer, for "Improvements in machinery for knitting."—Dec. 21.

Augustus Applegarth, of Dartford, Kent, calico printer, for "Improvements in machines for printing paper and other fabrics."—Dec. 21.

Moses Poole, London, gentleman, for "Improvements in steam-engines, and machinery for propelling machinery and fluids." (A communication.)—Dec. 21.

Antoine Perpigna, of Paris, advocate, for "certain Improvements in machinery for plaiting and braiding." (A communication.)—Dec. 21.

John Perry, of Leicester, wool-comb manufacturer, and James Noble, of the same place, wool-comber, for "certain Improvements in combing wool, and in preparing wool for combing and carding."—Dec. 21.

Pierre Frederic Gougy, of Leicester-square, Middlesex, gentleman, for "Improvements in apparatus and machinery for raising, lifting, and otherwise moving heavy bodies."—Dec. 21.

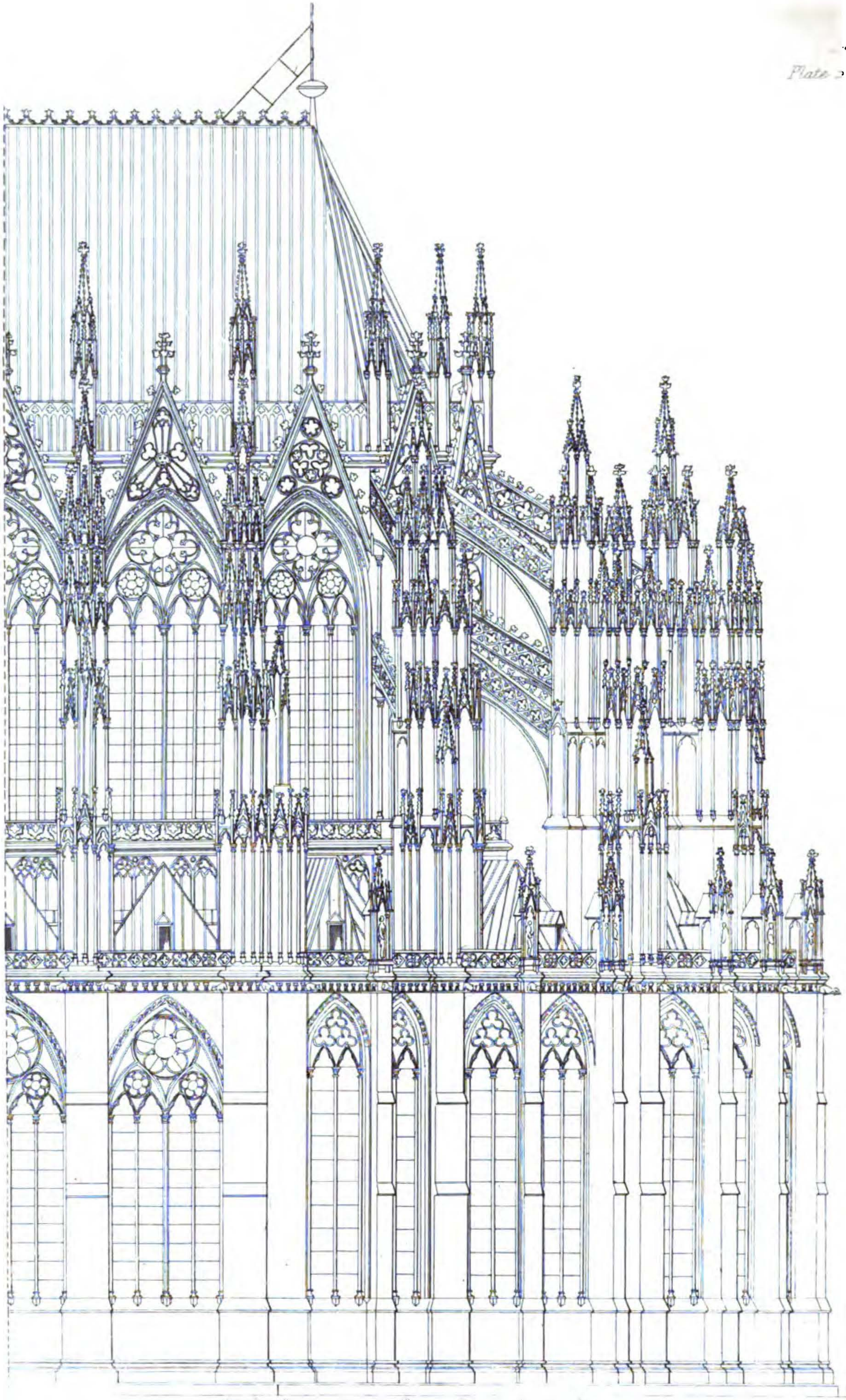
TO CORRESPONDENTS.

Sir Howard Douglas requests us to state that he will in a short time reply to the observations on the Strength and Stability of Hungerford Bridge, in our last (December) number.

H. S.—The second letter was, we suppose, intended to prevent the publication of the first, which would otherwise have been inserted. Perhaps our correspondent will write again after reading the letters on the subject in our present number.

Received: "Ancient and Modern Architecture;" "Life of Gandon;" X Y Z, North Wales,—Next month.

Plate



COLOGNE CATHEDRAL.

COLOGNE CATHEDRAL.

(*With an Engraving, Plate V.*)

It is not a century since Christian architecture was praised for its barbaric magnificence. The admiration accorded to it differed in degree, but was identical in nature, with that given to the grotesque Indian pagoda, or the fantastic extravagancies of Louis Quatorze. Vitruvius had reduced the proportions of temple architecture to numerical calculation, and shown how many times the height of a column should exceed its width: but as there was no book extant in which cathedral architecture was similarly treated, it was condemned as unsystematic and inharmonious. The plumb-line and foot-rule were then the critic's stock-in-trade; with these implements the "noble art of criticism" was worked out with all the mechanical precision of plane surveying.

After a time, however, the bright thought was suggested that, perhaps, the mediæval architects were not the barbarians they had been taken to be; that, with all their caprices and apparent defiance of rule, there might be some method in their madness, if it could but be found out. It was questioned whether there might not be other harmonies more subtle than those which are capable of being settled by the multiplication-table. And when these heresies in architecture had once been started, they were not forthwith silenced as visionary; but, on the contrary, spread and multiplied exceedingly. It is true, that the orthodox Academies and "legally constituted authorities" had nothing to do with the promulgation of the new doctrines, and that one of those Royal Societies who have been kind enough to undertake the protection of art—namely, the Académie Royale des Beaux Arts at Paris—did in its wisdom pronounce, in June 1846, a strong anathema against the revival of Pointed architecture. But, notwithstanding the resistance of this and other very solid bodies to external pressure, it has become more or less evident to all who are concerned in the matter, that the opposition, whether passive or active, was quite too late and might be safely disregarded.

Now, among all who love Art for its own sake, and who can, therefore, appreciate its existence independently of the aid of arithmetic, a general conviction seems to be growing up, that the most eloquent defence of their doctrines has been set forth on the banks of the Rhine. Universal consent appears to point to the fact that *there* stands the noblest and mightiest of all monuments of mediæval thought and skill.—The Cathedral of Cologne, wasted by time and the elements, despoiled by French soldiery, despised by classic connoisseurs, and neglected by its own proper guardians, has come to be considered the most beautiful of poems which man's hand has ever written in stone.

But this builded poem, though it excel all others in beauty, is yet one of the least complete; so to speak, only a few books of it remain, and those have been sadly marred by the notes and emendations of commentators. Accordingly, the promulgators of the new architectural doctrines were desirous to repair the injuries which false friends and professed enemies had inflicted upon Cologne. But the work of reparation had scarcely been begun, before it was found out that another work, far more magnificent, might be attempted with every prospect of success—namely, that of completion. Now, in order to comprehend the magnitude and boldness of this project, it is requisite to understand clearly the original plan and design of the building, and to what extent the intention of the first architects had been carried into effect.

The design of the building comprehended, in the first place, two enormous towers at the west end, surmounted by spires; and this part alone, as it surpassed in magnitude everything similar to it in the world, so also would have been superior in the costliness of its decorations. For the spires were each to have attained the height of 536 feet—a height nearly double that at Lincoln, and exceeding that at Salisbury by 132 feet; and the profusion and delicacy of sculpture would have outvied Strasburgh itself. The height of the nave internally was to have been 150 feet, and some idea of its magnitude may be formed from the assertion, that it is of sufficient capacity to contain the Chapel of King College, Cambridge, completely within it. The nave at Cologne was to have double aisles, including which, its total breadth would be the same as its internal height, namely 150 feet. The approximate equality of the breadth and height of the nave is observed in most of the English cathedrals.

Besides the parts described, there were double transepts, and beyond them the stately choir delineated in our engraving, which is the only complete part of the building. The external height of the choir is 208 feet—as nearly as possible the height of the *towers* of Westminster Abbey!

The total length of Cologne Cathedral is not very great compared with its width, being 500 feet. In this respect it is exceeded by three of our own cathedrals—Winchester, Ely, and Canterbury, and equalled by two others—York and Lincoln: and it is curious to observe, that while in these edifices the length is six or seven times the breadth, in the great continental church the length is only three times and one-third the breadth.

Of the vast pile thus contemplated, comparatively little has been actually executed. The choir, as we said, is the only complete part. In each transept a portion of the east walls is erected. Of the nave little is built, and there exists a great gap, which is covered in by temporary walls and roofs: the northern aisles are in the most perfect condition, seven compartments in their roofs being groined over, and the windows being finished and filled with stained glass; but in the southern aisle the windows had only reached the springing of their arches. In the grand western façade of the cathedral there is a large vacant space between the north and south towers; and of these towers, the southern only had reached to the height of the nave and choir-roofs, the northern being only just commenced.

It will be seen, therefore, that the work of completing this Cathedral excels in magnitude that of erecting almost any other. And this consideration alone can give us an adequate notion of the boldness and enthusiasm which must have actuated the Germanic nations when they undertook this gigantic task: for though the mere magnitude of the work may be understood from the foregoing dimensions, their variety and intricacy can only be ascertained from minute local inspection. The tracery is different in every window (the manufacture of "Gothic windows" at so much a dozen being a somewhat later invention). The whole structure, as may be seen from the view of the choir, would tower above a forest of finials, pinnacles, and flying buttresses. Every part seems literally covered with the luxuriant overgrowth of delicate sculpture—rich canopies for figures of the saints, crockets carved into the semblance of roses with the minuteness of nature; every beautiful form which Flora could suggest, and every strange form which a fantastic imagination could create, seem here embodied in stone. Amidst flowers and foliage and clustering fruits, appear strange fabulous monsters, dragons, griffins, and winged unicorns. The demons and hobgoblins who, as every one knows, used in olden time to play such terrible pranks about the mountains of the Rhine, here live again, long after the printing press and the steam engine have laid them low.—As you walk round the building, look up suddenly, and you will probably see some fantastic merry devil grinning at you from beneath a water-shoot or corbel; suddenly turn the angle of a buttress, and you find that a troop of little imps have been watching you round the corner: while within the gorgeous choir, solemn figures of the saints look down from their lofty niches, and gigantic angels seem to hover high up above the altar. Towards dusk, it requires strong nerves to look at these mysterious forms without awe, for they gain in apparent size, and look tenfold more mysterious, in the twilight; and no one, probably, would like to be locked up all night in Cologne Cathedral, with no other company than these saintly effigies, the sepulchral monuments, and the reliques of the Three Kings.*

* The account of the works of Cologne Cathedral will be continued, with additional Engravings: for the one now presented to our readers we are indebted for the original to "Gailhabaud's Ancient and Modern Architecture."

HALL OF LIBERTY (LIBERATION), KEHLHEIM.

It is not only by its pregnant historical and ethic character, but by the massiveness and sterlingness of its architectural conception, that this monument (called forth by the will of the King of Bavaria) deserves especial attention. Thus, Liberty Hall, with its huge bronze memorial tablets, will infuse new ideas and thoughts in the mind of nations, which, however they may be imparted, we are much in need of.

Kehlheim is situated about four leagues above Donaustauf; opposite which latter place the Walhalla reflects its shadows in the waters of the Danube. Celebrated for years past by its valuable limestone quarries—another consideration has induced Lewis I. to select it for the site of his new creation, viz., it being the place where the Ludwig canal disembogues into the Danube. In the nearly right-angle space which the river and canal form here, the *terrain* ascends considerably, and forms, towards the Danube, an elevated steep wall of rocks. It is on this commanding plateau that Liberty Hall is being erected. The main structure, a huge rotunda with a dome ceiling, forms a *octo-decagon* (*Achzeneck*) of 206 feet diameter in the greatest width of the hall, exclusive of the outer groined vaulted arcade that surrounds it; the outer hall abuts to a height of 60 feet (including a flat roof) against the dome structure, and round the outer vaulted hall extend the groined vaulted arcades, of a joint height of 22 feet, including the groining. The building will rise, up to the highest point of the lantern in the cupola, to the elevation of 175 feet. The height from the vaulting to the entablature is 100 feet. Beneath the latter extends the outer triumphal-area, consisting of double arch-openings, separated by two pilasters, all round the octo-decagon. Above the entablature, three steps surround the outer dome vaulting.

The stairs, from the entrance, lead up to half the height, straight to the main building; they then branch off, laterally, in two ascents. If, therefore, we step in the centre of the building, we are surrounded by a cycle of columns, whose diameter, from the centre of one column to the opposite column, through the diagonal of the rotunda, measures 100 feet. Eighteen columns rise from the floor, on the radii of the octo-decagon. They are monoliths of granite, and measure (including bases and capitals, of white marble) 27 feet, and have a diameter of 4 ft. 4 in. Above these, spring circular arches with archivolts, also of white marble, and the eighteen mural surfaces above them are of yellow marble; on these are inscriptional tablets of white marble. The space above the eighteen mural surfaces is divided by double arch openings, with pilasters and semi-columns. Behind these, extends the inner triumphal area. Above these arch-openings of the inner triumphal area, the vertical portion of the building extends to a height of 84 feet above the inner floor. The inner dome vaulting rises thence to a height of 30 feet up to the lantern, whose diameter in the clear, is 31 feet. Behind the circle of columns, on the ground floor, extends an arcade with groined vaultings, which the architect intends to dress with dark red marble, the effect of which will be surprising. This arcade is surrounded by a cella-wall of 8 feet thickness, which latter divides the inner from the outer arcade. According to these measurements, the plan, elevation, and sections of this gigantic structure may be easily conceived.

This huge rotunda and cupola structure is merely destined to be the shell of its internal, strictly monumental, kernel. If we again go to the centre of the podium of the hall, under the lantern of the cupola (which *alone* will light this huge space), we shall see ourselves surrounded, at the distance of 40 feet, by a ring-formed stylobate, which has no entrance, save by one opening, opposite and in a right line to the main entrance of the hall. On this (continuous) stylobate, stand, in a circle, *thirty-four colossal* Victories, in pairs, close to each other, before the columns, and holding each other with one hand; with the other, each pair grasps a bronze shield, made of the enemies' cannon. On the gilded front of these shields are inscribed the names of the different battles, &c., and the names of the leaders will be put in the corresponding marble tablets on the same wall-face of the octo-decagon. The backs of the shields will not be gilded, for the purpose of showing the metal they are made of. The winged Victories are each 10 feet high, and of white marble, and form, with the mass of shields which they bear, an unterrupted and most imposing circle; this being only open at one place—the main entrance. They are to be made after models of Master (*sic*) Schwanthaler.

In conclusion, it is to be remarked, that the king of Bavaria has ordered that not one piece of wood is to be used in this structure, which will consist entirely of Kehlheim limestone, granite, Slander's marble, iron, and copper, with which latter metal the cupola and the entrance-hall will be roofed. The very foundation of the walls had to extend, at places, to the depth of 50 feet, owing to the inequality of the *terrain*, is, in itself, a vast complex of numberless arches and vaults, well worthy the attention of builders. The ingenious manner in which the architect has executed the double vaulting of the dome is not to be passed over in silence. The name of this worthy master is Sir Frederick Gaertner, P.R.A. of Arts at Munich.

J. L——y.

DISCOVERY OF TERMESSUS.

The site of Termessus, one of the largest and most important cities of Asia Minor, has long been a matter of doubt. The recent travels of Lieut. Spratt and Professor Forbes in Lycia, have however settled the dispute, and to these enterprising travellers we are indebted for a discovery of great interest in an architectural point of view, and one which adds to the records of ancient art a whole city filled with Roman edifices, many of them very important and in an excellent state of preservation. Of these, one of the principal is the ancient theatre, which is minutely described. The nature and extent of the discoveries will be seen from the following narration:—

"The valley became more and more confined. We were evidently entering an important pass; every here and there were traces of fortifications: suddenly, in the narrowest part of the gorge, we came upon a range of perfect and admirably built Hellenic walls, stretching across it, fortified by towers, and passable only by the ancient and narrow pathway. The fortifications mentioned by Arrian, the pass through which the army of Alexander marched, seemed before us, and at every turn we expected to see the walls of Termessus. Our guide pointed to the summit of the mountain above us, and said he had heard of ruins there. About a mile beyond the gateway, we reached a khan, consisting of three stone buildings, and a coffee-house, kept by Turkish soldiers, acting as guards to the pass. Here we put up for the night, not a little gratified by the assurance given us by one of these men, that the report of ruins on the neighbouring mountain was true.

Early in the morning we commenced the ascent of the mountain, to seek for the ruined city. The first part was over steep and rocky ground, but after a time we came upon an ancient roadway, leading towards an opening in the mountain side between two towering rocky peaks. Following this road, which was buried in trees, and encumbered by underwood, for an hour and a half, we suddenly came upon two ancient guard-houses, almost perfect, one on either side of the way. We did not linger to trace any connecting wall, but hurried anxiously on with sanguine expectations. For nearly a mile we met with no other traces of ruins; some sarcophagi were at length discovered among the thicket, and near them, on the face of a great rock, were carved in large letters, the words ΠΛΑΤΩΝΙΚΟΣ ΦΙΛΟΣΟΦΟΣ.

Suddenly, after crossing a low wall, we emerged from the thicket, and entered an open and flat area between the two great rocks, and walled in by inaccessible precipices. On it ruins were profusely scattered; numerous tombs and sarcophagi, fallen buildings of large size, and a temple, the ornamented doorway of which still stood, fronted by a goodly flight of steps. Fluted columns of large dimensions lay strewed in fragments upon the ground. Unwilling to delay until we had ascertained the full extent of the city, after a hasty glance we proceeded to the upper end of the platform. Here the valley became more contracted, and a strong and perfect wall was thrown across it. Within this, ruins of nobler style and more perfect preservation appeared, especially a palatial building of great extent, having numerous doors and windows, and almost perfect to the roof; like the others, it was constructed of rectangular blocks of limestone, without intervening cement; before us, on what appeared to be the mountain top, a third wall appeared, to which we ascended, expecting to find the acropolis. Hitherto we had met with no mention of the city in any of the inscriptions, but, on ascending to the last-mentioned wall, we came upon an inscribed pedestal, which assured us we were in Termessus, a name shouted out by the finders with no small delight, and echoed by the old rocks, as if in confirmation. It must have been new to them after having rested so long unspoken. On reaching the third wall, our surprise was great at finding that hitherto we had been wandering as it were only in the vestibule of the city, and that Termessus itself was yet to come, built on the mountain top, even as Arrian has recorded. It stood on a platform, surrounded by a natural wall of crags, three to four hundred feet high, except on the east, where it terminated in a tremendous precipice, diving into a deep gorge, opening into the Pamphylian plain.

After crossing the third wall, our attention was first attracted by an avenue, bordered on each side by a close row of pedestals, terminated at each end by public buildings, apparently temples. These pedestals were almost all inscribed, and the inscriptions in good preservation. One of them was of peculiar interest, confirming this site as Termessus Major, ΕΡΜΗΣΣΕΩΝ ΤΩΝ ΜΕΙΖΟΝΩΝ ΠΟΛΙΣ.

Above the avenue to the west, appears to have been the habitable portion of the city,—the buildings there, which are all fallen, having the aspect of the remains of dwelling-houses. To the south and east the ground is covered by public edifices, many in tolerable preservation, others prostrate,—all of substantial architecture. In the centre is an open levelled space, which, from an inscription, proved to be the Agora. In the midst of it stands an isolated rock, about fifteen feet high, surmounted by a plain sarcophagus, below which, at the head of a flight of steps, hewn out of a rock, is a recess with a seat (a Bema?). There are also niches for votive tablets. The area of the Agora is undermined by extensive cisterns, the roofs of which are supported by massive pillars and arches. This area seems, during the Middle Ages, to have been inclosed by the walls and cells of a monastery, one of the very few remains of Christian origin at this site. Termessus was the seat of an episcopal see. Around the Agora are the most important public buildings; the most perfect of these is a great square erection with highly finished walls, ornamented with Doric pilasters, and having only two windows, placed high up. A smaller and similar building stands behind the larger, the most prominent object among the ruins, and by its side a second, in front of which are two pedestals, bearing inscriptions, one in honour of Plato, who appears to have been held in high esteem by the Termessians, and the other dedicated to the Muses, of whom this was probably the temple. By the side of the Agora, and on the left of the great square building, are the fallen remains of a Doric temple, apparently (from an inscription) dedicated to the sun. Some of the blocks are of Parian marble, and are fragments of sculptured friezes. A search and excavation among them would most probably lead to the discovery of many works of art."

ANCIENT SYRACUSE.

Paper read by S. Angell, Esq., *at the Royal Institute of British Architects, Jan.* 11, 1847.

The ancient Syracuse occupied the first rank of all the cities of Sicily, or Magna Græcia, in point of extent and political importance; and there are few remains of ancient cities, even in Greece herself, which are more interesting to the scholar or the antiquary.

I visited the ruins and the modern city in company with some fellow-students in the summer of 1822. The classical interest of the spot, the beauty of the situation, and the splendour of the climate (noted by Cicero for its sunshine in every day of the year) were such, that not even a week's painful imprisonment in the quarantine, on a subsequent occasion, could diminish my feelings of admiration for this renowned spot.

The present paper being principally devoted to the architectural description of the ancient city, I will not occupy the time of the meeting with a long account of its history: it will be sufficient for our purpose merely to refer to the tradition of its having received its inhabitants, in very early ages of the world, from Egypt and Phœnicia; that they were driven out by the Siculi, who, in their turn, were replaced by a colony from Corinth, led by Archias, one of the Heraclidæ, in the second year of the eleventh Olympiad, or about 732 years before the Christian era. The city was named by them Ortygia, or the island of quails (the same name was originally given to the island of Delos).

We have the united testimony of ancient historians and poets to the effect, that the city rapidly increased until it arrived at so great an extent, and to such a degree of splendour, that Thucydides (long before it reached its summit of prosperity under Dionysius) acknowledged it to be equal in size to Athens; and Cicero mentions it, in one of his orations, as the *largest* and most magnificent city in Greece.*

The city was under different governments until freed from the tyranny of Thrasybulus, 446 B.C.; and sixty-one years afterwards it was usurped by the Dionysii, who were expelled by Timoleon, 343 B.C. The celebrated part it took in the wars with Carthage, its memorable conflicts with the Athenians, and its sad and mighty fall, after enduring a three years' siege by the Roman conqueror, Marcellus, are events so well known to every scholar, as to require no further allusion to on my part at this meeting.

In after years, the Saracens completed the ruin the Romans commenced; and A.D. 827 Syracuse resigned to her rival, Palermo, the proud title of Capital of Sicily. From that time the city has dwindled into comparative insignificance. Her population at the present time does not exceed 12,000; and that commerce which once filled its glorious harbours with the ships of Rhodes, Alexandria, and Carthage, is now confined to a few speronaras engaged in a miserable coasting trade.

Syracuse is said to have derived its name originally from the neighbouring Marsh Syraco (now called *Il Pantano*), and situate on the right bank of the Anapos: it was afterwards called *Tetrapolis*, a city formed of *four* distinct quarters, and these were named *Ortygia*, *Acradina*, *Tycha*, and *Neapolis*.

According to Strabo, the circuit of the ancient walls was 80 stadia, or 22½ miles, including the suburb of Epipolæ, which was to the westward of Neapolis, and commanded the whole city. At the extremity of Epipolæ was an almost impregnable fortress, called Euryale, mentioned by Livy, and other historians.

The great port of Syracuse—one of the finest in the Mediterranean—is about five miles in circumference. As you enter from the ocean, to the left hand is the rock Plemmyrium, distant from the opposite shore of Ortygia about half a mile. It was across this entrance to the port that the Syracusans, by advice of Hermocrates, threw a strong chain, and thus blockaded the Athenian fleet.

In modern times, the great port of Syracuse has its name connected with a glorious event; for it was here that Nelson revictualled his fleet previous to the battle of the Nile. The lesser port is on the other side of the island Ortygia; it was called Portus Marmoreus, according to some authorities, from the bottom having originally been paved with marble; but perhaps with more probability from the costly buildings which lined its shores.

I will now endeavour briefly to describe the four quarters of the city, commencing with the most ancient one. Ortygia was formerly considered the most important part, in consequence of its commanding the entrance to both the ports. The tyrants established their residences in this division, and added, from time to time, to the fortifications. The Romans also, when masters of Syracuse, regarded the situation of Ortygia in the same important light, and prohibited any native citizen from residing in that portion of the city.

The Temple of Minerva was the most sacred and important building in Ortygia: it now forms the cathedral, or duomo, to the modern city, to which purpose it was converted during the 12th century, when the Goddess of Wisdom was obliged to resign her shrine to "Our Lady of the Columns;" for such was the change in the dedication of this edifice.

The temple was of the Doric order, peripteral and hexastyle, with fourteen columns on the sides. The lower diameter is about six feet seven inches, and the height twenty-eight feet ten inches. The character of the order resembles the Agrigentine examples.* Twenty-one columns of the Peristyles, with portions of the entablature, are still standing; but, unfortunately, they are built up in the outer walls of the duomo. The two columns of the Posticum also remain. The columns, unfortunately, have been disfigured with modern plaster and additional mouldings; and it is much to be regretted that these, by some oversight, have found their way into an important work on Magna Græcia, and are there shown as part of the ancient work. It was only after much entreaty and persuasion, and offering ample security, in case of injury, that the church authorities (who, unfortunately, in Sicily, are not so devoted to archæological pursuits as the clergy in this country) gave us permission to raise a scaffold, and clear away these unseemly encumbrances.

Cicero has given us an excellent description of the gorgeous magnificence of this temple, which, spared by the piety of Marcellus, was stripped of every thing but the roof and walls by the rapacious Verres. "Its doors," says the Roman orator, "were the theme of universal eulogy, exhibiting the labours of Hercules, curiously wrought in ivory, the angles of each separate panel being adorned with golden bosses of exquisite workmanship, while a Medusa's head, formed of the same rich material, shone above the portal, surrounded with its bristling snakes." We learn also from Athenæus, that upon the exterior summit of the roof was elevated an enormous shield, consecrated to Minerva, and visible to a great distance by the reflection of the solar rays. A custom prevailed among the Syracusan sailors, to

* Urbem Syracusas maximam esse Græcarum urbium pulcherrimamque omnium sæpe audistis.—Cic. Orat. 2, in Ver, lib. iv.

* I have shown the capitals half the real size. The anta cap may be considered as a good example of the favourite Becco di Civetta, or Owl's Beak moulding of the ancients.

secure a safe return from their voyage, of carrying from an altar near the Temple of Juno some ashes in a chalice, which, with flowers, honey, frankincense, and other aromatics, they cast into the sea as soon as they were about to lose sight of this shield. The interior of the walls of this temple were covered with paintings, amongst which was an equestrian combat of King Agathocles, one of the most esteemed works of Syracusan art; this, with twenty-seven other admirable pictures, did the unscrupulous Verres carry away. According to tradition, Archimedes drew an equinoctial line in this temple, and Mirabella says that in 1582 the commissioners appointed by Pope Gregory for the correction of the calendar came to Syracuse for the purpose of examining it. This building has suffered much from earthquakes, but I strongly suspect the hand of man has been the great destroyer: the modern façade of the Borromini school forms a strange mixture with the rigid Doric of the ancient peristyle.

Of the Temple of Diana, two Doric columns with a small portion of entablature alone remain. To judge of the effect of them is no very easy matter, for the columns are unfortunately encased by the walls of a modern dwelling, and the capitals are absolutely inclosed in a wretched closet. Notwithstanding this sad modern degradation of the great Diana's fane, these scanty remains possess considerable degree of interest, as belonging to the most ancient temple of Ortygia; and it is a curious circumstance, that the style of the columns, with the bold swelling capital, strongly resembles the order at Corinth, the mother city. The Selinus and Pæstum examples have also a great resemblance to it. The intercolumniation must have been very small, there being only 1 ft. 6½ in. between the abaci of the two capitals. I am happy to state, that since my visit to Syracuse, the Duke of Serradifalco (a nobleman so well known to us all for his successful architectural researches in his native country, and for his contributions to the library of the Institute), has discovered the lower portions of these columns. Near this temple stood the celebrated Baths of Daphne, so named from a laurel grove sacred to Diana: the spot is now called Bagnara, and many remains have been discovered near it.

The celebrated fountain of Arethusa next claims our attention. This classic spot, sacred to the nymph to whom divine honours were offered, and upon whose shrine even Hercules sacrificed, still pours forth its abundant supply of fresh water as of old, but alas how different its present state! It is now the public washing place of the town; and when I saw it, a number of Hungarian soldiers were lounging about it, enjoying their merschaums, unconscious of the fame of the spot, or of the gibes and wit that the Syracusan laundresses were indulging in at their expense.

According to Diodorus, the celebrated building, the palace of sixty couches, which in magnitude and splendour was so superior to the temples, that the gods, from jealousy, are said to have destroyed it by thunder, was situate in Ortygia. This, together with the palace and gardens of Dionysius, the citadel surrendered by Dionysius to Timoleon, the Palace of Hiero, afterwards the residence of the Roman prætor and proconsuls, and the workshops of the infamous Verres, have all disappeared, and their sites are now occupied with modern fortifications, and narrow streets of miserable dwellings.

I now proceed to the adjoining quarter of the city, called Acradina, described by Cicero "as the second city, containing a spacious forum, a beautiful portico, and an ornamental prytaneum, or public hall, from which Verres stole the inimitable statue of Sappho, the great work of Silanion." Of these buildings there are now no existing remains. It is, however, probable that the Church of San Giovanni occupies the site of an ancient temple; and Mr. Hughes, in his admirable and elaborate description of the city, supposes it to have been the Temple of Jupiter, in which Hiero suspended the Gallic and Illyrian spoils presented by him to the Roman senate; and from a passage in which Cicero upbraids Verres for allowing a piratical corsair to sail into the port, and penetrate up to the very forum, we may infer that the forum was placed near the Isthmus.

In this quarter of Acradina are several of those Latomiæ, or stone quarries, which are so numerous in Syracuse. The most remarkable one is perhaps the one attached to the Capuchin convent, and now converted into a garden, forming one of the most beautiful and retired spots that possibly could be selected for devotional study.

There are also various subterraneous remains in this quarter, with vaults constructed of earthern pots, and the ruins of a bath excavated by Landolina, in 1804, in which was found the beautiful Torso of Venus, now forming the most valuable specimen of ancient sculpture to be found in the museum of the modern city.

The celebrated catacombs are in the quarter Acradina, and whether they are the works of the Syracusans previous to the Roman conquest by Marcellus, or subsequent to that period, is still a matter of conjecture. Mr. Hughes is inclined to attribute them to the Romans. At all events they are prodigious works. Denon describes them as a perfect subterranean city. The principal street or avenue in the catacombs is about eighteen feet wide and ten high, with numerous recesses and chambers on either side, with separate receptacles for the bodies, in one of which I counted no less than fifteen divisions. Swinburn relates that he saw a gold coin of the time of Icetas just taken out of the jaws of a body found in a tomb here; this must have been the *Naulon*, or Charon's fare.

Along the main street, at intervening distances, are transverse streets, forming at their intersections square and circular apartments, which are generally vaulted, and in some of them are conical apertures for light and air. Around these chambers are numerous recesses, symmetrically formed. In some parts the walls are covered with fine stucco, and there are the remains of painting, with monograms and symbolical devices, the works probably of the early Christians. An old Capuchin monk acted as our cicerone in going through the catacombs, and the effect of his slow and solemn step, and the glare of the torches through this city of the dead, will not be readily effaced from my memory.

Of the walls of Acradina there are still remaining considerable vestiges, and the rock itself is in some places formed into battlements.

Not far from a gap in the rock, called Scala Græca, where the quarter of Acradina terminated, and that of Tycha commenced, may be traced one of the principal gates of ancient Syracuse, and which, like some of the other gateways, was admirably contrived for defence, the assailants being forced to expose their *right* side, which was unprotected by the shield, to a great length of wall, and the missiles of its defenders.

From Scala Græca a broad road traversed the city to the point Ortygia, lined on each side by strong walls and towers. Fazello states, that a little beyond it, in the quarter of Tycha, stood the town called Galeagra, where a Roman soldier, during the conferences of Epycedes and Marcellus, by numbering the courses of stone and computing their height, found the wall much lower than common opinion, and scalable by the ordinary ladders. By these means Marcellus took the city in the night, during a festival of Diana, when the inhabitants, more attentive to their superstitious observances than the means of defence, were in a state of great intoxication.

The quarter, Tycha, is described by Cicero as the third city; and he says it was so named from the Temple of Fortune within its precincts, and that it contained a spacious Gymnasium, and many sacred edifices. Of this once splendid quarter of the city little now remains, excepting large sepulchres cut in the rocks, channels of aqueducts, and vestiges of the city walls. To account for so large a space being so completely cleared of the remains of the numerous buildings which formerly occupied it, one is almost led to the supposition that, from the facility of transport given by the immediate vicinity of the port, the materials must have been transported to other shores.

Neapolis is the fourth quarter of the city mentioned by Cicero, and, as its name implies, was the last built. It was adorned with a theatre of vast dimensions, two superb temples—one of Ceres and another of Proserpine—and a very beautiful colossal statute of *Apollo Temenites*.

The theatre is perhaps the most perfect of all the ancient buildings of Syracuse. It was the largest in Sicily, and is computed to have contained 30,000 persons. Its situation, on a rising ground, commands a magnificent view over the ports and surrounding country. The greater portion of the seats are cut out of the living rock.

In my examination of this edifice I had the great advantage to possess the elaborate and careful studies made in the previous year by Professor Donaldson; and as these have been given in so admirable a manner by that accomplished architect, in the supplementary volume of "Stewart's Athens," it is unnecessary for me to attempt a further description of a work already so familiar to the members of this Institute.

Above the theatre are numerous excavations in the rocks, remains of water courses, streets, and sepulchres. One, more perfect than the rest, is called the Tomb of Archimedes; and although the sepulchral stele, with the sphere and cylinder carved upon it, are no longer to be found to authenticate its identity, one feels unwilling to doubt that this must be the very monument discovered by Cicero, and pronounced by him as the sepulchre of the immortal Archimedes.

Not far from the theatre are the remains of an amphitheatre, which was also in part excavated from the platform of living rock. The arena, seats, corridors, podium, subterranean cells, and water-ducts are still easily traceable. The construction is evidently Roman.

The extensive quarries, or Latomiæ, are principally in this quarter of the city. They are said to have been excavated by the Athenian prisoners, and afterwards used as places of confinement. No greater contrast can be imagined than their former with their present state;

for those once gloomy abodes of the victims of Dionysius are now flourishing with the luxurious vegetation of the pomegranate and the orange, and are watered by the transparent streams which still flow along the ancient channels; and the spot where the infamous Verres incarcerated not only Syracusans, but Roman citizens, is now termed "*Il Paradiso.*" In this Latomia is the church of San Nicolo; under which is a chamber excavated from the rock, 64 ft. 6 in. long, 22 ft. 6 in. wide; and from the remains of a water-duct at one end it was probably used as a reservoir.

I must not pass by the curious cavern called the ear of Dionysius, which is about 170 feet in depth, 35 feet in width, and 60 feet in height. It is stated that Dionysius constructed this cavern on acoustic principles, for the purpose of overhearing the conversation of the prisoners confined within its walls. There is beyond doubt a wonderful power of conveying and increasing sound in this curious vault; but an examination of it, including the somewhat hazardous ascent with ropes and pullies to the cavity near the top, impressed us with the notion that this power, as is the case with most echoes, is more to be ascribed to accident than to art.

Neapolis was also adorned by a colossal statue of Apollo Temenites, which stood proudly pre-eminent on a rising ground, and was preserved, says Cicero, by its magnitude, from the sacrilegious grasp of Verres. Suetonius states, that it was contemplated by the emperor Tiberius to place it in the library which he had built, or restored, in honour of Augustus; but that he was prevented by the Deity in a vision.

The ruins of the Temple of Jupiter Olympius are situate on a gentle eminence on the right bank of the Anapus, overlooking the great port. Portions of the shafts of two Doric columns alone remain standing; but I am rather doubtful whether these are in the original position. It is to be much regretted, that so little is left of this temple, which, in its original state, was described as the richest monument in Syracuse. In its adytum was placed the famous statue of Jupiter, esteemed one of the three* most noble representations of that deity ever produced, and from which Dionysius stripped off the golden mantle, replacing it with one of wool, accompanying his robbery with the impudent apology, that gold was too heavy in summer and too cold in winter for the king of the gods, but that wool was adapted for both seasons.

I believe I have now generally, though I fear very imperfectly, described the principal remains of the four quarters of the ancient city; and I will trespass for a few minutes longer only upon the attention of the meeting, by making some short observations upon the suburbs and outworks.

Epipolæ, so celebrated in the sieges of Syracuse, is to the westward of Neapolis, on a spot (as its name imports) commanding the whole city. It was inclosed by Dionysius within those remarkable fortifications and walls said to have been constructed by him in the incredible short space of twenty days, and upon which he employed 60,000 workmen and 6,000 yoke of oxen.

It was also defended by a fort, which, according to Fazello, was called by the Greeks Labdalo, but Mr. Hughes is of opinion (judging from the descriptions of Thucydides and Dioduras) that Labdalo was considerably lower in the descent, and that the fort in question was the celebrated Hexapylon, a work constructed with extraordinary military skill and art. Mr. Cockerell (and I cannot appeal to a higher authority in these matters) states that he considers the remains of this fortress to be the most admirable specimen of ancient military architecture he had ever met with in all his extensive travels.

The principal entrance is admirably constructed for defence, with flank walls, from which the assailants were exposed to the attack of the defenders. Some of the walls are of solid masonry, 12 feet in thickness. Others, of that species of construction termed *Emplecton*,† are fifteen feet thick. At two of the angles of the walls are square towers of solid masonry, and there are several remains of fosses, 25 to 30 feet deep, cut in the solid rock, and defending the accessible approaches to the castles. In one part is a subterranean passage, nine feet wide and twelve feet high, leading in an inclined plane from the castle to the fosse, probably for the use of cavalry; and in other parts of the walls are small openings, about two feet in height, and sufficient to allow a man to creep through, by which the sorties were probably made.

The suburb of Epipolæ was terminated by a second almost impregnable fortress, called Euryale, mentioned particularly by Livy in his account of the siege of Syracuse, by Marcellus. In the 17th century the village of Belvedere was built on this spot, but no vestige of it now remains.

The river Anapus, so much vaunted by the poets and historians of old, is now a small stream, and its banks covered with lofty reeds and aquatic plants, growing so luxuriantly as almost to impede our progress in a small boat. We contrived, however, to reach the beautiful fountain of Cyane, a natural basin of about 50 feet in diameter, and celebrated by the poets as the spot where Pluto made his descent with Proserpine. We here saw the elegant Papyrus plant growing in great perfection, and it is said to be the only spot in Europe where this rare plant flourishes.

It has been remarked that there is no ancient example of any state so circumscribed in territory, extending so far and wide its influence, as Syracuse. In military fame she was equal to Lacedæmon, and contested successfully with the Athenians for naval pre-eminence! Her laws excited the admiration of Aristotle. The great Theban bard sung the victories of her conquerors in the games of Greece. From her power emanated the colonies of Acræ, Casmenæ, and Camarina. Her resources were so great, that Gelo offered to assist the Grecian states in their armament against the Persians with 28,000 troops and 200 *Triremes*, and, in addition, to supply provisions for the entire army of Greece, during the continuance of the war; and the perfection she had attained in the fine arts was such as to soften the hitherto rigid habits of her Roman conquerors, to refine their taste, and to excite and ensure their clemency.

Fazello tells us that her skill in works of gold, silver, and embroidery, was proverbial! The extent and magnificence of her buildings we have already adverted to. The superb medallions of Philistides sufficiently testify the superiority she had attained in the numismatic art; and of the extent of her sculptural embellishments we may form some idea from the remark of Cicero, that the Syracusans lost more *statues* by the rapacity of Verres than they did *men* by the *victories* of Marcellus.

The indefatigable Capodieci* presents us with a glorious list of warriors, statesmen, poets, philosophers, and men of science, whom he claims for Syracuse; and proud indeed must that city be which could produce Agathocles and Dionysius as commanders! Philistus as an historian! the poet Theocritus, and, greater by far than all these, her own Archimedes!

I trust this feeble attempt to describe the ancient Syracuse, will be excused, with all its imperfections; and most amply shall I be repaid if the interest of this meeting has been in the least degree promoted by a short account of that city, where the friendship of Damon and Pythias was fostered, and whose inhabitants derived their greatest pleasure in listening to the verses of Euripides!

* One, in the Roman capital, from Macedonia; a second at Pontus; and the third at Syracuse.—Cic. in Ver., 2, lib. iv.

† Plin. Nat. Hist., lib. 36, c. 22.

* The compiler of forty folio volumes on the antiquities of his native city.

INSTITUTION OF MECHANICAL ENGINEERS.

A second meeting of the promoters for establishing a national "Institution of Mechanical Engineers" was held at the Queen's Hotel, Birmingham, on Wednesday evening, the 27th ult., when it was at once resolved to establish the Institution. The meeting was attended by Mr. George Stephenson and about 70 other gentlemen. The object in establishing the Institution was explained by Mr. McConnell. It is to enable mechanics and engineers engaged in the various manufacturing and railway establishments of the country to meet and correspond. The early progress of the Institution having been briefly sketched by Mr. McConnell, and the formal resolutions adopted for conducting it,—

The President elect (Mr. Stephenson) addressed the members at some length, adverting to the difficulties he had encountered in his own early career, when, without education, assistance, or apprenticeship, and in the face of a vast amount of prejudice, he had succeeded in battling his way, until success crowned his exertions. He enjoined perseverance as essential to a young engineer, pointed out the folly of attempting impossibilities, for there was, he said, a law which governed mechanics, as everything else; there was a point to which mechanical skill could be carried, and no further. Mr. Stephenson concluded by observing that he should aid this rising Institution by every means in his power. The council, and other officers were afterwards appointed, and a general meeting of the members is to be held quarterly. A dinner afterwards took place; and in the course of some observations during the after *sederunt*, Mr. Stephenson said—"I have worked my way, but I have worked as hard as any man in the world, and I have overcome obstacles which it falls to the lot of but few men to encounter. I have known the day when my son was a child, that after my daily labour was at an end, I have gone home to my single room and cleaned clocks and watches, in order that I might be enabled to put my child to school. I had felt too acutely myself the loss of an education not to be fully sensible of how much advantage one would be to him. I may say, too, perhaps, without being deemed egotistical, that I have mixed with a greater variety of society than, perhaps, any man living. I have dined in mines, for I was once a miner; and I have dined with kings and queens, and with all grades of nobility; and have seen enough to inspire me with the hope that my exertions have not been without their beneficial results—that my labour has not been in vain."

CORDES AND LOCKE'S ROTARY ENGINE.

We have received a copy of a report by Mr. Josiah Parkes on the merits of "Cordes and Locke's condensing rotary steam engine." This engine is a contrivance for gaining power from the momentum or impact of steam, unassisted by its expansive force. The apparatus is so simple, that the nature of it may be readily comprehended without a figure: it consists of a vertical paddle wheel, revolving freely in a cylindrical case, and each float or paddle in succession is exposed to the action of a current of steam rushing against it from a pipe entering the side of the cylindrical case tangentially; so that steam impinges perpendicularly on each float.

The action may be compared to that of an undershot water-wheel, except that the steam does not act on the floats at their lowest position, but when they are about half-way between their highest and lowest position. The cylindrical case opens into a condenser, so that the steam may be said to flow from the boiler through the case into the condenser, meeting the paddles in its course. The extremities of the paddle-wheels do not quite touch the internal cylindrical surface of the case, and the expansive action of steam is in no way employed.

Mr. Parkes makes out that under these circumstances the steam acts with, as nearly as possible, the same efficiency as in an ordinary cylinder condensing engine. He arrives at this result in the following manner:—

"I must first state that this kind of engine precluded the employment of the indicator to ascertain its gross power, as in ordinary cylinder engines; and even if that instrument could have availed for the purpose, it was deemed to be of far greater importance to measure the amount of force actually disposable, as delivered off by the engine, rather than the power of the steam in action, which alone is denoted by the indicator. To attain this end it was necessary to fix upon some sufficiently uniform load to be applied to your engine, as well as upon some method of determining the resistance overcome. The load selected was a screw-propeller, submerged and driven round in a tank of water, 16 feet by 11 feet square. The resistance was weighed by Mr. Davies's dynamometer, adapted to a strap-pulley on a counter-shaft, working intermediate between the engine and screw-shaft.

These preliminary arrangements having been made, the engine was worked during several days; the quantity of water, as steam, which passed through the wheel-case, as well as through the small auxiliary engine which drove the air-pumps, being carefully measured on each occasion. The resistance shown by the dynamometer was continually noted; the number of revolutions made by the wheel was exhibited by a counter; the pressure of the steam as it entered the wheel-case, was observed on a thermometric steam-gauge; the value of the vacuum in the wheel-case was obtained by an ordinary gauge communicating with it; and the amount of power employed to drive the air-pumps and maintain the vacuum, was ascertained by an indicator. The diameter of the steam-wheel in question is 11 feet 7 inches, and at 502 revolutions per minute, its periphery travels at the rate of about 208 miles per hour. The width of the wheel-case is 15 inches; the number of vanes and radial arms 28; the breadth of each vane 6 inches, the depth 7 inches, and the area, therefore, of each vane about 42 square inches. The orifice of the steam-jet is of an oval shape, 3 inches by 2 inches, set vertically.

It appeared, after a great number of trials, that your engine gave the following results, when using steam in the boiler at a pressure of 2½ lb. per square inch above the atmosphere:

Revolutions of wheel per minute	..	502
Horses power per dynamometer	..	32
Vacuum in the wheel-case ..	..	27·2 in. of mercury.
Water expended per horse power	..	100 lb. per hour.

The same dynamometer and strap-pulley were then transferred to your works at Newport, Monmouthshire, and applied to a condensing engine made by Messrs. Bowman and Galloway, of Manchester, having the following principal dimensions, viz.: diameter of cylinder 30 inches, length of stroke 5 feet. Previously to the experiments, the engine was put into the best possible working condition. My indicator was applied to the cylinder; the dynamometer to the engine-shaft; cards were taken during several hours of continuous work, under an uniform load; the index of the dynamometer was noted down every five minutes; the water consumed, as steam, was accurately measured. The subjoined may fairly be considered to represent the mean result of numerous trials:

Speed of piston per minute	..	220 feet.
Mean pressure per indicator	..	10·342 lb. per square inch.
Mean vacuum throughout stroke		10·186 ,,
Vacuum in condenser ..	..	26·5 in. of mercury.
Water evaporated per hour	..	3248 lb.

The *indicated* power amounted, from the above data, to 48·73 horses; and the water expended for each horse power, per hour, to 66·65 lb.

The *dynamometric*, or effective power, as denoted by the instrument, was 32·29 horses; and the water expended for each effective horse power, per hour, was 100·5 lb.

It hence appears that the power actually delivered off by the cylinder engine, was less than the gross or indicated power by 33·73 per cent.; and, that a similar useful effect was obtained both from the cylinder, and your rotary engine, with the same expenditure of steam and fuel."

Mr. Parkes had some years ago the misfortune to publish, in the third volume of the *Transactions of the Institution of Civil Engineers*, a paper calculating the power of steam engines, in a manner much more amusing than instructive. The reader who is curious in such matters may find in the second edition of the Count de Pambour's Treatise on Locomotive Engines, an ample critique upon this paper, and exposure of its errors. We are not going out of the way in referring to this matter, because we can only conjecture Mr. Parkes' present mode of calculation, by comparison with what he did in 1840. At that time he could not understand that the effect of a steam engine depends directly and absolutely on the evaporation, and that it is utterly impossible to compute the effect without having estimated numerically the quantity of steam generated in a given time. Seven years of subsequent experience have not much mended matters, for the calculations now presented to us are evidently independent of the essential consideration just stated. The "mean pressure per indicator," or cylinder pressure is given, together with the quantity of water evaporated per hour; but nothing is said about the boiler pressure. Now, having given the quantity of *water* evaporated per hour, we must know the boiler pressure, in order to calculate the quantity of *steam* generated per hour; and this being known, we may calculate the velocity of the engine from the work done, or the work done from the velocity. By omitting, however, a single element of this computation, the whole chain of reasoning is broken, and when Mr. Parkes tells us that the "power actually delivered off by the cylinder engine was less than the gross or indicated power by 33·73 per cent." we are entitled to attribute the fault not to the engine but to his calculations.

The principal assertion, that an equal effect was produced from both kinds of engines, with the "same expenditure of steam and fuel," does not anywhere appear to have been corroborated by direct experiment. With respect to the expenditure of steam, we know that that could not have been ascertained, because the boiler pressure is not recorded: and if the expenditure of fuel in the cylinder and the rotary engines had been compared, something would have been said to show that in both cases it was consumed in firegrates of the same form and dimensions; as otherwise the comparison would not be a fair one.

Another altogether different application of the rotary engine was as an *auxiliary* to the common cylinder engine, by causing the steam in its course from the cylinders of the ordinary construction to the condenser to pass through a circular steam case with revolving paddles, as before described. The experiments on the rotary engine so employed were as follows:—

"One of the wheel or rotary engines, divested of its air-pump, condenser, &c., is connected at your works with a common reciprocating condensing engine, in the following manner. The steam wheel is placed near to the cylinder of the condensing engine, in the same room, and is simply acted upon by the steam discharged from the latter. It therefore stands intermediate between the cylinder and the condenser, and derives all the power it gives off from the waste steam of the condensing engine, in its passage from the cylinder to the condenser.

Each engine drives a perfectly distinct load in the manufactory, that is to say, each drives sets of machines perfectly distinct, and in separate buildings; the power of the cylinder engine being given off to a main upright shaft connected with one kind of machinery, and the power of the wheel engine applied to a strap communicating motion to machinery at a distance. This condition of things has existed in actual daily operation at the works for 18 months past. In order to arrive at the separate value of the effect produced by each engine, and of their combined effect, the following methods of proof were adopted.

The usual loads were disengaged, and friction breaks were applied in such manner as to balance the whole power delivered off by each engine. Indicator cards were frequently taken from the cylinder engine; each break was placed under the separate management of an experienced mechanic, with every provision to maintain uniform friction; the water evaporated was measured throughout the experiments. The results were,

Indicated, or gross H.P., of the cylinder engine, ..	22·96.
Effective H P., as per break	15·70.
Exhibiting a loss of about 31·32 per cent.	
Effective H.P., from the rotary engine, as per break ..	5·00.
Water evaporated per hour	1800 lb.
Giving for indicated H.P., per horse per hour ..	78·74 lb.
Giving for effective H.P., per horse per hour ..	114·65 lb.
Giving for combined effective H.P., per horse per hour,	86·99 lb.

The dimensions of the cylinder engine were :

Diameter of cylinder	19½ inches.
Length of stroke	3 feet.
Speed of piston, per minute ..	263 feet.
Mean pressure per indicator ..	10·1 lb. per sq. in.

The dimensions of the rotary engine were :

Diameter of wheel, 7 feet 9 inches.
Number of vanes, 30.
Size of vane 4½ inches wide, by 5 inches deep.
Two steam jets 2½ inches diameter each.

The useful fact developed by these last experiments, is the recovery of five horses effective power, in addition to 15·7 horses power from the same original steam, that is to say, steam which would otherwise have passed uselessly into the condenser, and been annihilated. It is, therefore, manifest that nearly one-third more power may be obtained from any cylinder engine by combining with it this rotary engine, without the use of additional fuel, boiler, or apparatus of any kind.*

With the view of proving that the auxiliary or supplemental wheel engine, as combined with the condensing engine, did not diminish the performance of the latter, the indicator and break were applied to it when working alone, the connexion with the wheel engine having been shut off, and the waste steam suffered to pass through its usual pipe to the condenser. Under these circumstances the effective power of the Condensing Engine came out 15·637 horses, and the water expended as steam 115·1 lb. per horse per hour; thus demonstrating that no diminution of its original power, nor increased consumption, were occasion by its combination with the Rotary Engine.

In order to prove that no opposition to the passage of the waste steam from the cylinder to the condenser is occasioned by the interposed wheel and case, the indicator was applied on the connecting pipe immediately in front of the jet holes, and the vacuum exhibited by it was in close accordance with the vacuum in the cylinder as ascertained by the same instrument. The wheel-case is, in fact, a virtual enlargement of the condenser, and the value of the vacuum in the cylinder suffers no depreciation from its interposition. The power recovered and given off by the wheel is simply due to the steam's momentum—low as is its elastic force—acting by impact on the wheel vanes *in transitu* between the cylinder and condenser;—the wheel working *in vacuo*, and therefore, unresisted, or resisted only to the extent of imperfection of such vacuum. The more perfect the vacuum maintained throughout the case, the greater will be the useful effect obtained from the wheel.

In respect of the practical economy of your rotary engine, as regards steam and fuel, and as compared with the ordinary unexpansive cylinder engines, we know that the latter are not worked with less than 70 lb. of water per horse per hour, and they much oftener reach or exceed 80 lb., deduction being made of friction only when the engine is unloaded, which is very small. It appears, however, from the foregoing dynamometric and break experiments, that fully 30 per cent. should be deducted from the gross indicated power of the cylinder engine, as the value of its friction when loaded; or, in other words, that we realise less than 70 per cent. of the gross power; and the loss of effect when speed has to be quickly got up, as in the case of marine engines working screw propellers, most probably considerably exceeds 30 per cent. The consumption, therefore, of 100 lb. of water as steam per horse power, per hour, by your engine, may be considered, in respect of economy, as placing it on an equally advantageous footing with the class of engines alluded to."

The errors of calculation here exhibited appear to be just the same as before, and destroy all confidence in the results. The question of the expediency of employing the revolving steam-wheel resolves itself simply into this—is more power gained from the impinging force of the steam than is lost by obstructing its passage from the cylinder to the condenser? The assertion that *no* force is lost by thus impeding the passage of the steam is manifestly absurd; for it is equivalent to saying that the efficiency of the condenser is just the same, whether the steam-ways be large or small. Mr. Parkes alleges, in proof of his assertion, a circumstance which does not bear on the case in the slightest degree. Premising that the power of the condensing engine in both cases "*came out*" nearly the same (by his calculations), he adds, when the rotary engine was at work, the vacuum in the cylinder and condenser was nearly the same. But the obvious way of testing his assertion was to try whether the vacuum in the cylinder was the same when the rotary engine was connected, and when it was disconnected—that is, to ascertain whether the resistance to the motion of the piston from imperfect condensation was not increased by the interposition of the steam-wheel.

We by no means take on ourselves to decide absolutely against the merits of Messrs. Cordes and Locke's invention. On the contrary, so little is known of the impinging force of steam that the question is still fairly arguable whether more be not gained by employing that force than is lost by obstructing the passage to the condenser. The circumstance stated in the foot-note, of 100 tons of coal being saved in 18 months, seems of itself an unmistakable fact—a *voie de fait*, as the French call it—in favour of the invention. At all events, the inventors deserve the credit of calling attention to a very interesting subject, and it may be hoped that for the sake of science they will continue their investigation. The foregoing remarks refer exclusively to the erroneous methods of calculation adopted in the report sent by them, and will, we hope, direct—not repress—their efforts.

* By reference to the coal account, during the last eighteen months, I find that a saving of 100 tons of coals has been effected within that period, by working the wheel in connection with the cylinder engine, whilst the power recovered from the cylinder engine has been more than equal to the duty performed by a separate engine, previously employed for that purpose only. And I also understand that the Rotary has not cost 5s. in repairs during that time; that the packing, in the stuffing boxes of the wheel-axle, has been but once renewed; and that nothing has occurred to require the case to be opened.—J. P.

DECIMAL METAL GAGES.

We wish to direct the attention of our readers to Mr. Holtzapffel's proposal for assimilating the Gages of Metals, by adopting a universal decimal system, as set forth in the annexed Table.

Values of Gages for Wire and Sheet Metals in general use, expressed in decimal parts of the inch.

SECTION ONE.		SECTION TWO.		SECTION THREE.					
Birmingham Gage for Iron Wire, and for Sheet Iron and Steel.		Birmingham Gage for Sheet Metals, Brass, Gold, Silver, &c.		Lancashire Gage for round Steel Wire, and also for Pinion Wire. The smaller sizes distinguished by Numbers. The larger by Letters, and called the Letter Gage.					
MARK.	SIZE.	MARK.	SIZE.	MARK.	SIZE.	MARK.	SIZE.	MARK.	SIZE.
0000—	·454	1—	·004	80—	·013	40—	·096	A —	·234
000—	·425	2—	·005	79—	·014	39—	·098	B —	·238
00—	·380	3—	·008	78—	·015	38—	·100	C —	·242
0—	·340	4—	·010	77—	·016	37—	·102	D —	·246
1—	·300	5—	·012	76—	·018	36—	·105	E —	·250
2—	·284	6—	·013	75—	·019	35—	·107	F —	·257
3—	·259	7—	·015	74—	·022	34—	·109	G —	·261
4—	·238	8—	·016	73—	·023	33—	·111	H —	·266
5—	·220	9—	·019	72—	·024	32—	·115	I —	·272
6—	·203	10—	·024	71—	·026	31—	·118	J —	·277
7—	·180	11—	·029	70—	·027	30—	·125	K —	·281
8—	·165	12—	·034	69—	·029	29—	·134	L —	·290
9—	·148	13—	·036	68—	·030	28—	·138	M —	·295
10—	·134	14—	·041	67—	·031	27—	·141	N —	·302
11—	·120	15—	·047	66—	·032	26—	·143	O —	·316
12—	·109	16—	·051	65—	·033	25—	·146	P —	·323
13—	·095	17—	·057	64—	·034	24—	·148	Q —	·332
14—	·083	18—	·061	63—	·035	23—	·150	R —	·339
15—	·072	19—	·064	62—	·036	22—	·152	S —	·348
16—	·065	20—	·067	61—	·038	21—	·157	T —	·358
17—	·058	21—	·072	60—	·039	20—	·160	U —	·368
18—	·049	22—	·074	59—	·040	19—	·164	V —	·377
19—	·042	23—	·077	58—	·041	18—	·167	W —	·386
20—	·035	24—	·082	57—	·042	17—	·169	X —	·397
21—	·032	25—	·095	56—	·044	16—	·174	Y —	·404
22—	·028	26—	·103	55—	·050	15—	·175	Z —	·413
23—	·025	27—	·113	54—	·055	14—	·177	A 1—	·420
24—	·022	28—	·120	53—	·058	13—	·180	B 1—	·431
25—	·020	29—	·124	52—	·060	12—	·185	C 1—	·443
26—	·018	30—	·126	51—	·064	11—	·189	D 1—	·452
27—	·016	31—	·133	50—	·067	10—	·190	E 1—	·462
28—	·014	32—	·143	49—	·070	9—	·191	F 1—	·475
29—	·013	33—	·145	48—	·073	8—	·192	G 1—	·484
30—	·012	34—	·148	47—	·076	7—	·195	H 1—	·494
31—	·010	35—	·158	46—	·078	6—	·198		
32—	·009	36—	·167	45—	·080	5—	·201		
33—	·008			44—	·084	4—	·204		
34—	·007			43—	·086	3—	·209		
35—	·005			42—	·091	2—	·219		
36—	·004			41—	·095	1—	·227		

NEW METROPOLITAN CHURCHES.

In almost every part of England new churches are being built, of which the architecture would be worthy of the best days of ancient ecclesiastical art. Those who love architecture for its own sake, and who, in order to see noble specimens of it, are willing to make short pilgrimages (no great labour in these railway times), may see, in every county, modern churches, the monuments of private munificence, which elicit the admiration of the strictest and most determined disciple of ancient art. The recent edifices, if they do not always possess the *massive* simplicity and unity which remains hitherto a characteristic of the olden time, still exhibit in their details a magnificence and propriety which we can hardly hope to see excelled.

In London, however, it is not so. Here, churches are built to cover in a given number of square feet of ground, and the architect must so arrange the building, that the greatest possible number of sittings may be contained within it. *It does not pay* to build London churches with thick solid walls and massive piers and buttresses—the pew-rents would not cover the outlay. Plaster and patent cement and deal boards keep out the weather (while they last) nearly as well as stone and oak, and, if properly coloured, look as well. To be sure, these lath-and-plaster edifices will not last for quite so many centuries as the mediæval piles which they mimic (one of these fragile fabrics has already began to fall, almost before its completion)—but, then, those who build these churches have no concern in the permanence of them for centuries—for to themselves the pew-rents cannot accrue beyond the term of their natural lives. They have made the churches to be houses of merchandise, and they build them just strong enough to answer the intended purpose. Our ancestors did not build in such a manner, nor with such objects. Do we wrong to commend the old custom, as a *good* old custom?

We are not "travelling out of the record" in making these observations: they have more connection with architecture than may appear at first sight. In many even of the best of modern churches—though the critic can detect no fault of design or detail—*something* is felt to be wanting which renders these buildings less impressive than their ancient prototypes. The detection of this *something* is oftentimes very puzzling—the construction of the building is faithfully expressed by the decoration, the materials are honest and real, the composition simple and connected, and the mouldings, tracery, &c. graceful, and appropriate to the style adopted—and yet the eye is not satisfied. The more this anomaly is considered (and we doubt not that it has occurred to many careful observers), the more readily will it be referred to the comparative slightness of building adopted in modern structures. This explanation may perhaps be objected to as too material. It may be thought a very matter-of-fact kind of criticism which measures the thickness of walls and the sectional area of buttresses; but it is precisely this kind of criticism which, if it be correct, is the most useful, because it is the most easy of application.

It is by no means to be inferred that we would commend heavy clumsy modes of construction, when our present increased knowledge of mechanics has revealed improved and more scientific methods. The worst sort of affectation is that which apes inferiority. But we do want to see churches built as if they were meant to last—not as if the architect had been accustomed all his life to "run up" cockney villas or new metropolitan streets—as if he had no idea of magnificence beyond the plaster glories of the Regent's Park or Belgravia. How willingly does the eye, wearied of this showy, ephemeral finery, turn to the ancient, unpretending, village church, with its vast bold buttresses and massive tower! Those venerable walls tell their story so simply, and yet so well—that within them successive generations of men have assembled in piety and reverence for, it may be, these six or seven centuries past. It is not merely that we admire the village church for its own intrinsic beauty, but that we feel that it was built for ages. It is the type of permanence, as far as the work of men's hands can be so. The ancient churchmen, it has been well said, built "for religion, not for fame; for endurance, not by contract; for devotion, not in a spirit of economy; *pro salute animæ, non pro crumenâ.*"

Old Street Road.—A new church has been recently built here by Mr. Ferrey, in the Early English style. The nave and aisles are under separate gables, and the entrance is under the tower, which is at the south-west angle. Externally, the masonry is of rag, with Caen stone dressings, which have (as in many other modern churches) a most unsatisfactory, "patchy" appearance. It is well enough to use Caen or similar stone for the mouldings or tracery of a church, for rag cannot be worked for the purpose; but there is now a mania for sticking all over a church bits of the former kind of stone; and its light colour, contrasted with the dark hue of the coarser material, gives the building an appearance of stone patchwork, or the fantastic pattern of a harlequin's dress. Besides, it is ridiculous to use the *weaker* stone for quoins and angles, where, if any difference be made, it should be in favour of the material which had the greatest cohesive force. Had the angles of the buttresses, &c. of Mr. Ferrey's church been of rag-stone like the rest, the effect would have been much better. The love of finery in architecture has grown into a habit which seems almost inveterate.

The windows on the south are arcades of four arches, two blank and two pierced for light—this arrangement, defended though it be by precedent, is most unworthy of modern imitation. Blank windows are equally inartistic, whether they occur in Classic or Pointed architecture. In the present case, the masses of Caen stone in the blank arches exaggerate the patchwork effect of which we have complained, to an unusual degree. The windows on the north side are couplets. This side of the building is much the best. The south side is next the street, and is of course made the most showy—for that very reason, it is inferior in appearance to the other. The rose window at the east end is much too large. We have not had an opportunity of seeing the interior of the building.

Horton.—Another Early English church is nearly finished here, which is a specimen of "Modern Gothic," of more than ordinary hideousness. It scarcely deserves a detailed notice. It is sufficient to say that it exhibits all the following characteristics of its tribe in an eminent manner—miserably thin walls, with square reveals to the windows, as in an ordinary dwelling house—poor tracery—cast iron girders—pinnacles ugly enough to have been built twenty years ago—plenty of plaster and stucco, and an enormous disproportionate chancel-arch, with a small communion recess beyond it.

RAILWAY STATISTICS.

From the *Eisenbahn-Jahrbuch* (Railway Year-book), recently published by the Baron de Reden at Berlin, we obtain some valuable additions to railway statistics. The author is now in office under the Prussian government, and formerly superintended the construction of the railway from Berlin to Stettin.

The analysis of accidents which occurred on railways in Belgium, England, France, and Germany, respectively, during five years, commencing 1st August, 1840, is as follows:—

	Fatal Accidents.	Total number of Accidents.
Belgium	35	100
England	300	1500
France	71	220
Germany	11	22

It appears, from this table, that the total number of persons in any way injured during this period, in the four countries, was 1,842; and of these accidents, 417, or between one-fourth and one-fifth, were fatal. The following table shows approximately what proportion of these accidents have occurred in each country, and also the annual average of accidents:—

	Fatal accidents annually.	Total accidents annually.
Belgium	7 or $\frac{1}{12}$th	20 or $\frac{1}{18}$th
England	60 or $\frac{5}{7}$ths	300 or $\frac{4}{5}$ths
France	14·2 or $\frac{1}{6}$th	44 or $\frac{1}{8}$th
Germany	2·2 or $\frac{1}{38}$th	4·4 or $\frac{1}{84}$th

In this table, the casualties on French lines include those of the Versailles catastrophe, by which 55 lives were lost. The accidents on the Belgian lines in 1843 and 1844 arose almost entirely from breakage of axles and from carriages getting off the rails.

A more accurate estimate of the relative insecurity of railways in either country is obtained by comparing the number of casualties with the total number of passengers conveyed. Taking the annual mean proportion, we get the following results, which distinguish whether the accident arose from the fault of the sufferers or of the railway managers:—

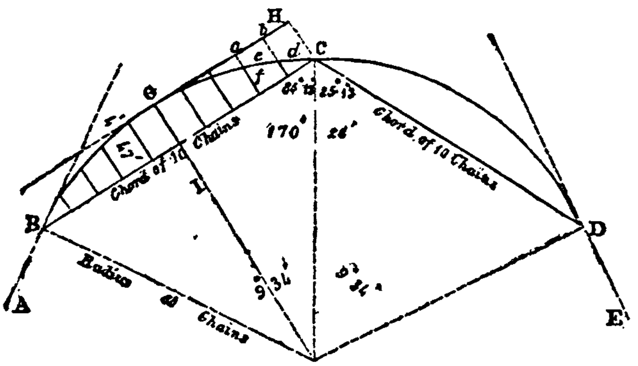
	Passengers killed from their own neglect.	Officials killed and wounded from their own neglect.	Persons killed from defective managemt.
Belgium	1 in 670,000	1 in 280,000	1 in 1,690,764
England	1 in 869,000	1 in 800,000	1 in 882,416
France	1 in 2,157,000	1 in 5,000,000	1 in 3,465,996
Germany	1 in 25,000,000	1 in 9,000,000	1 in 12,252,856

In this list, each country is placed in the order of the relative insecurity of its railways. The terrible disproportion in this respect, between the two former and the two latter, is very significant and deserves careful attention.

SETTING OUT RAILWAY CURVES.

SIR—The following mode of setting out curves, by means of equal chords and ordinates, which I have successfully practised, is both accurate and easy of being applied:—

Fig. 1.



Let B and D be the ends of two straight lines, tangents to the curve B C D, which we wish to set out—the position of the two lines having been correctly determined from the base line of the survey. We must then ascertain the angle that a chord of any convenient length (say 10 chains) makes with the tangent A B; which having found, the intermediate points on the curve are fixed by offsets from the chord. The radius being known, and the length of the chord determined, the following formula will enable us to find the angles of chord and tangent:

Radius : ½ chord :: 1 : sin ½ the arc.

$$\text{Therefore, } \sin \tfrac{1}{2} \text{ the arc} = \frac{\text{chord}}{2 \text{ radius}}.$$

Thus, if chord = 10 chains, and radius = 60 chains,

$$\sin \tfrac{1}{2} \text{arc} = \tfrac{10}{120} = \tfrac{1}{12} = \cdot 0833' = \text{nat sine } 4^\circ\, 47'.$$

To find the offsets, the line F G which bisects the chord is at right angles with it. G H, which is a tangent to the curve, is also at right angles with F G. G H and I C are, therefore, parallel. If H C be drawn at right angles with I G, it will be parallel to I G, and also equal to it; and G H = T C = 5 chains.

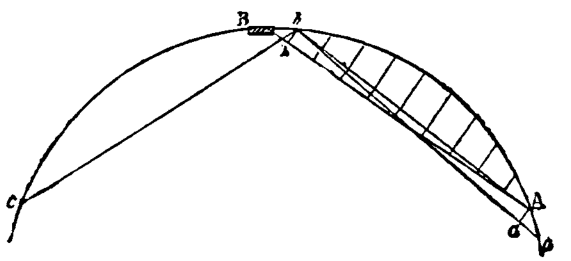
$$HC = FG - \sqrt{FG^2 - GH^2}$$
$$bd = FG - \sqrt{FG^2 - Gb^2}; \text{ and}$$
$$ac = FG - \sqrt{FG^2 - Ga^2}.$$

The parallel lines, H C, bf, ae, and G I, are all equal.

Therefore, $df = HC - bd$; $ce = HC - ac$, &c.; and $GI = HC$.

The formula $\frac{GH^2}{2FG}$ will give a very near approximation to the distance of the tangent from the curve, and might be taken as the offset without producing any appreciable error; $\frac{Gb^2}{2FG}$ will give bd; and $\frac{Ga^2}{2FG} = ac$, &c.

Fig. 2.



In the case where a building or other obstacle may intervene, at B, (fig. 2) to prevent the setting up of a theodolite; if from A we set off the distance A a' equal to $b\,b'$, we shall have the direction of a chord, ba, of 10 chains; by means of which we can determine the direction of a new chord, bc.

Carmarthen, Jan. 3, 1847. Z.

SIR—I had no intention to excite the ire of your correspondent, "An Engineer out of Employment." He has evidently mistaken my meaning. I shall leave him, therefore, to cool on it.

A specific chord line, it is well known, presupposes two points, already determined in a curve. The first, or starting point, can be attended with no difficulty; but the other, though easily found, or assumed, on paper, is not always so readily found *on the ground:* and when obtained, or given, on the ground, it must be SEEN from the other point in order to be of any use. "To find it out," as your correspondent says, "by the aid of a common theodolite," would be an endless affair—even if the surveyor knew how to set about it. The time occupied in his doing so might certainly be employed to more advantge, I may say, by *any other* mode of tracing a curve—even by "building," as your correspondent calls it!—*apropos*, my instrument does not, by any means, limit the length of the tangent: it may be either lengthened or shortened, according to local or other circumstances.

Military Library, 30, Charing-cross. W. TAIT.

SAFETY OF RAILWAYS.

(Extract from a Report made to the Minister of Public Works in France, by M. DE BOUREUILLE, head of the Railway Department.) Translated for the 'London Journal.'

The Special Commission, charged by the Minister of Public Works to inquire into the questions relating to the security of transit upon railways, has, from the first, had two subjects of very different natures to consider. The catastrophe of the 8th May, 1842, had called public attention most particularly to the construction of axles of locomotive engines and carriages, and to the terrible consequences of the shocks to which passenger trains might be exposed upon railways.

The safety of railway transit may depend on various circumstances; 1st,—On the state of the road or way, and the mode of its construction; 2ndly,—On the state of the materials employed, viz., the engines and carriages, and the different parts of which they are composed, viz., the wheels, axles, springs, &c.; 3rdly,—On the formation of the trains—that is to say, the mode of attaching the engines and carriages together, the kind of brake employed, the methods of deadening shocks, &c.; 4thly,—On the regulations to be observed when the trains are running, the speed at which they are to travel, the signals and means of communication established either between the engine-drivers, or between them and the officials at the stations or on the road; 5thly and lastly,—On the degree of intelligence employed in the service, and the ability and characters of the persons employed.

1. *On the Railway and its Accessaries, such as Crossings and Changes in the direction of the Road.*

It will be unnecessary here to recapitulate the various plans which have been successively employed for the construction of railways: it will be sufficient to observe that the method now generally adopted in France consists in fixing the rails by means of wooden chairs placed in cast iron bearings, which are fixed two together upon wooden sleepers, placed at equal distances apart: the number of sleepers varies according to the nature of the soil upon which the road is to be formed, the weight of the rails, &c. The sleepers are covered with sand to keep them in their proper position.

Some engineers, in order to render the rails more firm, and to prevent their bending between the transverse sleepers, have proposed to lay the rails upon longitudinal sleepers. The line of rail from London to Bristol is laid down in this manner; but it is not apparent that this plan has been much followed in France.

The Commission had therefore to inquire, on the one hand, whether this method of constructing railways was sufficient to maintain the rails at the required distance. This was answered affirmatively, adding, however, that it would be advisable to place the sleepers nearer together at the junction of two lines of rail, than at the intermediate points. As a corollary to this question, the Commission inquired whether the breadth between the rails most commonly adopted, viz., 4 ft. 8 in., was sufficient, and whether it would not be advisable to increase it. On the first point, the answer in the affirmative was given without hesitation; and, as to the width of road, the Commission was of opinion, that the gauge at present in use might be continued; adding, however, that it would be advisable to keep it in tunnels, and between the parapets of works, the same as on levels and in cuttings.

With regard to any alterations to be made in the position and form of the road, the Commission declares, that the depression or elevation of the rails, a defect in fixing them in the chairs, derangement of the sleepers supporting them, inequality in the sand forming the foundation of the road, or too thin a layer of this sand, must be considered as very likely causes for the carriages getting off the rails. The Commission mentions two other causes of the rails getting out of order, which seem to be quite as dangerous:—First, the displacement of the rails in a longitudinal direction, or direction of movement; and secondly, the uniform inclination of the sleepers supporting the chairs and the consequent displacement of the rails. These various causes of danger may be averted, or at least greatly modified, by a constant and attentive surveillance of the road.

The Commission had still to examine, on the one hand, whether the form adopted for the rails was the most suitable; and on the other hand, whether the test of the manufacture of the rails, before employing them, was sufficient to be relied upon.

There are three different systems of switches employed upon railways; the first—that of moveable rails, which act by pressing upon the inside of the carriage wheels, so as to force them to run in the required direction. This plan possesses the disadvantage of loosening the wheels and wearing them away quickly. The second system is, that of the moveable rails, which may, by turning on a pivot, be moved in the direction in which the train is required to run. In this plan, there is no pressure on the inside of the wheels; but, if by chance, the moveable rail is badly placed, the engine will run off the rails. And, lastly, the third plan, which is generally adopted at present, is one that unites the advantages of the first two. It is composed of double switches, arranged in such a manner that there may be always a moveable rail opposite each road; and the switches being always brought back to their original position, by a counterbalance weight, there is no danger of running off the rails. This latter plan is much preferable, as regards public safety.

Independently of the changes and crossings in a level, the Commission has given its attention to some questions which are of great importance as regards security in travelling. For instance, when a railroad is carried across a deep valley, which can only be traversed by means of lofty viaducts, or through deep cuttings, or across rivers, of greater or less width, it will be understood that it would be much more dangerous to run off the rails at such places than when travelling on a level road, although attended at all times with much danger. In order to prevent this, as much as possible, counter-rails are generally employed, placed either inside or outside the line of rails, and more or less elevated above the ground. The Commission has thought, that in certain cases, the counter-rails may be useful, adding besides, that when used, it is advisable to place them inside the ordinary rails. In fact, by this means, the height of the flange of the wheels is gained; and, besides, if an axle were to break, the wheel, instead of being dragged outside the rails, would have a tendency to run inside, which is an evident advantage as regards safety.

Lastly,—the Commission has had to examine whether, as regards safety of transit, there should not be a limit to the radius of the curves, and what this limit should be; but it was not long in perceiving that nothing positive could be decided on this point, and that it should be left to the government to determine, in each particular case, the limit to be adopted. This limit, as at present stated in the railway books, appears suitable and sufficient for preventing accidents.

II. *On the influence of the state of the materials, as regards safety of transit, and the precautions to be taken for that purpose.*

If the state of the rails, and the materials of which the railway is composed, have great influence upon the security of railway transit, the machinery employed in working it, viz.—the locomotive engines and carriages, is also worthy of serious attention.

Experience has proved, that by forming the upper surface of the rails of a slightly convex form, the oscillation may be much diminished, and the friction of the flanges of the wheels upon the rails will be reduced in proportion. They are, in fact, scarcely in contact, and consequently, the rails may be made about a third of an inch wider, which greatly facilitates the progress upon curves. These slight improvements need not increase the expense of the railway, but by their adoption the chances of accidents will be greatly diminished.

The next question to be discussed relates to the axles. This subject is one that has greatly occupied public attention, from most of the serious railway accidents having been accompanied, if not caused, by the breaking of an axle. The Commission has examined the axle, successively, in all possible positions:—first, in the process of manufacture, and in their form and adjustment; and, afterwards, in the different kinds of work to which they might be adapted. As regards the manufacture of axles, the Commission is of opinion, that this manufacture is now conducted on as perfect a plan as possible, as well for straight as cranked axles. The former are wrought by the hammer; and the cranked axles, which are always larger, are also made of fagotted iron; but in order to give them the desired form, only one method appears to have been thought worthy of being employed. This method consists in putting a number of iron bars together to form a parcel of about two feet square; and these, having been heated in a reverberatory furnace, are submitted to the action of a powerful hammer, and beaten on all sides, in order to weld the bars together: the bar thus made, is afterwards reduced to a thickness somewhat more than the diameter of the intended axle, keeping a sufficient width for the cranked part. Those parts of the axle which are to receive the wheels, are first wrought into the required form, and then the cranks (which do not require to be rounded) are brought to their proper shape.

The form to be given to the axles is not material. It has been proved by experience that axles nearly always break inside the wheels, and at or near the nave. It is therefore advisable to make this part much thicker than the others; and this is generally done by manufacturers; but they do not always pay great attention to the levelling of these parts with the body of the axle, as the incline is generally too abrupt. This mode of manufacture being very defective, and likely to decrease the strength of the axle, it is indispensably necessary to make the thick parts taper gradually down to the smaller ones, or in the form of a truncated cone, the apex of which would be equal to the diameter of the body of the axle.

The Commission had to inquire whether it was advisable, before employing the axles, to test their strength; and their opinion was, that this trial was not desirable, but that there might be certain modes of trial which would not injure the metal, and which would nevertheless expose the defects: such, for instance, as re-heating to a cherry red—an examination of the portions detached from the ends of the axles, &c.

In a word, the especial attention of the Companies should be called to this question, the importance of which may be easily understood; and they ought to be also obliged to keep registers, in which all the axles received should be carefully noted, together with all the circumstances of their reception, and a statement of the proofs to which they had been submitted.

When working on railways, the axles are subjected to strains of different kinds, and to shocks and vibrations, sometimes of a very violent nature, which may cause them to break. Accidents of this nature have frequently happened upon railways; but, in most instances, the circumstances have not been truly investigated, nor the appearance of the fracture considered; except in some cases (fortunately very few) in which the breaking of the axles occasioned serious injury or death. But in these cases, the two broken portions of the axle had been so twisted, that no conclusion could be arrived at from the appearance of the fracture. It is, besides, generally impossible to determine whether the breaking of the axle was the cause of the accident, or merely the effect.

From these circumstances, the Commission has been unable to discover any documents of a nature sufficiently conclusive to determine the probable time that axles would last; but it has no hesitation in declaring that they are deteriorated in quality by use. It may be concluded, from isolated but well-verified facts, that, after a certain time, depending upon the effective work accomplished by each, the axles will break.—Is this owing to any molecular change in the material? It is impossible to determine this from what we know at present; but it will be readily conceived that this is matter of serious consideration, and, consequently, the Commission thinks that every Company ought to be obliged to keep a register, in which should be entered, independently of the particulars of the time of receiving the axles, &c., the number of miles run over by each.

The documents extracted from these registers would doubtless be of great utility for solving the important questions relative to the duration of axles; but the fact cannot be denied that this will furnish no result until after a number of years; and, therefore, the Commission is of opinion that it would be advisable to make some experiments as to the means of ascertaining, at any time, the amount of alteration which has taken place in the axles; and either to restore them to their former state, or limit the period of their working.

After ascertaining the average weight which axles have to support, and the strain they undergo, the following experiments were proposed to be made:—On analysing the strain upon axles, it was found to consist, 1st,—Of a vertical strain, due either to that portion of the weight of the engine bearing upon that point, in consequence of the position of the centre of gravity, or to the action of the springs of the hinder axle in the six-wheel engines. This strain being thus defined, even supposing that the parts upon which it acts are as near as possible to the *point d'appui* formed by the wheels, tends, nevertheless, to bend the axle in a vertical direction.

2nd.—A twist or strain, arising from the conoidal form of the peripheries of the wheels, and inequality in the inclination of the rails; from which it happens that the peripheries of two wheels, fixed upon one axle, never touch the rails at the same part at the same time, and consequently, each of the wheels slip alternately on the rail: if the twist resulting therefrom is not too violent, it keeps all the molecules in a permanent state of vibration.

3rd.—The shocks arising from inequalities in the road, caused by the undulations of the rails, and the momentary depression of the rails at their point of junction when a train passes. These shocks increase in violence in proportion to the speed of the train, and act in a direction at right angles to the axis of the axle.

4th.—Another kind of shock, arising from the oscillation of the train, which acts on the axles both in the direction of their length and at right angles thereto, increasing in force in proportion to the diameter of the wheels on the axles.

In order to appreciate the effects of these four kinds of strain, the Commission is of opinion, that the first series of experiments to be undertaken, should be to inspect a certain number of axles which have already worked for a given time upon railways, and minutely examine their interior texture. As, however, these experiments could not lead to perfectly satisfactory conclusions, from the want of points of comparison, the Commission is of opinion that it would be advisable, at the same time, to commence experiments upon axles.

These experiments might be made by taking an ordinary locomotive axle, furnished with the two wheels, loading it as it would be if adapted to an engine, and giving to it a rotary movement, similar to that which it would acquire if employed upon a railway. By placing the wheels of this axle upon a frame, consisting of another axle, furnished with wheels, to which motion is communicated by a steam engine, the first class of action to be observed will be obtained.

All the other motions might be obtained by this means; and also, by a suitable construction of the wheels of the frame, the twisting of the axles, the shocks arising from the bending of the rails, and the shocks arising from the oscillation. By this method of proceeding, the axle submitted to experiment will be exposed as nearly as possible to the same injurious action as when in use; only, instead of advancing upon a railway, the railway will present itself to the wheels. The Commission, wishing to ascertain the expense of the above experiments, arrived at the following results:—

It will be understood, that the apparatus used for trying the experiments must be made of pretty large proportions, and all the parts must be sufficiently strong to resist the action, the effects of which it is intended to prove.

The details of this apparatus must be carefully attended to; but the expense cannot be estimated at less than from 400*l.* to 500*l.* In order that the experiments may lead to results worthy of interest, it will be necessary to try, comparatively, axles of at least three different diameters, and to act upon two axles of each kind, in all six axles, furnished with their wheels, the expense of which will be about 90*l.*

Lastly.—The working of the apparatus will require a certain amount of power, constant attention, and the renewal or repair of some parts of the mechanism, such as the brass bearings for the axles, or the tyres of the wheels.

In conclusion, the Commission is of opinion that, in order to make experiments in a suitable manner, an outlay of at least 800*l.* will be required. It is evident that these experiments will occupy a considerable time; but this does not appear to be a sufficient reason for abandoning them.

It was observed by the Commission, that in locomotive engines there were many parts subjected to considerable strain and violence, the rupture of which would be of minor importance, and that they might therefore, without much inconvenience, be allowed to remain in use until nearly worn out: of this kind are the rods which connect the locomotive to the tender, and also the bolts which serve to fasten them. By manufacturing several similar pieces with care, putting some of them in use, and keeping the others for the purpose of comparison, the Commission is of opinion that interesting results might soon be arrived at.

To conclude, as regards axles,—it only remained for the Commission to inquire into the precautions to be taken in the case of breakage of axles, in order to prevent any accidents arising therefrom. Plans have been proposed for this purpose by a great number of inventors, which it may be as well to make mention of here.

These plans may be divided into two categories; the first of which consists in the employment of wheels running on the rails in front of the engine, and serving as guides. The second consists in the employment of guides on the rails, the rods of which, being attached to the framing of the engine, are intended to keep the train in its place on the rails. Neither of these plans appeared to the Commission susceptible of useful employment. The guide-wheels would have the inconvenience of preventing the engineer from perceiving the breaking of the axle in time to stop the train.

With regard to the guides, if they were made as proposed, in the form of drags, they would cause shocks and serious accidents; they also would not offer any resistance to the oscillations of the engine; if made light, they would readily be broken when subjected to a violent shock; and if heavy, they would evidently facilitate the running of the train off the rails.

As regards the working of railways, another not less important question occupied the attention of the Commission. On the occasion of the Versailles accident the general opinion was, that nothing fatal would have happened if the locomotive "Matthew Murray" had been mounted on six wheels instead of four. This appeared also to be the opinion of Government, as one of the first precautionary measures was to prohibit the companies in the environs of Paris from making use of locomotive engines with four wheels. Before, however, this measure was made general (the immediate application of which would prove ruinous to many other companies besides those in the environs of Paris), the Commission thought proper to inquire into it as regards safety, and for this purpose took an account of the number of accidents which had happened upon railways worked with locomotives, either of six or four wheels, and the conclusion they came to was that, as regards public safety, the six-wheeled engine possessed some advantage over the four-wheeled engine, especially when the two driving-wheels are provided with flanges; this advantage is not, however, so great at present as entirely to do away with the four-wheeled engines. The attention of engineers must be especially directed to the improvement of the six-wheeled engines, and there is no doubt that when these engines have undergone the improvements which may be suggested, they will be generally preferred.

The parties in favour of the four-wheeled engines brought forward, in support of their opinion, the fact that, in six-wheeled engines, the centre of gravity of the whole was always before the cranked axle, and that, therefore, in case of the front axle breaking, these engines would fall as easily as the four-wheeled engines. On the other hand, by placing the framing which supports the four-wheeled engines inside, the fall of the wheels is prevented when an axle breaks, and there is no further fear of accident: but the Commission observes, that if in most of the present six-wheeled engines the centre of gravity is in front of the cranked axle, there is no practical impossibility in bringing it upon the axle itself. The front axles are, besides, not the only ones the rupture of which is to be feared; the cranked axles frequently break, and such accidents, which are not much to be feared in a six-wheeled engine, may have serious consequences in a four-wheeled.

With regard to the advantage attributed to placing the framing inside, it is, perhaps, sufficient to observe, that this arrangement does not apply particularly to four-wheeled engines, and that nothing conclusive can be arrived at as regards the safety of the engines fitted up in this manner. It does not appear certain that this will prevent the running off from the rails on the breaking of an axle.

Fires can only arise from two causes:—1st. The sparks escaping from the chimney of the locomotive: 2nd. Portions of incandescent or ignited fuel falling from the furnace, which falling pieces, even should there be no wind, are driven along by the current of air produced by the rapid movement of the train.

As regards the sparks which issue from the chimney, the Commission observes, that since railways were first worked, the chimneys of locomotives have always been furnished with a woven wire guard, which stops the sparks, and at the same time returns into the smoke-box a portion of the pulverulent substances, which, when allowed to escape, cause great inconvenience to travellers. This guard has since been somewhat improved; for instance, it has been formed of a closer fabric; also the chimney has been formed trumpet-mouthed, with iron wires stretched across it, whereby a stronger guard than the ordinary one is formed. The employment of the guard not having, however, always produced satisfactory results, other methods have been resorted to, which it will perhaps be advisable here briefly to describe:—

A strong metallic basket was placed at the lower part of the chimney, in the form of a truncated cone with its small end downwards. By this arrangement the portions of cinder and ignited fuel are presented obliquely to the meshes of the fabric, and therefore the smoke will have great difficulty in drawing them up. A horizontal cover was placed in a part of the chimney to arrest the portions of cinder and fuel, and throw them back to the bottom of the chimney, and the smoke escaped by lateral openings. In some cases, these two plans have been combined in one chimney, one above the other. Lastly.—A plate of iron pierced with round holes, about one-third of an inch in diameter, was placed in the smoke-box, in a horizontal position; whereby all the solid portions of fuel, which were not presented directly to the orifices, were immediately thrown back to the bottom of the smoke-box.

To these may be added another method tried in Germany, which appeared to produce satisfactory results. It consists in placing a fan, or wheel furnished with wings, on the top of the chimey, at an inclination of 45°, which, being put in motion by the heated air issuing from the chimney, drives the sparks to the sides of the chimney, where they are extinguished and fall back.

The Commission having ascertained the advantages of these several plans, was of opinion that there was no occasion to recommend any one of them in particular, but that it would be advisable to submit each to regular experiment; and until it should be shown by experience which was the best, the railway companies should be obliged to use one of them.

With regard to the ignited fuel falling from the furnaces of locomotives, the only means known of preventing the accidents which may result therefrom, is by employing an ash-pan to catch the cinders, and thereby prevent them from falling to the ground. There are, however, several disadvantages attending their use, such as—preventing the draft; being too near the ground; causing the bars of the furnace to wear away more quickly, and rendering the cleaning of the furnace more difficult; and, lastly, preventing the engineer from immediately putting out his fire, should it be necessary to do so.

An arrangement might, however, be contrived to do away with these disadvantages, either wholly or partially, in which case the ash-pans might be employed with great advantage; but in the present state of things, the Commission is of opinion that there is no occasion to recommend their employment, and can only propose to await the result of longer experience.

III. *On the mode of attaching the engines and carriages together, the kind of break employed, and the method of deadening shocks.*

A very important question was next discussed by the Commission, viz., whether more than one locomotive ought to be allowed to be attached to a train. The conclusion arrived at was, that there was always disadvantage, and sometimes danger, attending the use of more than one engine. It is, in fact, impossible that the engineers of the different engines should always act in concert; and moreover, if the foremost engine should meet with any accident, rendering it necessary to stop, the hinder one, continuing to progress, would most likely throw it off the rail, if the speed were considerable.

The Commission is therefore of opinion that more than one engine ought not to be used to one train, except, in certain cases, on railways in the environs of Paris, or other large cities, where there are an immense number of passengers.

Under these circumstances, when it is absolutely necessary to use two engines, how are they to be attached? If one of them is a six-wheeled engine, which of them is to be placed in front; and if both are six or four-wheeled engines, should the heaviest or the lightest be placed in front?

In order fully to answer these questions, the Commission thinks fit to remark that the principal danger consists in the probability, in certain cases, of the front engine being pushed forward by the hinder one; in which case it is liable to go off the rails, and might thereby cause very serious accidents. Under these circumstances, as the six-wheeled engines are more firm than the four-wheel, and are for that reason less likely to get off the rails, when two engines, one of six and the other of four wheels, are to be employed in one train, the six-wheeled one should be placed in front. For the same reason, when two engines of different weights are employed, it is desirable to place the heaviest foremost.

The Commission adds, that it will be better to have both engines exactly alike, and that the principal point to be observed when two engines are employed is, never to allow the hindmost one to be driven at a greater speed than the foremost, and also to take care that the driver of the front engine has the driver of the other engine under his control.

The next question discussed by the Committee was, whether, as regarded safety, the position of the engine in front or behind the train was material. With respect to this, it appeared evident that the engine-driver, if placed behind the train, could not easily see what was going on in front, and that, therefore, there would be great danger of his not perceiving any obstacle. The Commission was therefore decidedly of opinion that the locomotive ought never to be attached to the hinder part of the train.

Having thus disposed of the questions relative to the engines, the Commission inquired into the different plans employed for linking the carriages together. There appeared to be three:—The first consists of chains of a certain length, leaving a certain space between the carriages, independently of that allowed for the play of the springs. The second consists in the employment of moveable bars, which also allow of the play of the springs, but unite the carriages more rigidly than the first plan. The third, and last plan, consists in uniting the carriages rigidly together, by screws and keys.

On comparing these plans, the Commission remarked, that as regarded the first, independently of the disadvantage it possessed of causing unpleasant shocks in starting, serious accidents might be occasioned, in the case of a violent shock, by permitting the carriages to run over each other. It was, therefore, considered that the best mode of uniting the carriages would be by rigid fastenings acting upon springs. By this means, in case of a collision, the train would offer the resistance of a solid mass, and there would be no danger of the carriages running over one another.

The only disadvantage of this plan would be, requiring more power from the locomotive; but this is a minor consideration, when the safety of the passengers is concerned. The Commission was therefore of opinion, that the carriages should be united in such a manner as to allow of the buffers being always in contact.

Another no less important question was, whether vehicles with cast-iron wheels ought to be allowed between the tender and the passenger carriages. This was decided in the negative, as it appeared that cast-iron wheels, running with great speed, would soon wear, and were liable to break; in which case, the train would be almost sure to be thrown off the rails.

The Commission having thus decided upon the best means of forming the trains, as regarded the safety of the passengers, the subject next to be considered was the best means of regulating the speed of trains, and freeing them as much as possible from danger of accident, to which they might be exposed.

The most usual causes of accidents may be resolved into one, viz., a sudden shock, produced either by the locomotive coming into contact with some obstacle; by the breaking of an axle; or by running off the rails.

As regards the breakage of axles, accidents likely to occur therefrom may be most readily prevented by the promptitude and intelligence of the engine-driver.

With regard to shocks and sudden stoppages, what tends most to increase the danger is the speed at which the train is travelling; in order therefore either wholly or partially to obviate them, it is desirable to find out the best means of slackening the speed at pleasure. For this purpose brakes are used, which act by pressing on the periphery of the wheels of one or more carriages of the train, and by that means diminish the speed.

The brakes most commonly used upon railways may be divided into three classes.—1st. Brakes acting on one wheel only of each axle, and pressing on one side of the wheel.—2nd. Brakes acting on one wheel of each axle, but pressing against both sides of the wheel.—3rd. Brakes acting on both wheels, and on one side of each wheel.

Neither the first nor the second ought to be used, as they have a tendency to dismount the wheel opposite to that on which they act; and the first, especially, has a tendency to destroy the parallelism of the axles, which might occasion serious accidents.

The third class of brakes possesses neither of these inconveniences. It is true that, by acting on one side of the wheel only, the whole of the pressure will be exerted upon the pivot of the axle; and although this pressure is equal to the weight supported by the wheel (and consequently the pivot of the axle does not sustain much more strain than under ordinary circumstances), the best plan would no doubt be that by which a pair of wheels would be acted upon on both sides simultaneously; the efforts of inventors should therefore be directed to this object.

With regard to the brakes now in use upon railways, the Commission was not sufficiently informed upon the subject to be able to recommend any one of the proposed plans, and it appears that careful experiments would be necessary to decide the question. The following are the facts to be considered in these experiments:—

1st. What is the time necessary for enabling the person having the management of the brake to produce sufficient pressure on the wheels to stop them, including the time necessary for signalling?

2nd. What is the time necessary to elapse, and what distance will have been travelled, before a carriage, travelling at various speeds and provided with efficient brakes, can be stopped?

This experiment ought to be tried many times, under various atmospheric tendencies, in order to test the effects of dryness, dampness, or hoar-frost, or the effect of throwing sand on the rails, as was proposed and practised on the railway from Saint Etienne to Lyons; the experiments should be made upon levels as well as inclines.

3rd. What is the time necessary to elapse, and the distance to be run over, in order to stop a train composed of a locomotive and tender, and six or eight ordinary carriages, on different inclines and under various atmospheric influences, the carriages being provided with brakes, and driven at various speeds, making use,—1st. Of the tender brake, the steam being shut off.—2nd. Of one, two, or more of the carriage brakes, the steam being shut off.—3rd. Of all the brakes, and reversing the engine; in fact, employing all the means known for stopping.—The Commission, in considering the question as to the propriety of skidding all the carriages, is of opinion that it would perhaps be advisable, when proceeding at a speed of from twenty-five to thirty miles an hour, to adopt this method; but generally, in a train composed of a locomotive, tender, and seven or eight carriages, only one of the carriages is provided with a brake, and the Commission wished to ascertain which carriage it should be applied to.

It was remarked that, independently of the momentum acquired by the carriages respectively, each of them is, at the time of stopping, pushed forward by the one behind it, especially when connected loosely by chains; it therefore appeared advisable to provide the last carriage with a brake, which should act at the moment of stoppage, and, by thus offering a resistance, the force of which may be mathematically calculated, tighten the connecting chains or rods of the front carriages.

Should any apparatus be used to deaden shocks? And if so, what position ought it to occupy?

On this subject, the Commission is of opinion, that if it were possible to throw the whole or the greater part of the force of the shock upon any inert body, the safety of the carriages would be much increased; and as to the place it ought to occupy in the train, the Commission considers it best to place the brake between the tender and the passenger carriages.

Several kinds of apparatus adapted for this purpose, were presented. Some of them were composed of metallic springs, which would be gradually compressed by the shock, and by that means slacken the speed of the train; and others were composed of air-springs acting upon the same principle.

With regard to the former, they would be the more efficacious, in proportion to the time they allowed the train to run while compressing the springs; but, at the same time, the length of the springs must not be such as to cause danger of running off the rails when traversing curves. On the other hand, it will be understood, that it is advisable to construct them so as to offer the greatest possible degree of resistance; their weight must not, however, be greater than that of an ordinary loaded carriage. In order to produce the desired effect, the apparatus should be so constructed as to allow the train to bear the greatest possible compression without injury; occasion no danger in traversing curves; and offer the greatest possible resistance with the least weight.

With regard to the air apparatus, it would not act efficiently unless made of very large dimensions, so as to present a large body of air to be compressed; this kind of buffer is therefore inadmissible, from its bulk. In fact, as the density is in an inverse ratio to the volume of air, the apparatus would not act until the piston, meeting with resistance from the air, would be nearly at the end of its course, at which point it would not offer any efficient resistance to a shock of any considerable violence.

It appeared to the Commission, that an apparatus offering great resistance would not act so efficiently as one which would be broken by the shock of a collision.

It was thought that it would be advisable to propose a prize to the inventor of any apparatus, which, after being in use for some time, was found to act efficiently.

There are some preliminary arrangements, as regards safety, to be considered. One precaution which has been adopted consists in interposing between the tender and the passenger-carriages as many empty carriages as there are locomotives: this precaution may, in most cases, preserve the passengers from injury.

IV. *Of Rules to be enforced by Law in Working Railways.*

The first point to be considered, as regards safety in railway transit, is the working with perfect regularity, and subject to fixed rules, which must never be infringed; it is clearly the duty of Government to legislate on this subject.

By the present laws, railway companies are empowered to frame bye-laws for working, but they are obliged to submit them for the approval of the higher authorities. This is a salutary regulation, and the companies ought to be bound to inform the Government, in good time, of the hours fixed for the departure of the trains, as well from the termini as the intermediate stations.

Express trains must be used as rarely as possible, and only when they are absolutely necessary: their approach must be signalled along the line.

The Commission has not given much attention to cases where accidents might happen from two trains meeting on the same line. On railways, by which a great number of persons travel, there are always at least two lines of rail, and the only likelihood there is of one train running into another, is when they are both travelling the same way; and even this might be avoided if the officials were to adhere to the times fixed by the authorities for departure from the termini, and those fixed by themselves for the intermediate stations.

Independently of the shocks which may happen when the trains are in motion, passengers have sometimes been seriously injured from shocks occasioned on stopping at the termini, by coming into contact either with the walls or the carriages. This occurs either from the ignorance or negligence of the engineers, and sometimes from a derangement of the brake not allowing the train to be stopped with sufficient promptitude.

In order to obviate this, it would be advisable to direct the engine-drivers to stop the train completely before reaching the place where the passengers are to alight. When a train is in progress, it is indispensably necessary for the engine-driver to be constantly warned of all that passes on the line; and for this purpose there must always be, between the engine-driver and station-guards, certain signals, which may be readily understood by the latter; and by means of which the station-keepers may always communicate with each other. Signals between the engine-driver and guard of railway trains either do not, for the most part, exist, or are very imperfect. It will, nevertheless, be readily conceived, that many casualties may arise during the progress of a train, of which it is necessary for the engine-driver to have notice,—as in case of the breaking of an axle, the carriages running off the rails, &c. The Commission thinks that Government ought to direct, that in each passenger-train there should be a guard, furnished with the means of communicating the necessary intelligence to the engine-driver.

Another subject of great importance in railway transit is the question,—at what speed they should travel? and on this head, the Commission deliberated, first, whether it would be advisable to fix a maximum speed; but it was found, that a speed which would be without danger on very slight inclines and curves of large radius, would be extremely dangerous on steep inclines and curves of small radius, and which were to be traversed by heavy trains; it is, therefore, proposed to fix a maximum speed for each road, regard being had to the inclines and curves on each line, and also to the trains to run upon it.

It would also be very useful for each engine to be furnished with an apparatus for indicating (permanently and independently of the will of the engineer) the maximum speed of the train at any period of its journey.

Note on Experiments made upon the new line of rail at Saint Germain, with a Locomotive constructed by M. Flachat.

The town of Saint Germain is situate on an elevation of about sixty yards above the plain upon which the line of rail terminates at the Pecq Bridge. The atmospheric railway overcomes this difference of level by means of a series of gradients, forming altogether a parabolic curve, sloping towards the earth, and terminating in a gradient of 1083 yards in length, and having an inclination of 35 yards.

M. Flachat, who was charged with the superintendence of the works, acknowledged the necessity of constructing a powerful engine, capable of propelling upon steep inclines the materials necessary for the construction of the road, and the apparatus for the atmospheric plan. The engine is now employed for drawing earth from cuttings in the forest of Saint Germain: the wagons running up empty, and returning full.

The experiment made on the 17th of June last, was for the purpose of ascertaining the maximum weight the engine was capable of drawing on the above incline. The train consisted of four wagons loaded with earth, and weighing, when empty, between three and four tons. One wagon was found, when loaded with earth, to weigh nearly 12 tons. The load, on descending, was therefore—

The Engine, weighing about	20 tons.
The Tender	9 ..
Four loaded Wagons	44 ..
A Brake Carriage	3 ..
	76 tons.

The train started at a moderate speed, with the regulator entirely closed. The train having once stopped, it was found to be impossible to ascend again. One, two, and three wagons were then successively emptied, and it was not possible to ascend the incline until this was done. The train therefore consisted of—

The Engine	20 tons	29 tons dead weight.
The Tender	9 ..	
Three empty Wagons	9 ..	23 tons useful weight.
A loaded Wagon	11 ..	
A Brake Carriage	3 ..	

This experiment was made twice, and gave the same results both times.

The engine was working at a pressure of five atmospheres; the power it exerted, supposing the action of the steam to be the same throughout, was therefore about 3 tons 4½ cwt. The resistance to be overcome was as follows:—

	tons.	cwt.	lb.
Friction of various kinds, reckoned as 200th of the weight (76 tons)	0	7	56
Action of gravity	1	16	0
	2	3	56

There remains a difference of 1 ton, 1½ cwt., owing to the diminution of pressure, and additional friction of all kinds, and other casualties. It will, of course, be understood, that on less steep inclines this tractive power will be much increased.

REVIEWS.

The High Pressure Steam Engine investigated: an exposition of its comparative merits, and an essay towards its improved construction. By Dr. Ernst Alban, practical machine maker, Plau, Saxony. Translated by W. Pole, F.R.A.S. Parts I. and II. Weale, 1847. 8vo., pp. 145. Six plates.

The object of this book is a novel one. It is to advocate the superiority of the high-pressure over the low-pressure engine; and the omission of all exceptions in favour of the latter kind of engine leads to the inference, that the author recommends the adoption of the former under all circumstances, and for all purposes.

Dr. Alban tells us that he is a practical manufacturer of engines; that he has been engaged for thirty years, without intermission, in studying this subject; that he has made a large number of engines of various dimensions and varieties; and has been in the constant practice of experimenting with a view to their improvement. A man who brings forward his opinions thus authenticated by long experience, has a right to demand some attention to them, and will generally have something to say which is worth listening to. This is the case in the present instance; but while full credit is to be given to our author for his practical knowledge, it must be premised that he has confined his attention almost exclusively to engines worked by high pressure, and consequently is far more qualified to speak respecting their advantages and capabilities than respecting those of low-pressure engines. Possibly, had he studied the latter more, he would have thought better of them.

These considerations apply exclusively to Dr. Alban's practical knowledge—his theoretical opinions are to be criticised independently and abstractedly. We shall find that his physical conceptions, though often clear and vigorous, occasionally lead him into serious errors. The translator of this work sets out with high professions of the necessity of theoretical accuracy, and laments the aberrations of the unlearned in a manner which to some of his readers will appear amusing. He is very caustic respecting the unhappy frequency of blunders arising "from the practical methods adopted by ignorant men," and complains that "unhappily, in most cases, the unfortunate public have to pay for the schooling of their engineer,"—"unless the engineer has a knowledge of principles to guide him, and a capability too of reasoning on those principles." After this wholesale condemnation of engineers, it might have been hoped that Mr. Pole would have at least avoided the errors which he denounces, and that he would not have published in an English form several notions grievously at variance with the said "knowledge of principles." He professes to correct his author's mistakes, but the worst of them are passed over uncorrected, and apparently unobserved.

Of the two Parts of the work before us, the first is theoretical; the second refers to details of construction. We shall for the present confine our attention to the former, in which the author examines the objections brought against high-pressure engines, and replies to them, and then proceeds to a serial account of the advantages peculiar to these engines.

The objections may be considered first—they are principally these five. 1st. The danger of explosion: 2nd. The loss of heat: 3rd. The relinquishment of that power which arises from condensation: 4th. The consumption of oil and grease for lubrication: 5th. The wear and tear of metal from the rapidity of motion. We will take these objections in their order.

The first objection—respecting the danger of explosion—may be considered to be of a two-fold nature: for we have to ascertain primarily whether a high-pressure boiler be more likely to explode than a low-pressure boiler; secondarily, whether the results of an explosion are more disastrous in the former case than in the latter. Our author does not make this distinction; but it is obviously necessary for the complete examination of the subject. In comparing the probabilities of an explosion occurring in either case, we must, of course, for the fairness of comparison, pre-suppose that, *cæteris paribus*, the metal of the boiler is always made of a thickness proportional to the intended steam pressure: that is, that a boiler intended to bear a pressure of four atmospheres, is made twice as strong as one intended for a pressure of two atmospheres, &c. Unless this supposition be made, an accurate general comparison of the probabilities of explosion would be impossible; and, moreover, the precaution is one so palpably necessary, that no man of common prudence would neglect it. This being premised, we proceed to our author's first view of the case.

"Every boiler may become supercharged with steam when the quantity drawn off is less than the quantity generated, and when the safety-valves, in consequence of imperfections in their action or condition, do not properly perform their duty. Therefore, in so far as similar safety apparatus are used for both high and low-pressure boilers, they must be liable to similar interruptions in their working. Experience has shown this very often, and it has been found that even the vertical open-mouthed feed-pipes of low-pressure boilers, which act as escape-pipes when the boiler pressure is too great, (these are wanting in marine engines,) are not always secure. If then an overfilling of the boiler with steam is equally possible in both high and low-pressure engines, both are liable to danger from this source; as the strength of the metal is adapted to the working pressure, and therefore the proper elasticity for which the vessel is constructed must be exceeded when such an occurrence happens. But there is an advantage on the side of the high-pressure engine, for the elasticity must be increased in a much higher ratio than with the low-pressure engine, before it overcomes the pressure at which the boiler is proved (usually three times the working elasticity); and therefore a much longer time will elapse before absolute danger arises. For example, in a boiler working at eight atmospheres, it will take a much greater lapse of time for the pressure to rise to 24-atmospheres, than it would to reach 12 lb. per square inch in a boiler working at 4 lb.; and these would be the points at which danger may be supposed to arise in the respective cases. This gives a key to the experience of late times, that as great a proportionate number of low as of high-pressure boilers have exploded, as well in England as in America and France; and that among the latest instances, the accidents with the former have reached an alarming extent."

This extract brings us to the first allegation, that it takes a longer *time* to overcharge a high-pressure than a lower pressure boiler. The general truth is not stated with sufficient precision; it may be explained by the following example: by referring to the best tables for the relative volumes of steam at different pressures, we find that any given quantity of water will produce 249 times its bulk of steam of eight atmospheres' pressure, and 1669 times its bulk of steam of one atmosphere. Consequently, to fill a boiler with the latter or low-pressure steam, rather less than seven times as much water would be required as would be necessary for filling it with the former or high-pressure steam.

Now, it has been ascertained that the pressure in the boiler has no influence on the rate of vaporization—that is, with a fire of given intensity and a fire-box of given dimensions, the same number of pounds of water will be converted into steam in a given time, whether the boiler-pressure be one atmosphere or eight atmospheres. Coupling this consideration with that in the preceding paragraph, we arrive at the conclusion that the overcharging a boiler which can only resist a pressure of one atmosphere, takes about one-seventh of the time required for overcharging a boiler which will bear a pressure of eight atmospheres. In order to the accuracy of this conclusion, it is requisite however to suppose nothing altered but the boiler pressure, and that the capacity of the boiler, the intensity of the fire, and the dimensions of the fire grate, are in all cases the same. With this proviso (which is not stated by Dr. Alban), we may establish the general conclusion, that a low-pressure boiler is overcharged in a shorter time than a high-pressure boiler.

Our author then proceeds to consider the causes of explosion, and details the various hypotheses which have been suggested, such as that of the generation of an explosive gas from the decomposition of the water—the generation of hydro-electricity—and the sudden conversion of water into steam by coming in contact with overheated parts of the boiler. The latter of these hypotheses is by far the most probable; but there is one important point of agreement in them *all*, namely, that the ultimate or inducing cause of an explosion is the sinking of the water too low in the boiler, and the consequent over-heating of the metal. To this point, therefore, attention must be confined, when the safety of high-pressure and low-pressure boilers is compared. We have simply to ascertain which of the two is most liable to be overheated. One of the principal causes of this evil is

"Too great an accumulation, either general or partial, of scale or earthy sediment in the boiler. These substances being bad conductors of heat, prevent, when in large quantities, the proper distribution of caloric to the water, or at least injuriously retard its transmission. The heat of the metal then increases to too great an extent, and may frequently rise to incandescence. Sometimes it happens that the layers of deposit arrange themselves in such wise as to leave interstices to which the water cannot penetrate: now if any of the adjacent portions become cracked, the water will suddenly find its way upon the hot metal, and will cause a local explosion, thereby loosening the scale not only from the part previously affected, but for a considerable distance round, and consequently increasing the contact of the water with the heated metal. This produces a rumbling commotion in the water, which, if the incandescent spot be large, may be in the highest degree injurious to the structure of the boiler. The steam thus suddenly formed augments the pressure, and hence again increased danger may ensue, particularly as the spot overheated will have been rendered more susceptible of damage. It has often been remarked that explosions were immediately preceded by the rumbling noise alluded to above. The high-pressure engine has in this respect also an advantage over the low-pressure, in that the sediment, when the elasticity is great, seldom attaches itself firmly to the sides of the boiler, but collects in a loose state, and is easily removed."

The comparison proceeds in a fair manner as follows:—

"Boilers which are fitted with imperfect water gauges or feed apparatus, are particularly liable to the evils of a partial exposure of the fire surface, and unfortunately these defects are but too common, particularly with high-pressure engines. The same liability to danger is also incurred where internal fire-tubes are inserted, or where the water space is too flat and confined, and is exposed in an injudicious manner to the flues. When tubes are introduced, they seldom lie deep enough under the water level, and are therefore soon left uncovered by an accidental slight depression of the latter; and if the water chambers are too confined, the water will be often driven out during violent ebullition. Marine and locomotive boilers are particularly liable to this. A steam boat boiler which burst at Hull (an account of the accident, with a description of the appearance of the boiler after the explosion, will be found in the '*Civil Engineer and Architect's Journal*,' August, 1838, p. 283) furnishes an example of such an improper make. Both imperfections were united in its construction, and the collapsed fire-tubes showed that the metal of these parts had been overheated in consequence of the water being driven out of the too contracted surrounding chambers, and that by such overheating the parts were weakened, and at last suddenly gave way to the pressure. It is much to be regretted that marine boilers are usually subject to the evil of too confined and too shallow a water space; because the ship's motion renders them particularly liable to the exposure of the fire-tubes: the use of sails increases the mischief, for when the ship has lain over on one side for some time, her righting or careening will throw the water back upon any portions of the metal that may have become over-heated, and thus danger may ensue in proportion to the length of time the parts have been exposed and the degree of exposure. Hence we find the majority of explosions occur on board steam boats, and proportionately but few on shore.

Now since all marine boilers, as well for low as high-pressure, are liable, if injudiciously constructed, to similar dangers of the kind we have named above, no conclusion to the prejudice of high-pressure engines can be drawn from such accidents. Indeed of late years a general comparison has been in favour of the high-pressure system.* One reason why low-pressure boilers must, under the evils above-mentioned, be less secure than high pressure, is that in the former the ebullition is much more violent, and the water thereby more liable to be expelled, whereas under a great elasticity the bubbles of steam generated take a smaller volume, the ebullition goes on more quietly, and therefore the danger is lessened.

The common chest form of low-pressure boilers with straight sides tends to increase the liability to the exposure of parts heated by the fire, especially if furnished with internal flues, as is generally the case with marine boilers. The large flat surfaces easily bulge out by an increased pressure within, and the consequent augmentation of cubical content causes a sinking of the water surface; after which the restoration of the elasticity to its original degree may throw back the water over the spots it formerly left, and thus the source of danger is at hand."

The last mentioned evil is not enlarged upon in a manner corresponding to its importance. It may be demonstrated that boilers with flat sides are subject to much greater strain than those which are curvilinear in every part If the boiler be of the form known in geometry as a solid of revolution without flat ends (that is, if every section perpendicular to its axis be a circle), the elastic pressure within will not tend to *bulge* it. We think it may be shown that, in this case, the tension of the metal is direct or tangential, and that there are no transverse strains, analogous to those of a deflected beam or girder. But where *flat surfaces* are exposed to the action of steam, there is a tendency to make them belly out, like the sails of a ship. In this case, the metal *is* subject to transverse strains, and in consequence of the tendency to bending, will be subject to forces of both extension and compression (like a deflected beam); these forces greatly exceeding those arising from direct tension in the solid of revolution. It will be seen therefore that boilers with flat sides have a great disadvantage—in addition, it must be observed, to the weakness at the angles,—from the imperfect connection of the plates.

Another cause of danger in low-pressure engines, which Dr. Alban insists upon, is their great size.

"The greater the content of a boiler, the greater surface it must offer to the pressure of the steam, and the greater danger it must be subject to. This truth is so self-evident, that it is incomprehensible how it should be so universally neglected. The size of many boilers at present in use is truly astounding. I have not unfrequently seen them as large as 5 or 6 feet in dia-

* Vide 'Echo du Monde savant,' No. 24, p. 178. Up to the year 1834, only twenty explosions had occurred in America with high-pressure engines, while thirty-two had happened with low-pressure; and it is well known how common the high-pressure engine is in that country, particularly in the Western States. At a later date, the proprietors of steam boats in North America have stated, in a memorial to Congress, that since the more general introduction of high-pressure steam. the number of accidents has not only not increased, but become lessened in an extraordinary degree.

meter. Such boilers ought indeed to be named *exploders*, and the legislative restriction as to the amount of pressure to be used with them is, as far as it goes, a salutary measure. Still better would the law stand if it began at the other end, and limited the size of the vessels instead of the elasticity of the steam within them; for such an enactment would be free from the objection of discouraging the use of high-pressure steam, now promising so much advantage to industry. We can scarcely hope, however, for the full realization of our wishes in this respect, unless a bold and enlarged view is taken of the system; for, as I shall hereafter show, the high-pressure engine cannot be made to display its advantages with steam under about six atmospheres' pressure. A compulsory enactment restricting the size of the generating vessels would tend much towards promoting the use of steam of such high pressures, and, by producing a necessity for acquaintance with the working of the engine, would undoubtedly further its real improvement."

The comparison is not, however, here stated quite fairly. It is true, that all things else remaining the same, the tension of the boiler increases with its size; but then we set out by supposing the strength of the material increased in like proportion. The author himself insists that it be presupposed, *in limine*, that the thickness of the metal be proportioned to the tension to be resisted; and, as we have already said, it is absurd to institute a comparison on any other terms. In objecting therefore to the great size of low-pressure boilers he should condemn—not their weakness (which is supposed to be provided against)—but the great weight of metal required to make them sufficiently strong.

The relation between the thickness of the metal and the dimensions and pressure of the boiler, may be easily determined in most cases; and we intend to lay before the reader, in a separate paper, the means of calculating, with great facility, the proper thickness of a boiler of given form and size, in order to sustain a given pressure. For the present, however, we may observe, with Dr. Alban, that when the plates of a large boiler are increased to a thickness proper to its dimensions, they may become so thick as to be liable to crack from the sudden application of heat. This is a source of danger altogether independent of those hitherto considered,—it must be prevented either by making the plates of metal of superior temper and tenacity; or by gradual and careful heating; or lastly, by reducing the size of the boiler, and consequently, the thickness of its plates. Dr. Alban must, however, recollect that, in respect to this danger of cracking, low-pressure and high-pressure boilers are frequently on a *par*. He says—

"It is indeed customary to give to boilers of great size a proportionate thickness of metal, but this helps the case very little; for experience has shown that thick plates, especially if of cast metal, are more liable to crack by the action of the fire than thin ones; inasmuch as the temperature of their two sides, exposed respectively to the fire without and the water within, does not quickly assimilate; whereby unequal expansion and contraction ensues. It is moreover a difficult matter to determine what the proper strength ought to be in proportion to the diameter and the pressure, and there is a great difference of opinion among those who have given their attention to this point. It must also be noticed, that thick vessels tend more to retard the transmission of heat to the water than thin ones, although this fact seems often to have escaped the notice of engineers."

But how extremely unphilosophical is it to urge this as an argument against low-pressure boilers exclusively! A boiler of large dimensions and low pressure may require the same thickness of metal as a boiler of small dimensions and high pressure.

The second objection against high-pressure engines—the loss of heat—we must, for the sake of brevity, dismiss with the following brief consideration, which, in fact, embraces the sum of our author's arguments. By a well-known property of steam, ascertained by Watt and many others, the sum of the latent and sensible heats is constant at all pressures, and therefore the same fire will evaporate equal quantities of water in a given time, whatever be the boiler pressure. Now, it may be demonstrated mathematically that steam acts with most effect when used at a high pressure and worked expansively. Consequently there is, *cæteris paribus*, a greater economy of fuel when the steam is generated at high pressure.

The third objection—the relinquishment of that force arising from condensation—is stated correctly by Dr. Alban, except in that he under-estimates the amount of power obtained in practice by condensing the steam.

"Partly through imperfect condensation, partly through the working of the air and cold water pumps, and from other causes of the same description, the useful effect of low-pressure engines is reduced from about 17 lb. per square inch absolute pressure upon the piston, to about *seven*, as made available in power obtained; so that the use of condensation only in reality offers a gain of from 4½ to 5 lb. per square inch, or one-third of the atmospheric pressure........ The objection loses in weight as we use steam of higher pressure, and at seven or eight atmospheres is scarcely to be considered, because the surface of the piston becomes proportionately less as the elasticity is increased, and therefore the loss of the vacuum is less to be felt; while the advantages of the system are increased by such increase of elasticity. When the pressure used is too low, for example, only two or three atmospheres, as is most common, the loss may be important, and the advantages of the high-pressure system are not sufficiently developed to cover it. For instance, an engine of 10-horse power at two atmospheres' pressure, will require about twice as much steam as a condensing one of the same power: it must be of about the same dimensions, and by the want of a vacuum must be supplied with steam of a double elasticity to produce the same effect. Here, therefore, a power of ten horses will be sacrificed by the want of the vacuum; that is, as much as the whole power of the engine. But if a pressure of eight or ten atmospheres be used, and the principle of expansion applied, the proportionate loss, by the sacrifice of the vacuum, will be scarcely equal to 2-horse power out of ten,—a loss of very trifling weight when compared with the advantages possessed by such an engine over a low-pressure one. Yet more in favour of the high-pressure engine would the comparison be if we could substitute steam of sixteen atmospheres for that of eight; but unfortunately, through practical difficulties in the working of the machinery, our limits of available elasticity are at present too confined."

We may here observe, that elsewhere Dr. Alban recommends that the steam should always be generated at a pressure of eight or ten atmospheres, or 120 lb. to 150 lb. to the square inch. He speaks of employing what we should consider excessive pressures, with great composure. "Once," says he, "I worked an engine, for the sake of experiment, to a pressure of 1000 lb. on the square inch, and it was found that under this tremendous pressure, the engine itself remained perfectly firm and steam-tight"! He tells us also, that in the ordinary working of his steam engines "the steam makes its exit from the cylinder with a pressure of about three atmospheres," or 45 lb. Now, in English railway locomotives, steam is often admitted *into* the cylinder at the pressure with which Dr. Alban suffers it to escape. So that if it were possible for him to send his steam here when he had done with it, we might use it in working our locomotives. It seems scarcely possible that there can be any economy where steam is suffered to escape at this high pressure: for supposing it to be admitted to the cylinder at eight atmospheres, and to maintain uniform pressure throughout the stroke, the effective pressure is (8–3, or) 5 atmospheres: consequently, ⅜ths of the power is wasted. The reason assigned for expelling the steam at a high pressure exhibits some very odd philosophy:

"The steam leaving the cylinder would at the end of each stroke retain too little excess of pressure above the atmosphere, and therefore would blow out with too small a velocity, and leave behind an increased resistance to the piston. For example, steam of three atmospheres, expanded to three times its volume, would scarcely balance the atmosphere, and would thus have no tendency to blow out; while steam of two atmospheres similarly expanded, would sink so much under the atmospheric pressure, as to cause a very injurious counter-resistance to the piston from the entering air."

The phrase, "leave behind an increased resistance to this piston," is to us perfectly unintelligible. If the escaping steam be of high elasticity, it will doubtless have a great tendency to rush out by the eduction-port—but the same elasticity also acts to retard the motion of the piston. Of course, it is desirable that the steam should be got rid of with facility; and, in order that the piston may drive it out with as little resistance as possible, the escape-pipes should be made of ample size. But a "tendency to blow out" in the steam itself is of no advantage: for it has no power of itself to "blow out," after so much of it has escaped as to make the pressure of the remainder equal to that of the atmosphere. This remainder is expelled by the piston. Consequently, the piston will always have to drive out steam of *not less* pressure than the atmosphere—if it be much greater than the atmosphere, an unnecessary resistance is created. We come, then, to the conclusion that, in all engines in which the steam issues directly from the cylinder into the air, the issuing steam ought to be as nearly as possible of atmospheric pressure: in other words, if the steam be admitted from the boiler at a high pressure, its maximum effect is obtained by working it expansively and reducing it to about 15 lb. pressure, before the eduction-port is opened.

The fifth objection—the wear and tear of metal from rapidity of motion—our author tries to overcome by theoretical arguments: but the facts are too strong for him. That the rubbing parts of the best locomotive engines suffer a great wear and tear, due to the rapidity of motion, is an incontestable truth, which no arguments such as the following can get rid of:—

"It is inconceivable how the apparatus for transmitting the motion of the piston of a high-pressure engine to the machinery can be more subject to destruction, in regard to the durability of its joints, than in a low-pressure. If the power of each be the same, the machinery must have in each case equal strength: the stress to which it is subject is the same (or rather is less in the high-pressure engine, on account of the diminished prejudicial resistance, and consequently diminished total pressure required), and there is no reason whatever why any required strength may not be given to these parts; so that if there should be apprehension from the unequal action of the piston when expansion is used, the strength may be increased at pleasure. Can the gradually diminishing force of the steam of an expanding engine do more mischief than the great shock which must occur in low-pressure engines, owing to their increased resistance? Then every one knows what sudden concussions are produced throughout the machinery of a condensing engine at the moment when the air-pump discharges its contents, at which instant the whole pressure of the atmosphere is suddenly thrown upon the area of the pump."

The parenthesis in the above extract involves a serious error. Even supposing we admit the "prejudicial resistance," and consequently the "total pressure," to be less in the high-pressure than in the low-pressure engine, it by no means follows that the strains of the individual parts are diminished. Those strains arise not merely from the external resistance, but also from the momentum of the working parts—or, to use mathematical language, they depend upon both the effective and impressed forces. For instance, a grindstone, though suffering no retardation from the friction of its axle, might revolve so fast as to be torn to pieces by its own centrifugal force. Similarly, the parts of a steam-engine may move backwards and forwards so fast, as to be fractured by excessive strains: these molecular strains being, moreover, far more dangerous where the motion is reciprocating than where it is rotary.

With respect to friction and attrition, also, it is undeniable that both increase with increase of velocity. If a drill, for instance, revolve slowly on a plate of steel, it will make no impression—if it revolve very fast, it will wear away a hole for itself immediately: the same considerations apply to the rubbing parts of steam engines. The review has, however, already extended to such a length, that we must not at present pursue the subject any further.

The Life of James Gandon, M.R.I.A., F.R.S., Architect, *with Original Notices of Contemporary Artists and Fragments of Essays. From materials collected and arranged by his son,* James Gandon. Prepared for publication by the late Thomas Mulvany. Dublin: Hodges and Smith. 1846. 8vo. pp. 297.

Gandon, though an Englishman by birth and education, executed the greater part of his architectural works in Ireland. Those by which he is best known are the Custom House, Courts of Law, and King's Inn, Dublin.

He evinced early in life a strong predilection for mathematical and engineering drawing—pursuits for which some of the most celebrated architects have exhibited great aptitude. His professional career commenced under Sir William Chambers, from whom he acquired, besides his architural knowledge, a vast stock of general information: for his preceptor was a great traveller—borne a Sweede, he had travelled much in the East, visited China, and wrote a book on its architecture—had resided several years in Italy, and minutely informed himself respecting Roman architecture. Gandon began life well: greatly to his preceptor's gratification, he obtained the first of the architectural medals given by the Royal Academy. This achievement took place in 1769, the year after that body was instituted, and is described in the following terms:—

"As soon as I read the advertisement for the distribution of these premiums, I was like a person electrified. I hurried to my friend Paul Sandby, who soon assured me that I could have no chance of success as a competitor for the gold medal in architecture, inasmuch as I was not elegible to be a candidate: the advertisement requiring that all the candidates should be students of the Royal Academy. This restriction certainly appeared a formidable obstacle to my becoming a competitor on the occasion. I had not much time for reflection, and the temptation was great, but I soon determined how I should act: I immediately entered my name as a student of the Academy, and attended all the lectures given by each professor. This was my only alternative.

"The Academy gave ample time for the candidates to prepare their respective productions. I commenced instantly to arrange my ideas on the subject given, which was a triumphal arch, commemorative of the Seven Years' War.

"The day at length arrived when the candidates were to send in their designs, and I was soon informed, to my very great gratification, that my design was declared the best, and that, consequently, I should obtain the gold medal.

"On the day fixed for the distribution of the medals, but before they were actually delivered, the architectural class were required to attend a Committee of the Academicians in a private apartment, in order to test their respective powers in impromptu composition. The different subjects were deposited in a vase, out of which each candidate drew his envelope, in which the subject was written. That which came to my hand was a park-gate, or rather an ornamental entrance to a park. Having first arranged my ideas, I then sketched out my design, and it was more admired by the Committee than my triumphal arch.

"When the medals were being distributed I was congratulated by many of the members, but particularly by Sir William Chambers, who expressed the pleasure he experienced on finding his pupil so early distinguishing himself."

Gandon next obtained the second of the premiums offered by the merchants of Dublin for a new Royal Exchange, and it appears from the biography that the award of first premium was influenced by private interest—a circumstance by no means unparalleled, as (we doubt not) many of our readers could attest. The next premium gained by Gandon was one of 100 guineas for the "new Bethlehem Hospital." This was the last public work for which he competed in England.

In 1779, he received an invitation from Lord Carlow to go over to Ireland, which he accepted, and was then appointed architect of the New Custom House. They manage matters in Ireland in a manner peculiar to themselves, as Gandon found out to his cost: for on his arrival, the opposition of individuals to the removal of the Custom House had become so strong, that it was actually necessary that he should secrete himself for several months. The foundations of the new building had scarcely been commenced before the mob were instigated to destroy the fences surrounding them. The architect received letters threatening him with personal injury, and in consequence always visited the works with a good cane sword; and "having been in early life a good swordsman (says he), I am determined to defend myself to the last." There were other difficulties however besides those of a personal nature.

"The labourers had scarce got down two feet below the surface when they came to water, which four men emptied with scoops as they continued to extend the line of trenches, which were carried on in short lengths, and, for convenience, of different depths. It became necessary to make dams across parts of them with sods, and to empty the water from the lower to the higher dam, until it was at last sent off in a drain prepared for that purpose, our pumps not being then ready. The ground was opened first at the north and continued round to the east front; then to the south end, where a boiling spring with sand appeared at about four feet below the surface, which filled up as fast as it was cast out. It extended for a considerable distance. Inch and half sheeting piles, about seven feet long, were driven down with a maul, to keep up the bank, and sods were fitted in layers between it and the piles, which prevented the sand from being washed out, thereby enabling the men to clear out the trenches to the depth required. The general texture of the ground was gravel, mixed in some places with a layer of blue clay and sand, under which was a hard strong gravel. When the trenches were thus prepared and cleared out, the rough masons then proceeded to carry on the first bench or course with all possible expedition with the black stone, and immediately filling in with earth, in order to give less water to the pumps. In the meantime another length, and of the same depth, was got ready, and an additional number of masons set to work. In this manner the whole was continued until all was brought up to the level of the ground.

"The quay wall or road on the south front was an old embankment, made about the year 1725; it was sixty feet wide at top, and badly constructed; the walls of black stone; its foundation laid on the surface of the strand; on the side next the river it was twelve feet high, but on the inside only eight; the filling between the walls was a sand used for ballast; the base of the foundations stood at least six feet above the bed of the river; the tide not only soaked under them, but filtered in several places through the joints of the masonry. It was, therefore, deemed most prudent to commence with the north-east wing, after the portion of the store-room, it being less liable to be incommoded with water from the river.

"Directions were now given for excavating that part of the centre of the south front for the cupola and portico; and as this advanced so near the river we were certain of much obstruction from the flowing of the tide, which was the only water that now gave us any trouble, for the springs were now pretty well dried and kept under. The pumps hitherto used were but thirteen or fourteen feet, we now used two of eighteen feet in length. As the ground altered in its texture towards the river, becoming more loose, with small sandy gravel, like that of the south-west angle, to which depth we had sunk, we deemed it prudent to bore it in several places which were near the angles of the front of the portico, but particularly where the walls of the cupola were to be erected, to the depth of eight feet below the then surface, and it appeared to be much of the same substance as that already described. A pile ten feet long and one foot square was driven down in the centre to nine feet depth; but after twenty strokes of the ram it could be driven no further, which assured us that we had got down to firm ground.

"Upon consulting with the principal artificers on the spot, it was thought advisable to desist from sinking any more, but to make an artificial foundation, in order to sustain the great weight of the cupola; but whether by piling or otherwise was submitted wholly for my consideration. This part of the work had long occupied my thoughts, and to it I had given every attention, my conjectures having led me to expect great difficulties on this subject. I had nearly made up my mind as to the means I should adopt, and was the more strongly confirmed in my intentions, having remarked a circumstance which escaped the notice of those around me. Immediately after the pile had been driven, I perceived a small stream of water arising up close all around it, as if it had pierced a spring; and recollecting an observation in Labelye's* account of Westminster Bridge, 'that piles sometimes loosen and open fresh springs, which often make it very difficult to get rid of the water,' I was now apprehensive of just such an impediment. The great expense of preparing the piles, and the very long time it would take to drive so great a number as would be required, presented a strong objection to the use of them. I therefore gave directions to have a grating of Memel timber prepared, the timber to be one foot square, to have the upper ones notched down three inches in the ground pieces, which were to be bedded on a layer of cut heath, the whole ground being first correctly levelled; the interstices of the grating to be filled in with hard sound stock bricks, up to the level of the timbers, swimming in mortar composed of pounded roach lime and mortar well mixed, which answered nearly as well as tarras; over which was laid four-inch fir plank fastened down on the grating with oak trennels, which was all completed. The foundation walls were then set out on the 17th of September. The part directly under the cupola was laid with rough blocks of mountain granite in regular courses; in the first course was sunk an iron chain of flat bar, four inches wide and two and a half inches thick, into collars which were run with lead, but the bars were only covered with a cement of wax, resin, and stone dust. The rest of the foundation was done with the usual black stone, and was carried up to the plinth by the 16th October, 1782, thereby completing the whole of the foundations in one year and four months from the opening of the ground."

Another of Gandon's works consisted in several extensive additions and alterations in the Irish House of Lords—a large edifice, now converted into a bank. On the east side of the building a Corinthian portico was erected, in the construction of which many local difficulties, arising from the declivity of the ground, appear to have been overcome with great ingenuity and sound architectural taste. The dome, which was part of the original work, was destroyed by fire under circumstances which indicate that crotchets respecting ventilation have been fostered by other parliaments besides our own.

"This dome was subsequently destroyed by fire caused by the following circumstances. A man of the name of Nesbit, a smoke doctor, had been introduced to the Speaker, and recommended to his notice as a prodigy, in producing the greatest heat with the least possible portion of fuel. He was, therefore, employed to warm the House of Commons: and was suffered to cut into the walls, in order to lead flues into copper tubes, which he proposed to place on the angles of the dome. These tubes, from their nature, were very liable to be choked, and were often observed to be on fire, and large flakes of burning soot to fly out from them, to the great alarm of the neighbours, who gave repeated information of the fact, but to which no attention was given. The windows of the dome were also left very frequently carelessly open; the burning soot was driven in by the wind, and, resting on the framing, the wood-work took fire, and on the 27th February, 1792, totally destroyed the dome, during the sitting of the house. An inquiry was afterwards made as to the cause of the fire, but the real facts of the case were suppressed, and—the inquiry ended in smoke!

The foundation stone of the Courts of Law, or Four Courts as they are called, was laid in 1786; the erection of this building was impeded by the same factious opposition which attended Gandon's other works. The last public edifice erected under his superintendence was the Hall and Library and other offices of King's Inn, an ancient legal society constituted in a similar manner to the Inns of Court in London. This was the only building which Gandon left unfinished; the completion of the work he assigned to other hands on his retirement from professional life. His architectural labours extended over the long period of sixty years, and he died in 1824, at the age of eighty-two years.

Gandon's works appear to be characterised by the same merits and the same defects as those of his preceptor, Chambers. Judged by external appearance only, his works exhibit symmetry and unity, and impress the mind by their grandiose combinations: but their great defect is the presence of adscititious inconstructive ornaments. Gandon was essentially a Roman architect. In his time, almost all that was known of Classic architecture came from the Romans and Revivalists. The labours of "Athenian" Stuart and Revett were very recent and little known; and, until their time, there was an almost entire ignorance of Athenian, or pure trabeate architecture. The first volume of the Antiquities of Athens was published during Gandon's apprenticeship to Sir W. Chambers, and its appearance caused a great sensation. Still less was known of Pointed architecture—as Gandon himself shows in an essay at the end of the biography. It is not therefore to be wondered at that the dependance of decoration on construction was in his day little attended to.

The biography before us is well arranged, but there is too much gossip in it; notices of people of no note, and of transactions not worth recording. The architectural accounts are exceedingly meagre, and it is surprising that no technical or illustrative description of Gandon's works has been given. This omission greatly diminishes the value of the work. However, many of the observations show great taste and discernment, and the authors have the credit of recording the honours of one who in his day and generation laboured earnestly for the advancement of architecture.

Ancient and Modern Architecture, consisting of Views, Plans, &c. of the most remarkable edifices in the world. By Jules Gailhabaud. Third series. Fermin, Didot, & Co. 1847.

The third series of this work is by no means inferior to the preceding parts of it. The conductors seem to have kept steadily in view their object of furnishing a complete set of illustrations of all known styles of architecture, from the earliest monolithic to the latest Italian and bastard Classic structures. Among the plates before us we have several illustrations of Celtic monuments, details, &c., of the arch of Septimius Severus, the tomb of Cecilia Metella, and the church of St. Ignatius at Rome. There are also numerous illustrations of St. Peters, at Rome, and St. Paul's, at London. We were especially pleased with the view of the interior of the church of St. Front, at Perigueux, which displays in an extraordinary degree the possibility of producing beautiful effects by the simplest means. This church, a very early specimen of the combination of the round and the pointed arch is remarkable for its severity; the interior has scarcely a single moulding or other ornament, and yet the effect is extremely impressive, simply because the architecture is *faithful*. It would be absurd to recommend the massive arches and piers of this church for modern imitation; but it it is far better (say we), that the architecture should be, as here, without ornament, than that it should be covered with the adscititious finery stuck upon buildings which by modern courtesy are called "Classic."

The letter-press of the series before us is not satisfactory—the descriptions are far too concise; and another defect is that they are published on loose sheets of paper, so as to be liable to be lost before the series is completed. Moreover, these "Sybilline leaves" are always dispersed (in the copies sent us, at least) in a most irregular manner. The history of Stonehenge accompanies the plates of Cologne Cathedral, and the description of the Temple of Vesta follows the views of a vile Parisian church of the sixteenth century. However, these defects are comparatively trivial, and might easily be remedied—we mention them because the work is a good one, and deserves all the care that can be bestowed on improving it. The following account of triumphal arches may serve as a specimen of the letter-press. The writer remarks, rather simply, that "the Greeks do not appear to have built any triumphal arches"—for which circumstance two very sufficient reasons may be assigned: first, that they could not, if they would, have done so; secondly, that they would not have done so if they could. The Greeks were ignorant of arch construction, in the first place: in the second place, they never made a single architectural member do duty for a whole building; and consequently had they employed arches at all, would have *made use* of them to support edifices, and not have displayed them for mere show.

"Triumphal arches are isolated portals erected at the entrance of towns, on public places, roads, or bridges; they are generally intended to commemorate a victory, sometimes also to perpetuate the memory of the real or supposed virtues of a prince, or to do honour to persons who have rendered great services to the state. In this last case they might more properly be denominated honorary arches. Not to mention here the great number erected for this last purpose in China, where arches called *Pay-leou* are often raised in honour of the most humble virtue, we might name a host of these monuments consecrated to civil virtues, such as the Arch of Ancona, built in honour of Trajan, to show the gratitude of the citizens for the improvements he made in the port, and bearing a dedication in which the name of the Emperor is associated with those of his wife and sister. We learn also from ancient inscriptions that monuments of this kind were occasionally erected in honour of the gods. It is very probable also that many of these arches answered a twofold purpose, being at the same time triumphal or honorary monuments, and gates of towns. We must be careful not to confound the subjects of the present article with those structures which are merely town-gates, like those of St. André and Arroux, at Autun, in the Department of the Saône and Loire, though they present a close analogy with triumphal arches. It is equally necessary to distin-

* M. Labelye, a native of France, was the engineer of Westminster Bridge.—Ed.

guish those arches with four fronts, called Janus Arches, erected in market-places as a shelter for buyers and sellers, and of which a very beautiful specimen is still extant at Rome, in the *Forum Boarium.*

The Greeks do not appear to have built any triumphal arches. All those in Greece or Asia Minor belong to the period of the Roman domination. The Romans must therefore be regarded as the inventors of these edifices, which, at first were nothing more than wooden structures raised across the streets where the triumphal processions passed. These fragile and temporary constructions undoubtedly supplied the original model of the form and decoration of triumphal arches. The descriptions in ancient authors inform us that it was usual to place musicians and men bearing trophies on the top of these monuments, while the spoils of the enemy and representations of battles covered the sides. Such were the nature and object of the structure, that the architect was afterwards required to produce in solid materials calculated to endure for centuries.

The first permanent triumphal arches were reared under the Republic, but they had no pretensions to splendour. Rosini says of them: "Primo rudes et simplices fuere cum præmia virtutis essent non ambitionis lenocinia. (*Antiq. Rom.* l. x.) The Arch of Romulus was rudely built of bricks; that of Camillus, of stones, almost as rough as they came from the quarry. For a long time these monuments consisted merely of a semicircular arch, surmounted by trophies and the statue of the conqueror. Such was the one which Cicero called *Arcus Fabianus.* Triumphal arches did not hold any honourable rank among the monuments of art until the time of the Emperors; and it is a remarkable fact, that, notwithstanding several were erected to Augustus, and very probably in his lifetime, Vitruvius does not even allude to them. At a later period, when a considerable number had already been erected, Pliny speaks of them as a modern invention.

Down to the time of the Antonines, arches generally consisted of a single arcade; but this rule was not always adhered to, as the arch built in honour of Tiberius, Drusus, and Germanicus, on the bridge of Saintes, in the Department of the Lower Charente, had two openings of equal dimensions. This last style, though commonly and judiciously reserved by the Romans for gates of towns, was also employed in the Roman arch at Langres, in the Department of the Upper Marne, probably for the purpose of expressing the equality of the two Gordians, who both received the honours of a triumph at the same time. The use of three arcades, at an earlier period, is proved by medals of Domitian and Trajan, relating to arches no longer in existence; but we find instances of one principal arch, with a small one on each side, for the first time in the Arch of Orange, belonging to the early years of the empire; again, under Septimius, and his successors, as well as in most of those belonging to modern times. Thus we see, in accordance with the usual course of human affairs, that the richness of triumphal arches increases in an inverse ratio to the merits of the actions and men whose memory they were intended to perpetuate.

The Engineer and Contractor's Pocket Book, for the Years 1847 *and* 1848. Edited and Published by John Weale.

This work contains a great deal of useful information suitable to the engineer. Besides the Standing Orders of the House of Commons and House of Lords, and Acts of Parliament relative to railways passed in 1844, and for constituting commissioners of railways passed in 1846, it also contains prices for mechanical engineering, an interesting description of the electric telegraph, numerous tables of reference, and memoranda. We recommend Mr. Weale, in a future edition, to arrange the work a little more systematically, and to withdraw the "Practical and Experimental Researches on Hydraulics," for the reasons stated in our review on that paper a short time since.

HISTORY OF ENGINEERING.

By Sir J. Rennie, President of the Institution of Civil Engineers.

The Address of Sir John Rennie to the last year's Annual General Meeting of the Institution of Civil Engineers, contains a most valuable and elaborate report on the progress of engineering during the past century. The length of the address precludes the insertion of the whole of it at once, but as from the importance of the subjects considered, it is necessary that the reader should be put in possession of the whole, the report will be completed in successive portions without any omissions:—

Before I attempt to point out the course which it behoves us to pursue as regards ulterior proceedings, let us pause and take a retrospective glance at the changes which have been effected in Great Britain since the days of that great man Smeaton, to whose genius and exertions Civil Engineering may be said to owe its establishment as a profession in this country. Previous to that period (1724), Great Britain may be said, comparatively speaking, to have been lamentably deficient in public works. There were no canals, railways, nor artificial harbours, or machinery, which at the present day would be thought worthy of the name; and the public roads were little better than mere tracks across the country. Communication between towns was difficult; and the few wheeled carriages in use were of a rude and inefficient description. The inland commerce of the country was chiefly carried on by transport on the backs of "*pack horses*;" and the old-fashioned term *load*, so commonly in use as a measure or weight, is a remnant of that custom—meaning a horse load. The luxuries, and even necessaries of life, were, consequently, extremely dear and difficult of attainment. Inland navigation, which was carried on in the rivers as nature had left them, was both tedious and uncertain; and this navigation, imperfect as it was, could only be adopted at times when there was sufficient water, arising from floods, or other causes; occasionally (but of this the instances were very rare) rude temporary stanches, or flash-weirs, were used to pen up the running water in shallow places; these weirs, or stanches, were then suddenly withdrawn, and thus the increased depth of water and the current enabled the boats to float over them; these were followed by rough unwalled locks; then by short side-cuts to avoid the difficult places of the rivers; in these side-cuts the pound-lock was introduced, with side-weirs to enable the floods to escape, and to supply mills with water, thus answering the double purposes of navigation and supplying power for machinery.

The above may be taken as the extent of improvement to which inland navigation had arrived in Great Britain up to the middle of the last century. The navigation of the ocean, depending upon the inconstant agency of the winds and tides, required months, nay, years, for communicating between distant quarters of the globe. The reckoning of a ship's course, during a long voyage, was most uncertain; neither chronometers, nor lunar observations, nor accurate instruments for making such observations, were known.

Steam Engine.

The Steam Engine (to the honour of inventing which so many individuals lay claim) had, in 1698, been so far improved, and was, for the first time, constructed by Savery so as to be employed as an efficient agent for raising water, was brought into active operation, in 1712, by means of a steam cylinder, into which cold water was injected for causing a vacuum, so as to enable a moveable piston to be impelled by the pressure of the atmosphere, and thus, by the intervention of a lever, to work pumps for raising water; this was further improved by Potter and Beighton (1713-18), so as to become self-acting; and thus Newcomen's engine, by degrees, became generally adopted for pumping water from collieries, and from a few rich mines, and for supplying the metropolis with water; but the consumption and expense of fuel was so considerable that, even great as were the advantages derived from its employment, still its application was very limited. After Beighton, followed Leupold, Hulls, Belidor, Payne, Blake, Fitzgerald, Emerson, and others, who made various suggestions, without, however, adding anything material to the engine as improved by Newcomen, Potter, and Beighton. The relation between the quantity of fuel consumed and the effect produced by an engine, had never been determined; and knowledge was wanting for the investigation of the important subject, until Black and Cavendish, in 1760-62, had made their experiments and discoveries on the combination of heat with bodies in their solid, liquid, and gaseous states. Notwithstanding the great advantages resulting from the employment of Newcomen's engine, still, for the reasons above mentioned, its application was very limited; wind and water were alone used as powers for driving machinery and working mills, which were rare, and only adapted for performing rude mechanical operations, such as grinding corn, fulling cloth, pumping water, blowing furnaces, hammering and rolling iron, and such other purposes as the feeble powers of human labour were unable to accomplish; and with the exception of the silk mills introduced from Italy by Sir Thomas Lombe at Derby in 1720, and which were worked by water, there was nothing in the nature of manufacturing machinery.

Engineers.

Smeaton, born in 1724, at an early age applied his ingenious and vigorous mind to the cultivation of philosophical knowledge and thought, for the benefit of mankind. He commenced his career as a mathematical-instrument maker in 1750; after obtaining some celebrity in the scientific world by his air-pump in 1752, he took up the subject of wind and water-mills, which had, up to that period, been much neglected, and soon made such improvements in them as greatly increased their powers and efficiency; he constructed several of both kinds according to his improved principles with great success, which were considered as models, and soon afterwards universally followed. In 1753 he was elected Fellow of the Royal Society; in 1759 he communicated his celebrated paper (being the results of his experiments in 1752 and 1753) on the natural powers of wind and water to turn mills and other machinery depending on circular motion, for which he obtained their gold medal. These improvements of Smeaton were of manifold importance, and produced, directly and indirectly, the most beneficial results, as they enabled a greater quantity of work to be performed both by wind and water, particularly during temperate and dry seasons; hence, better roads became necessary to carry away the increased produce of the mills; and when they were worked by water on rivers, the mill-owner became interested in the improvement of the navigation, and, by economising the water on Smeaton's plan, obtained one-third greater result with the same quantity, thus benefiting himself as well as the navigation. Windmills have been rendered still more perfect than Smeaton left them, by making them self-regulating as to the extent of the surface of their sails presented to the action of the wind, according to the form and mode invented by Meikle in 1772; by Bywater in 1804, with an improved mode of clothing the sails; and still further by our valuable member, Cubitt, in 1807, who brought the system to perfection. Smeaton was amongst the first to point out the laws which govern the formation and maintenance of harbours; and, after undertaking a voyage of observation through Holland, he introduced great improvements in the draining of marsh lands (as at Holderness and the North Level), a subject which had up to that period been very imperfectly understood; and, by the design and construction of the celebrated Eddystone lighthouse in 1755-59, Smeaton introduced a new era in masonry, which forms a brilliant epoch in his valuable life, spent in the service of mankind, but more particulrrly for the benefit of his country. In 1765 Smeaton directed his attention to Newcomen's engine, and constructed a small engine, at his own house at Austhorpe, in order to conduct his experiments and obtain more accurate results in practice. By the judicious improvements which he introduced in the proportions and structure, he diminished materially the consumption of fuel, then an object of paramount importance, and soon after constructed engines on Newcomen's principle, which far exceeded anything of the kind hitherto produced: amongst these may be mentioned the engines at Long Benton, near Newcastle, and at Chasewater, in Cornwall; he thus rendered the system of Newcomen as perfect as it could be made. From the improvements of Smeaton on wind and water mills, we may date the foundation of the modern system of manufacturing, and from those in Newcomen's engine the modern system of mining.

Watt.—In 1736 Watt was born, and from his early years manifested symptoms of that genius and sagacity which, at a later period, enabled him to work out, with wonderful success, those grand discoveries which have immortalized his name. He began his career as a mathematical-instrument maker, and subsequently became an engineer. He proposed a plan for improving the river Clyde, and suggested the idea of the Caledonian Canal, but afterwards devoted himself almost exclusively to the improvement of the steam engine. His improvements, or rather inventions, may be stated, generally, as follows:—the separate condensing vessel, with an air-pump for exhausting the steam cylinder, instead of injecting cold water into it for impelling the piston on Newcomen's plan, by atmospheric pressure; in conjunction with Boulton, he brought these improvements into operation about the year 1773, and produced a still greater diminution in the consumption of fuel than Smeaton had done, thus rendering the application of the steam engine for pumping water much more general. In 1781 he invented the means of producing rotatory motion by the steam engine, first by the crank, and afterwards by the sun and planet wheel, thus rendering it applicable for the purpose of driving all kinds of machinery, which was a grand step towards the improvement of manufactures. In 1777-82 he invented the application of steam, with expansive action and with double action, alternately above and below the piston. In 1784 he invented the parallel motion, or working gear and valves, the governor, and other important details. All these improvements or inventions were carried into effect in an engine made by Boulton and Watt, in 1784, for one of the London breweries, and in 1785 in others for the Albion mills, which were the first steam-mills, now become so general; thus steam power was rendered available for working machinery of every kind, by following the best examples of this most wonderful and useful of all machines, which has so deservedly immortalized the name of Watt. The account of the extraordinary labours and inventions of Watt and his successors is well given by our valuable member Farey, in his excellent work on the steam engine, to which I would refer you, and also to the treatises by Tredgold, Arago, Scott Russell, and others.

Brindley.—About this period (1716), Brindley, who may be justly called the father of inland canal navigation in England, was born. He commenced his career as a millwright, and was withdrawn from that occupation by the Duke of Bridgewater in 1758, for the purpose of executing his great canal. Pound locks had been introduced long before on river navigations, and on the Exeter and Topsham Canal, which was commenced in 1581, and terminated about 1695; they were also used on the Sankey Canal in 1755, for the purpose of rendering Sankey Brook navigable; which was effected by making an almost entirely new channel. Brindley subsequently executed, with great success, the Trent and Mersey, or Grand Trunk, the Leeds and Liverpool, the Birmingham, the Forth and Clyde canals, in conjunction with Smeaton and several others, with all the necessary works belonging to them, which will ever remain as lasting monuments of his skill and genius in this valuable department of Civil Engineering. At an early period of the reign of George III., the importance of canal navigation became universally acknowledged as one of the greatest means then known, of facilitating the transport and reducing the cost of the necessaries and luxuries of life, and thus contributing to the wealth and prosperity of every part of the kingdom; those prejudices and obstacles by which, at the outset, every great improvement is surrounded, gradually began to give way, canals became popular, and superseded river navigation so much as to call forth the celebrated answer of Brindley to the question, "What is the use of rivers?"—"To supply canals." Engineers who had displayed such abilities in planning and executing works of the nature above described, began to acquire that importance as a profession which was soon after destined to work such a beneficial change, nay, almost a revolution in society, and accelerate so greatly the civilization of mankind.

Smeaton and Brindley were accompanied and followed by a number of able men in rapid succession; amongst whom Jessop, Whitworth, Mylne, Yeoman, Henshall, Golborne, Huddart, Rennie, Ralph Walker, Chapman, Telford, and others, all stimulated to exertion by the magnificent career before them, each contributing, more or less according to their several opportunities, great skill and invention of their own, in addition to that acquired from their predecessors. Favoured by the command of great funds (which were rapidly forthcoming as the success of the works already executed became manifest), better workmen and materials, new and improved machinery, steam power, and greater influence over the public mind, their operations were conducted upon a scale of magnitude, utility, and importance which gave a new character to the age in which they flourished, and advanced the prosperity of the empire.

Engineering Works.

Canals.—To attempt to enumerate all the various public works which then crowded each other in rapid succession, constituting the character of the profession, and entitling it to public confidence, would be both difficult and tedious; they are well known and duly appreciated, and it will suffice to point out some of the most important. The Forth and Clyde Canal by Smeaton, (1768,) length 24 miles, depth 8 feet, locks 19 feet by 75 feet, top-width of canal 66 feet; the Ellesmere by Jessop and Telford, with its magnificent aqueduct across the Dee near Llangollen, consisting of 19 arches 40 feet span, the centre being 126 feet above the Dee, with a total length of 1020 feet, and a width of 12 feet, the piers of stone, and the arches and aqueduct of cast iron; the Caledonian Canal by Jessop and Telford, 22 miles long, depth 16 feet, locks 40 feet wide by 172 feet long, 8 feet rise, top-width of canal 110 feet; locks intended for a depth of 20 feet; commenced in 1803, opened October, 1820; the first and last of which, together with the Gloucester and Berkeley Canal, may be cited as the first upon which sea-borne vessels could navigate, and thus extend the benefits of ship navigation into the interior of the country, without the delay and expense of transhipment of cargoes until arriving at the warehouses whence they are to be distributed. The Grand Junction (Jessop and Whitworth), Lancaster and Kennet and Avon (Rennie). On the Lancaster navigation the canal is carried across the Lune by a stone viaduct of 5 semi-circular arches, 75 feet span each; the total length of viaduct is 600 feet, and height 55 feet above the river. The Aire and Calder, the Union, the Shrewsbury, New Birmingham and Liverpool, Carlisle, the Grand and Royal Canals, Ireland, amongst many others may be quoted as examples of artificial canals for vessels, so as to enable them to continue their navigation inland from large rivers and estuaries. The total length of canal navigation now in operation in England, Scotland, and Ireland, amounts to about 3,000 miles.

The most advantageous speed for boats on a canal is about 2½ miles per hour, at which rate an average horse is capable of drawing about 22 tons without injuring his physical powers; when this is much exceeded, the ratio of resistance approaches the cube of the velocity. The speed must be diminished in proportion, and the horse exerts his powers to great disadvantage. Large canals, where practicable, on account of the trade and other circumstances, are preferable to small ones, as they are worked more economically. Various contrivances have been made to obviate the necessity of locks in overcoming extensive lifts or declivities, amongst these may be mentioned the inclined planes on the Duke of Bridgewater's and the Tamar and Shrewsbury canals. Double locks, side ponds, hydraulic lifts, by Woodhouse, Salmon, Congreve, Underhill, Green, and others; but extensive reservoirs and feeders are indispensable in most districts where there is a great traffic, and steam engines have been extensively used to pump back the water to be used over again in case of deficiency.

Steam Dredging.—The improvement of the River Clyde, begun by Watt and Golborne, received fresh stimulus under Rennie and Telford, from the application of steam power to the dredging-machine by Grimshaw, in 1796, and Bentham in 1802; thus forming a new era in the means of improving river navigation and harbours, since which this important department of engineering has been carried to an extent which could not otherwise have been attempted. Steam-dredging machinery is now generally adopted with success, more particularly in rivers where their beds and channels can be excavated to a certain degree of uniformity, and where the inclination of the tidal and fresh-water currents can be reduced to such an extent, by the removal of obstructions, as will enable them to keep their channels open. As successful examples of this, I need only adduce the Lagan, the Boyne, the Newry, the Liffey, and the Shannon, in Ireland. The Clyde, the Leith, the Don, in Scotland. The Tyne, the Wear, the Tees, the Thames, the Dee, the Ribble, the Severn, and others, in England; and as to harbours, most, if not all, of them can be maintained by steam-dredging, in addition to other means, to a greater depth than could be obtained without such an important aid.

Stone Bridges.

Westminster Bridge, by Labelye, in 1740-47, may be considered the first example of extensive structures of this kind. It consists of 13 semi-circular arches (the centre of which is 75 feet span), 1164 feet long; it was originally intended for a wooden bridge, and was partly commenced on this principle; it was a great work at the time, but as might have been expected, contained defects, particularly in the foundations, which at that time were but imperfectly understood, and have suffered much by the scour of the current; it will probably be rebuilt in a short time. Caissons, or water-tight chests, were first introduced there for the purpose of found-ng the piers below the level of low water. Previous to this, the principal existing bridges consisted of a number of small Gothic or of circular arches, with rough piers of masonry built either upon a foundation of loose rubble stones thrown promiscuously into the river until sufficiently high and solid, or upon timber platforms resting upon piles surrounded by large bulwarks of timber, filled with loose stones, called starlings, which materially contracted the water-way where they were placed, and by causing increased rapidity in the current, created great obstacles to the navigation, as well as to the drainage of the adjacent country. Of this, the well-known examples of Old London Bridge, those at Newcastle-upon-Tyne, Rochester, and Belfast, may be mentioned. All these, with the exception of Rochester Bridge, are now removed, and are replaced with others constructed upon the modern improved principles. Westminster Bridge was followed by that of Blackfriars by Mylne (1760-71), consisting of nine semi-elliptical arches, the largest of which is 100 feet span and 41 feet 6 inches rise; the total length of the bridge is 995 feet, and 45 feet wide; here the elliptical arch was introduced about the first time in this country. Smeaton's bridges of Coldstream across the Tweed, in 1763, composed of five circular arches, the largest of which is 61 feet span; that over the Tay at Perth, in 1766, of nine circular arches, the largest of which is 75 feet span; at Hexham, over the Tyne, in 1767, of nine circular arches, the largest of which is 52 feet span, and others, for that period, were works of considerable magnitude. These were followed by numerous smaller works all over the kingdom, more remarkable for convenience and utility than for any peculiarity in their construction worthy of notice, until in 1809-1817, when Waterloo Bridge, across the Thames, consisting of nine equal semi-elliptical arches, 120 feet upon each, and 35 feet rise, was built of granite in a style of solidity and magnificence hitherto unknown; there the elliptical arch, with inverted arches between them to counteract the lateral pressure, was carried to a greater extent than in former bridges, and isolated coffer dams upon a great scale in a tidal river, with steam engines for pumping out the water, were, it is believed for the first time, employed in this country; the level line of roadway, which adds so much to the beauty as well as the convenience of the structure, was there adopted. The bridge across the Severn at Gloucester, in 1828, by Telford, is worthy of remark, as being the first with one arch, of 150 feet span, like those of the bridge across the Seine at Neuilly, near Paris, by Perronet, where the interior of the arch is elliptical and the exterior circular.

New London Bridge (1825-1831), consisting of five semi-elliptical arches, viz., two of 130 feet, two of 140 feet, and the centre 152 feet 6 inches span, and 37 feet 6 inches rise, is perhaps the largest elliptical arch ever attempted, the roadway is 52 feet wide. This bridge deserves remark on account of the difficult situation in which it was built, being immediately above the Old Bridge, in a depth of from 25 feet to 30 feet at low water, on a soft alluvial bottom, covered with large loose stones, scoured away by the force of the current from the foundation of the Old Bridge, the whole of which had to be removed by dredging, before the coffer-dams for the piers and abutments could be commenced, otherwise it would have been extremely difficult, if not impracticable, to have made them water-tight; the difficulty was further increased by the Old Bridge being left standing, to accommodate the traffic, whilst the New Bridge was building, and the restricted water-way of the Old Bridge occasioned such an increased velocity of the current, as materially to retard the operations of the New Bridge, and at times the tide threatened to carry away all before it. The great magnitude and extreme flatness of the arches demanded unusual care in the selection of the materials, which were of the finest blue and white granite from Scotland and Devonshire; great accuracy in the workmanship was also indispensable. The piers and abutments stand upon platforms of timber resting upon piles about 20 feet long. The masonry is from 8 feet to 10 feet below the bed of the river.

I will conclude this division of the subject with the celebrated bridge across the Dee at Chester. It consists of a single arch, the segment of a circle 200 feet span, with a versed sine or rise of 42 feet, which is the largest stone arch upon record; the arch stones at the crown are 4 ft. 6 in. deep, and 7 feet at the springing, and the abutments on both sides of the river are founded on new red sandstone. The centre for building the arch was remarkable for its simplicity, strength, and rigidity, by which means the greatest effect was produced by the smallest quantity of timber, and any change of form, so prejudicial in centres, was prevented. This fine structure is due (it is believed) to the combined talents and energies of the late Mr. Harrison, the architect, of Chester, who made the original design; to Mr. George Rennie, who equilibrated the arch, gave the proper dimensions of the voussoirs and form and dimensions of the abutments, the mode of constructing them, and designed the centre, the original model of which is now in our gallery; and to Mr. Jesse Hartley and Mr. Trubshaw, who worked out the details, and carried the whole into effect.

A proper theory of the equilibrium of the arch, which shall satisfy all the conditions of the question, when applied to practice, may be said to be still wanting, though much valuable information may be derived from the scientific works of Hutton, Attwood, Moseley, Gwilt, and others, on the subject.

Oblique or skew bridges have but recently obtained extensive use. Chapman built some in Ireland many years ago, and wrote an account of his mode of constructing them. On railways they were introduced by Stephenson, and are now generally employed. Buck's excellent treatise on the principles and practise of their construction greatly facilitated their execution.

Iron Bridges.

The introduction of cast iron for the construction of bridges commenced about the year 1779, when that over the Severn, near Coalbrook Dale, by Darby, was the first; it consists of a circular arch 100 feet span, and a versed sine of 45 feet, approaching nearly to a semicircle; the height of the springing is 10 feet above low water, and the total height to the underside of the soffit is 55 feet; the banks of the Severn being high, this form accords well with them. It is formed by five ribs of cast iron, with perpendicular spandril pieces, resting upon them to support the roadway. This, for a first attempt, is well adapted to the situation, and has answered the purpose. This was followed by the bridge over the Wear, at Sunderland: the design for this was said originally to have been made by Thomas Paine, the well-known political writer, and was cast at Rotherham, being intended for erection in America; but the materials were subsequently employed in constructing Sunderland Bridge, under the direction of Wilson, in 1796, the idea having been suggested by Rowland Burdon. The curve of the arch is that of a segment of a circle, the length of the chord or span is 200 feet, and the versed sine or rise 30 feet, the total height from low water to the underside of the soffit of the arch is nearly 100 feet. It consists of six ribs, each composed of 105 cast iron radiating pieces, connected at the top and bottom by the circular pieces which form the curve of the arch; these ribs are united in their transverse direction by tie-pieces; the spandrils are filled in with cast iron circles, touching each other at their circumferences, and supporting the roadway, which consists of a strong frame of timber, planked over and covered with a cement of tar and chalk, upon which a layer of marl limestone and gravel is placed. The centre deserves notice on account of the difficulty and confined nature of the situation, which rendered it necessary to preserve a constant passage for ships with their standing rigging; this was effected by a perpendicular framing resting upon piles in the bed of the river, with a sufficient opening on each side for the vessels. Upon the top of this perpendicular framing, the transverse framing or centre for supporting the arch was fixed, and answered its purpose well. Some time after the removal of the centre, the arch was observed to swerve bodily in a horizontal direction to the eastward, forming a curve having a versed sine of about 12 or 18 inches; if this had continued to increase, it would no doubt have soon occasioned the downfall of the structure; it was, however, very skilfully remedied by the introduction of transverse and diagonal tie-bars and braces, assisted by wedges and screws, so that ultimately the whole was brought back and secured in its original form and position, where it has since remained in a substantial state without alteration. The width of the bridge is 30 feet; the abutments are of stone, founded on rock; they are 24 feet thick, and from 42 feet to 37 feet wide. This bridge, for boldness of the design and construction, as well as for its elegance and lightness, must be considered a work of peculiar merit; particularly if the period in which it was constructed be remembered.

About the same time, the bridge at Buildwas, across the Severn, by Telford, was erected. It consists of a single arch, segment of a circle, whose chord or span is 130 feet, and versed sine or rise 27 feet, the depth of the iron frame forming the arch being 3 ft. 10 in.; it consists of three ribs, 18 feet wide from out to out, connected together in their transverse direction by tie-bars. The spandrils for supporting the roadway consist of vertical pieces, resting upon the segments forming the arch; the abutments are of stone. There is a novelty in the construction of this bridge worthy of remark. The two outer ribs consist of two segments of circles, each struck from different centres, the crown of one terminating immediately below the roadway, the other at the top of the parapet, so that the platform forming the roadway is both suspended and insistent. The object of this being, it is presumed, to increase the depth of the truss supporting the roadway, and thus to add to the strength of the bridge: but it was unnecessary, and does not appear to have been adopted in any of Telford's subsequent designs, which are numerous. Amongst them may be mentioned that of Bona, Tewkesbury bridge over the Severn, also that over the Dee, near Corwen, &c. Bristol bridge over the Avon, by Jessop, is a neat simple structure. Boston bridge, by Rennie, over the Witham, of 100 feet span, with a versed sine of 4 feet, is remarkable for its boldness and lightness. The principle of construction resembles that of Sunderland, but is an improvement upon it, in having a better system of transverse and diagonal braces, and the spandrils consisting of vertical instead of circular pieces. All these have, however, been far exceeded by the Southwark bridge over the Thames, by Rennie. This consists of three arches, all segments of the same circle; the centre arch is 240 feet span, with a versed sine or rise of 24 feet, and the two side arches are 210 feet span each, with a versed sine or rise of 18 ft. 10 in. each. The arches are formed by eight solid ribs in each, and each rib consisting of fifteen pieces, 6 feet deep at the crown of the arch, increasing to 8 feet deep at the springing, 2½ inches thick in the middle, and 4½ at the top and bottom: these ribs are connected together in their transverse direction by cast iron tie-braces of the same depth as the ribs, but open in the centre, and in the diagonal direction by another series of ribs; the whole of the segmental pieces forming the arch, as well as the transverse and diagonal tie-braces, are kept in their places by dovetailed sockets and long cast iron wedges, so that bolts for holding the several pieces together are unnecessary, although they were used during the construction of the bridge to keep the pieces in ther places until the wedges had been driven. Thus the ribs formed, as it were, a series of hollow masses or voussoirs similar to those of stone; a principle which it is believed is new in the construction of cast iron bridges, but it has succeeded so well that it is worthy of adoption elsewhere. The spandrils are composed of cast iron diagonal pieces, connected together in a similar manner, and the roadway is formed by solid plates of cast iron resting upon the spandrils, and joined together by iron cement. The piers and abutments are of stone, founded upon timber platforms, resting upon bearing piles, and surrounded by sheathing piles, driven sufficiently deep below the bed of the river. The masonry is tied throughout by vertical and horizontal bond stones, so that the whole acts as one mass in the best position to resist the horizontal thrust. The ribs forming the arches were commenced in the centre, and were continued regularly on each side towards the piers and abutments, upon which a cast iron bed and connecting plate were laid, nicely let into the masonry to receive the ribs forming the arches; when the last segment of each rib was fixed in its place, three cast iron wedges, each 9 feet long and 9 inches wide, were placed behind each rib, and nicely adjusted and fitted to them; these having a very slight taper, were driven simultaneously by heavy hammers, and thus the arches were nearly lifted from the centres, so that the wooden wedges upon which the segment pieces rested were easily removed by a few blows of a hammer; the arches were thus relieved from the centres in a very simple and efficient manner. The whole of the iron-work had been so well put together by Messrs. Walker, of Rotherham, the founders, and the masonry by the contractors, Messrs. Jolliffe and Banks, that when the work was finished, scarcely any sinking was discernible in the arches. During the progress of the work, some experiments were made, in order to ascertain the extent of the expansion and contraction between the extreme range of winter and summer temperature, and upon taking the average of numerous trials by different gauges, it was found that the crown of the arch rose in the summer about an inch to an inch and a half. The work was commenced in 1813, and the bridge was opened in 1819.

Whilst upon the subject of cast iron bridges, we must not omit the Swivel or Turning Bridge. The invention, if it may be so termed, is, it is believed, due to England, and one was first made of iron about the year 1810. They are now almost universally adopted over locks, to the extent of 50 feet span, in preference to the old lifting bridge. Since the introduction of the railway system, cast iron bridges have become very general, and have been particularly serviceable, being formed of girders, where the height was too limited to admit of the arch principle being adopted. Experience of the value of wrought iron in roofs and for other building purposes has induced R. Stephenson to propose that material for constructing the bridge to carry the Chester and Holyhead Railway across the Menai Straits. His design consists of a close wrought iron tunnel or tube, 14 feet wide, 30 feet deep, and 1500 feet long, supported in the middle by a stone pier built upon a rock in the middle of the Straits, with two other piers at the low-water mark on either side, leaving four openings, two of them 460 feet, and two of 230 feet each, and 100 feet above high water, so as to admit of masted vessels sailing under it. Cubitt has also proposed to adopt wrought iron on a great scale, for constructing landing platforms at Liverpool, where the difficulty of building docks or quays, which large steam vessels can approach at all times of tide, render works of this kind necessary to accommodate the immense traffic frequenting Liverpool. The landing platform designed by Cubitt, and now in course of construction, consists of a wooden frame, 500 feet long, by 80 feet wide, floated upon a number of wrought iron pontoons, each 80 feet long, 10 feet wide, and 6 feet deep; it is connected with the shore by two bridges, each formed of two hollow wrought iron beams, 150 feet long, carrying the platform of the bridge; the attachment with the shore and the stage is so made as to admit of motion, both vertically and horizontally, to accommodate itself to the rising, falling, ebbing, and flowing of the tide, which there rises about 30 feet.

Suspension Bridges.

The invention of chain or suspension bridges is said to have been imported from China and India. The first of the kind in England was that across the Tees, at Middleton, consisting of two common chains stretched across the river, and secured to the adjoining rocky banks; the span was 70 feet. To Capt. Sir Samuel Brown, however, who had previously brought chain cables into use for ships, may be attributed the introduction into England of the improved system of the bar link, which is now so generally adopted. Brown, in 1818, first constructed a large model of 100 feet span, capable of supporting a carriage and horses, indeed adapted for general traffic. He afterwards constructed (1819), upon this principle, Union bridge, for general traffic across the Tweed, near Berwick; the span was 450 feet between the supporting towers, which were of masonry. He subsequently built another, of smaller dimensions, across the Tweed, at Dryburg. He also constructed that at Montrose, one over the Hundred Feet river in the Fens, and others, and applied the same principle with effect for landing-piers at Brighton and Leith. This system was afterwards carried out to a far greater extent by Telford, in his great suspension bridge across the Menai, at Bangor, in 1818-20, so well described by Provis. It consists of three openings, the centre is 580 feet span, the deflection of the chain being 42 feet, and the two side openings are 260 feet span each; the platform of the roadway is 100 feet above high-water mark; the sustaining towers of masonry are 50 feet above the roadway, and are connected to the shore by three stone arches on one side, and four on the other, 52 ft. 6 in. span each. There are sixteen main chains, each 1770 feet long, in sets of four each, suspended above each other, on each side of the roadway, which is 30 feet wide from out to out, divided into three parts, two for carriages, on the outside, 12 feet wide each, and one for foot-passengers, in the middle, 6 feet wide. Each main chain consists of five bars or links, 10 feet long each, by 3½ inches and 1¼ inch, connected together by plates and pins, on Brown's system, the whole being properly secured to the solid rock on each side. The total suspended weight of the main opening is 644 tons. About the same time, he constructed another upon the same principles, 300 feet span, across the river Conway, at Conway. These are fine works, and will remain as lasting monuments to his fame. The recent structures of Hammersmith, across the Thames, and Shoreham across the Adour, by Tierney Clark, who is now erecting another upon a grander scale, 700 feet span, across the Danube; and, lastly, that of Brunel across the Thames, at Hungerford Market (1845), show the progress made in this class of structures, which are well adapted for crossing large and deep rivers where economy is an object; great care, however, is necessary in proportioning the strength of the chains, and their curve; the selection and manufacturing of the iron for them, and also in the connexion and bracing of the roadway platform, in order to insure the greatest strength and solidity of construction; of this, the improvements to the Montrose Bridge, by Rendel, is a good example, and the system should be generally followed, as several disastrous failures have occurred from neglect of these important particulars.

Amongst variations of the system, that of Dredge may be mentioned.

The wire suspension system, although in extensive use on the Continent, the largest example of which is at Fribourg, in Switzerland, where a bridge has been constructed of 800 feet span, for carriages as well as foot passengers, has been rarely used in this country. Although economical in the first cost, it requires constant attention, and it scarcely possesses sufficient durability for permanent structures.

Wooden Bridges.

In wooden bridges, little was formerly done in Britain beyond the common pile bridge. These were formed by rows of piles for piers, driven at short distances from each other, and connected together by straight girders planked across to form the roadway, with a wooden railing on each side. Of this kind of construction, the bridges of Londonderry, across the Foyle, Waterford, across the Suir, Battersea, Fulham, and others, across the Thames, are examples. In some cases, this system was extended, by adopting larger openings, having diagonal struts, or butting pieces, between the underside of the girders and the piles forming the piers, in order to reduce the bearing of the girders, and thus give them greater stability. The straight trussed frame or girder, so much used in America, was employed by Rennie, to a considerable extent, as service bridges, during the construction of the Waterloo and Southwark bridges, in 1809-19, and at New London Bridge, in 1825-31, with openings of above 100 feet, capable of supporting the heaviest weights. The late Colonel By, of the Royal Engineers, gave an account of a bridge of this description, said to have been built across the Terrebonne, a large river near Montreal, in Canada, 600 feet span between the piers. It is said that this was carried into effect, and actually stood for a short time; but, in consequence of its having been badly constructed, it required heavy repairs, and whilst these were being effected, the whole structure came down, and was carried away by the floods. The trussed system has been applied with considerable success in some well-constructed bridges across the Tyne, for the Newcastle and Carlisle Railway, by Blackmore, and in several other places. The system of Wiebiking, of combining small curved pieces of timber connected together in the form of an arch, adapted for large spans, was first introduced, I believe, on the Ancholme, in 1826, when a bridge of 100 feet span was constructed with complete success. This has been used by Green, in the viaducts for the Newcastle and North Shields Railway; and has been followed by others also. Price, long ago, proposed a similar system; but the scarcity and dearness of timber, and the prevalent use of iron, probably prevented its application before. The lattice bridge, of American origin, has latterly been introduced on the Birmingham and Gloucester Railway, by Moorsom, and on the Dublin and Drogheda Railway by McNeil, and as they are economical and simple in their construction, they are applicable in some cases with advantage.

In the designing and constructing of bridges of stone, wood, cast and wrought iron, an accurate knowledge of the strength of materials is peculiarly important, nay absolutely indispensable; and the profession is much indebted to George Rennie, who commenced a series of investigations on this subject in 1817, which were communicated to the Royal Society, and published in their Transactions in 1818. These experiments were among the first to determine with precision the absolute and relative strengths of materials, under the effects of tension and compression. He subsequently made above six hundred experiments in 1827, on the friction of plane and round surfaces, with and without unguents, under the different circumstances of time, surface, and pressure, which were published in the Philosophical Transactions, in 1828. In 1830 he also made experiments on the friction and resistance of fluids, which were published in 1831. Morin's experiments did not appear until 1834—Tredgold, Barlow, Fairbairn, Hodgkinson, Wood, and others, have since carried these experiments to a greater extent.

Concrete, a mixture of gravel, sand, lime, and other cements, in certain proportions, was well known to the ancients, and in conjunction with the invaluable natural cement, Pozzolana, was applied with the greatest success in the then numerous moles and other submarine works, and its use has been still continued in Italy to the present day. Wren is said to have used it for a portion of the foundation of St. Paul's, where it was defective. Semple also alludes to it in 1776. Its use appears to have been discontinued for a time, but recently to have been resumed. Rennie proposed it for the foundation of the Penitentiary in 1811; Smirke and others followed in the same track, and now the employment of concrete for the foundations of buildings has become nearly universal, wherever it is necessary.

Brick has been much used for bridges over canals and drains by Rennie, and in railway bridges by Stephenson, Cubitt, Locke, Rastrick, and others; and, latterly, it has been carried to a far greater extent by Brunel in his bridge across the Thames at Maidenhead, for the Great Western Railway. It consists of two semi-elliptical arches, each 130 feet span, and rising 24 feet; they are built wholly of brick, in Roman cement.

Roman Cement, discovered by Parker, in 1796, is chiefly made from a stone found on the shores of the Isle of Sheppy, near Sheerness; it is burnt in a kiln, and when ground into fine powder, possesses the peculiar property of setting hard immediately, although exposed to water, which renders it very valuable in hydraulic works. It had been little used in public works until it was adopted by Rennie and others. It was extensively employed in the naval works at Sheerness and elsewhere, and is now universally employed in buildings where immediate induration or setting is required, in order to prevent the action of water, or where any settlement from insistent weight would be injurious. Latterly Roman cement has been found at Harwich and other places. Aberthaw, Lyme, Barrow and other limestones also possess valuable properties for waterworks. The success of buildings depends materially upon the cement or mortar employed: and much has been done by Smeaton, Rennie, and Telford, in the selection of the best lime, sand, and other materials, in combining them in proper proportions for the respective parts of the works where they were employed, and in the application of machinery for the more thoroughly mixing up and incorporating the materials together. Great credit is also due to Higgins, Pasley, Donaldson, Smith and Godwin for their valuable experiments and treatises upon this important subject.*

Additional strength has been given to brick structures, by the introduction of bands of thin hoop iron between the courses; this improvement was first generally introduced by Sir M. I. Brunel.

Tunnels.

Subterranean tunnels have been much used in inland navigation, particularly in the Duke of Bridgewater's Canal, some miles of which, at Worsley, are made under ground; in the Harecastle Tunnel, by Brindley, on the Trent and Mersey Canal, in 1776, which was rendered more convenient by Telford, in 1826, by adding another parallel to it, of larger dimensions; in the Huddersfield Canal, where there is a tunnel 5280 yards long; in the Braunston Tunnel, on the Grand Junction Canal, and many others: all of these, however, have been surpassed by the Tunnel under the Thames, at Rotherhithe, by Sir Isambard Brunel, which, for magnitude, boldness in the design, and ingenuity in the means of construction, as well as the extraordinary difficulties by which the work was attended, will long remain a lasting monument of the talents and perseverance of that celebrated engineer. This extraordinary work was commenced in 1825; it consists of two arched openings 1200 feet in length, 14 feet span each, 16 feet 4 inches high, separated from each other by a pier 4 feet thick, having sixty-four lateral arches of 4 feet span, to communicate between the main openings, the whole being surrounded with massive walls. The external dimensions of the walls, including the openings, are 38 feet wide, and 22 feet high. It is approached at each end by a perpendicular shaft, 50 feet diameter, and 80 feet deep; but the tunnel was intended hereafter to be carried out to the surface f the adjoining streets, at such a moderate inclination that carriages could easily pass through it from both sides of the river. The crown of the tunnel is about 16 feet below the bed of the river. In order to carry into effect this very difficult work, unusual means and precautions were necessary. The ordinary wooden centre framing scarcely presented sufficient strength and connexion for that purpose. Brunel accordingly invented a cast iron frame (which he termed a shield) sufficiently large to embrace the whole width and height of the intended structure, and divided into thirty-six compartments, each sufficiently large for a man to work in, yet capable of being closed to prevent the access of water when required; the whole was impelled forward by powerful screws, bearing upon the work behind, as it was finished. This ingenious contrivance was perfectly successful; and although the works were twice stopped by the irruption of the Thames, nevertheless the apertures were stopped by bags of clay and other materials, and the structure was continued with extraordinary perseverance until finally completed and opened to the public in 1843. The whole was constructed with bricks set in Roman cement, and cased inside with the same material; and it gives every prospect of permanence and solidity.

A tunnel under the Thames had been previously proposed at Rotherhithe by Trevethick, and had advanced to some distance under the river, when it was abandoned; also one by Dodd at Gravesend, which was scarcely commenced. A tunnel was also carried to a considerable extent under the Severn, at Newnham, but failed for want of funds.

Tunnels form part of the works of almost every considerable railway, and the art of constructing them with accuracy and expedition is now brought to great perfection. Amongst the most remarkable tunnels executed upon railways, may be mentioned that at Kilsby, 2398 yards long, on the Birmingham and London line, by Stephenson; that at Box Hill, 3195 yards long, on the Great Western Railway, by Brunel; and that on the Sheffield and Manchester line, 5280 yards long, by Locke. Several others of great length are now in progress.

Harbours.

In the construction of harbours, Smeaton, as already observed, had pointed out the proper course, in his reports on Lynn, Wells, Aberdeen, Dundee, Dunbar, Port Patrick, Sandwich, Scarborough, Sunderland, Workington, Rye, Dover, and others. Ramsgate harbour was originally designed by Labelye in 1744; it had been partly executed by others, and continued with little success through a tedious succession of years, with various changes of plan, until 1774, when it was placed under Smeaton's direction; he soon saw the evil arising from the constant accumulation of mud which threatened to fill it up, in consequence of there being no backwater or scouring power to remove it. He therefore divided the harbour into two parts by a cross wall; the part next the shore formed a basin of eleven acres, in which the water could be retained by means of a lock, and discharged through powerful sluices in the cross wall into the outer harbour at low water, and thus form an effectual scouring power for removing the mud. Here was the introduction of a new principle for the maintenance of harbours, which is so difficult on an alluvial coast, operated upon by the tides and currents; and although previously in use on the Continent, it is believed to be the first example of the kind in Great Britain. Smeaton afterwards continued the works, and introduced an improved system of masonry; in 1788, he founded the outer and inner walls of the outer piers, below low water, by means of caissons or boxes of wood, and so far improved the diving-bell as to render it useful in carrying on the operations, although he did not build with it, and about the same time he used it for examining the foundations of the piers of Hexham bridge, one of which had partially sunk. The late Mr. Rennie, who after Smeaton's decease took charge of the works at Ramsgate, profiting by what had been done, carried out the system to a greater extent, by enlarging the sluices and making them of cast iron, the old ones being of wood and frequently out of repair; a greater quantity of water could then be discharged in the same time, when required, and thus act with greater effect; or the discharge could be prolonged, according to circumstances. The masonry also, which, although good for the early period at which it was constructed, had become dilapidated, was rebuilt, where requisite, in a much more substantial manner. The steam-dredging machine was also applied to remove that portion of the mud which could not be effected by the sluices. The diving-bell was afterwards perfected by Rennie, so as to be perfectly manageable, and being suspended from a frame worked by proper machinery, it could be raised and lowered, or moved laterally, in any direction, with facility and promptitude, either according to the directions of the diver within the bell, communicated by means of signals, made by striking the sides of the bell with a hammer, or given by the superintendent above. All the operations for preparing a foundation, and afterwards laying the prepared blocks of masonry upon it, could thus be performed with as much certainty below as above the water. Rennie first used his improved apparatus in 1813 for rebuilding the advanced East Pier Head at Ramsgate Harbour, which was founded 17 feet below low water of spring tides with complete success. The value of this invention for submarine operations was now completely established, and he afterwards employed it with advantage in founding the pier heads and outer walls of Holyhead, Howth, and Sheerness Harbours, and other works under his direction, and it is now generally adopted in all similar circumstances. The diving-helmets and dresses, improved by Deane, Bethell, Edwards, Seibe, and others, have also materially contributed to the success of submarine operations.

After Smeaton, numerous artificial harbours were designed and constructed, and natural ones improved; amongst the former may be mentioned Holyhead, Howth, and Kingstown; at the latter there is a depth of 26 feet at low water of spring tides, and an enclosed area of 250 acres at low water; which is the largest harbour attempted in this country by Rennie. Here and at Howth he substituted the flat slope for the upright wall to resist the waves,* and introduced the plan of throwing down loose blocks of rubble, or unhewn stone, for forming the main body of the piers, allowing the slope or angle of repose, at which the materials would lie, to be formed by the sea. In his system of making low-water harbours, which, up to that period, were almost unknown in Great Britain, he adopted the plan of enclosing the area by piers composed of several straight arms or lengths, intersecting each other according to particular angles, instead of making them curved, which, in his opinion, only served to increase the action of the waves. In asylum harbours, when practicable, as at Kingstown, he preferred making the entrance open to the dangerous wind, thus rendering them more accessible for vessels in distress; but in order to prevent the prejudicial effects of any waves which might roll into the harbours, he adopted the returning and inclined form of entrance, by which means increased facility of entrance and departure was also given. He also designed his harbours with a view to preserving the original depth, as far as practicable, which is a principle of the greatest importance, and ought not to be lost sight of. The artificial harbours

* From the valuable researches of these authors it appears, that the hydraulic cements contain considerable portions of silica and alumina, and in some cases metallic oxides; and, where natural hydraulic cements cannot be obtained, they may be produced artificially, by the combination of these ingredients in their proper proportions.

* This system was latterly always adopted by Rennie and Telford in preference to the upright wall, as being better adapted to resist waves, and it has been invariably successful, wherever it has been properly carried into effect.

of Ardrossan, the Troon, Peterhead, by Telford, Scarborough, by Chapman, Hartepool, and others, are worthy of remark.

In the improvement of natural harbours, may be mentioned Sunderland, Berwick, Aberdeen, Dublin, Newry, Drogheda, Leith, Belfast, and others. The principle generally adopted has been to confine and direct the tidal and fresh waters, by piers, in proper and sufficient channels, whence they are discharged into the ocean, so as to enable them to act with greater effect in counteracting the baneful effects of the antagonist operations of the winds, waves, and sand, brought in from the sea; also to increase, as far as practicable, the receptacle for tidal and fresh waters, and to dispose of them in such a manner that they shall act with effect in maintaining and preserving the channels. These operations, as in the case of the Clyde, are materially assisted by the employment of that invaluable auxiliary, the steam-dredging machine, which ought to be attached to every harbour. I must not omit to mention the breakwater in Plymouth Sound, by Rennie and Whidbey, which is the first and largest example of a detached mole or breakwater in this country. It is a mile long, constructed in a depth varying from 5 to 8 fathoms at low water, formed of loose blocks of rubble, of all sizes, up to 10 or 12 tons weight each, thrown into the sea to form their own base and slope, according to the action of the waves. The surface from low water mark to its full height, which is 2 feet above high water, has been paved with masonry, and at the base of the sea slope, at the level of low-water, there is a berm or benching to protect it. At the western extremity a lighthouse has been built, to point out the western or principal entrance to the Sound, and a beacon on the eastern extremity points out the east entrance. The whole of the work, except a portion of the masonry, which is granite, has been built of limestone, brought from the adjoining shores. The intention of the work was to protect the Sound against the heavy swell, which formerly used to roll in with considerable violence during strong westerly and south-westerly gales; this object has been completely obtained, and the roadstead has been rendered perfectly secure. The work has been eminently successful in every respect, for besides obtaining the desired protection, the original depth of water has been preserved, the facility of ingress and egress has not been diminished, but rather increased, and the cost has corresponded as nearly as possible with the original estimate.

Another class of harbours, called Floating or Wet Docks, for receiving merchant vessels out of the tide or sea-way, was first introduced at Liverpool about the year 1716, and wet docks have been since constructed in almost all the principal ports of the kingdom—viz., London, Bristol, Hull, Leith, Sunderland, as well as for the Royal Navy at Portsmouth, Plymouth, Sheerness, Chatham, and Woolwich. The East and West India Docks, by Jessop, Rennie, and Ralph Walker; the London, Leith, and Dublin, by Rennie; St. Catherine's, London, by Telford; the New Docks at Liverpool, by Hartley; at Hull, by James Walker; at Cardiff, by Cubitt; at Newport, by Green; at Southampton, by Giles; and the great works now in progress at Birkenhead, on the Mersey, opposite Liverpool, and at Great Grimsby, by Rendel, are magnificent examples of private enterprise for facilitating the commerce of the empire. The design of Rennie for a grand naval arsenal on the Thames, at Northfleet, immediately above Gravesend, intended as a substitute for the imperfect naval establishments at Deptford, Woolwich, Sheerness, and Chatham, is worthy of remark. This magnificent design consisted of six capacious basins, with a total surface of 600 acres within the walls, the largest being 4000 feet long, and 1000 feet wide, and covering 87 acres; the whole to communicate with each other, and be provided with capacious quays, dry docks, building-slips, and storehouses; steam machinery for manufacturing cordage, blocks, anchors, flour, and bread, sawing and converting timber, pumping, and working cranes; in fact, for almost every operation connected with the naval service, and so systematically arranged and disposed, that the required operations should succeed each other with the greatest dispatch and economy, whether of time, labour, or cost. The estimate was £11,000,000, which was perhaps more than would have been required: any portion could have been executed as it was wanted, without interfering with the general plan. It is to be regretted that this plan was not carried into effect, for it would have repaid the cost in the increased economy of fitting out fleets, and since that period about £5,000,000 have been expended on the old establishments in the Thames and Medway, with a small degree of benefit, compared with what would have been obtained from Northfleet. His design also for the improvement and enlargement of Chatham Dockyard is worthy of remark. It consisted of a new channel to be made for the Medway below Rochester Bridge, and converting the bend of the river, in front of the Dockyard, into a magnificent floating dock of above 100 acres, and from thence making a canal, 1¼ mile long, 300 feet wide, and 30 feet deep, to the deep water in the Medway at Gillingham, by which means vessels of war of the largest class could come to the Dockyard with the whole of their armament, which they cannot do now; the course to sea would have been shortened, and the shallow water of the Medway avoided: thus Chatham Dockyard would have been rendered the most convenient and extensive in Europe, and its proximity to London by a railway would have rendered the yards at Deptford and Woolwich unnecessary. The estimate for this work was only £700,000, whereas since that time fully as much, if not more, has been spent upon Woolwich, with a very inferior result; indeed, it is not even too late to undertake this plan for Chatham now, and would well repay the expenditure. In designing and carrying into effect this important class of public works, so as to render them successful, a thorough knowledge of the nature and operation of tides, winds, currents, soundings, and all the departments of hydrography, physical geography, and geology is necessary, and in these sciences much is due to the exertions of Beaufort, Bullock, Washington, Denham, Buckland De la Béche, Lyell, Greenough, Sedgwick, Murchison, Phillips, and others.

Revetments, or Retaining Walls.

These, until near the latter end of the last century, had been usually built with horizontal foundations and courses, the interior side being almost vertical, and the exterior with a flat face and very little batter, or in many cases vertical. The curved face retaining wall was latterly introduced, with the foundation and courses inclining from the horizontal, so as to conform with the radius of curvature; this form of wall is preferable, in many cases, to the old, as combining greater strength with a less section, and being more convenient in other respects, and was commonly used by Rennie in his various works, when applicable.

To whom the introduction of this improved form of wall is due it is difficult to ascertain with accuracy; but Rennie, Ralph Walker, and Jessop were amongst the first who brought it into use. A further improvement was made in the retaining walls used at Sheerness in 1815 by Rennie, where the foundation being composed of soft alluvial mud and quicksand, to a great depth, more than usual precautions were necessary to render the walls substantial and secure. The object was effected by enlarging the base, and making the interior hollow, like a caisson, with the bottom in the form of an inverted dome; the outer or river face being concave, and the foundation, for a certain width, laid inclining at right angles to a tangent from the curved face of the front of the wall; the remainder of the foundation was horizontal, and the back or land side of the wall was vertical. Thus there was both a front and back wall connected together by cross walls, forming one mass; the inverted arches or domes under the hollow spaces being filled with chalk and gravel concrete, and the whole resting upon a well-connected platform of piles and cross-beams and planking. By thus distributing the same quantity of materials over a greater surface, the vertical weight per square foot was reduced, and the desired stability was obtained upon this very difficult and treacherous foundation. Rennie had previously tried, with success, a wall of a similar principle, and under similar circumstances at Grimsby. General Bentham also tried a similar principle, about the same time, which was not so successful, in consequence of an unsuitable form and construction.

The *Coffer-dams* which Rennie employed for constructing the walls at Sheerness are worthy of remark, as being the most extensive and difficult that had been constructed up to that period. The bottom being soft mud to a considerable depth, piles of 60 feet to 80 feet in length, were necessary, and when driven and braced in their places as far as practicable, chain bars and raking-shores from the land were requisite, in order to counteract the alternate pressure inwards and falling outwards, occasioned by the badness of the foundation and the heavy shocks of the waves to which they were exposed. In order to break the effects of the sea during storms, he employed a series of old men-of-war hulks, to act as floating breakwaters; these were useful to a certain extent, so long as they held firm in their places; but at times, during heavy gales, they dragged their moorings, and driving against the dams, occasioned considerable damage; upon the whole, however, they were useful.* In order to give greater security to the dams, and to prevent leakage, a considerable quantity of grooved and tongued sheathing-piles were necessary for the works; and to effect this, he invented a machine worked by a steam engine, which answered the purpose effectually, at a cost of one-sixth of the price of manual labour, and as it was unsafe to withdraw any of the coffer-dam piles, he made another for cutting them off at the ground level, below low water, which was also found very useful.

The dams for founding the sea-locks of the Caledonian Canal at Fort William and near Inverness, by Telford, are worthy of remark. In the former case, great difficulties arose, in consequence of the foundation being rock, at some depth below low water; this was overcome by ingeniously securing the piles to the rock; and in the latter case, where the bottom was soft mud, the difficulty was obviated by bringing cargoes or masses of earth and clay from a considerable distance, and afterwards driving the piles through the made ground. The great dam, 1000 feet in length, for building the foundations of the river-wall and New Houses of Parliament, by James Walker, is another good example. The late Peter Ewart was among the first who introduced cast and wrought iron for dams, for piling in general, and for wharfs; it has been since employed by Walker, Sibley, Stevenson, and others, in many situations, with great success. At the Albion Mills, already mentioned as the first steam-mill constructed in 1785, by Watt and Rennie, on the banks of the Thames, close to Blackfriars Bridge, the foundation being soft mud and moving sand, inverted arches were formed upon the ground, between the foundation courses of the walls, so that the whole area of the building obtained support by the same weight resting upon an increased base.

* Floating breakwaters of timber have latterly been tried, as a substitute for more solid constructions, but they have not hitherto succeeded.

(To be continued.)

REGISTER OF NEW PATENTS.

ELECTRIC TELEGRAPHS.

John Nott, of the city of Cork, gentleman, for "*certain Improvements in the means of communicating intelligence from one place to another.*"—Granted January 20; Enrolled July 20, 1846.—*(Reported in Newton's London Journal.) With Engravings, Plate VI.*

These improvements in the means of communicating intelligence from one place to another consist in certain novel arrangements of apparatus, by which audible and visible signals can be given through the agency of electro-magnetism.

In Plate VI, fig. 1 represents the external appearance of the apparatus, as seen in front; fig. 2 is a vertical section, taken transversely through the apparatus, nearly at its centre; fig. 3 represents the internal construction and arrangement of the working parts of the apparatus, as they would appear if the dial-plate and front part of the case were removed; and fig. 4 is a horizontal section of the apparatus, taken below the magnets, showing the mechanism by which the course of the electric fluid may be changed from the electric telegraph to the signal-bell.

In the front of the box or case, a circular dial-plate, fig. 1, is fixed, on which are four series of letters, which are pointed out by the long arm of the index; and also two concentric circles of numerals, indicated by the short arm of the index. This plate is graduated on its face into ninety-six equal divisions, formed in a circle; and to each, one of the letters or one of the numerals refers. Upon the outer end of an arbor *a*, passing through the centre of the dial-plate, a index *b*, is affixed, which is carried round upon the face of the dial-plate by successive actions of the mechanism, produced by the electric fluid; each successive action moving the index over one space of the graduated circle, so as to enable the operator to leave the point of the index in a state of rest, opposite to any letter or numeral, as the case may be; and, by repetitions of the like movements and rests, to point to such letters as will spell, or numbers that will indicate, the word required to be communicated. These actions of the mechanism are effected by currents of electricity, through the agency of a key or lever, rising or falling at the touch of the operator, as in a piano-forte.

The electric fluid is derived from a galvanic battery near the apparatus, as at A, B, fig. 4, and passes, by wires coiled round electro-magnets, from one pole to the other pole of the battery. Two electro-magnets, C, C, D, D, are attached to the vertical backboard *c, c*, of the apparatus, as shown in figs. 2 and 3; and in the same plane, nearly concentric with these magnets, is a ratchet-wheel *d*, fixed upon the arbor *a*; which latter passes through the centre of the dial-plate, and carries the hand or index *b*. Two lever armatures *e, e*, are supported by fulcrum axles, turning in the brackets *f, f*, which armatures cross each other, and their movements are rendered simultaneous by a connecting link *g*, immediately over the axis of the ratchet-wheel *d*. To the extremities of the inner arms of these lever armatures two pallets *h, h*, are connected, by joints; which pallets are pressed against the periphery of the ratchet-wheel by delicate springs, causing the pallets to take into the teeth of the ratchet-wheel; and, by the rising and falling of the armatures, these pallets move the ratchet-wheel round;—the extent of action of the pallets being limited by two latch-stops *i, j*, which give rise to a dead-beat movement of the index, as it is carried round the dial-plate. The outer extremities of the armatures bear upon slight springs *k, k*, fixed to the back-board of the instrument.

A third electro-magnet E, E, is affixed to the back-board, figs. 2 and 3, and is intended to give motion to the machinery of the signal-bell, attached to the telegraph. The armature of this magnet is shown at *l, l*, and is a T-formed lever, supported at the extremities of the edge of its longitudinal bar by pivots, bearing in the brackets *m, m*, projecting from the back-board. The arm of this lever *l*, passes through an opening in the back-board, and lies inclined, as shown in fig. 2. When this armature is attracted by the magnet, it will be drawn up into a horizontal position, and, in rising, the extremity of the arm will take into the fork at the end of the lever *n*, and thus cause the hammer *p**, to strike upon the bell or gong F.

The means by which the electric fluid is conducted from the battery, through the wires of the electro-magnets, to the corresponding apparatus at the distant station will be clearly understood by the following description:—Two wooden cylinders G, H, are supported on horizontal axles, by standards fixed to the longitudinal support I, I. Two separate strips of metal, as conductors, are passed nearly round the circumference of each of these cylinders, leaving unoccupied a conducting portion on each cylinder between the ends of the strips. Upon the support I, I, eight erect springs 1, 2, 3, 4, 5, 6, 7, 8, are fixed; which springs severally press against the peripheries of the cylinders G, and H. The springs 2 and 3, are connected by a conducting strip of metal, fig. 4, and the springs 6 and 7, are also connected in like manner; the latter being perfectly detached or insulated from the former. A wire 9, connected with the pole A, of the battery, leads to the stud K, where it is held fast by a binding screw; and to this stud K, the end of another wire 10, is soldered, which passes under, and is attached to the operating finger-key J, and, bending down, terminates immediately over a cup of mercury 11, best seen in fig. 2. The end of a wire 12, is soldered to the erect spring 6, and is brought round into communication with the mercury in the cup 11. On the key J, being depressed by the finger of the operator, the pendent end of the wire 10, will be brought into contact with the mercury in the cup 11, when the electric fluid from the battery A, will be instantly conducted from the pole A of the battery, through the wires 9, 10, 12, to the spring 6, and from the spring 6, through its connection (fig. 4), to the spring 7, and thence over the band on the cylinder H, to the spring 8, and from that spring, by a wire 13, to one pole of the electro-magnet C, as shown in fig. 3. The electric fluid will then pass through the coils of this magnet C, and thence, by a wire, to one pole of the magnet D, and, proceeding through the coils of this magnet D, will then descend from its other pole by the wire 14, to the stud L, fig. 4; to the under part of which stud it is soldered. Another wire 15, is attached to this stud L, by a binding screw, from which it proceeds to the telegraph at the distant station, and the current of electricity is by that means conducted through the electro-magnets of such distant telegraph, which is precisely similar in construction to the apparatus above described. The electric fluid having passed through this course returns from the distant telegraph by the wire 16, to the stud M, fig. 4; which wire is secured thereto by a binding screw. Another wire 17, soldered to the under part of this stud M, conducts the electric fluid to the erect spring 4, from whence it proceeds over the band on the cylinder H to the erect spring 3, and from that spring by a wire 18, to the stud N; from the binding screw of which another wire 19, soldered or connected to the under part of this stud N, leads the current of electricity to the other pole B, of the battery, and thus the electric circuit is completed.

It will now be seen, that when the finger of the operator depresses the key J, the pendent end of the wire 10, being thereby brought into contact with the cup of mercury 11, will cause the electric fluid from the battery to pass through the circuit as described. The electric fluid, in proceeding through the coils of the electro-magnets C, and D, develops an attractive force, which, acting upon the lever armatures *e, e*, attracts the arms of those levers toward the poles of the magnets, and, in so doing, raises the pallets *h, h*; one of which then moves the ratchet wheel *d*, and with it the arbor *a*, and index-hand *b*, through a space equal to one division of the circumference of the dial-plate. On raising the finger from the key J, the wire 10, is withdrawn from the mercury cup 11, and the circuit of electricity becoming thereby broken, all the parts will fall into their original position, as shown in fig. 3; and the other pallet will move the ratchet, and thereby cause the index-hand to pass over another space or division of the dial. A repetition of the touch upon the key J, produces the same effect as described, and moves the index-hand through another space or division of the dial-plate, and so on,—the operator resting when the hand *b*, arrives at any letter or number upon the dial which he wishes to have noted; and by a succession of these movements and rests, the letters or symbols of any desired word or words may be indicated at the distant station.

In commencing the telegraphic communications, it is desirable, in the first place, to indicate whence it proceeds, which may be done by giving one, two, three, or any other conventional number of strokes on the signal-bell. In order to effect this at the remote station, a current of electricity is conducted in the way above described; but a slight change in the positions of the cylinder G, H, of the apparatus is first made.

It has been already stated, that the wooden cylinders G, and H, have metallic conducting bands placed partially round them; which bands leave non-conducting portions on the periphery of the wooden cylinders. It is by means of these that the operator is enabled to change the current of the electric fluid from the telegraph to the bell, and *vice versâ*, by a simple movement. At figs. 3 and 4, (which represent the conducting wires in connection with the telegraph) it will be seen that the erect springs 1, and 5, bear against those parts of the cylinder G, over which the metallic bands do not extend,—consequently those springs are at this time insulated; but if the cylinders G, H, were turned round simultaneously about a quarter of a revolution, the metallic bands of the cylinder G, would be brought into connection with the springs 1, and 5; and at the same time the springs 4, and 8, would become insulated, by having the non-conducting parts of the cylinder H, brought into contact with them. This is effected by the movement of a sliding-bar P, in front of the apparatus, shown at fig. 1; which bar is attached to parallel levers *p, p*, fixed upon the outer end of the axles of the cylinders G, H; and at the centre of the bar is an erect index *q*. If the bar is slidden toward the left, as shown in the figure, its index *q*, will point to the mark T, (referring to "telegraph,") and the cylinders will be situate as shown at fig. 3; the apparatus being then in a position to communicate with the telegraph. But if the bar P be slidden to the right, so that the index *q*, points to the mark B, referring to the "bell," then the cylinders G, H, will be turned round about a quarter of a rotation; by which means the conducting bands of the cylinder G, will be brought into contact with the springs 1, 5, and the bands of the cylinder H, will be withdrawn or insulated from the springs 4 and 8. When the cylinders G, H, have been thus turned round, the electric fluid will be conducted through the magnet E, E, instead of following the course previously described.

The finger of the operator being now applied to the key J, the electric fluid will pass from the pole A, of the battery, by the wires 9, 10, and 12, to the spring 6, and thence, passing over the band of the cylinder G, will proceed through the conducting spring 5, and wire 20, up to one pole of the magnet E, E. The electric current will now pass through the coils of the magnet E, E, and decend by a wire 21, leading from the opposite pole of the magnet; which wire is connected to the wire 14, which is soldered to the stud L, as previously mentioned and shown at fig. 4. This causes the electric fluid to pass from the stud L, through the wire 15, to the distant telegraph, and return again by the wire 16, to the stud M, as before explained. This position of the cylinders G, and H, being such as to carry the electric fluid through the coils of the electric magnet E, the lever armature *l*, will be drawn up into a horizontal position, and in so doing will cause the hammer p^*, to strike the gong or bell F.

The patentee next describes certain appendages which he proposes to adapt to the electric telegraph. Firstly, of a commutator, or pole changer, for reversing the direction of motion of the electric current; secondly, of a rheopeter, for changing the direction simply of the electric current; these being for the purpose of separating any number of intermediate stations from the telegraphic circuit, or of connecting any of those stations with the circuit, when desired. Fig. 5 is a front elevation of the commutator, and fig. 6 a top view of the same. A, is a block of wood, and B a wooden cylinder, turning upon an axle mounted in standards. Upon the periphery of this cylinder seven strips of copper are arranged, as shown in fig. 7, which represents the periphery of the cylinder B, extended in a plane. One of these strips of copper, *a*, is imbedded transversely in the periphery of the cylinder; the other six strips, *b c d* and *e*, are also imbedded, and extend partially round the periphery of the cylinder. These latter strips are intended to reverse the direction of motion of the electric current: the strips d^1 and e^1 are directly connected by two wires with *b* and *c*; and the strips *d* and *e* are alternately connected with *b* and *c*, by two wires crossing each other, one of which, *f*, forms a communication between *b* and *e*; and the other wire *g*, between *b* and *d*. These wires, *f* and *g*, are insulated from each other, and deeply imbedded into the cylinder, and they are covered by a transverse piece of ivory *h*. Four erect springs, *i k l* and *m*, are affixed to the base block A; their upper parts pressing against the periphery of the cylinder. A handle *n* is affixed to the axle, for the purpose of turning the cylinder round; and an elongation of the handle forms a pointer, to indicate the extent to which the cylinder is to be moved. A wire is attached to each of the springs, for the purpose of connecting this instrument with the electric circuit; and by turning the cylinder to the right or left, the direction of the electric current may be changed, or, in other words, the poles of the battery may be reversed.

The rheopeter is shown in horizontal view at fig. 8, and in vertical section at fig. 9. A, is a circular block of wood, in which two permanent magnets are imbedded; their poles extending upwards, as at N, S, N*, S*. *x y z*, are three glass cups containing mercury. *a a*, is a bar of soft iron, supported in a horizontal position by the vertical pin *b*; round this bar an insulated copper wire *c c* is coiled, the ends of which exten at right angles to the bar, and are bent down so as to touch the surface of the mercury in the cups. A wire *d*, being supposed to communicate a current of electricity (say from London) to the mercury in the cup *x*, that electric current will be conducted by the wire *c*, to the mercury in the cup *y*, and from thence pass on by the wire *e*, to the place of its destination (say Rugby), and thence through the remainder of the telegraphic circuit, back again to its starting point. As the electric fluid thus passes, the bar *a* becomes magnetised, and its ends are attracted by the poles of the permanent magnets, S and N*, as shown at fig. 8. If, for example, the current of electricity is required to be cut off from the telegraph at Rugby, and directed, say towards Birmingham, the poles of the battery are changed, by means of the apparatus shown at fig. 5. The direction of motion of the electric current being thus reversed, it will, in passing through the wire *d* (figs. 8 and 9), cause the ends of the bar *a* to be attracted by the reverse ends of the magnets, that is, N and S*; by which means the pendent end of the wire *c* will be brought from the mercury cup *y*, to the mercury cup *z*, and the current will then, instead of proceeding through the wire *e*, as before, take its course through the wire *f*, and so on, to Birmingham; by which means the telegraph at the Rugby station is effectually thrown out of the circuit.

When the circuit of the telegraphic apparatus is required to be closed, the key J, fig. 1, must be depressed. In order to keep the circuit closed, the draw-stop Q Q is pulled out, which draws down a small lever R, into the position shown by dots in fig. 2. This lever R, keeps the key in a depressed position, and the instrument is thereby prepared for receiving communications from a distant telegraph.

At figs. 10 and 11, a modification of this rheopeter is shown, in which the electro-magnet is made to move in a vertical instead of a horizontal plane. The advantage consists in the facility which it affords of changing the local direction of the electric current, without interrupting the current itself in so doing. This results from the manner in which the wire of the electro-magnet is coiled. Upon each half of the soft iron bar there is a separate coil of insulated wire; the length of the wire of each of these coils proceeds from the extremity of the bar to its middle, and then returns, by overlapping, to the same extremity of the bar where the ends of the wire, forming the coil, are made to dip into mercury cups. By this arrangement, one of these coils is dextrorsum, and the other sinistrorsum relatively to the side of the bar at which the electric current enters the coil. Then, if the electric current be supposed to branch off in two different directions, and pass from the same side of the bar, through these two coils simultaneously, the electric current would flow in the same direction through both coils, and, consequently, the polar unity of the resulting electro-magnet would be preserved. It is therefore obvious, that when the electric current enters either coil from the same side of the bar, a similar polarity results, and a corresponding motion is communicated to the bar, by the influence of the permanent magnets, as will be subsequently described; and when the electric current enters either coil from the opposite side of the bar, the polarity, and, consequently, the motion of the bar, is thereby reversed. In these alternating motions, when the bar becomes horizontal, as seen in the drawing, the ends of the two coils are immersed in the mercury cups, and therefore, without interrupting the electric current, its local direction may be changed, by depressing either end of the bar, as will be seen by the following description of the several parts of the instrument.

Fig. 10 is a plan view of the instrument, and fig. 11 is a vertical section. A is a block of wood, forming the base, and N^1 S^1 N S two permanent magnets, having their similar poles opposite in the same vertical plane, and fixed to the base A by brass clamps C C. D D, are two brass standards, screwed to the base, and carrying set screws with sunken centres, which form the bearing-points of the horizontal axle E, which passes through the soft iron bar F. Round one-half of this bar a double coil G of insulated wire is wound; and the ends of this wire dip into the mercury cups H and I. Round the other half of this said bar there is a similar coil K of wire, the ends of which dip into the mercury cups L and M. The two mercury cups L and H at the same side of the bar, are both connected by the wires P^1 P with the stud O, to which the main circuit wire V, is fastened by a binding screw. The mercury cup M is connected by the wire S with the stud T, to which, by a binding screw, the current-entering wire U of the telegraph is fastened. The mercury cup I is connected by the wire Q, with the stud R, which latter is connected by the small branch wire W, with the current-issuing wire of the telegraph, which passes to the remote terminus. Now, for example, suppose the electric current to be passing from the stud O, to the mercury cup L, it will then pass through the coil of wire K, to the mercury cup M, and so on through the current-entering wire U, of the telegraph. The electric current now passing through a sinistrorsum coil, the extremity Y of the iron bar becomes a north pole, and the other, Z, a south pole. This extremity Y, of the bar is then repelled by the pole N^1 of the permanent magnet, attracted by the pole S^1; it therefore descends, and releases the ends of the coil G, from the mercury cups H and I. The telegraph is then within the electric circuit.

If the direction of motion of the electric current be now changed, the current-entering wire U becomes the current-issuing wire, and the stud R is now connected with the current-entering wire. The electric current then passes from the stud T, to the mercury cup M, and thence through the coil K, to the mercury cup L, and so on to the main wire V. As the electric current, in this case, passes through the coil K, from the opposite side of the bar, this said coil is thus rendered dextrorsum; the polarity of the iron bar is therefore changed, the end Z becoming a north pole, and the end Y a south pole. This end Y of the bar is therefore repelled by the pole S^1 of the permanent magnet, and attracted by the pole N^1. The extremity Y of the bar is therefore raised from its inclined position, as in the first instance, and releases the ends of the coil K, from the mercury cups L and M, at the same time that its other extremity, being depressed, immerses the ends of the coil G, in the mercury cups H and I, and this immersion takes place before the ends of the coil K leave the mercury cups L and M.

As the stud R is now externally to the telegraph connected with the current-entering wire, the electric current, instead of passing through the telegraph, branches off to the stud R; it then passes to the mercury cup I, thence through the coil G, to the mercury cup H, and so on to the main wire V. The telegraph is thus, without any interruption of the electric current taking place, put out of the circuit; and as the electric current now passes through a sinistrorsum coil, the bar retains its position, until the direction of motion of the electric current is reversed, to bring the telegraph again within the circuit.

Fig. 12 represents, in elevation, one of the posts for supporting the circuit wires of the telegraph along the line of communication. This post is of wood, and is to be sunk about five feet into the earth, the sunken portion being imbedded in Roman cement. A wooden lantern-shaped box completely covers about 16 inches of the upper end of the post, so as to protect this portion of the post (which is to be well varnished) from the humidity of the atmosphere. The box is made in two parts; the cover is of a pyramidical form, and is firmly fixed on the post; the case is made to slide up and down upon the post, and is fastened to the cover, so as to completely envelope the varnished portion of the post, and the broad binding screw clamps thereon, which carry the telegraphic wires. No metal whatever is used in the construction of this box, to the outside of which an insulated lightning conductor, passing down to the earth, is attached.

The patentee claims, Firstly,—the construction and use of the direct action electro-magnetic telegraph, as before described; and particularly the arrangement of the letters or symbols on the dial plate; and the means applied to communicate direct circulate motion to the ratchet-wheel, and the index, by the alternate motion of two jointed lever armatures, working simultaneously, by being connected with one another, in the prolongation of the vertical diameter of the wheel; the pendent portions of these lever armatures forming the pallets of the escapement, and taking into the teeth of the ratchet-wheel; their ascending and descending motions being regulated by the latch-stops, which produce a dead beat escapement; he also claims this escapement, whether it be worked by two levers, as described, or by one lever only. Secondly,—the adaptation of the electro-magnets of the telegraph, as before described and represented in the drawings, whereby they form what may be called a magnetic circle, and attract the extreme and mediate ends of the armatures simultaneously, when the electric circuit is closed; and by the proximity of the bell-electro-magnet and its armature, one edge of which is always in contact with the poles of the said magnet, the reactive force of electrical induction is brought to bear so as instantly to destroy the attractive force of the electro-magnets of the telegraph, as soon as the electric circuit is opened. Thirdly,—the arrangement of the machinery of the signal-bell of the telegraph, as before described. Fourthly,—the means employed for throwing the telegraph out of the electric circuit, and bringing the striking machinery of the bell into the electric circuit, and *vice versâ;* and also of permanently closing the said circuit by means of a lever and draw-stop. Fifthly,—the means of communicating with all the stations simultaneously, or throwing any of the said stations out of communication, at pleasure, by the employment of the commutator and rheopeter, as hereinbefore described. And, Lastly, he claims the said improvements, however they may be varied in their constructive details, so long as the general arrangement of parts, as above set forth, is retained.

STEAM ENGINE REGULATOR.

Moses Poole, of London, gentleman, for "*Improvements in regulating the velocity of steam engines.*"—Granted June 29; Enrolled December 29, 1846. (*With Engraving, Plate VI.*)

The improvements relate to an apparatus to be used in connection with a governor of a steam engine; firstly, to the mode of employing the power of compressed air forced into a chamber by means of a double-beat valve-pump, worked by the engine, so that the air in the chamber may be kept in a more or less compressed state according to the resistance of the engine; the piston-rod of the piston, which is acted upon by the compressed air, communicates with a valve, to regulate the opening of the throttle-valve, through which the steam passes to the steam-cylinder, by which the engine is kept in a uniform state, whatever be its variation. Secondly, to the application of another apparatus similar to the one hereinbefore described, the difference of which consists in using the pressure of the atmosphere acting upon a piston, to press it into a vacuum in place of compressed air; so that the same apparatus, by reversing the action of the valves (causing them to open outwards, instead of inwards) might be used practically for either purpose.

The engraving, Plate VI., shows a vertical section of the apparatus; *a* is the air pump with piston, worked by a rod connected with the driving shaft; *b, b, b,* valves opening inwards, at top and bottom of the cylinder; *c, c,* wind-bores or ports with valve-beat; *d,* condensed air passage; *e,* condensed air cylinder; *f,* pressure piston; *g,* piston-rod, passing up through the conical standard *h,* to lift a counter-balance weight *i,* which is connected with the throttle-valve of the steam-pipe; *j* is a small regulating valve, and *m* a regulating tube, with a regulating cock *n,* worked by the action of the governor *o,* through the intermediate rod and lever *p.*

The apparatus is worked in the following manner: the driving-shaft of the engine gives motion to the piston of the air-pump *a,* and at each upward and downward stroke forces, through the ports *c, c,* compressed air into the condensed air passage *d,* and lifts the piston of the small cylinder *e,* together with the weight *h,* which is kept suspended by the elastic power of the air. If the air be condensed too highly, it is enabled to escape through the valve-plug *j.* When there is any deviation in the speed of the engine, the governor immediately corrects by allowing part of the condensed air to escape through the regulating cock *n,* and causes the piston *f* and balance-weight *i* to be slowed, and through the latter the throttle-valve is acted upon.

By the combination of the air pump with the governor, the patentee states that the steam way of the engine is capable of being regulated to a greater nicety.

CHANDELIER SUSPENDERS.

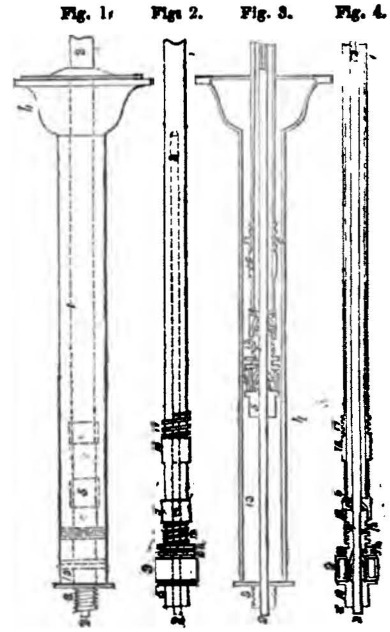
John Finlay, of Glasgow, ironmonger, for "*Improvements in raising and lowering Gas and other Lamps, Lustres, and Chandeliers.*"—Granted February 18; Enrolled August 18, 1846.

This invention consists of a method of supporting, by atmospheric pressure, such gas and other lamps, lustres, and chandeliers, as require to be raised or lowered, in the following manner:—

There is to be attached to the ceiling of the room from which the chandelier is to be suspended a rod, carrying at its lower end a piston, constructed in the manner hereinafter described. The chandelier to be suspended is connected to a tube, which is made to slide air-tight on the said piston. A vacuum being produced in the tube beneath the piston, as hereinafter particularly described, the pressure of the atmosphere supports the said chandelier; the area of the piston, and diameter of the tube in which it slides, are proportioned to the weight of the chandelier to be supported.

Fig. 1 is an outside view of a gas lamp slide, of 1½ inch diameter, inside measure, consisting of a gas tube, attached to the ceiling of the room, from which the lamp is suspended, by means of atmospheric pressure being brought into operation by means of a vacuum in the cylinder at 18, on the under side of the piston, 5; the position of the piston and of the tube are denoted by the dotted lines. 3 is a screw for attaching the slide to the lustre, the weight of which should be about twelve pounds. 2 is a tube placed within the roof tube 1, which conveys the gas to the arms of the lamp, and is made fast at the screw 3. Fig. 2 is an outside view of the roof tube, with the piston, 5, on the lower end. The tube, 2, indicated by dotted lines, projects beyond the under side of the piston. 15 is a shoulder, and 17 a helical spring, for preventing the lamp tube from sliding off when the lamp is drawn down. Fig. 3 is a section of fig. 1. The piston is shown

Fig. 1. Fig. 2. Fig. 3. Fig. 4.



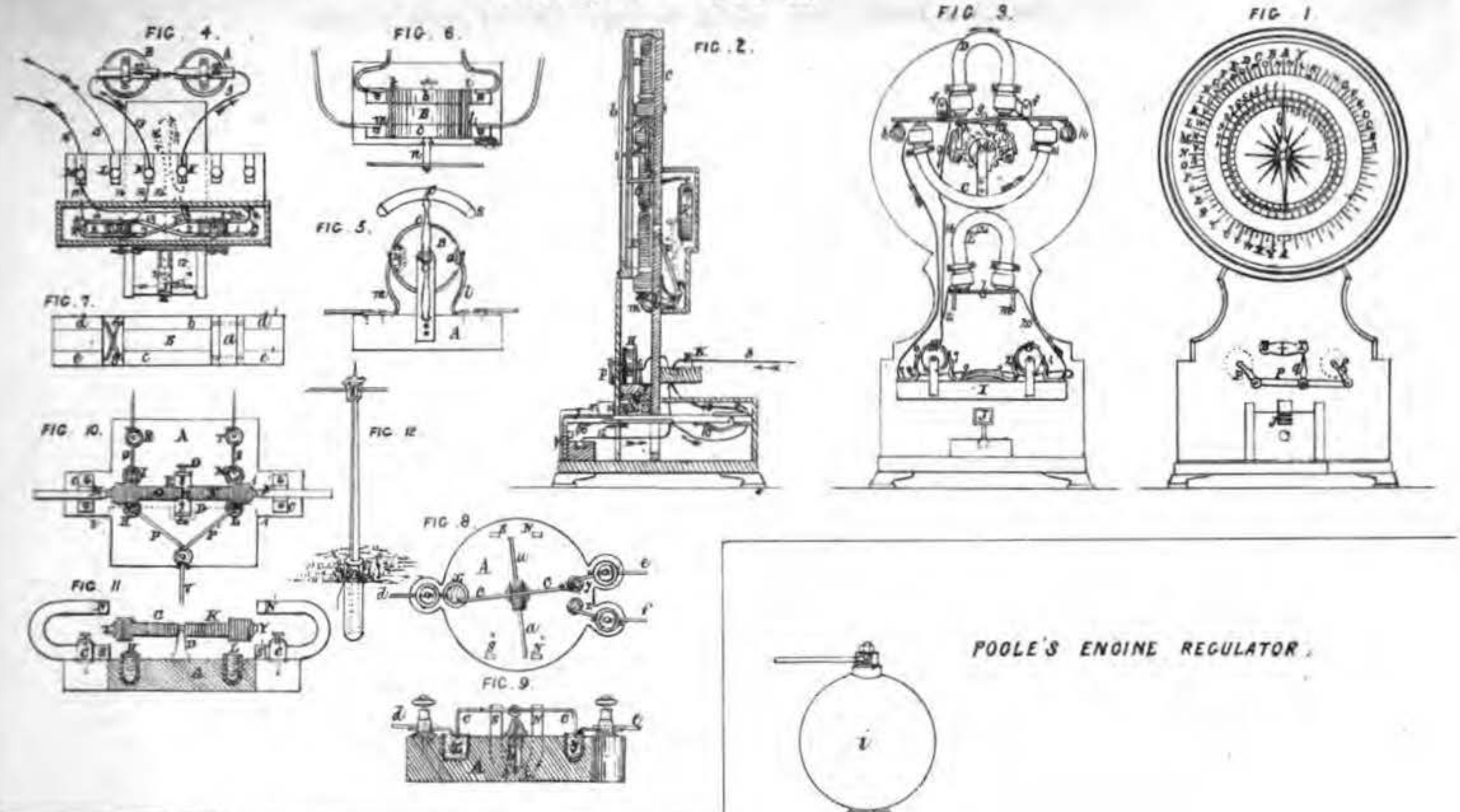
midway in the cylinder, and the exhausted or vacuum portion of the cylinder, 6, represents oil, put on the top of the piston, for lubricating the tube, and keeping the leather cups, 8 and 9, which form the packing, air tight. 16 are two small holes, drilled through the body of the piston, which holes are covered by a valve formed of a leather washer, 10, on which the brass washer, 11, is pressed by the spiral spring, 12. The object of holes and valve is to produce and maintain the vacuum by which the pressure of the atmosphere is brought into operation; for when the lustre tube is raised, the air which is included between the bottom of the piston, 5, and the bottom of the said tube, is compressed, and elasticity causes it to raise the leather, 10, and the brass, 11, and escape through the oil, 6. When the tube has been raised to its fullest extent, until the bottom of the said tube is brought into contact with the bottom of the piston, 5, the whole, or nearly the whole of the air is removed from under the said piston, and the spring, 12, forces down the leather valve, 10. On drawing down the lustre tube the oil, piston, and valve, prevent the re-entrance of air under the said piston, and the vacuum existing there causes the lustre tube, and lustre attached thereto, to be supported by the pressure of the air external to the said tube. If from any cause air or oil should have descended below the piston, it may be made to escape through the holes by the raising of the lustre tube. 7 are two small holes made through the piston, 5, for feeding the inner cups, 8 and 14, with oil. The cup or washer, 14, is for the purpose of preventing the gas from passing the sides of the tubes, 2, and coming out at the holes, 7, when the level of the oil is below the said holes. 4 is a cup for receiving a part of the oil when the lustre is drawn down. Fig. 4 is a sectional view of the roof tube, 1, with the piston exhibiting the position of the inner tube, 2. 19 is a screw in the body of the piston, by which the leather cups, 8 and 9, are kept in their respective places; and 18 is another screw for keeping the leather cup or washer, 14, in its place.

SEWAGE MANURE.

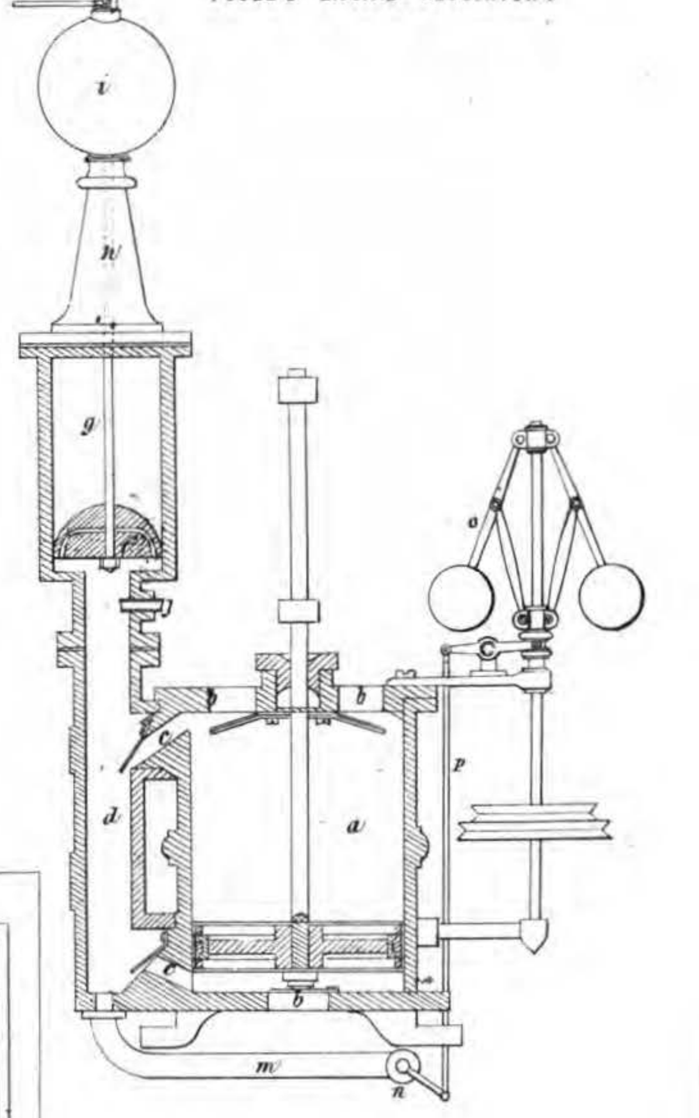
William Higgs, of Westminster, chemist, for "*the means of collecting the contents of sewers and drains in cities, towns, and villages, and for treating chemically the same; and for applying such contents, when so treated, to agricultural and other useful purposes.*"—Granted April 28; Enrolled October 28, 1846. (*With Engravings, Plate VI.*)

The invention consists, firstly, in the construction of tanks or reservoirs in which the contents of sewers and drains in cities, towns, and villages are to be collected, and the solid animal and vegetable matters therein contained solidified and dried as hereinafter described. Secondly, in the construction of buildings over such tanks or reservoirs in which the vapours and gases, evolved from the collected mass of sewage below, may be collected, retained, condensed, and combined with chemical agents, a hereinafter described, and also in the arrangement of spars or bars on which the salts, formed by the combination of such gases with other substances, may rest or crystallise. Thirdly, in the construction and arrangement of machinery and apparatus to be used in distributing and depositing chemical agents over the mass of sewage collecting and collected in the

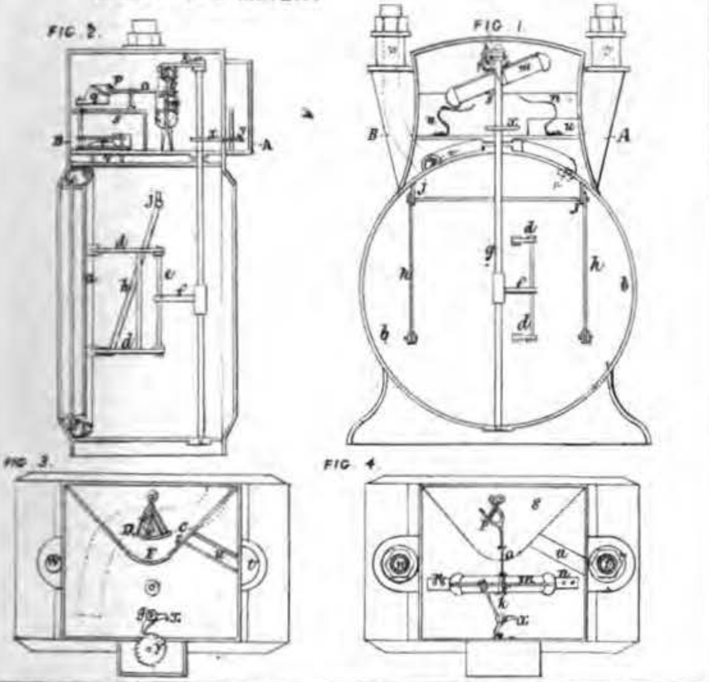
NOTT'S ELECTRIC TELEGRAPHS.



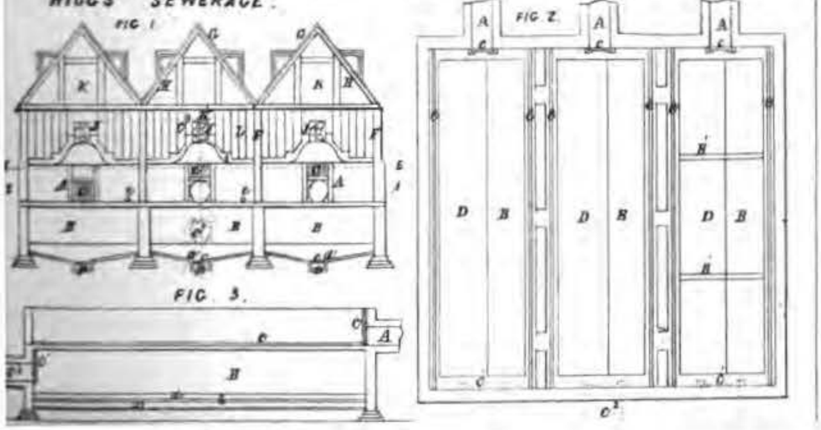
POOLE'S ENGINE REGULATOR.



CROLL'S GAS METER.



HIGG'S SEWERAGE.



tanks or reservoirs above mentioned. Fourthly, in the use and application of chemical agents for the purpose of precipitating the solid animal and vegetable matter contained in sewage water, and also for the purpose of absorbing and combining with the gases evolved in such sewage water, and the animal and vegetable matters contained therein or precipitated therefrom.

The first part of the invention relates to the construction of tanks or reservoirs. Fig. 1 is a transverse vertical section, and Fig. 2 a plan, of three tanks or reservoirs, in which the mass of sewage is to be collected; also a section of buildings to be erected over the tanks or reservoirs in which the vapours and gases arising from the tanks are to be collected and condensed, or combined with other substances. A, the extremities of the sewers, through which the sewas matter is to pass, communicating with the tanks B, in such a manner that the sewage water will run freely into them. The sewers A have sluices C, opened or closed at pleasure, so as to allow or prevent the flow of the sewage water and matter into the tanks as may be desired.

The tanks or reservoirs, B, may be constructed of brick, stone, or other fit materials, and of any number, form, and depth, as may be found most suitable and convenient, according to their local position and the quantity of sewage matter to be treated or operated upon. It is preferred that each tank should be made in the form of a parallelogram, the sides to which shall be three times the length of the ends, and varying in depth from twelve to fifteen feet. The bottoms of these tanks or reservoirs must be so constructed as to drain down to some one or more places where a filter or filters is or are to be placed for draining and drying the solid matter in the tanks, and with proper drains under such filters for carrying off the water passing through them. It is preferred to construct the bottoms of the tanks with double inclined planes, and with drains running down the centres of the tanks, and into which the water in the tanks will drain. Over each of these drains is placed horsehair cloth, or some other porous and filtering material, to be supported upon gratings. The drains under the filters must be made to communicate with a cistern or other receptacle for receiving the filtered water, and so that the water may run freely from them into such cistern or receptacle.

The sewage water from time to time poured into the tanks B, after being deprived of the solid animal and vegetable matter contained therein, is to be let off through the floodgates, C^1, into the water-ways, C^2, so as to leave the precipitated animal and vegetable matter, remaining in the tanks, to be afterwards treated as hereinafter described. The floodgates, C^1, must be placed about three feet from the bottoms of the tanks, so as to leave a convenient space below the level of the floodgates.

When a sufficient quantity of animal and vegetable matter has been collected in a tank, the floodgate is closed, so as to prevent any further flow of sewage into the tank until after it has been emptied of its solid contents. The filtered water contained in the cistern, or other receptacle, must then be pumped up from time to time, or got rid of in some other way, so that the drains under or communicating with the filters may be kept free from water, and the filters so left free to act efficiently.

In order to facilitate the process of depriving the solid matter in a tank of its moisture, a partial vacuum under the filters is formed, so that the pressure of the air upon the contents of a tank may have the effect of drawing the water contained in it down through the filters into the drains below; and for the purpose of producing and keeping up such a partial vacuum, the patentee either uses an air-pump for exhausting the air in the drains under the filters, from time to time, in the same manner as air-pumps are generally applied to such purposes; or he produces and keeps up such a partial vacuum by means of the pump by which, from time to time, the filtered water is to be pumped out of the receptacle.

The tanks B may be subdivided into two or more compartments by divisions, B^1. The line E, E, fig. 1, represents the ground line, or level of the ground, showing how much of the building is to be raised above ground.

The second part of the invention relates to the buildings above the tanks already described, F. Fig. 1 shows the walls of a buildings erected over a set of tanks. G, the roofs furnished with a number of openings H, through which the air may escape. I, are ceilings, furnished with one or more of Day's Patent Archimedian Ventilators J, or other similar machinery, for effecting an upward current and drawing off the vapours and gases evolved from the tanks, and carrying them up into the chambers K, to be condensed or combined with some chemical agents or matters, as hereinafter described.

In the chambers, K^1, are fixed a number of uprights of wood, C^2, and to these a number of spars are secured in a longitudinal position, on which the salts or other substances formed from the vapours or gases may rest and attach themselves, as hereinafter described.

The third part of the invention relates to the construction and arrangement of machinery and apparatus to be used in distributing and depositing chemical agents over the mass of sewage collected in tanks or reservoirs, which arrangement consists of trams or rails, fixed along the edges of each side of the tanks or reservoirs B, on which suitable carriages may travel.

The operator will, by these means, be enabled to distribute the chemical agents or substances equally over the whole or any part of the surface of the contents of the tanks or reservoirs, as may be required. And for the purpose of more equally distributing the contents of the wagon over the surface of the matter in a tank, the bottom of the wagon may be constructed like the hopper of a flour mill, and have motion given to it in the same manner, or any other similar means may, if thought fit, be adopted for making the bottom of the hopper self acting for the purpose of distributing or throwing down its contents into the tank below.

The fourth part of the invention relates to precipitating all the solid animal and vegetable matter contained in the sewage water from time to time run into the tanks, and to cause the vapours and gases arising therefrom to be condensed, absorbed, or combined, with some other substances in the chambers above. For this purpose, hydrate of lime, commonly termed slaked lime, is preferred, being the cheapest and most efficient chemical agent for effecting it.

For the condensation of the vapours and gases arising from the mass of sewage, it is proposed to use chlorine gas to unite with and condense all such vapours or gases as are composed of ammonia, or sulphurretted hydrogen, which are evolved whilst sewage matter is collecting or under the chemical treatment in the tanks or reservoirs. Hydrochloric acid gas, and some other chemical agents, may perhaps be capable of effecting the condensation or absorption of the various vapours and gases arising from sewage matter, but chlorine gas is preferred, because of its efficacy and the facility and economy with which it may be obtained.

The solid animal and vegetable matter remaining in a tank after the greater part of its water has been drained out of it by means of filters, as before described, ought to be dried so as to prevent the chemical decomposition of it, and render it fit for being transported to distant places, for application to agricultural or other useful purposes.

This solid matter ought first to be formed into pieces of suitable shapes and dimensions, and then dried by any means which may be most convenient according to circumstances.

SHIPS' LOGS AND SOUNDING MACHINES.

Thomas Walker, of Birmingham, stove maker, for "*Improvements in ships' logs and soundings.*"—Granted June 22; Enrolled December 22, 1846.

These improvements relate to apparatus for registering the speed of vessels and sounding depths at sea. The first to registering the speed of vessels by external or internal rotators. Fig. 1, shows the rotatory placed on

Fig. 3.

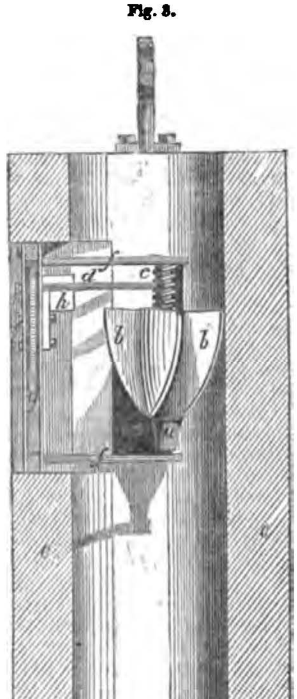
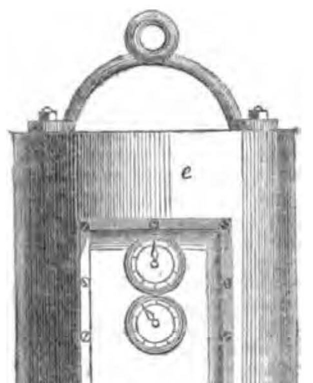


Fig. 4.



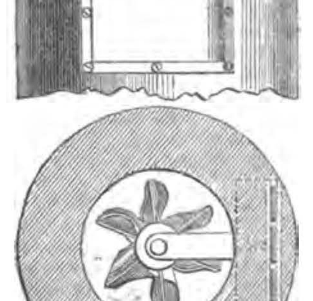


Fig. 5.

one side of the vessel, with its index above the side of the ship. *d* is a suitable metal tube, inclosed in the connecting medium, such as rope or chain; *a*, is the rotator; *b*, the rope, with a universal joint attached. Fig. 2, is a view of another description of rotator for registering the speed of currents, which is contained in a circular box or tube, *a*, having flanges for the purposes of removal; *e*, *f*, are metal tubes, formed in the manner shown in the cut; *d*, is a vacuum pipe, for the purpose of extracting the air and filling the tubes with water, to admit of a passing current through the blades *b*, *h*; *g*, is the water line. The whole apparatus being above it, more readily admits of repairs. Figs. 3, 4 and 5, represent the application of the rotator within the weight or cylindrical metal *e*. *a* is the rotator; *b*, the blades; *c*, the screw into which a small pinion takes; *d*, the pinion spindle; *e*, *e*, the weight or cylindrical case; *f*, *f*, horizontal bearings; *g*, tooth and pinion wheels; *h*, a longitudinal stop; *i*, *i*, indicators; *l*, *l*, a semicircular channel, fitted with an adhesive compound for the purpose o

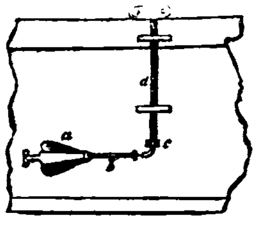


Fig. 1.

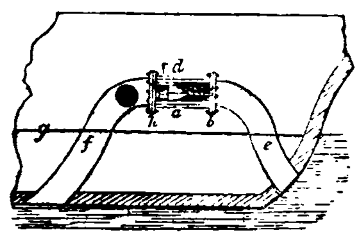


Fig. 2.

ascertaining whether the log reaches the bottom or not, by collecting particles of dirt or rubble therefrom. The action is as follows:—The log, on descending rapidly through the water, causes the blade *b*, to rotate, which is transmitted to the tooth and pinion-wheels, *g*, and from thence to the hands or indicators i, i, which revolve until the log has reached the bottom, when it is necessary, in order to keep the hands or indicators in the position last indicated by the motion of the rotator, to employ the stop, *h*, which is put in action by the pressure of water when the log is being withdrawn, thereby preventing a retrogressive movement of the hands.

GODDARD'S IMPROVED ANEMOMETER.

It consists of a double vane, shaped like a truncated cone, the small ends being fixed to a brass tube about 1 inch in bore; this tube, penetrating the roof, rests on a hollow socket fixed into a table, which supports the instrument; immediately above the table the tube passes through a solid cylinder, whose top is cut oblique to the axis, thus forming a solid, termed a hoof, the tube forming its axis; so that as the wind shifts its quarters, vane, brass tube, and hoof, all revolve together in the plane of the horizon: beside this rotating hoof, a brass piece is placed vertically upon the table, and has a slit in it, so that a slider, containing a pencil, may rise and fall as the thick or narrow part of the hoof comes under the sliding pencil, the former being the case with a north wind, and the latter with a south wind. Therefore it will be understood that the pencil is lifted to the top of the scale at north, and depressed to the lower end by a south wind; the east and west occupying the mean or middle, it will be readily seen that the east and west are in the same place on the scale; but in order to distinguish them from one another, a pencil (below the former pencil in its lowest excursions) is made to mark in the eastern semi-circle, and remain inactive on the western. This is the *direction* of the wind-pencil.

To the minute-hand of a clock is attached a light arm, which, being connected with another pencil by means of a beam (similar to that of a steam-engine) placed in the same slider, only above the highest limit of the direction-pencil and its auxiliary, alternately raises and depresses it, according as the minute-hand points to 30′ or 60′. This is the time-pencil. Inside the brass tube an iron rod passes, connected at the upper end with a fan wheel, which the wind turns in proportion to its velocity; and to its lower end with an endless screw, which, communicating a motion to a few simple wheels, gives a slow rotating motion to a cylinder, upon which a sheet of paper is fixed: upon this cylinder, and whose axis is vertical, all the pencils describe their evolutions. The office of the two first pencils is to record the direction, and of the last the time and miles of wind; it being previously ascertained how many revolutions of the fan-wheel correspond to a mile or ten miles of wind.

The advantages of this anemometer are stated to be:—

1. That the scale of time is five times greater within an equal compass of paper than Mr. Osler's.
2. That the register of direction is fully eight times as large, with equal sized sheets, as that of the ordinary construction.
3. The data registered are more comprehensive than those of Whewell's, Osler's, or Foster's, viz.:—
   1. Miles of wind blown during the day.
   2. Miles of wind blown in each direction.
   3. Miles of wind blown between any given periods.
   4. Hour and minute of the highest gust.
   5. Hours in which most wind has blown.
   6. Times of calms, and length of continuance.
   7. Velocity of wind at any hour.
   8. Time occupied by the wind going any certain distance at any period of the day.
   9. Direction of wind at any minute.
   10. Mean direction.
   11. Direction of longest continuance.
   12. Direction of greatest passage of wind.

INTERNAL FITTINGS OF ST. DENIS.

In the *Annales Archéologiques* for October, appears an able criticism, by the Baron de Guilhermy, of the recent restoration of the Abbey of St. Denis, near Paris. The severity of this paper, from which some extracts are given below, is fully justified by the obvious incompetence of the architect, and the desecration of an ancient and beautiful edifice by modern make-shift expedients. We can testify from personal observation that the architecture of the Abbey now looks very *pretty*, but prettiness and the imitative decoration now exhibited in St. Denis are worthy only of the gaudy shops in the Palais Royal.

"The capital vice of the actual decoration of St. Denis is to our eyes the absence of all serious character. You would fancy you saw the work of a sceptical and mocking age, which, forced to raise up again the ruins of the old church, wished to indemnify itself for this constraint by treating in the most cavalier fashion things of a class altogether grave and respectable. Here they have played at catacombs, and at primitive Christians; there they have pruned away from the legends the miracles which God could not have wrought without wounding our reason; elsewhere they give you, by way of tombs of the martyrs, blocks of stone which only possess the appearance of such, and altars really consecrated shelter under their tables those lying representations; finally, to crown the derision, two or three square metres of bad red serge, hung to a pole of gilt wood, at the end of the apse, sacrilegiously parody that glorious Oriflamme of France, which our fathers, in their religious enthusiasm, imagined was sent down from Heaven, and placed by an angel in the hands of the first Christian king.

"*Chapels of the Nave.*—Seven chapels border the nave of St. Denis on the north; the first serves for a lodging to the guardians of the church, and the seventh is occupied by the two mausoleums of Louis XII. and Henry II. The five other chapels have been restored to the purposes of worship, and at the present hour the last hand is being actually put to their decoration. Two alone amongst them, those of St. Martin, and the Trinity, preserve their ancient titles; the three others, which bore the names of St. Lawrence, St. Louis, and St. Denis, have lost their old patrons. But an illustrious martyr, like St. Laurence, a king like St. Louis, an apostle like St. Denis, merited some regard; accordingly they have given them a compensation in the chapels of the apse, where they have in their turn supplanted saints of a less value. The confusion resulting from all these displacements, will in no little degree obscure the history of the Abbey, for him who would wish to study it in the different works left by the Benedictines. It was not without a motive that the monks of St. Denis had settled the titles of their different chapels; the choice of each patron was connected with some remarkable circumstance in the history of the monastery.

"At St. Denis the decoration of the lateral chapels of the nave has been treated as if it were a case of furnishing the halls of a museum. The people who had suppressed the Museum des Petits-Augustins, and who no longer knew what to do with the immense quantity of fragments of which this collection was composed, entertained the unhappy thought of enriching St. Denis with the spoils of a hundred churches. On their side the architects gave themselves incredible pains to make use of all these *debris*. So that the eye is every where shocked with a disorderly accumulation of sculptures which have neither connection of subject nor community of origin, nor analogy of style."

"Four bassi-relievi of the sixteenth century are fixed in the wall."......

"In order to give this chapel an altar worthy to figure in the midst of a like disorder, they have gone and chosen in the magazine of arches, several pointed arches of the thirteenth century in coloured stone, formerly comprised in the decoration of the charming apse of the Sainte Chapelle at Paris, and on these supports of a new sort is placed a great slab which forms the table of the altar. At one stroke the Sainte Chapelle has been deprived of an important portion of its ancient ornamentation, and St. Denis has been enriched with a pitiable monument. These arches so disposed form an open space, a sort of cage, whose bars emprison a statue reclining on a sheet; look at it well, and you will recognise the lover of Diana of Poitiers, (Henry II.) who here fulfils the functions of a Christ in the sepulchre."...."Above this altar of sufficiently profane composition rises a curious reredos of wood worked with more patience than art."...."The style of this sculpture proves a Flemish origin. Finally our chapel has been entirely painted; but, in place of clothing it with those brilliant colours of azure and gold for which the middle ages had such an affection, they have given it a costume of the saddest and palest tint. Certain columns reproduce, on a gigantic scale, those innocent sticks of apple-sugar or chocolate which our confectioners display less to cheer our eyes than to excite our *gourmanderie*. If, as they have dared to say, the money to do better was wanting, would it not have been fit to have waited? The church of St. Denis will survive us. A pretended drapery of a greenish colour, powdered with meagre ornaments of gold, (if it can be so called,) hangs heavily all round the chapel, to the lower part of the walls. Higher up, house-painters, turned into historical painters, have executed two abominable frescoes representing Moses on Sinai, and the Last Judgment. In the scene of the Judgment the tribunal only is given; the whole human race is missing. Let us not forget to mention, by way of memorandum, three or four bad modern pictures straying about this toy-shop, and to state that at this very moment workmen are finishing a great beam starting from the mouths of dragons, which will soon be, if the new architect does not rectify it, planted across the arch of the opening of the chapel; this piece of wood will serve as support to some twenty bad little statues, which will be disposed like a calvary, such as still exists in certain rural churches, particularly in Britanny. I simply announce these facts: they speak sufficiently for themselves, without their having need of a commentary."

In the choir to the south of the nave some ancient wood-work was pressed into service, of which—

"Two bassi-relievi were missing; to replace them, they have modelled twice over in papier-maché, a Preaching of St. John Baptist, which is thus found thrice repeated. All the little statues which were destroyed, have been also restored in papier-maché. This wood-work, of which the execution is admirable, is now found so glued over with oil-paint (*quære* varnish?) that one can no longer appreciate the delicateness of the tool: the figures and the misereres of the stalls have had the same fate. Some panels of the wood-work offered no subject; they have caused marquetry work to be imitated there by the pencil—every where and always the intention to deceive the eye." "They have had the barbarity to use up, to cut, to pare doors, which came from Gaillon, which passed for a *chef-d'œuvre*. They have employed the pieces to make a frame for the painting over the principal altar, benches for the choir-boys, and desks for the cantors. "In a sculpture of the Nativity in this choir, they forgot, while restoring it, to place Our Lord in the cradle."........"In this same choir are now found the monuments of some abbats of St. Denis; they are the only ones which the revolution has not destroyed. But before they found here the right of asylum, they have been compelled to suffer rude outrage."—"They also devised the fabrication of a Suger, by means of a grotesque face of pure fancy, taken from a boss of the ancient cloister, a bloated and trivial face, recently illuminated with a drunkard's red."......"From four or five Apostles of the Sainte Chapelle which had been carried to St. Denis, they have drawn out the twelve by moulding them one upon another. These twelve figures, executed in plaister, are placed against the pillars of the winter choir."....
"A glazed enclosure guarantees the canons from every current of air, it is a real frame of glass, set in plaister foliage, and papier-maché mouldings. The poor royal church is cruelly expiating its passed magnificence."

"We have not to talk either of the high altar, nor of the stalls of the great choir, nor of the mosaic pavement of the sanctuary; they have none of them any archæological pretensions; let us leave them in peace. The choir is paved in black and white squares, just like the vestibule of a *bourgeois* house, or a dining room. At the extremity of the apse, two marble columns annulated like those of the twelfth century, and crowned with capitals of the thirteenth, carry a wooden platform, on which repose, in shrines of gilt bronze, the relics of the three martyrs, and which serves at the same time as canopy to the seat of the first dignitary of the chapter. They have also cut up by slices some precious wood-work of the chapel of Gaillon to compose with it a niche for the armed chair of the *primicier*, which has remained empty since 1830."

"*Chapels of the Apse.*—If we run over the chapels ranged round the apse, we again find there all the faults which abound in those of the nave."....
"Plaister displays all its magnificence in the whole circuit of the sanctuary."
......"As the height of luxury they have spread with full hands on the borders of the tables of the altars, nasty pieces of glass picked up in the stalls of the Boulevards." "In the chapels of St. Benedict, St. Geneviève, and St. Eugenius, under the tables of the altars, great tombs of stone, which appear to contain bodies of the saints, are each fairly composed of a huge block, of which the exterior alone has the form of a sepulchre.......In the chapel of St. John Baptist, a cross of the fifteenth century, a curious monument extracted from the ancient cemetery of the Innocents, is now planted on a balustrade. This cross finds itself exalted on a column channeled in chevrons, in the style of the twelfth century; it is sustained by a bar of iron, without the aid of which it would immediately fall upon the pavement. The Virgin and St. John the Evangelist ordinarily accompany, as is known, the representation of Christ upon the Cross;—they thought of placing here the statues of these two personages. It was not very difficult to procure a St. John; but there was a want of a suitable Virgin. What was to be done in this penury? The restoration of St. Denis is fertile in expedients. A very innocent Apostle was condemned to the punishment of decapitation, and on his masculine shoulders they adjusted the head of a woman with tearful eyes. On the façade, they had travestied the Virgin into a man; they wished to give her her revenge. But unhappily in spite of the feminine head and veil, we travellers by the old roads recognise the poor Apostle, by the book which he carries, and the bareness of his feet.

"We trust the reader will pardon us such minute details. We have reserved the strongest for the last. They had in their hands the front of a sarcophagus, which may well date from the eighth century. What a windfall for people who have seen Rome, and know a little of their catacombs. The front of the tomb, in spite of its purely funereal inscription, has become the front of an altar. If we complain of it, they answer us that it is seen at Rome in all the basilics. On the marble has been placed a reredos of a new make, with Monogram, Fish, and Dove; one might really fancy one's-self at the end of the grottoes of St. Sebastian. In order to render the illusion more entire, and the parody less imperfect, they conceived the idea of expressing in a lively manner, the defeat of paganism, and this is the way they set about it. At the sale of a defunct antiquary, of I do not know what illustrious society, they purchased a little marble vase perfectly intact, sculptured with an eagle, and decked with an epitaph. This sufficiently impure vase was destined to become a reliquary. A primitive Christian could not have seen without horror upon an altar, the eagle of the persecutor, and the names of the Dii Manes; two strokes of the chisel therefore dealt justice to these pagan emblems, and on the *debris* of the eagle, they traced a cross, which they took care to make as awkward as possible, in order to make it pass for the work of a primitive Christian, fanatic and maladroit. It is thus that at St. Denis they make a joke of the Christianity of the catacombs."

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

SOCIETY OF ARTS, LONDON.

Jan. 14.—JOSEPH PAYNE, Esq., in the Chair.

The first communication read was "*On a new Condensing Rotary Steam Engine*," by Messrs. CORDES and LOCKE. Models and drawings of the invention were exhibited.

This is an invention belonging to the numerous class of rotary steam engines, but differs from them in two respects. 1st. That whereas they have extensive rubbing surfaces, which require great accuracy and careful packing, and are attended with much friction and loss of power, the newly invented engine has no packing and scarcely any friction, being merely a wheel or vanes revolving within a case, and receives impact from the steam as it passes from the cylinder to the condenser. 2nd. That whereas the common engine, revolving at high velocities, has to encounter great resistance from the air, this wheel revolves in vacuum, by means of a condenser worked by a triple pump, separated from the machinery of the engine. The proof which the patentees offer of the excellency of the engine, consists in the results of certain experiments, made on a large scale, in pumping water, and in direct competition with engines of the common form; in which experiments, it was made to appear that the same general useful effect was obtained from the new as from the old engine, but with a much simpler and cheaper apparatus. The paper concluded with an account of a large experiment, in which the rotary engine was used as an auxiliary to a common engine, with a gain of one-third more power.

Mr. CORDES gave an interesting account of the working of the engine, and the results of the various experiments that had been made; after which a lengthened discussion took place, in which Mr. Newton, Mr. Rotch, and other scientific gentlemen and engineers, bore testimony to the ingenuity of the invention. The cost of constructing an engine on Messrs. Cordes and Locke's principle is stated to be from £15 to £20 per dynometric horse-power, exclusive of boilers, the weight of engine per horse-power not exceeding 4 cwt.

ROYAL SCOTTISH SOCIETY OF ARTS.

Dec. 14, 1846.—DAVID MACLAGAN, M.D., F.R.S.E., President, in the Chair.

The following communications were made:—

1. "*On the means of Preventing Accidents to Railway Trains.*" By J. STEWART HEPBURN, Esq. Two expedients are proposed—for preventing collisions, and for rendering them less fatal when they do happen. To prevent collisions, he proposes a break of a much more effectual kind—not rubbing on the tyre of the wheels, but pressing down upon the rail, and at the same time lifting two of the wheels off the rail altogether. This he proposes to be worked from the last carriage in the train, and gradually to be taken up by the next break in front, and so on to the locomotive. In this way there would be no danger of the carriages in the after part of the train running into those in front when the breaks are applied.—To render collisions less fatal, if they should happen, he proposes to have one of the luggage vans, both in front and in the rear of the train, fitted up as buffer wagons, with a set of very strong springs at both ends of the wagon, to deaden the stroke, still continuing the usual buffers in all the other carriages.

2. Description and drawing of an "*improved Railway Indicator and Alarum.*" By Mr. ANDREW CARRICK. He proposes that a lever be attached to the locomotive (with a rule joint to prevent its action on reversing the engine), which shall come in contact with a short inclined plane, at a certain distance from each station, when the engine should be slowed. The lever is pushed upwards by the incline, and strikes a bell, which gives notice to the engineer, especially in foggy weather, immediately to take the steam off, as he is approaching a station.

3. Description of an "*Ink to be used in Writing to the Blind, with some remarks on whether the Roman Alphabet should be used, or one of easier formation by the Pen.*" By ROBERT FOULIS, Esq. The ink is of a peculiar kind, composed of common ink, acetate of lead, and gum arabic, by writing with which on common paper, the letters, which must be of a tolerably large size, are easily felt and read by the blind. This was proved by his making a blind boy read several sentences which he had not previously done. Mr. Foulis also goes into the question, whether it would not be better, in writing to the blind, to have an arbitrary character of easier formation with the pen than the Roman alphabet.

4. Dr. Wilson exhibited in action, and described an "*Electro-Magnetic Coil Machine*," constructed by Messrs. Kemp and Co., Infirmary-street, and showed that Mr. Brown's coil machine, lately exhibited, is made on the same principle as Mr. Kemp's, which had the priority.

Jan. 11.—George Tait, Esq., V.P., in the Chair.

The following communications were made:—

1. Description, with a drawing, of an "*Hourly Self-Registering Barometer*." By Mr. P. M'Farlane. He proposes to have twelve barometer tubes placed side by side in a case dipping into separate cups of mercury, the lower end of the tubes being bent at a right angle, and ground even at their mouths. A valve is fitted to act on each of the mouths, and to the other end of the valve is attached a lever, on which at every hour, a wire moved by clock work presses and shuts each valve in succession: thus retaining the mercury in each tube at the exact height at which it stood at that particular hour of the day or night, and as they are all read off at one time, there will be no occasion for correction for temperature.

2. Proposed improvement in "*Locomotives and Railway Carriages, particularly in their Wheels and Breaks.*" By Mr. J. Wight. He proposes a new form of wheel for the running wheels of locomotive engines and railway carriages. In place of running in a vertical direction, which he finds by experiment to be very apt to cause the wheels to leap off the rail on arriving at some impediment, perhaps a very slight one, especially when on a curve, he proposes to have the wheels (except the driving wheels) running at an angle of 45 degrees, the upper part of the tyre to be next the carriage, and the lower part of it upon the rail, with two sets of spokes, one set as at present, and the other vertical, so as to bear the weight of the carriage. He conceives their axles, which are to be separate, and not in one piece as at present, will be much stronger, though lighter, for the section, taken at the angle of 45 degrees, is stronger than a section perpendicular to the horizontal axle. But the chief improvement he conceives, consists in their safety, having no tendency to run off the rail, although upon a curve of small radius. He also proposes that the break, instead of checking the wheel by rubbing on the tyre, should be made to rub upon the rail itself. The break to be about 2 feet long, so as to present a large rubbing surface to the rail, and to be moved by the ordinary lever or screw power.

3. On a new and improved "*Method of Saving Life on Skating Lochs and Curling Ponds.*" By Mr. James Baillie. He proposes to have a flat-bottomed boat, with mallets, ropes, short ladder, and other implements, kept at the side of the loch, and a long rope also to be managed by two men at the opposite sides, who, when any one has fallen into the water, can speedily bring this rope over the spot, which the person immersed may lay hold of until the boat arrives.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

Jan. 11.—Mr. Tite, V.P., in the Chair.

A paper was read on the Ancient City of Syracuse, by Samuel Angell, V.P., which is given in another part of the Journal.

Mr. Scoles, honorary secretary, exhibited a drawing of an ancient bath in Syracuse (he considered it Roman), the vault of which was formed by earthern cylindrical tubes, 2½ inches in diameter, like a wine-bottle with the bottom out, the smaller end of which entered the larger end of the tube next it, and so, without involving the principle of the arch, formed a vault, in this case seven feet in span. The tubes were filled with cement, and covered on the top with a layer of tiles.

Mr. Donaldson communicated a paper, "*On a mode of Measuring and Valuing Carpenters' and Joiners' Work, with the view of obtaining greater correctness than by the mode now pursued.*" By Mr. Browning, architect.

Mr. Tite said, architects had been told recently, in a work which had attracted some notice, that this was a matter with which they should have nothing to do. But the fact was, they couldn't help it, and moreover would not do their duty towards their employers if they neglected attention to it. He had himself no liking for measuring and valuing, but nevertheless he was obliged to do it. As to any change in the mode of measuring, he thought it would have to come from the operatives rather than from the profession. That it was much needed there could be no doubt. The mode of measuring stone was especially empirical. Measuring first the cube stone, then "face," "bed," and "joint," as plain work: then the sunk work; then the moulded work; led to a false result. Sir Robert Smirke, at the Post Office, had struck a blow at the system when he refused to allow the bed and joint to be measured, and gave an increased price for the cube stone. The engineers had cut the knot which the others attempted to untie, by measuring the cube stone and nothing else, including all labour in the price. This, however, was manifestly an unsatisfactory mode. Returning to the general question, architects were bound to see that their employers were fairly dealt with. It was easy to certify an amount, but no man should do so unless satisfied as to its correctness. The art could not be separated from the business. Measuring might be delegated to others, but even then the architect was justly held responsible. It was so also in Greece, where, if an architect's estimates were exceeded in the execution of the works, his own fortune was liable for the difference.

[Will Mr. Tite tell us how to get at the labour of sawing the stone and sunk work and other labour connected with beds and joints, or the labour on the face, without first measuring them. It is very true that builders, to suit the convenience of some architects, give a price for stone per foot cube, including beds and joints; but before they do so, they first calculate from an average, in the best manner they can, the value of the sawing and setting, and then add it to the price of the stone. The only advantage of such a practice is that it saves a little trouble in measuring the work, allows a clerk of the works to measure the stone work, and dispenses with the employment of an experienced surveyor. In the same manner, it might be advocated that buildings should be taken at so much per foot cube, and doubtless this method would save much trouble;—but what dependance could there then be in the correctness of the value of the work and labour done?—Ed. C. E. & A. Journal.]

The Papworth Testimonial.—Several architectural friends of Mr. Papworth, on his retiring from the profession as an architect, at the age of 70 years, met at Mr. Donaldson's house, in Russell-square, on Monday, the 25th ult., to present him with a beautiful Silver Inkstand, "as a tribute of their respect and esteem for his talents as a distinguished architect, and for his worth as a man." The testimonial was presented, with an eloquent oration, by Mr. Cockerell,—the lateness of the month prevents us giving even a brief outline of it, or Mr. Papworth's reply.

INSTITUTION OF CIVIL ENGINEERS.

Jan. 19.—*Annual Meeting.*—Sir John Rennie, President, in the Chair.

The following gentlemen were elected officers for the ensuing year: *President*, Sir John Rennie; *Vice-presidents*, W. Cubitt, J. Field, J. M. Rendell, and J. Simpson; *Council*, J. F. Bateman, I. K. Brunel, J. Locke, Sir J. Macneil, J. Miller, W. C. Mylne, T. Sopwith, R. Stephenson, G. P. Bidder, J. Cubitt, Captain Coddington, and C. Holtzapffel.

Telford medals were presented to Messrs. Barlow, Snell, Harding, Williams, Parkes, West, and Ritterbandt; and premiums of books to Messrs. Turnbull, Heppel, and Robertson.

Council Premiums, consisting of collections of books of considerable value, were presented to Messrs. Barlow, Snell, and Harding, in addition to the Telford medals. Succinct memoirs were given of the deceased members, Messrs. Crane, Deville, Handley, and Winsland.

The Report, which stated that the Institution was in a most prosperous condition, entered fully into a description of the alterations of the building during the recess. The principal works appeared to be the remodelling the basement story, putting a portico at the entrance, and balconies to the first and second floors, and enlarging the theatre. Thanks were unanimously given to Mr. T. H. Wyatt, the architect, Mr. Grissell, the builder, and Mr. Manby, the secretary, who superintended the execution of the works.

The President's Address.—Sir J. Rennie, after alluding to the stimulus the profession had received from the number of public works recently undertaken, and the high position which the Institution had obtained from the successful labours of its various members, impressed on them the necessity of still further exertions, in order to support the scientific character they had earned. He then reviewed the progress that had been made in railway travelling and steam navigation, and made some valuable remarks on the formation of bar harbours and the drainage of extensive districts of marsh lands. The president then remarked upon the appointment of civil engineers by government to investigate into the merits of various projects which had been submitted to the Health of Towns Commissioners, and observed, that if the same system had been pursued with regard to railways, the public would have derived infinitely greater advantages than they were likely to do from their present system. Sir J. Rennie concluded his able address by thanking the officers and members of the Institution for the kindness, attention, and support which they had on all occasions exhibited towards him.

Thanks were voted to the president, vice-presidents, and other members of the council, and to the secretary, and the meeting adjourned.

NOTES ON FOREIGN WORKS.

Machine Manufactories in Germany.—The construction of the manufactory established at Esslingen (Würtemberg) proceeds rapidly. On the 1st of May last, the building, 1000 feet by 60 feet, was begun, and one half is now completed, and workmen are already employed in the carriage department. For removing the single engines, some new water-works are being erected, the establishment having a 100-horse water power at its command. The annual produce will amount to 600,000 florins (£150,000, English), and employ 500 workmen. It will shortly be completed, and thus Würtemberg will not only produce her own locomotives, wagons, and other railway requisites, but it is said that even the Roman lines will be supplied from Esslingen. The direction is confided to M. Kessler, and government has assisted it with every facility and aid desirable. The same gentleman was also the founder of the Karlsruhe manufactory, commenced in 1837, which has since 1842 produced an immense quantity of railway implements. It now employs 860 workmen, and since its erection has constructed 70 locomotives, and 90 are now in hand, for the lines of South Germany, Switzerland, Hanover, Prussia, &c. If the making of turn-tables, bridges, and other structural parts of railways, be taken into account, the activity of these two establishments may be easily calculated. Occupying, jointly, 1800 workmen, and producing 2,000,000 fl. (£350,000) of work a-year, they may vie with any establishment in Belgium or England. Ten years ago, any such plan would have been considered in Germany quite impracticable and chimerical.

M. Rugendas, the painter, who has travelled twelve years in different parts of South America, the Brazils, &c., has brought back a collection of about 3000 sketches, some of large size. The views of American cities, and their chief buildings, with architectural details thereof, will be the more interesting, as plans of the ancient structures erected by the Jesuits, and even the new public buildings of these infant commonwealths, are not sufficiently known.

Interruption to the great Water-Works at Hamburg.—These important works have come to a stand-still, by the burghessen council having refused a supplementary grant of some 500,000 marks. This, after millions have been already expended, seems a strange manner of doing business. It is said, however, that the citizens of Hamburg never contemplated the erection of such stupendous show-buildings; besides, yielding to private interests, and other paltry practises, are also objected to.

Great Scientific Prizes in France.—Our French neighbours regret, very justly, the falling into disuse of those *prix décennaux*, instituted by Napoleon, towards which, not merely monetary graspingness, but legitimate emulation, were once aspiring. Still, the prizes proposed every year for the advancement of science are *greater* in France than in any other country. We report on the present occasion one of the *Prizes of Argenteuil*—viz., "Is the intervention of water, in the state of combination, necessary for effecting chemical reaction between acids and their bases?" This important question has been treated by M. Frémy in his interesting memoir "On the Hydrates." It has been completely refuted, by the experiments of this philosopher, that all anhydrous acids (*i. e.* those deprived of water) cannot combine with bases; which signifies that they have lost their quality of acids. He then proves that the carbonic, sulphuric, sulphurous, phosphoric, and other acids, combine very well, in their anhydrous state with bases. And it is only those compounds which are both acids and bases in their turn, which require the existence of water for displaying their chemical affinities or attraction.

The New Great Prussian Line.—The Berlin government have definitely decided on a direct line to Kœnigsberg, which will be begun next spring. It is said that this resolution has been hastened by that of the Russian authorities, who intend to construct a line from the Interior to the Prussian frontiers.

Frost-Phenomena at Rome.—The present severe winter has imparted to the capital of the artistic world a strange appearance: the palaces of the Emperors, the Coloseum, triumphal arches, and temples, are covered with a thick coat of ice, and the wide plain of Latium, from the mountains up to the Mediterranean, is covered with a crust of snow, which even the midday rays of the sun are unable to melt.

Impracticability of Continental Railways in the Winter Season.—All the lines in the north of Germany have been, more or less, interrupted by the late severe frosts; as, for instance, the Berlin and Silesian, as well as the Berlin and Hamburg, which had been only opened a few days previous to being thus obstructed. On the frontiers of the Mark and Silesia, where the line has been carried through the forests of the Lausnitz, a company of sixteen or twenty travellers had to remain a whole night on the rails, on which the engines had been frozen in; and in the village of Kohlfurth there were, at one time, six trains stuck fast, so that no others could proceed, although three lines cross each other at this point. The mails and passengers were obliged to be conveyed on sledges.

Destruction of a high-road near the Rhine by an Earthquake.—A most extraordinary phenomenon, caused by the upheaving of the earth (similar to those which sometimes occur in South America, &c.), has lately taken place at Unkel, on the banks of the Rhine. In this neighbourhood, there exists a quarry of basalt, from which the stone is taken for the high-road. Between this basalt-stratum and the Rhine a large plain extends, through which passes the high road. This plain has now been converted into a mount, and the road thrown up 100 feet into the air. The locality resembles a place blown up by the bursting of a mine. Some minutes before the eruption took place, a terrible roaring was heard, like the approach of a hurricane, which caused the mail-drivers, who were passing at the time, to hasten away. This, however, was not heeded by a carter, whose vehicle, with a load of 5,000 kilogrammes, was rolled like a pebble, lifted up in the air, and then buried 100 feet beneath the ruins of the falling rocks. To the north of the basalt stratum extends a vineyard, on a high elevation of ground: this mountain was ripped asunder, at the same time that the plain was upheaved. The appearance of the spot is altogether extraordinary and curious.

Naples.—Two new churches, of good style, have been lately erected here, likewise two large public fountains, with antique figures and bas-relievos. Broad footpaths have been laid in the most frequented streets, as far as Posilippo, and the square before the church of St. Francisco macadamised, which hitherto has been very uncomfortable to the public. High-walled, broad quays line the shore, up to the Villa of St. Lucia;—still, landscape admirers say, that the former rocks and gravel, binding the sea were more picturesque. An artesian well is being dug in the gardens of the Palazzo Reale, and huge iron gates are being erected, on the grand pedestals of which the two bronze horses, presented hither from St. Petersburg, are to be placed. A large heap of splendid gold coins of the oldest period of Roman history, have been discovered at Pompeii, which has filled our antiquarians with extasy.

An Italian Model Railway.—The line between Lucca and Pisa has been lately opened, and the communication between the two cities takes place four times a-day, and on holidays—as those set forth for the recreation of the humbler classes—five times a-day. The line was constructed under the direction of M. Dohlmeyer, a German engineer, and is built in a very workmanlike, sterling manner. Even the carriages of the last class are covered, and the sides protected by leather curtains—if such be necessary in that Ausonian climate. The prices are not higher than on the other Italian lines, and the road passes through all the luxuriant olive groves of the Lucchese. A person is now able, during one day's stay at Livorno, to pass a few hours at Lucca, and also at Pisa, and return in the evening to Civita Vecchia;—a *forced* way of travelling, it is true, but one in accordance with the rapid progress of our times. A steam communication between Livorno and Corsica has existed for some time past; and another with Elba is projected. The line to Florence progresses very slowly—which, however, is rather creditable to the Tuscan government, as the rural communities raise some objections to the intersection of their communal roads, and which the grand duke does not wish to cut through in an arbitrary manner.

Gold Mines on the Coast of Guinea.—The attempt to regularly work these famous mines has often been tried, but without any beneficial result; most probably arising from the climateric condition of the country; with which, however, our present hygiæcistic knowledge is more likely to cope successfully. The Dutch Government has now formed a new and systematic plan, and a person connected with the Colonial Office has visited Freyburg, for the purpose of engaging the most skilful miners. This has been effected, and the whole mining colony will immediately start for its destination.

Governmental Chemistry in Bavaria.—A society has been formed at Munich for the dissemination (not dif-*fusion*) of useful knowledge, under the presidency of the royal heir to the throne. The first work published by this society is a "Handbook of Chemistry," by Runge. A most novel plan has been adopted in this work—namely, to put chemical solutions and compounds, *in natura*, upon slips of paper, which, exhibiting all the variety of chemical colours, and being pasted beside the text, afford to the incipient chemist, and such as have no laboratory at their command, the very substance described and dilated upon, before his eyes; and which, in many cases, shows traces of crystallization, &c. The book exhibits, thereby, a very pleasing and varied appearance, and is, moreover, written with that simplicity and system, as to be intelligible to the capacity of every intellectual person—a merit more unusual than is generally supposed.

J. L——Y.

NOTES OF THE MONTH.

The Hall at Hampton Court Palace, known as Wolsey's Hall, has been re-opened to the public; having undergone a series of embellishments by Mr. Willement, which contribute to make it one of the grandest in Europe. The large windows, thirteen in number, on the north and south sides of the hall, have been filled with new stained glass, harmonizing with the noble windows at the east and west extremities. The compartments of the east and west windows are occupied by the arms of Henry VIII. and those of his house. The subjects of the thirteen new windows now added by Mr. Willement are the armorial pedigrees of the six wives of Henry VIII., alternating with the eight heraldic badges of the monarch—the Tudor rose, the *fleur-de-lis*, the portcullis, the red dragon, &c., within separate wreaths of foliage.

The *Globe* states that the Commissioners of Woods and Forests have resolved on carrying into effect the long-projected improvements in the vicinity of Buckingham Palace. In the course of the ensuing summer, various buildings, nearly opposite the equerries' entrance, are to be razed with the ground; and shortly after Midsummer, it is rumoured, Charlotte-street Chapel is to be taken down.

Mr. Dyce has been commissioned to paint, on the walls of the staircase at Osborne House, in fresco, on a large scale, an historical, or rather poetical, subject—"Neptune yielding to Britannia the Sovereignty of the Seas." The finished study for the picture has been submitted to Her Majesty and Prince Albert; who have expressed their satisfaction by ordering its immediate execution.

Cases have arrived in Athens containing the collection of casts taken from the bas-reliefs of the Parthenon, now in London—and which the British Government has presented to the Athenian Museum. These works of Art have been temporarily deposited in an ancient Turkish mosque; and will, in a few days, be ready for the admission of the public.

Royal Steam Navy.—It is in contemplation to appoint an additional comptroller of the steam machinery of the Royal Navy, and Captain Eliot will have the aid of a practical engineer in this department. Mr. Lloyd, chief engineer at Woolwich Dockyard, is named for the appointment of the steam machinery branch, with offices at the Admiralty. Mr. Bigby is appointed second assistant to the chief engineer at Woolwich Dockyard, the increase of the works requiring the addition of a second assistant to the department.

The Tubular Bridges.—The platforms and workshops required for the construction of the Menai and Conway bridges are in progress. The platform at the Menai Straits will be 1000 feet long. The works will be superintended by Mr. Edwin Clark, the resident engineer, whose assiduity and earnestness in the experiments and other labours connected with this undertaking have proved very valuable.

The New Planet.—Mr. Adams's mathematical investigations are now published as an apendix to the *Nautical Almanack*. A very clear paper on the subject of the controversy has recently appeared in the *Mechanics' Magazine*, under the title "Axoniensis," bu tthough the ability of the writer and his zeal in defence of our countryman's claims are deserving of great praise, we think that he has entertained the question somewhat too warmly. The priority of Mr. Adams's discovery is now established beyond dispute, and all further discussion should be maintained without even the appearance of personal recrimination. *Non tali auxilio tempus eget.*

Dr. Morse's System of Cerography.—By this invention a map may be drawn as quickly and as well with a pen and ink on paper, in a ground as thin and perfect as a common copper plate etching ground, and in a few hours, perhaps in a few minutes, obtain from it a type-metal plate, which shall print every point, line, and letter of the drawing under the common printing press as rapidly as newspapers or wood-cuts are printed. Several maps executed by Dr. Morse were upon the table, and for clearness and beauty far exceeded any wood engraving. In particular, the writing on the lines representing water, and which can hardly be done at all in wood, is effected in a manner little inferior to copper-plate. Already, in America, the discovery has been most extensively applied, putting the means of instruction into the hands of the many at the cheapest possible rate.—*Geographical Society, Jan.* 11.

An analysis of Bohemian glass, by Dr. Rowney.—This is the glass so valuable for its infusibility in the construction of the combustion tubes used in organic analysis. Although soda was found present to the extent of ½ of the potash, the glass appears to be essentially a silicate of lime and potash, in which the oxygen in the silicic acid is to that in the bases as 6 to 1. It gave 73 per cent. silicic acid, 11½ potash, 3 soda, 10½ lime, with small quantities of alumina, peroxide of iron, magnesia, and oxide of manganese, to make up the 100 parts.—*Chemical Society, Dec.* 1.

COVENT GARDEN THEATRE.

We have had an opportunity of watching the progress of the alterations of this house, from the commencement of the works on the 3rd of December last to the present time, and have been surprised to see such a gigantic concern proceed with so much rapidity. During the two months the works have been in hand the whole of the interior of the theatre, from the ceiling to the foundation, has been taken down; two walls, varying from 3 to 4 bricks thick, and 22 feet high, have been carried up in cement from the foundation to support the front and back of the boxes, and on these walls are erected cast iron columns, 10 ft. 4 in. apart in front, and 11 ft. 6 in. apart at the back of the boxes, and 6 in. to 8 in. in diameter, from the level of the pit tier of boxes up to the ceiling, which support five tiers of boxes. Two new stone staircases, surrounded with brick walls, carried up from the level of the ground to the upper tier of boxes and gallery, have been built, and all the stone steps prepared, and the saloons, grand staircase, and the entrance halls and lobbies have been completely changed and re-constructed. When we tell our professional readers that these works have been executed within the short period of two months, out of which three weeks were occupied in pulling down the old interior, we think they will be surprised; and, we must observe, that all the works have been carried up in the strongest manner. We state this because a malicious report has been spread that part of the works had failed during the progress. This, we can positively state, is not the case. If there be a fault, it is that too much materials have been used; but when it is recollected the necessity of having a theatre constructed without vibration, this additional strength will not appear superfluous. The decorations will be superbly grand, and are commenced.

From our last view of the premises on the 28th ult., we have no doubt of the works being completed, with all the decorations, by the middle of March. Too much praise cannot be awarded to Mr. Albano for his persevering labours in directing the works and labours of from 600 to 700 men, constantly at work night and day.

During the progress of taking down the interior fittings, it was discovered that the plates, 9 inches by 6 inches, in the main wall of the building 4 feet thick, were entirely perished, although they appear to have been of sound Memel timber when put into the building. These timbers, to the extent of from 800 feet to 900 feet run, have been removed, and replaced with brickwork pinned in with cement. We firmly trust this will be a warning to architects against using large timber plates and bond timber in brickwork.

When the whole of the works are complete we will give our readers some detailed account of the extent of the works, to show what may be done by perseverance in a short period

LIST OF NEW PATENTS

GRANTED IN ENGLAND FROM DECEMBER 31, 1846, TO JANUARY 21, 1847.

Six Months allowed for Enrolment, unless otherwise expressed.

Thomas Edge, of Great Peter-street, Westminster, gas-meter manufacturer, for "Improvements in the manufacture of gas-meters."—Sealed Dec. 31.

George David Myers, of Bridge-row, London, engraver and printer, William Cooper, of Saint Paul's Churchyard, bonnet manufacturer, and Thomas Wansbrough, of Southwark Square, Surrey, hatter, for "Improvements in the manufacture of caps, bonnets, book-covers, curtains, and hangings, show cards or boards, labels, theatrical decorations, and coffins."—Dec. 31.

William Knowlsden, of Great Guildford-street, Southwark, engineer, for "Improvements in steam engines."—Dec. 31.

Stephen R. Parkhurst, of Leeds, York, manufacturer, for "Improvements in carding wool, cotton, and other fibrous substances."—Dec. 31.

Clemence Augustus Kurts, of Salford, Lancaster, manufacturing chemist, for "certain Improvements in the mode of preparing and using indigo in the dyeing and printing of woollen, cotton, and other fabrics."—Dec. 31.

Adrien Chenot, of Clichy la Garenne, near Paris, for "certain Improvements in the treatment of metallic oxides and other compounds, and in apparatus for the same."—Dec. 31.

Charles Dowse, of Camden Town, Middlesex, gentleman, for "Improvements in applying springs to braces, to portfolios, to hats and caps, and memorandum and other books."—Dec. 31.

John Clegg, of Oldham, Lancaster, machinist, for "Improvements in looms for weaving."—January 7.

Moses Poole, of London, gentleman, for "Improvements in fish-hooks." (A communication.)—January 7.

Samuel Burrows, of Sheffield, York, manufacturer, for "certain Improvements in the manufacture of knives."—January 7.

Pierre Louis Thimote Thiers, of No. 40, Passage Choiseul, Paris, for "an Improved instrument for drawing off the milk from the breasts of women, and for raising and protecting the nipple both before and after childbirth."—January 7.

Charles Runhold Lethman, of Craven-street, Strand, chemist, for "Improvements in the manufacture of white lead."—January 7.

Joseph Benoit Pierret, of Old Compton-street, Middlesex, engineer, for "Improvements in steam-engines."—January 11.

John Chubb, of St. Paul's Churchyard, London, and Ebenezer Hunter, the elder, of Wolverhampton, Staffordshire, lock-makers, for "Improvements in latches, latch-locks, and other locks for fastening."—January 11.

Douglas Pitt Gamble, of Crouch End, Middlesex, gentleman, for "Improvements in electric telegraphs."—January 11.

John Platt, of Oldham, Lancaster, machine maker, for "certain Improvements in the method of consuming smoke and economising fuel."—January 11.

John Britten, of Liverpool, Lancaster, chemist, for "certain Improvements in machinery or apparatus for printing, ruling, and damping paper for various purposes."—January 12.

Lionel Campbell Goldsmid, of Rue Mogador, Paris, Esq., for "Improvements in applying rudders to ships and other vessels." (A communication.)—January 14.

John Fray Poole, of Bolton-le-Moors, Lancaster, book-keeper, for "certain Improvements in machinery or apparatus for spinning cotton and other fibrous substances." (A communication.)—January 14.

Joseph Seraphin Faucon, of Rouen, France, banker, for "Improvements in the manufacture of soap."—January 14.

Alexander M'Dougall, of Longsight, Lancaster, gentleman, for "Improvements in the manufacture of glue, and in treating products obtained in the manufacture of glue."—January 14.

Stephen R. Parkhurst, of Leeds, manufacturer, for "Improvements in rotary engines." January 14.

Henry Grafton, of Holborn-hill, London, engineer, for "Improvements in railways wheels and apparatus connected with railway carriages."—Jan. 16.

Frederick Leonard, of Chester-street, Kennington-lane, Surrey, engineer, for "Improvements in obtaining motive power."—Jan. 16.

John M'Intosh of London, gentleman, for "Improvements in rotary engines, and in moving carriages up inclines, and in propelling vessels."—Jan. 19.

John Read, of Regent Circus, Middlesex, mechanist, for "Improvements in certain implements in the cultivation of land,"—Jan. 19.

Edward Vickers, of Sheffield, York, mechanist, for "Improvements in machinery for cutting files." (A communication.)—Jan. 19.

Towers Shears, of Bankside, Southwark, for "Improvements in treating zinc ores for the purpose of producing zinc ingots, which improvements are applicable to the production of other ores and metals."—Jan. 19.

Thomas Deakin, of Kings Norton, Worcester, engineer, for "Improvements in the construction and arrangement of machinery to be used in cutting, stamping, and pressing."—Jan. 21.

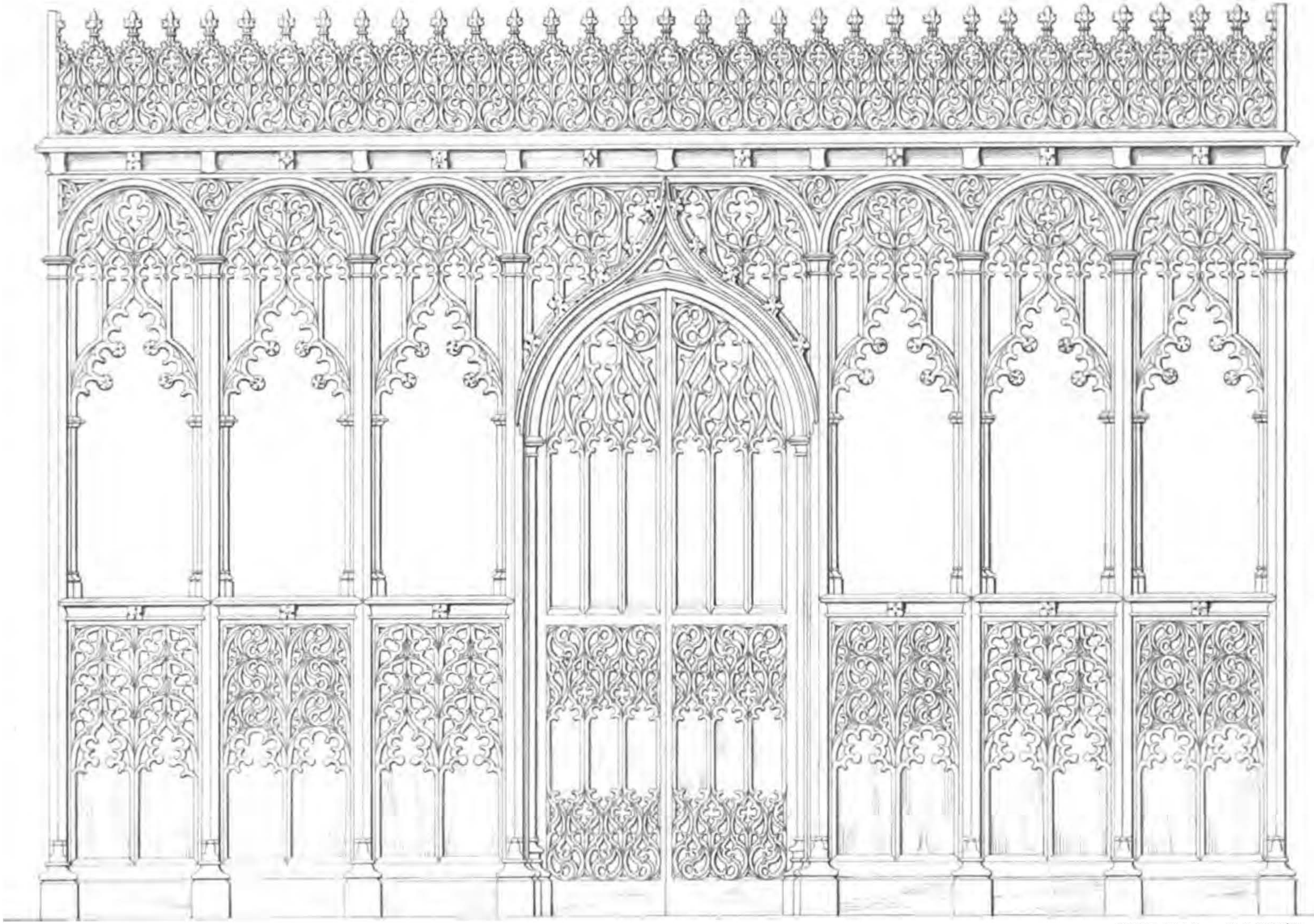
Thomas Onions, of Calais, France, engineer, for "Improvements in rotatory steam-engines."—Jan. 21.

George Beadon, of Taunton, Somerset, commander in the navy, and Andrew Smith, of Princes-street, Leicester-square, Middlesex, engineer, for "Improvements in warping or hauling vessels, which improvements are also applicable to moving other bodies."—Jan. 21.

TO CORRESPONDENTS.

Sir Howard Douglas has sent a valuable paper on the Strength and Stability of Hungerford Bridge, which we regret being compelled to postpone till next month.

In reply to the inquiry respecting the dimensions of the model experimented upon at Millwall last month, we refer to the number for October 1846. The dimensions there stated were the same as in the recent experiments, except that the thickness of the bottom-plate which has no cellular compartments, was doubled for twenty feet on either side of the centre.



ENGRAVED BY C. B. SMITH.

CHANCEL SCREEN — GREAT MALVERN CHURCH.

ARCHITECTURAL CARVING.

(*With an Engraving, Plate VII.*)

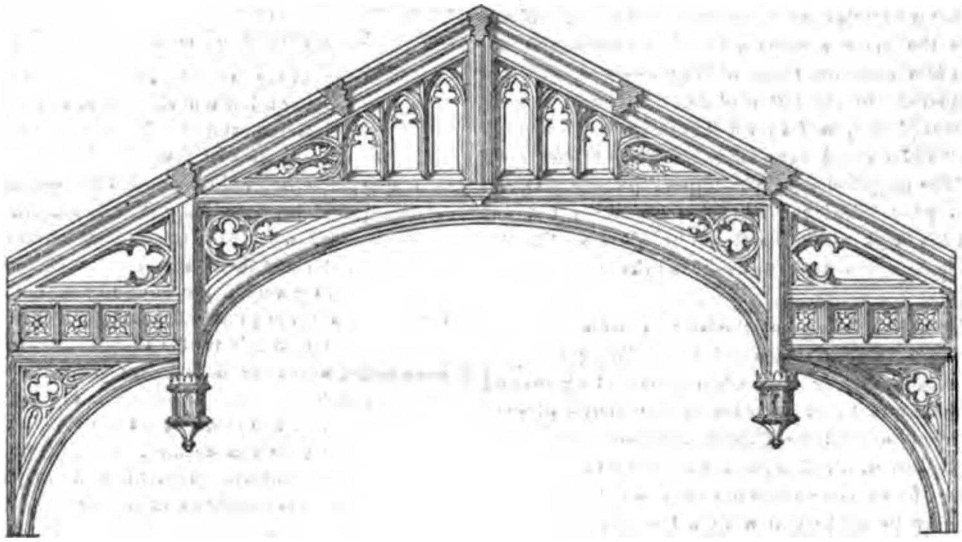


Fig. 1.—Roof of Ravensworth Castle Dining-Room.

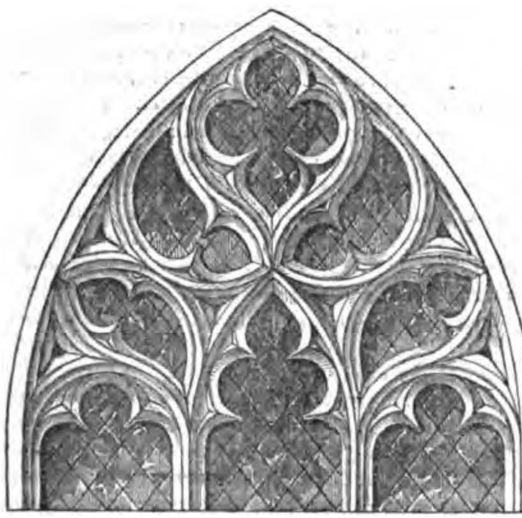


Fig. 2.—Stone Window—Carlisle Cathedral.

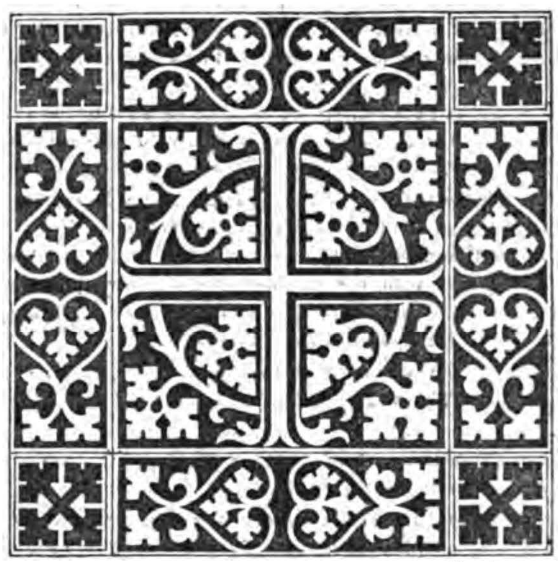


Fig. 3.—Inlaid Stone Paving—Great Malvern Church.

To our strong consistent advocacy of the introduction into architecture of real materials, which in modern times have been supplanted by counterfeit, one of the most obvious objections is—where is the money to come from to produce such an architectural effect as we are enabled to do by the aid of compo, papier maché, composition, and such productions? The ornamental work of the Italian façade architecture exemplifies the nature of the effect produced. Abstract reasoning is wasted on these reasoners: perhaps a reference to the practical effect of their doings may throw light on the subject. No doubt they succeed in producing a *momentary* effect on the spectator when the building is first cleared of its scaffolding,—but how long does cheap splendour last? Let the unbiassed spectator walk up Regent-street—Regent's-park—on the terraces at Brighton—and view the motley appearance of the buildings; some of one tint and some of another; one half of a pediment light stone, the other half a dark stone tint; the divisional line of two houses continued down to the ground through the blank windows, and half a column to each; —and let him take into account the weather-marks of the winter months, and the peeling off here and there of the dishonest integument, and he shall allow that these patches and stains are as motley as the rags of poverty,—it is but a beggar's dress which is held up for his admiration.

It is not to be inferred that, because we condemn the imposture when unsuccessful, we condemn it *because* it is unsuccessful. Deceit and trickery are not the less detestable because they are occasionally practised so well as to escape detection. These plaster-clad edifices have a multitude of faults besides the patchwork. To take one of the most practical arguments as most suited to the capacities of those who constitute our opponents—the stucco usually disguises wretchedly inferior brickwork, of bad materials imperfectly put together. The vile pretenders assume the appearance—the strength of stone masonry, while they have not even the ordinary stability of brickwork. They are like the feeble beast in the fable, who indued himself with the skin of the lord of the forest.

Not unfrequently they are prostrated in ruin, the result of their own pretensions. Some of these vile showy structures in the new metropolitan streets have recently failed in this manner. We are not destructionists, but we rejoice greatly at the intelligence. If any one would compare the mere workmanship of plastered and unplastered houses, let him compare those of Regent-street with the adjacent Hanover-square. In the latter place, the honest homely bricks show themselves plainly, as if they had nothing to be ashamed of. But an honest builder could have taken no pride in his work when "running up" the neighbouring linen-drapers' palaces. Deceit begets dishonesty: a good bricklayer will soon become a bad one when he knows that his work will be concealed by white slime. He has no gratification in doing his work well—he shirks it and cheats his employer.

To assist the architect in carrying out the system we so strongly advocate, steam has been brought to his aid in rendering the productions of carved work less costly than when produced by manual labour. It is our intention to direct attention to the merits of such works. We have already noticed the Patent Architectural Carving Works, in Eccleston Street, Pimlico, and explained the machinery. The experience of two more years has enabled the proprietors to adapt the machinery to works that were not originally so produced. In the show-rooms may be seen architectural perforated pannelling for gallery fronts, parapets, ceilings, roofs, and wainscotting, lecterns, furniture, church screens, and other works, generally possessing the merit of correct design and perfect workmanship. One of these elegant screens we have shown in an Engraving (Plate VII). It has been lately erected at Great Malvern church, in the archway of the chancel, and is entirely executed in wainscot by the aid of the machinery of the Patent Carving Works, at a very small cost; its length is 16 feet, and height nearly 12 feet.

The annexed wood engraving (fig. 1) is another happy example of the application of the labours of the same Works; it shows the truss of an open timber roof, 30 feet span. There are eight of these trusses, together with the moulded purlins, ridge piece, cornice, rafters, &c., all executed in oak, for Ravensworth Castle dining-room. The roof is 30 feet span, and 70 feet long.

Another specimen, in a different material (fig. 2), exhibits the head of a window. This was executed in Caen stone, for Carlisle Cathedral.

Fig. 3 is a specimen of inlaid stone paving, which was also executed by the carving machinery for Great Malvern church.

The Company have recently executed various other works, among which we may mention the flooring of Sir Robert Peel's Picture Gallery, and a beautiful stone screen for St. John's Church, Stratford, in Essex, which has excited great admiration.

It will be seen from the drawings we have given, and the prices, that ornamental architectural works, of a highly ornate style, may be produced in real materials, at about the same price as the counterfeit, when we take into consideration the cost of staining or painting, graining, and so forth. Much may be done if the architect will devote his attention to the subject, and get rid of the prejudices which he has been led into by a false education;—let him well study *proportion*. More is produced by this in a public building than all your excresences of enrichments, which are too often applied as if the structure were intended to be the show-building of a plasterer or artificial ornament manufacturer.

NOTES ON ENGINEERING,

No. VII.

THE FORM AND EQUILIBRIUM OF ARCHES.

The object of the present paper will be to explain a few theorems respecting the equilibrium of arches, which are very simple, and of great practical importance. They may, however, be prefaced by a notice of the authors who have already written upon the subject.

It may be considered certain that the mediæval architects, notwithstanding their extraordinary skill in constructing arches and flying-buttresses, and in determining the position and dimensions of piers and buttresses, derived their rules from experiment, and not from theory. This opinion rests upon the authority of the most eminent architectural writers of the present day, among whom may be cited Professor Willis, who fortunately is able to combine two very different kinds of knowledge, which are both necessary for the examination of the subject—archæology and mechanical philosophy. Parent and De la Hire, who wrote about 150 years ago, seem to have been the first who endeavoured to give a mechanical theory of the arch; and since their time, the number of writers on the same subject has been extremely numerous, and has included some of the most eminent mathematicians in Europe.

It would occupy too much space to notice the labours of these authors, or even to enumerate their works. But a sufficiently distinct notion of them may be obtained by considering them divided into two distinct classes, who investigated the theory from two altogether different points of view. The first class—the earliest and the most numerous—directed their attention chiefly to the conditions to which the component stones of an arch must be subjected in order that they may not *slide* upon the surfaces of mutual contact. The second class consisted of those who neglected this idea of sliding altogether, and confined themselves to the conditions necessary to prevent the joints from *opening*. The first class includes the names of Conplet, Bernouilli, Belidor, Coulomb and Bossut, continental writers, who have been followed by Hooke, Gregory, Hutton, Emerson, Whewell and Gwilt, in this country. Many of these writers have considered the arch as composed of perfectly smooth voussoirs, and sustained independently of friction—in this condition the arch is said to be "equilibrated."

Now this theory of the arch, though long in vogue and sanctioned by the highest authority, has been found practically insufficient for the purposes of the engineer. As a matter of fact, the voussoirs of arches have always so great friction that they never slide upon each other. The old theory, therefore, speculated about an accident which experience showed to be never likely to occur. Consequently the investigations, though frequently exhibiting extraordinary mathematical research, and leading to very beautiful results, could scarcely be of any direct value to the practical engineer; and accordingly, a writer, who has taken the highest position in this country for his practical applications of mechanical principles—Professor Moseley, has in his writings entirely excluded the speculative investigations just mentioned, and has confined his attention to the statical conditions necessary for preventing that accident which may and does occur—the opening of the joints.

In this pursuit we shall endeavour to follow him. It has unfortunately happened that though his principles are characterised by extreme accuracy, the results are frequently too complicated to be of value to an engineer. Now what will be here attempted, is to establish a few general propositions which are frequently unknown or misapplied, and to give some methods by which the form and thrust of arches may be calculated,—not with anything like the generality and precision studied by Professor Moseley, but with accuracy quite sufficient for ordinary purposes, and with perfect facility of computation to all who are acquainted with common arithmetic.

There are three conditions to be considered as affecting the equilibrium of the arch—1st. The form and dimensions of the *intrados* or internal lower curve of the arch: 2nd. The form and dimensions of the *extrados* or external curve of the arch: 3rd. The weight and disposition of the loading. The first condition of courses includes the rise and span; the second, combined with the first, is equivalent to a determination of the depth of the voussoirs; the third exhibits the external forces to which the system is subjected: for we suppose that not only is the weight of the loading known, but also the manner of its distribution—that is, whether and in what degree its specific weight or density varies in different parts of it.

But, it may be asked, is not this enumeration of the conditions of equilibrium imperfect from the omission of the form, number, and position of the joints? The answer to this question is important, because it exhibits in the strongest light possible the distinction between the ancient and the modern theory of the arch. It is manifest that the extrados and intrados, which have been enumerated as two of the "conditions," simply define the depth of each voussoir and the form of its upper and lower curved surfaces: the lateral dimensions of the voussoir, and the form of those surfaces of it which are in contact with the adjacent voussoirs, are as yet left indeterminate. Consequently it is not known how many joints there be, or even whether there be any joints. Neither is the direction of the joints ascertained; they may be plane converging joints, or they may be "joggled," or all vertical, or all horizontal—(as an instance of the latter case may be cited the Treasury of Atreus at Mycene, where the stones are not wedged together, but are merely disposed in horizontal courses, each *resting* upon and over-lapping that beneath it, the whole being hewn in such a form as to give the structure the appearance, but not the mechanical properties, of a dome).

It is as well to consider these objections *in limine.* The answer then is this. The theory which Professor Moseley has exclusively, and Professor Whewell and other writers partially, adopted, and which we are endeavouring to set before the reader in a new form, presupposes that the stones are sufficiently cuneiform to be incapable of sliding past each other: but further than this no consideration is paid to the form of the bed-surfaces. The mutual friction of the voussoirs is so great, that there is not the least difficulty in so shaping them, that the arch shall not fail by their sliding past each other—that accident, as has been said, is never known to occur. So that the precautions under this head being perfectly obvious, the theory does not at all deal with them, and, as we shall see further on, is independent of the form and direction of the joints—or to speak more precisely, the theory shows how to ensure the stability of the arch, whatever may be the inclination of the beds, &c., however numerous, or however few they may be; so that the structure should stand even if intersected by infinite number of joints running in every possible direction—provided always that they were sufficiently convergent or joggled, so that the voussoirs could only fail, if they did fail, by opening, and not by slipping.

The reader who approaches the subject for the first time will not perhaps perceive at once the full effect of these observations. But his attention is now directed to them, as he will be left hereafter to apply them for himself to the cases particularly discussed. Returning now to the three "conditions" which have been enumerated, we find that they give rise to four distinct problems—three of the problems arise from combining any two of the conditions as data to find the third, and the fourth problem arises from the combination of all three conditions considered as known data. The four problems are these—

1. Given the distribution of the loading and the intrados to determine the extrados proper for stability.
2. Given the distribution of the loading and the extrados to determine the intrados proper for stability.
3. Given the extrados and intrados to determine the distribution of the loading proper for stability.
4. Given the extrados, the intrados, and the *amount* as well as distribution of the loading to find the consequent horizontal thrust of the arch.

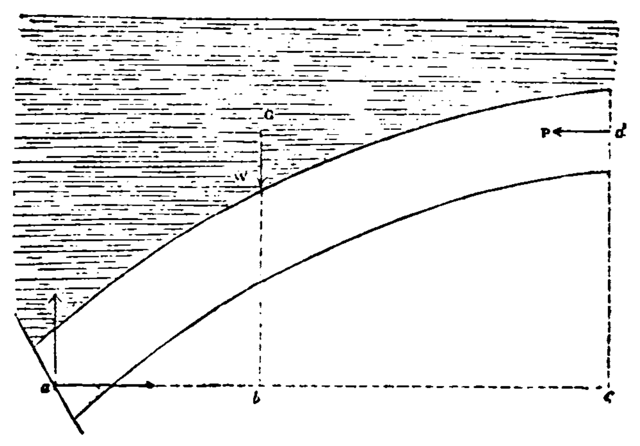
It will be observed that the absolute weight of the loading is taken into account in the fourth problem only: in the other problems the *relative* weight is alone considered; in other words, the form of the arch is connected not with the actual amount of the external forces, but with the relation or comparative amount of those forces, as they vary in different parts of the structure. It may perhaps be as well to recollect that in this respect there is an analogy between the arch and the other two contrivances employed for spanning the interval between piers or abutments—namely, the catenary and the girder. For respecting the catenary, it is known that if a heavy cable and a fine thread, both of the same length, span the same distance, they will assume the same form: and this similarity of form will be observed either when the cable and the thread are each of uniform thickness throughout its length, or when (the thickness not being uniform) the law of variation is the same for each. Also the form of the girder of uniform strength, or the variation of the sectional dimensions of a girder that it may be equally strong in every part, depends not on the actual amount of the load, but on its distribution or comparative weight in different parts. This digression will not appear superfluous when it is considered how much the physical conception of a subject like the present is cleared by a distinct apprehension of its relations to kindred subjects.

We shall take the fourth problem first, because it is the simplest. Here, however, as elsewhere, it is simply intended to show how much may be done by very simple calculations—the discussion of the problem in all its generality, and with perfect accuracy, will not be attempted.

Thrust of Arches.

The thrust or horizontal pressure of the arch tending to push its abutments outwards is the distinguishing characteristic of that structure. This kind of force does not exist in the other contrivances for spanning the intervals between abutments. The suspension chain, attached at its extremities to the summits of two towers, exerts at those points a horizontal force *inwards*, equal to the tension of the catenary at its lowest point. In the beam or girder, the forces of tension and compression are equal and opposite, and there is, therefore, no external horizontal force on the abutments.

The following method will explain the cause of the horizontal thrust of the arch, and serve in estimating its amount. Let the accompanying diagram represent the half of an arch, and its own load considered as a separate statical system. And to make the case simpler, let us suppose the load on the half arch sustained entirely by it, and not supported in any way by the contiguous portions of loading on either side of it, which are supposed to be removed. The half-



load here represented will not, in that case, have any external force acting upon it to modify the effect of its weight on the half arch.

Let it also be supposed that the half arch removed had the effect of exerting on the half arch represented certain pressures, of which the resultant is a force P, acting at some point d in the crown. P will be wholly horizontal, if the two halves of the arch be similar and similarly circumstanced. For, if every part of their mutual pressure were vertical, it must act upward on one half arch; and in the opposite direction, or downwards, on the other half arch. And this is evidently inconsistent with the hypothesis that both half arches are similarly circumstanced.

The other forces of the system are its pressures upon its abutment. These pressures will have a single resultant, acting at some point, a; and by equating the vertical and horizontal forces, it follows that the components of this resultant are an upward vertical force equal to the weight of the system (W), and a horizontal force equal to P, but contrary in direction.

Now, the tendency of the weight W to turn the half arch about the abutment may be considered the cause of the force P at d being called into existence. As no horizontal forces but those mentioned are supposed to act, the horizontal force P exists in every part of this arch.

Draw $a\,c$ horizontal, and G b vertical from G the centre of gravity of the system: this latter line is that in which the weight of the system acts. Draw also $c\,d$ vertical.

The vertical distance of the upper force P from a is equal to cd, and the horizontal distance of the force W from a is $a\,b$. The moment of P about a is therefore $P \times cd$, and that of W is $W \times a\,b$: these moments are equal to each other.

$$\therefore W.\,ab = P.\,cd, \text{ or } P = W.\,\frac{ab}{cd}.$$

If, therefore, we knew the exact value of ab, cd, and the total weight W, we should be able to get P at once from the above simple equation. But, in fact, we do not know the exact point a, which is the point of application of the resultant of the forces at the springing; neither have we ascertained the exact point c. All we know of either point is that it is somewhere between the extrados and intrados at the springing and vertex respectively.

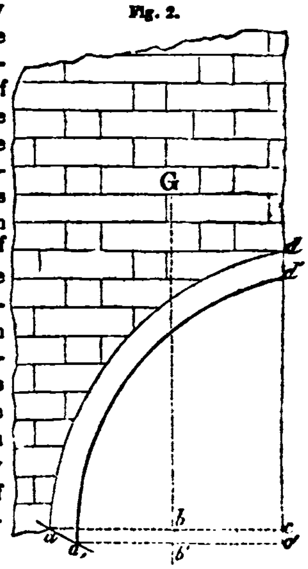
It is not necessary, however, for our purpose to define either point for the limits assigned for its position are generally small enough to define P from the above equation with sufficient accuracy for pr ctical purposes. By referring to the equation, it will be seen that the *greatest* value of P is derived from giving $a\,b$ its greatest, and $c\,d$ its least, possible value: and conversely, the *least* value of P is derived from giving $a\,b$ its least, and $c\,d$ its greatest, possible value. The real value of P lies between these limits.

1st. The greatest value of P is derived from giving ab its greatest and cd its least value; which conditions are satisfied by supposing a to be in the extrados at the springing, and d in the intrados at the vertex. Hence, from the equation we get this rule—"The greatest value of the horizontal thrust is derived from multiplying the tota weight of the half arch by the horizontal distance of its centre o gravity from the springing of the extrados, and dividing the product by the *least* height of the arch, or the height of the vertex of the intrados above the springing of the extrados."

2nd. The least value of P is derived from giving $a\,b$ its least, and $c\,d$ its greatest, value. Hence, a must be taken in the intrados, and d in the extrados; and the corresponding rule will be—"Multiply the otal weight of the half arch by the horizontal distance of its centre of gravity from the springing of the intrados, and divide the product by the *greatest* height of the arch, or the height of the vertex of the extrados above the springing of the intrados."

Having obtained these rules we may proceed to practical illustrations of them. It may however be first observed that their accuracy depends entirely on the supposition that the half arch does not sustain horizontal pressures from the effect of the loading: if it did, the horizontal thrust P at d, would no longer be equal to the P at a, fig. 1.

Fig. 2.



Let us take the case of a half arch, $a\,a'\,d\,d'$, supporting a mass of masonry above it, as in the accompanying figure 2. This would be the case of a gate-entrance, or arch beneath a tower. If the tower be lofty compared with the rise of the arch, we may suppose G the centre of gravity of the half load centrically situated. This hypothesis saves the trouble of calculating the position of the centre of gravity of that part of the masonry which is situated in the spandril of the arch: the *weight* however of that portion must be included in the total load W; taking G in this position, then the rest of the calculation is very simple. Draw the vertical line $b\,b$, indicating the direction in which W acts. Then, as we have already shown, the greatest and least values of the horizontal or lateral thrust are respectively,

$$W \times \frac{a\,b}{c\,d'} \text{ and } W \times \frac{a'\,b'}{c\,d'}.$$

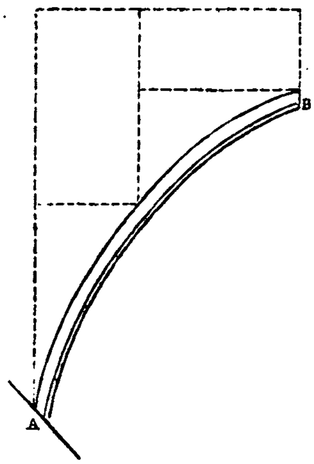
Suppose, for example, that the weight of the masonry W is 20 tons; that by measurement $c\,d'$ the least rise of the arch $=$ 8 feet, and $a\,b=$ 4 feet, (the span of the arch being about four times as much), then we get immediately the greatest value of the thrust $=$ 20 tons $\times \frac{4}{8}$ or $=$ 10 tons. And suppose it to be also found by measure that $c'\,d$, the extreme rise, is 9 feet, and $a'\,b' = 3\frac{1}{2}$ feet, then the thrust $=$ 20 tons $\times\, 3\frac{1}{2} \div 9 = 7\frac{1}{2}$ tons.

Now it will be observed that between the greatest and least value of the thrust so obtained ($7\frac{1}{2}$ and 10 tons), there is a considerable discrepancy, namely, upwards of two tons. But it is to be remembered, that methods here explained, though founded on exact principles, are merely approximative; and, moreover, we have purposely chosen a much more unfavourable instance than will generally occur in practice.

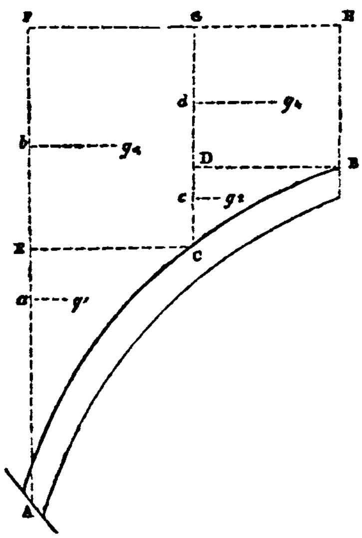
In making a section, as in the above figure, dividing the arch and its loading into two parts, it is virtually assumed that the part of the loading which is represented in the figure is not subject to forces arising from its connection with the part supposed to be removed. That, in general, this hypothesis is nearly correct, will be allowed when it is considered that the masonry of the superstructure is laid on gradually in successive horizontal courses, and that each stone is supported in its place by those below it, and has no tendency to roll over or move sideways. Where the workmanship is accurate, there will be little strain between the two halves of the load, except from "settling" or similar accidental causes, the nature of which precludes specific calculation.

The above method of determining the thrust cannot apply except when the form of the structure is such as to allow of a tolerably accurate guess as to the position of the centre of gravity of the load sustained by the half arch. This can only be made where the specific gravity of the loading is uniform, and the structure is so lofty compared with the rise of the arch, that the mass contained in each spandril is too small to materially affect the centre of gravity. Where, however, the rise of the arch is considerable compared with th dimensions of the superstructure, we may resort to the following method, which wi l be found very convenient, and which will have the advantage also of determining the thrust when the loading is heterogeneous.

Let A B F H represent the vertical section of the half arch; the part of the load below B (in the spandril) bearing a considerable proportion to the part above B. And to take all the variations of circumstances at once, let us suppose that it has been found necessary (from considerations which will be referred to hereafter) to load the arch with heavier materials in one part than in another, for instance, with light sandy ballast near the vertex, and heavy granite rubble towards the springing.



Instead of taking the load, as before, as a single mass, consider it made up of several portions, as in the figure. Let the part in the spandril be taken as two (nearly) triangular masses or



prisms, A E C, C D B. The forms of the rest of the loading will depend upon the nature of the superstructure. But where the upper line, F G H, is a horizontal straight line, we may consider the rest of the loading as rectangular masses, E C G F, D G H B.

One of the advantages of this hypothetical division of the loading is that it enables us to estimate the effect of variations in the density of the ballast. For example, A E C may be one kind of ballast, C D B a second, E C G F a third, and D G H B a fourth. The first operation in the calculation will be to find out the weight of each portion as nearly as possible. This will easily be done (the form of the arch and superstructure being already determined upon) by estimating the cubic content of each portion, and multiplying this quantity by the weight of each cubic foot of the material employed. It is scarcely necessary to observe, that the weight of the voussoirs themselves must be included in the lower or triangular portions.

The weights being found, there will be very little difficulty in ascertaining their effect or moment in producing the thrust. Let g be the position of the centre of gravity of the lower triangle. By a known property of the centre of gravity of triangles, $ag_1 = \frac{1}{3}$E C. Now, ag_1 is equal to the horizontal distance of the centre of gravity from A, and therefore determines the moment. Hence the weight of the triangle A E C, multiplied by $\frac{1}{3}$E C, is the moment of that portion about A.

Similarly, in the triangle C D B, if g_2 be the centre of gravity, $cg_2 = \frac{1}{3}$D B. Therefore, the horizontal distance of g_2 from A is E C $+ cg_2$: the moment of the triangle C D B is, consequently, its weight multiplied by (E C $+ \frac{1}{3}$D B).

The two parts E F G C and D G H B, being rectangles, their centres of gravity may be considered as situated in the centres of those figures. Consequently, $bg_3 = \frac{1}{2}$F G; and $dg_4 = \frac{1}{2}$G H. On the whole, then, if we call the first mentioned weight W_1; the second third, and fourth, W_2, W_3, W_4, respectively, we have for the sum of, the moments, the expression

$$W_1 \times \tfrac{1}{3}EC + W_2 \times (EC + \tfrac{1}{3}DB) + W_3 \times \tfrac{1}{2}EC + W_4 \times (EC + \tfrac{1}{2}DB)$$

Adding these moments together, and dividing by the height of the arch, the result or quotient is the amount of the thrust.

This method, like the one first explained, merely suffices to indicate the limits within which the value of the thrust lies. There will be, as before, a maximum and mininum value, but the difference between them will be very small, except where the voussoirs are of great depth compared with the other dimensions of the arch. The maximum will be determined by estimating the horizontal distances of the weight from the springing of the extrados, and by giving the rise its least value, namely, the vertical height of the vertex of the intrados above the springing of the extrados: and conversely, for the minimum value of the thrust, the horizontal distances of the weight must be measured from the springing of the intrados, and the rise must have its greatest value, namely, the vertical height of the vertex of the extrados above the springing of the intrados. With these limitations, the following is the general rule for calculating the thrust:—"Consider the loading as composed of triangular and rectangular portions. Multiply the height of each portion by the horizontal distance of its centre of gravity from the springing. The sum of the products divided by the rise of the arch gives the value of the horizontal thrust."

To take an instance in illustration of the rule, suppose that in the last figure, the rise of the arch is 19 feet, and E C = 6 feet, and D B also = 6 feet, in this case the rise of the arch will be about 9 feet less than the span. Also let $W_1 = 4$ tons, $W_2 = 3$ tons, $W_3 = 6$ tons, and $W_4 = 5$ tons. The moment of W_1 will be $4 \times \frac{1}{3}$ E C = 8. The moment of W_2 will be $3 \times$ (E C $+ \frac{1}{3}$ D B) = 24. The moment of W_3 will be $6 \times \frac{1}{2}$ E C = 18. The moment of W_4 will be $5 \times$ (E C $+ \frac{1}{2}$ D B) = 45. The sum of these moments is 95, and this quantity divided by 19, the rise, gives 5 tons for the value of the horizontal thrust. If the above admeasurements be supposed to correspond to the maximum value of the thrust, a second calculation must be made, as above explained, with the admeasurements corresponding to a minimum value. The true value will lie between these two results.

Of course, where further accuracy is required, the load in spandrils may be considered as divided into three or more triangular portions, with as many rectangular portions above them. As the divisions are perfectly arbitrary and hypothetical, they may not only be of any number most convenient, but also the intersecting lines may be taken wherever they afford the greatest facility of calculation. In a four-centred arch, for instance, a vertical division may be made where the segment of short radius ends and the segment of large radius begins: or if there be an abrupt change from a heavier to a lighter loading, the vertical line at the place of change may be adopted in the calculation.

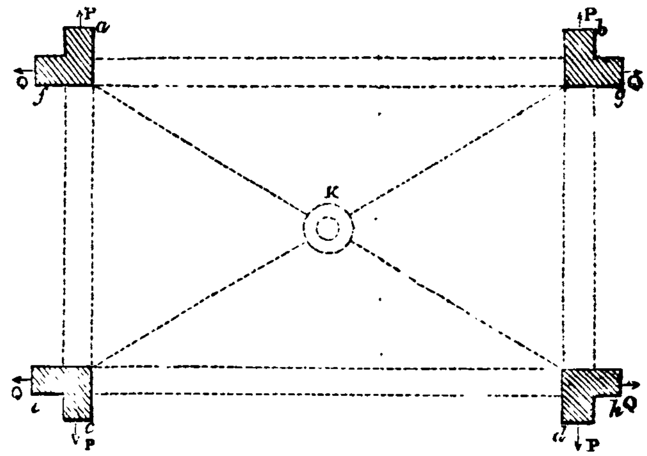
It must be carefully borne in mind, that the whole of these investigations presuppose that the only external forces are vertical weights. Where the loading rests firmly on the arch, and has no tendency to slide down the side of it, the hypothesis is strictly true; but in the case of a series of arches, as in bridges, the spandrils which adjoin at each pier are filled up simultaneously by throwing in the ballast, till it reach the intended height of the roadway. In this case it is clear that unless the ballasting were rammed hard, or concreted, the removal of the portion in one of these spandrils would cause the portion in the other spandril to slide down. Here, it is obvious that the two portions of the loading exert a mutual horizontal pressure, by which each prevents the other from slipping. This horizontal pressure must, in considering the equilibrium of each half arch separately (as has been done above), be reckoned among the external forces of the system. The thrust of the arch is uniform in every part of its haunches where there are only vertical forces. But were the horizontal external pressures just alluded to exist, the thrust of the arch will be greater at the crown than at the abutments—being greater than we have calculated it at the crown, and less than we have calculated it at the abutments. It seems impossible to calculate the amount of this alteration, for to ascertain it we must know the mutual pressures of the contiguous portions of loading, the friction of the materials, and the degree of cohesion produced by ramming or settling—effects utterly beyond calculation. It may be observed, however, the ballast will generally be so firmly compacted that the part of each spandril, even if unsupported, would in most cases have little tendency to slide: and therefore where this precaution is used, the above methods will answer all practical purposes.

Sometimes the voussoirs of two arches, which spring from the same pier, do not rise independently, but are built together, and press upon each other at their extradosses for some distance as they rise together from the pier. It is clear that for the purposes of our calculation, the springing of each arch must be reckoned to commence from that point where the adjacent arch ceases to affect it. Wherever the spandrils of the contiguous arches are connected near their springing by small inverted arches (as in Blackfriars bridge), the modifying effect of these subsidiary structures must be taken into account. The thrust in such cases can only be reckoned for that portion of the main arch which is not affected by the contiguity of the other arches.

The general conclusion from the above reasoning is, that the smaller the rise of the arch in comparison with its width, the greater *cæteris paribus* will be the lateral thrust (of course these conclusions cannot be applied to the platebande or flat arch, where the depth of the voussoirs is so great, compared with the other dimensions, that the methods given above are totally inapplicable). As instances of this truth, may be cited the lofty Pointed arches of cathedrals, which frequently sustain enormous weights without exerting great lateral thrust. But it may be as well to refer, in passing, to an erroneous notion which is frequently entertained, that because high Pointed arches *can* sustain great weights, they therefore *ought* to do so for the sake of their stability. An idea of this sort is expressed in Pratt's Principles of Mechanics, and is supported by very confused and perfectly inapplicable reasoning: as has been already said, and will be proved hereafter, the form of the arch depends not on the amount of the loading, but on the distribution of it.

To return from the digression—we easily see that the limiting cases of the general conclusions just stated respecting the thrust of the arch are these.—If the arch were quite flat (the voussoirs not being of appreciable depth), a finite load would produce an infinite lateral thrust: again, were the arch so lofty that its span could be considered inappreciable in comparison with its rise, the greatest load would produce no horizontal thrust at all. In fact, this last hypothetical case is equivalent to that of a weight sustained by vertical posts or columns.

The consideration, that the thrust of the arch depends only on the rise and span—that the form does not affect the thrust (except indirectly, by influencing the position of the centre of gravity of the load), forms an appropriate introduction to the investigation of the lateral pressures of groined vaulting. In plain cylindrical arches, the thrust determined above is distributed in lines parallel to the axis of the arch throughout the whole of the springing. Consequently, it acts on the piers of a bridge (to take an instance) along a surface of which one of the dimensions is the breadth of the roadway, and may in general be considered as uniformly distributed. But if we take the case of double or intersecting groined arches resting, as supposed in the following diagram, on four detached piers, the amount of surface over which the thrust will be distributed is diminished with the diminution of the horizontal dimensions of the piers. In this case also the double arch will exert a double set of thrusts. Supposing the plan a rectangle, and that the arches and the distribution of the loading are perfectly symmetrical. Let $a\,f$, $b\,g$, $d\,h$, $c\,e$, be the four piers, and K the keystone or boss. Also let P be the thrust arising from the arch of which the axis is parallel to $f\,g$; and let Q be the thrust



arising from the arch of which the axis is parallel to $c\,d$. We may suppose that the forces at a, b, c, d, are all equal to P, and the forces at e, f, g, h, are all equal to Q, since we have supposed the two halves of each arch to be under exactly the same circumstances.

Now, if we take moments about $a\,c$, for the half arch, of which the axis is parallel to $a\,c$, no other moments will appear in the equation but that of the pressure at the crown of this arch, and that of the weight resting upon it. Hence the strain P is determined by the rules already laid down for single cylindrical arches—that is, it is equal to the moment of the weight divided by the rise of the arch. In the same way is the pressure Q determined. And hence we arrive at the conclusion, that the total pressure on any one of the four piers, may be considered to be made up of two component forces,—the thrust of each of the two arches considered separately and independently of the other.

It may so happen that the form of the groining materially affects the position of the centre of gravity of the loading. There will not however be generally much difficulty in estimating the moment of the weight by methods analogous to those already described.

This is as much as it seems necessary to say at present respecting the thrusts of arches. Of the means of resisting those thrusts, or of fixing the dimensions of the buttresses or piers which sustain them, mention will be made hereafter. In conclusion, it may be observed, that though these methods are confessedly approximative, they appear quite as much entitled to confidence as others of a more elaborate nature. M. Garidel has, with wonderful ingenuity and labour, formed tables of the thrusts of arches (*Poussees des Voutes*), calculated from a long mathematical formula, analogous to that arrived at by Prof. Moseley. Respecting, however, all long mathematical formulæ applied to practical mechanics, we are convinced, from considerable experience, that the following strictures are correct—first, these formulæ are too difficult to be employed by the engineer; secondly, if he could employ them, it would not be worth his while to do so—for they generally neglect some practical circumstance which entirely destroys their accuracy. In the case, for instance, of M. Garidel's tables and Prof. Moseley's formulæ, both proceed on the supposition that the materials of the voussoirs are perfectly unyielding and mathematically adjusted. If, by the slightest settling, the point of application of the resultant of the forces at the crown and springing be altered, the whole investigation fails. It is also obviously impossible to estimate rigorously the effect of the cohesive forces between the contiguous portions of loading resting on a series of arches; and the heterogenity of the materials is an insuperable obstacle to any but approximative calculation.

H. C.

ON THE DESTRUCTION OF MOUNTAINOUS FORESTS AS THE CAUSE OF LATE INUNDATIONS.

The dreadful disasters which have, of late, visited several of the French Departments, have induced the secretary of state for public works to order the subject to be investigated by competent persons; and we derive the following particulars from the reports of Messrs. Blanqui, Maunier and Rubichon:—

In several parts of the Departments d'Isère, des Haûtes et Basses Alpes, and du Var, especially in the mountainous regions, the destruction of forests has not only caused the disappearance of vegetable fuel, but even springs and courses have vanished, and the soil has been carried off by the force of torrents. About Grénoble, this inconvenience has reached so far, that the peasants are obliged to bake their bread on the excrements of cattle, &c. The abuse of out-wooding, tillage, and pastures, deprive the soil of mountain-slopes of all cohesion, and no resistance whatever is offered to counteract the action of floods or heavy rains. The rapid slope of mountainous terrains increases this evil, and the loose and detached soil rolls, in the form of a torrent of black lava, into the valleys, where it spreads over plains which are either already cultivated or at least fertile. Oftentimes, a whole mass of earth is thus detached from a mountain, which thereby becomes visibly indented. Nothing can equal the scene of such terrible irruptions. Immense beds and layers of pebbles and débris, to the depth of many yards, cover the plains, and neutralise and destroy for ever the fertility. Trees and other vegetation vanish under the pressure of these débris; and the beds of rivers and streams, gradually heightened, reach at last the piers of the bridges, which are carried away.

Such are the effects of out-wooding a terrain. And as the forests consist, in the above-mentioned parts of France, merely of underwood, and are generally composed of fir (coniferous) trees, which do not grow again from their roots when once cut, the evil will become irrecoverable if no remedy be devised for it. In several localities, not a tree has been left; and as the peasants, therefore, have recourse even to the shrubs and brambles, M. Blanqui thinks that, fifty years hence, France and Piedmont will be separated from each other by a desert, as in the case of Egypt and Syria!

The diminution of springs and sources is seriously felt in the Departments of the Basses Alpes and du Var, in some of whose ravines and slopes all vegetation has also vanished. If a gale floods such localities, torrents sweep these desolated places, which neither cultivate nor fertilise them. As population increases and accumulates in other places, even the steep slopes of mountains are put under tillage, which still more augments the existing evil. The measures which have been hitherto resorted to, to bar these inundations, are—says M. Blanqui—both inefficient and unsystematic. The owners of the lands on the banks of rivers and torrents quarrel and litigate, instead of combining against the common enemy. Nothing can be more strange than the aspect of these isolated, ill-concerted works—here and there an embankment, a wall of piled-up stones, a coffer-dam of wood, or some patches of masonry. M. Blanqui thinks that none but government, aided by the combined efforts of accurate surveys and scientific systematic construction, can properly stay these yearly-increasing devastations: as, both for the re-plantation of out-wooded terrains and the embankment of the rivers, the skill and capital available by private persons, will ever be insufficient.

In the Pyrenees, also, the out-wooding of terrains, inundations, and scarcity of crops, have gone hand in hand. The area of forests which belonged to the crown, at the end of the sixteenth century, was equal to 250,000 hectares, which, in 100 years, was reduced *one-half;* and, at the end of the last century, amounted merely to 40,000 hectares. The out-wooding of private forests has been on as great a scale as those belonging to the crown. Thus, the outskirts of the Pyrenees, which once yielded a superior kind of timber for naval and structural purposes, are now scarcely sufficient to supply to the inhabitants the necessary quantity of fuel. Tillage has also been carried out to a senseless degree; and after the slopes have been put under cultivation, even the very crags of the mountains are taken possession of;—and here also, every inundation, however slight, sweeps all traces of vegetation and soil into the bed of the Garonne, and the Mediterranean.

We broach this subject the more eagerly, as ample allusion has been made thereto in the "Atti dei Scienziati d'Italia," Florence, 1844, 4to.—whence it appears that the same causes, and the same punyness and insufficiency of remedies, exist in nearly all the mountainous parts of the Italian peninsula.

J. L——Y.

ON THE PHYSICAL IMPROVEMENT (ATHLETISING) OF ARTISTS.

"Mens insana—sini corpore sano."

History ought to be, and can be, the teacher of every one—not merely the warrior and statesman, but of *every one;* for history does not comprise merely the fates of such men, but of *all men.* We do not think that our "young architects" (artists) have ever directed their thoughts to those unobtrusive, but unrepudiable lessons and hints, which history has so extensively placed before them. Let us not speak of Greece and Rome—where it is known that even Plato *danced* at some public festive games; but come point blank to those prototypes of modern art. Where was Raffaelle born—how did he pass his earlier years? Why, his cradle stood on one of the most commanding situations of the Appennines, and in youth he became a wanderer to and fro Urbino, and to and fro a host of monasteries and castles—where he saw *nature,* men, and manners. But we will at once transgress to the putting down an axiom: "that there never was a great man, whose bodily and physical powers were not adequate to the part he had to perform." Sir Christopher Wren, who would have been considered nearly worthy of apotheose in former times, attained the age of ninety-two;—no bad proof, indeed, that he must have been a man of pith, stamina, muscle, and nerve. And again, to transgress from artists to all kinds of men,—Sir John Herschel and James Watt both attained the age of eighty-four; the former a *wanderer* as well—and a soldier to boot. Most of this class of people, when young, had neither carriages nor railways at their command; and wherever they wanted to go, they had to go *per pedes Apostolorum.* Take, therefore, the journeys of Raffaelle amidst the hills and dales, the forests and bushes, and the freshness and the sun of the Appennines, and that of many—nearly all—of our young men now. Born in Chancery-lane, or the Bull Ring at Birmingham—with a view on some ricketty, lumbery, smoked, brick casement. When children, walking down this street and another; and when young men, loitering from a musty, dark, cheerless office in Fleet-street, to the coffee or eating house; and so on. The greatest feat they may subsequently perform, is to go *on business* to Manchester or Liverpool—stowed in the wooden case of a railway carriage.

"Their is a life for you—
This is what you call life!"

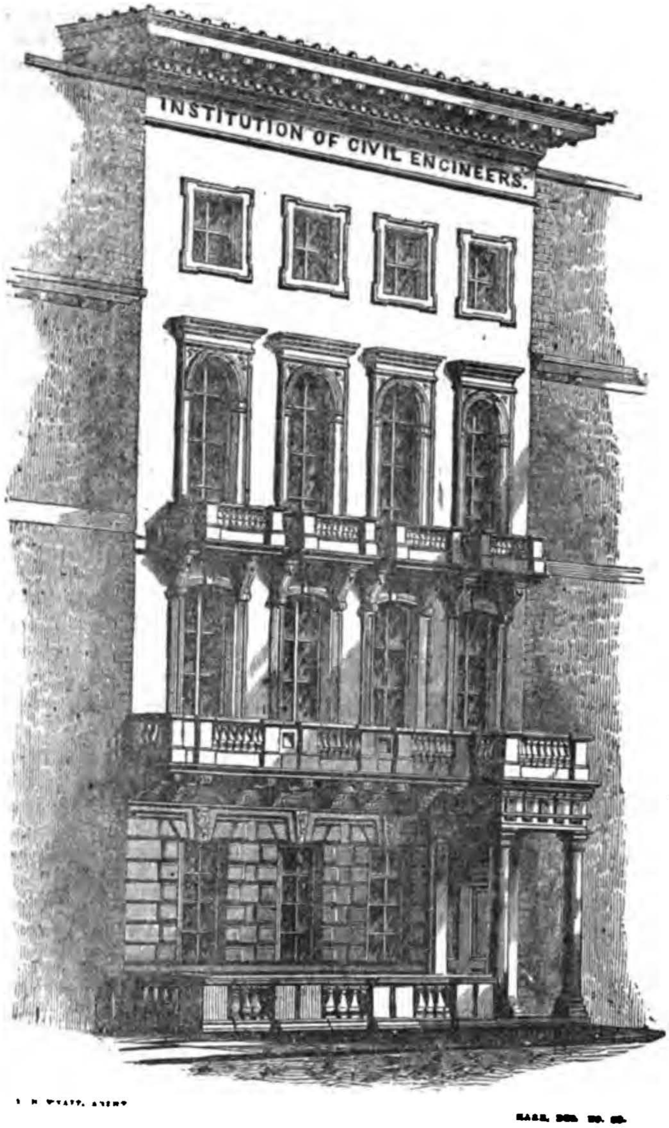
makes Goethe exclaim Faust under nearly similar circumstances.

And then, the working man's sanatory association exclaim, "Why is there so much disease amongst us?" *We* know it—*they* do not. Young people's physical powers, if not (we would say terribly) used, will be terribly abused: thence our present pigmy generation—deplorable in all and every respect. But to revert to the artist. Training and knowledge are as one thing—they produce the *prosy man* of business. So far so good: such men must also exist. But, if the aspirations of the nation have to be raised above that, we cannot accomplish it but in the manner in which it has been before accomplished, cannot but be *so* accomplished, and *has* been *so* accomplished in Egypt, Asia Minor, Greece, Rome, Italy, Flanders. It is mere chimera to think that the mind can soar above, while the body is dwindling—crumbling down to the very soil, into the embraces of which it is hastening headlong. The thing cannot be done; we are not mere spirits, mere minds—but, as Goethe has it, both are the same. It is well known, that several of the great artists of mediæval Italy were great fencers,—cheap *athletics*, indeed, accessible to all means. And then our young men must betake themselves again to the *staff* of the Grecian wise and good—to the knapsack worn by Cornelius, Overbeck, &c. Even a constitution and mind, somewhat damaged in Chancery-lane, may recover on the hills of Scotland or Wales, or amidst the luxuriant scenery and sunny skies of Southern Europe.

J. L——Y.

INSTITUTION OF CIVIL ENGINEERS.

[FAÇADE OF THE NEW BUILDING.]



We present our readers with a view of the new façade of the Institution of Civil Engineers, from the design of T. H. Wyatt, Esq.; as will be perceived, it is of the Italian style, and is faced with Caen stone, and forms an admirable specimen of street architecture. For the proportions of the openings of the doors and windows, Mr. Wyatt was compelled to be guided by those of the old brick elevation that was taken down. The frontage is 30 feet.

The building of the Institution has undergone, during the late recess, a complete metamorphosis; the theatre has been reconstructed and considerably enlarged, it is now 45 feet by 29 feet. The floor which was formerly nine feet above the ground line, is now reduced to that level; the seats of the president and council face the entrance, and those of the members are arranged in concentric curves, rising gradually up to the level of the entrance. The area of theatre is increased full one-third, giving accommodation to nearly one hundred persons more than the former room. The height to the ceiling is twenty-two feet. The evening lighting is partly through the inner skylight, by means of a gas ring, and by six gas burners provided with the means of conveying away the products of combustion. In the day-time, a skylight over the entrance, and three windows at the north-east end, afford ample light.

The ventilation is provided for by a shaft rising from the centre of the ceiling to a large cowl on the roof, and an ample supply of warm or cold air can be admitted, through apertures in the skirting, from Price's warm-water apparatus, according to the temperature of the theatre.

Above the theatre is a well-lighted room, for receiving the models and drawings, and affording accommodation for taking copies of them. The access to it is by a lateral staircase, from the ante-room, and also across the lead flat from the principal staircase.

The house department has likewise been considerably altered, and adapted to hold occasional conversazioni. The two rooms on the first floor, which form the libraries, have been thrown together, and by fixing a temporary staircase from the back window, a communication will be formed with the theatre, on the ground floor, for public occasions; the false floor for the raised seats will be removed, leaving a level floor the whole extent, and on the same level as the council-room and office, which will form, at those times, refreshment rooms, by this arrangement there will be a suite of rooms on the ground floor, 114 feet in length, and 29 feet wide.

There have been also alterations made in the other parts of the premises, and every attention made to the warming and ventilation, to render the building both convenient to the members, and suitable for the important occasions of the conversazioni.

The alterations have been conducted under the guidance and immediate direction of Mr. Manby, the indefatigable secretary, and the works executed by Mr. Grissel, the eminent builder, from the designs of Mr. T. H. Wyatt.

ON WATER AS FUEL.

This seemingly strange idea originated in an occasional remark of Sir Humphrey Davy—that on the problematic exhaustion of coal, men will have recourse to the hydrogen of water as a means of obtaining light and calefaction. As the gas used for lighting consists of hydrogen and a little carbon—it is only the latter which would have to be *added*, after the water had been decomposed into its elementary parts. M. Jobard, of Brussels, was the first who extracted from water a gas, of twice as great an illumining power as that obtained from coal. This gentleman produces hydrogen gas by the decomposition of vapour, passing through vertical retorts filled with coke, being in a state of white heat. And at the moment of the hydrogen being thus formed, it is mixed with a little carbonic acid gas, obtained by the distillation of oil, tar, or naphtha, or other coarse substance, hitherto useless in the gas manufactory. In the *Bulletin du Musée d'Industrie*, M. Jobard's method has been amply detailed. He says that at the expense of one pennyworth of oil, a light may be obtained during twenty hours, equalling that of ten tallow candles. Even conceding that M. Jobard's discovery has not quite attained the object of using water for light, fuel, &c.,—still, it has done something towards it.—These ideas lead us to a calculation of Prof. Faraday, that the elements of a single molecule of water contain 800,000 charges of an electric battery, consisting of eight troughs of two inches in height, and six inches in circumference. At the amount of these slumbering forces, the human mind is startled; because if we should ever be able to elicit and make them available, the power of the mightiest steam engines would dwindle to nothing—and thus, ends would be attained by the means of things seemingly trifling and worthless, which cannot now be accomplished by any sacrifice or expense.

J. L——Y.

STABILITY AND STRENGTH OF HUNGERFORD BRIDGE.

[Reply to the Objections raised in the "Civil Engineer and Architect's Journal" of December, 1846, to the Analytical Investigations and Dynamical Observations, contained in the Pamphlet entitled "Metropolitan Bridges," showing the Defects and Insufficiency of Hungerford Bridge, by Sir Howard Douglas.]

"In the pamphlet entitled 'Metropolitan Bridges,' &c., it is intimated that, at the tops of the piers of Hungerford Bridge, there exist horizontal forces, represented by $a - a'$, by which those piers are continually strained; and which, in consequence of the concussions produced by the vibrations of the Bridge, may ultimately destroy them.

Concerning these forces some explanations will presently be given; but as, in a well written paper which appears in the *Civil Engineer and Architect's Journal* for December, 1846, an attempt has been made to show that the danger which might arise from these forces is obviated by the friction rollers under the saddles to which the chains of the bridge are attached at the tops of the piers, and believing that there is ground for considering the effect of the saddles in diminishing the strain to be very small or nothing, we feel it incumbent on us, first, to say a few words on this subject.

It is much to be regretted that experiments on the friction of cylindrical rollers are as yet too few to allow any precise determination of its value to be founded on them, yet such experiments are not wanting; and from those of Coulomb principally may be obtained approximations which will suffice for the present purpose: it may be admitted, in fact, agreeably to many of the experiments made by that distinguished philosopher, that the friction of rollers varies inversely as their diameters, and directly as the pressures which they support. Now, suspending equal weights on opposite sides of a cylinder by means of a string passing over a pulley to which the cylinder served as an axle, and then applying on one side additional weights sufficient to overcome the friction, Coulomb found the values of that element for wooden cylinders of different kinds and sizes; reducing these, by the first part of the rule above mentioned, to cylinders four inches diameter, which is the size of the rollers under the saddles of Hungerford Bridge, the friction of wooden rollers is nearly one-hundredth part of the weight. This agrees with the experiments made by Mr. Babbage on wooden rollers, if as usual we estimate the power requisite to draw a body horizontally on a sledge to be one-quarter of the weight of the body. But all these experiments having been made with cylinders compressed by weights which are comparatively small, the above estimate is far less than it would be under the enormous pressure to which the rollers supporting the weight of a suspension-bridge chain are subject.

The experiments of Coulomb on iron axles turning between cheeks of copper give for the friction of metallic rollers a value bearing a much higher ratio to the pressures than that of wooden rollers: the diameter of his axles was 1·46 in. (English), and the friction, without grease, was one-sixth of the weight; this value, increased in the ratio of 1·46 to 4, gives, for the friction of iron four-inch rollers, one-fifteenth of the weight or pressure. It would seem, therefore, that the friction of such rollers, even in circumstances far more favourable to the freedom of their motion than those of the rollers under the saddles on the piers of Hungerford Bridge, cannot be estimated at less than the quantity last named. Now the pressure in the vertical direction, arising from the weight of the suspending chains on the tops of the piers on each side of the centre of Hungerford Bridge, being estimated at 850 tons, it must follow that the friction and inertia of the rollers are together equivalent to nearly 57 tons; or strains at the tops of the piers, to that amount, may take place before the saddles will move. What has been said must be considered as independent of the increase of resisting power in the rollers, arising from the probable alteration of their figures and the indentation of the planes on which they rest, in consequence of the great pressure to which they are subject, each of the twenty-five rollers* under the saddle bearing one-twenty-fifth of the weight on that saddle, or above 17 tons. The resistance arising from the force of cohesion may also, in time, become sensible under such pressure. The estimate of the friction of rollers on the pier of a suspension-bridge which, in the paper referred to, is derived from that of a railway carriage, is by no means admissible: as well might it be assumed that the body of a railway carriage, if moving on rollers four inches diameter, would have only half the friction which it has on its wheels. A railway carriage may be considered as moving on rollers whose diameters are ten or twelve times as great as those of the bridge rollers; and, if any comparison could be made between cases which are so much unlike, it should be inferred that the friction of the Bridge rollers, instead of being half that of a railway carriage, should be ten or twelve times as great.

By an oversight, it was stated in the pamphlet on 'Metropolitan Bridges &c.,' that the side chains of Hungerford Bridge have the same droop or deflexion as those in the centre; whereas, the side chains, being carried below the level of the road, the droop is greater, while the horizontal length or span is nearly equal to that of half the centre chain: the inference drawn from the difference between the parts of the chain, is, however, correct; the value of a' being still less than than that of a. This is manifest from the approximative formula which is given in the pamphlet; since x^2 is small when compared with $3y^2$, and the whole numerator is divided by an increased value of $6x$. But if the weights suspended from the central and side chains be taken into consideration, the value of a' relatively to a will be much less than that which would result from merely substituting the augmented value of x in the formula above alluded to. For the weight of half the chains and roadway between the piers being estimated at 500 tons, while, between either of the piers and the abutment on the land side, the weight of the chains with the portion of roadway which they in part suspend, and in part support, is about 350 tons:* then, still, for simplicity, considering the curves as common catenaries, and using the correct formula for horizontal tension, viz., $a = \frac{s^2 - x^2}{2x}$ in which s, the length of the chain between the points of attachment (in this case, the length between the highest and lowest points of the curve,) may be taken to express the weight of the chain and loading between such points, it is evident that a' will be less than a, both on account of the smaller value of s and the greater value of x.

It is, therefore, very correct to say that there exists a force of considerable intensity, expressed by $a - a'$, which is constantly acting towards the river at the top of each pier, and which may ultimately be the cause of its destruction. And though it should be admitted that motion may take place in the saddles so as to produce some compensation to the excess of strain towards the middle of the river, yet the effect of such motion would be far from equalising the contrary strains. In the actual state of the Bridge, the horizontal tension of the side chains at each abutment is about eleven-twenty-fifths of the like tension of the centre chains; and a movement of the saddle to the extent of eighteen inches towards the river, while it would diminish the horizontal tension of the centre chains by about one-eight part of its value, would increase that of the side chains by one-hundredth part only; and this is the whole extent to which the compensation alluded to in the *Civil Engineer and Architect's Journal* for December (p. 365, col. 1.) would amount. It may be observed, that a strain which should cause a movement of a saddle towards the river to the extent of eighteen inches, must be accompanied by a descent of the lowest part of the centre chain as much as six feet vertically.

The effects of the strains at the pier heads may, obviously, with propriety, be determined by the parallelogram of forces as explained in the fifth page of the 'Reply' addressed to the Editor of the *Civil Engineer and Architect's Journal*; and of such resoluion of forces an instance occurs in the description of a Jib-Crane, which appears in that journal for December, 1846, p. 367. It is not, however, to be supposed that a pier of brick or stone is overturned as if it were a vertical rod, capable of turning on a joint at its lower extremity only; this is an effect which can scarcely take place in such structures; but continual pressures and accidental strains at the head of a pier have tendencies to destroy the adhesion of the materials, and cause the pier to fall in ruins in consequence of a fracture taking place at the point where the fulcrum of the lever may be situated. The position of such point will depend upon the construction of the piers, and those of Hungerford Bridge are not solid in all their height, but each is perforated at a certain distance above the roadway by arched openings at right angles to one another, so that the top of the tower with the saddle is supported only on the four portions of the side-walls at the angles.

This construction renders the towers far less strong than they would have been if solid, and makes it very probable, that, in the event of undulations of the bridge producing a pressure even less than that value of $a - a'$ which has been above found, fractures will take place in those portions of the side

* These observations are all made with reference to an accurate plan, showing, in detail, the principle and construction, elevation, plan, and end view of the saddles on the tops of the piers; the girders, the coupling bolts, and suspension rods, the holding down girders, &c.; and very accurate observations have been made, by which it appears that there is very little, if any, shifting of the saddles, since the bridge was constructed, as stated at page 9.

* It must be observed, that this portion of the roadway, which is equal in length to half the distance between the piers in the river, is supported at both its extremities.

walls; while it is not impossible that, from unequal settlements in the bed of the river, combined with strains at the tops of the towers, the latter may be wholly overturned.*

From the estimate which has been made of the weight, (850 tons) on either of the pairs of saddles, and the horizontal pressure (57 tons) which may take place before the saddles will move, it may easily be computed by the parallelogram of forces, that in either of the two towers on one side of the centre of the bridge, the diagonal which represents the resultant of the forces would make towards the river, an angle of 3° 49′ nearly, with a vertical line passing through the centre of the saddle, and that the value of the resultant for one tower only, is 429 tons. The direction of this resultant, if produced, would fall within the base of the tower and therefore the latter may seem to have sufficient stability; but if, in the tower, a line be drawn from the top of a saddle to the foot of the opening, towards the river, at its middle point, that line will make an angle of 22° 45′ with the resultant just mentioned; therefore, multiplying the pressure in the direction of that resultant by the cosine of this angle we should have 395 tons for the pressure thrown obliquely on that side wall of the tower. Such a pressure, being but slightly counteracted by the tenacity of the walls on the other sides of the tower, would be sufficient to cause the wall to bulge towards the river, and would prostrate the fabric in ruins.

Under the enormous pressure which the saddles have to support, it may be presumed, that these have scarcely moved from their places since the construction of the bridge, having experienced only the slight agitations produced by the small number of foot passengers who have hitherto been on it at one time, and it may be readily admitted that, as yet, the strains on the pier-heads have produced no effects which appear to be detrimental to the stability of the bridge. But the case will be different should even such strains be long continued; and no one can, without dismay, contemplate the probable consequences of failure should such a bridge be frequently subject to the sudden rushes on it of bodies of people, and the rapid movement of numerous trucks and other carriages, laden with baggage, proceeding from the main terminus of the several stations and roads leading from Kent, Sussex, and the south-western counties, which it is proposed to establish opposite to Hungerford, and for which it is imagined this bridge may serve as a viaduct.

Melancholy instances of the fatal consequences attending the failure of these graceful but treacherous structures, are too frequently taking place. Mr. Trollope relates,† that while he was in the West of France, a suspension bridge over the river Dordogne gave way, at the time that a heavy van was conveying, to the place of their destination, criminals who had been condemned to the gallies, when the unhappy persons, being unable to disengage themselves, were all drowned; and an account of a still more lamentable occurrence is given in the *Civil Engineer and Architect's Journal*, for Jan. 1847, page 31. The suspension bridge recently completed at Jinguratchy near Jessore, and the iron-work for which had been obtained from England, gave way at a time when 5 or 600 persons had assembled on it to witness a poojah, and when three boats were passing under it; the sad accident was caused, as in the case of the Yarmouth catastrophe, by the whole crowd suddenly rushing to one side of the bridge; and it is reported that 100 persons were killed or drowned.

But a case which must be considered as one of the highest importance on account of the lesson which it offers with respect to the instability of suspension bridges when the great strains to which they, above all other bridges, are liable are not duly counteracted, is that of the *Pont des Invalides*, which was constructed across the Seine, between the years 1824 and 1826, and which immediately upon the centering being removed gave way, so as to render its entire removal a measure of necessity.

The span of the bridge was about 557 feet, and the deflexion of the chains, in the middle, nearly 33 feet. The dimensions of these were more than sufficient to enable them to resist the tension to which they would be subject; but the chains were supported on the tops of four Egyptian columns, (of which the two at each extremity of the bridge, were connected by iron braces,) and, descending abruptly from thence on the land side, they passed down a deep pit formed in masonry, to which, at the bottom, they were firmly attached.

If mere strength, unaccompanied by equilibrium, could have ensured stability, this bridge ought to have stood, a monument of elegance. But though here, as in Hungerford Bridge, there was an effort made, by permitting the chains to slide on the tops of the piers, to produce a compensation for an excess of pressure on the bridge, yet experience has shown that such compensation does not take place; and it is evident that, in consequence of the great friction, the horizontal pressure towards the river, is allowed to take effect at the tops of the supporting piers or columns; that pressure, ($a - a'$ above,) combined with the normal or vertical pressure of the chain, produced a resultant force which overturned the piers.*

It is remarkable that the project for the bridge was sanctioned by the approval of a commission constituted of engineers, in the department des Ponts et Chaussées, and that its construction was superintended by two engineers specially appointed for the purpose, as well as by the distinguished projector himself. It is painful also to reflect, that the failure of the bridge pressed so heavily on that talented individual as to cause his premature death.

The writer of the article in the *Civil Engineer and Architect's Journal*, endeavours to show, that the dangers which may be apprehended from vibrations, undulations, sudden additions of weight, and rushes of people, are rather imaginary than real, and treats this question as one purely statical, considering the bridge as a rigid, solid, inflexible structure. But it is clear that in all the preceding cases, as well as those of North Yarmouth and Broughton, the catastrophes that occurred, arose from the dynamical effects of oscillations and undulations; these the writer entirely rejects, on account of the difficulty of investigating and determining mathematically the effects of the forces, which ought to be taken into account, from the mutual action of the flexible bodies on each other. There is no doubt that it is extremely difficult to investigate these dynamical effects, and to assign precise values for them; but are we therefore to reject them altogether, in determining the strength which should be given over and above that which is required to sustain the statical pressure, and are we to make no allowance whatever for the additional strains which the dynamical effects produce? It might as well be said, that no considerations, with respect to the action of winds and waves of the sea, ought to be made in erecting Piers, Light-houses, &c., because we cannot estimate exactly their dynamical amounts."

The above is Sir Howard Douglas's rejoinder to the remarks made by us upon his former paper in this Journal. As might be expected of two disputants who set out, open to conviction, and determined that the discussion shall never digress to topics foreign to the question, there remains now but little difference of opinion between us. We think that he has made out a strong *primâ facie* case for the necessity of determining, by actual experiment, whether the "shifting saddles" be really efficient for their proposed object. At the same time, we still think the horizontal friction overrated: it is difficult to suppose that the rolling friction of wooden cylinders can be less than that of iron cylinders, and "the experiments of Coulomb on iron axles," included (we presume) the effect of *rubbing* friction, and therefore are not strictly analogous to the case before us.

The fact is we are contending in the dark. To make anything like an accurate estimate of the friction of the Hungerford Bridge saddles, we must not content ourselves with the confessedly inadequate experiments which have been hitherto made, but ought to make a direct experiment upon the Bridge itself. When the consequences of the failure of a Metropolitan Bridge are considered, it will not seem unreasonable to ask that this inexpensive investigation should be undertaken. Even supposing it ascertained that the saddles move with the greatest facility when the Bridge has its extreme load,† the mere fact of satisfying the public mind would be ample recompense for the trouble and cost incurred. Not only ought the Bridge to be secure, but every one ought to be satisfied that it is secure. As far as we know, Hungerford Bridge has never been in any way *proved* by heavily loading it.

By analogy, from what little is known of rolling friction from former experiments, it certainly still seems to us that the *statical* effect of the friction of the saddles would be small. But friction, like other forces, may be of the nature of impact. A crowd suddenly running from the side spans to the

---

* The piers rest upon the natural gravelly bed of the river, like those of Westminster bridge! surrounded by sheet piling driven, it is said, fifteen feet; an expedient which has not, however, prevented the subsidence and ruin of the two main piers of Westminster bridge. Though the towers of Hungerford bridge were erected in coffer-dams, there is no piling underneath.

† A Summer in Western France, vol. 2, p. 259.

* This description of M. Naviers' bridge is taken from an accurate plan in my possession, shewing, in detail, the construction and dimensions of its several parts. The true causes of its destruction were, the inequality of the angles formed by the chains, with the vertical lines, at the towers, and the insufficiency of these at the abutments; both of which defects exist in considerable degrees in Hungerford bridge.

† If this were found not to be the case, many mechanical contrivances might be suggested for diminishing the horizontal strain on the piers.

centre span of the platform would produce a sudden or *impulsive* horizontal force on the top of the piers which could never be estimated from statical principles. There is, moreover, the apprehension of the rollers becoming, from long disuse, settled and fast in their place, by indentation, the accumulation of rust, or other foreign substances, &c.: from not being called into action under ordinary circumstances, they might be inoperative just at the time when they were wanted.* This point ought also to be examined experimentally.

We have confined our attention almost exclusively to the stability, and have said little of the strength, of the Bridge. The following seems a simple and satisfactory method of ascertaining the tension of the main chains at the points of suspension. If t be that tension, l the load borne by each half of the main chain, and θ the inclination to the vertical at the point of suspension, we know that

$$t. \cos \theta = l, \text{ or } t = l. \sec \theta,$$

whatever may be the form of the chain. In other words, we may ascertain the tension of the chain at its highest point, by multiplying half the total load by the secant of the angle at which the chain is inclined to the vertical at that point. The advantage of this method is, that it is independent of any assumption respecting the form of the catenary, and is strictly true, if we suppose what, in fact, is the case, that no part of the load is sustained by the platform itself resting on the piers. In answer to an application for the value of the angle in Hungerford Bridge, we were promised the particulars by Mr. Brunel, but subsequently found that he had been too much engaged to send them. Probably, the subject (the mere question of a few hundred lives) was too trivial to engage his attention.

There are many points in Sir Howard Douglas's paper on which remarks might be offered, but, for the sake of brevity, we refrain from making them; though, in one or two cases, our arguments seem to have been somewhat misunderstood. However, there can be no doubt that, if the traffic of Hungerford Bridge should appear likely, from a change of circumstances, to be hereafter greatly increased, the question will engage the attention of those who have more power than ourselves to demand information upon it. The inquiry which Sir Howard Douglas has personally undertaken (notwithstanding great obstacles), has, we believe, been most minute and laborious: such exertions can have no possible object but the public security and the advancement of engineering science, and ought, therefore, to be appreciated in proportion to their disinterestedness.

† The powerful effect of the accumulation of rust and concretions is frequently exhibited in a striking degree in the second or subsidiary safety-valves of steam boilers. These valves are never called into use except in unusual emergencies, and then, from long disuse, are often clogged and stick fast, notwithstanding the very great pressure exerted to open them.

HISTORY OF ENGINEERING.

By Sir J. Rennie, President of the Institution of Civil Engineers.

(*Continued from page 55.*)

Drainage.

In works of draining extensive districts of low marsh or fen lands, the Romans, with their usual energy and ability, effected much, and the Podike, Caer-dike, and the embankment of the Thames, amongst other works, are good examples. After they left the country, it relapsed into its former state of barbarism, and so remained for ages, until the art of drainage may be said to have been lost. Upon its revival the Dutch, from necessity, had become extremely skilful, and were celebrated throughout Europe at a remote period, almost before engineering commenced in Great Britain. On account of the proximity to England, and their experience in these kind of works, when it became a question of draining the extensive districts of low marshy land on the east coast of England bordering upon the Humber, the Witham, the Ancholme, the Welland, the Nene, and the Ouse, it was natural that recourse should be had to those who, from their skill and experience, had already acquired such reputation as the Dutch; accordingly we find, in the reign of Charles the First (when it was determined to drain the great level of the fens, afterwards called the Bedford Level, from the name of the Earls of Bedford,) Cornelius Vermuyden came over from Holland, and after draining the level of Hatfield Chase, adjoining the Trent, and acquiring considerable celebrity and influence, was knighted by the king. He planned great works in 1640, at the Bedford Level, for Francis Earl of Bedford, but the execution of Vermuyden's plans were prevented by the Civil War, and were afterwards carried into effect by William, the successor to Francis, Earl of Bedford, after much discussion and controversy, and were successful in draining the level to a certain extent. The plan in 1651 consisted in placing a sluice across the River Ouse, at Denver, about 15 miles from the sea at Lynn, where the Ouse enters the Great Wash, so as to exclude the tidal waters, leaving the channel of the River Ouse, above that sluice, for discharging the fresh waters only; these it was proposed to conduct from all parts of the land by small lateral drains or canals, carried to the river in as direct courses as practicable, having sluices at their junction with the river, to prevent the floods from entering them and covering the adjacent lands. He also cut a new channel, about 20 miles long, called the Bedford, or Hundred Foot River, for a part of the River Ouse, from the point where Denver Sluice was erected, to the old channel of the Ouse, at Earith, where another stanch or sluice was placed for preventing the tide from going beyond that point.

Vermuyden considered that by adopting this plan, and having only the fresh waters to contend with, he would get rid of that most powerful enemy to drainage, the tide; and then, having only to deal with the fresh water, he anticipated no difficulty in accomplishing the complete drainage of the land. For a time the plan answered tolerably well, and effected considerable improvement in the drainage; but he overlooked the important facts that the tidal waters formed the most important agent in keeping open the channels of the rivers, in preserving a good outfall for the drainage waters to the sea; that by excluding the tidal waters, the channel of the rivers would suffer, in proportion to the quantity of water which was thus abstracted from them, and that thus in time they would become incapable of effectually discharging the drainage waters; that the outfalls of the rivers would also suffer in the same proportion, and then the marsh-land districts, depending upon them for their drainage, would revert to their former inefficient state, and so it happened with the Bedford Level. The mouth of the channel of the River Ouse, which is the chief outfall for the drainage of the district where the Bedford Level is situated, being deprived of its accustomed and natural scouring power of tidal water, became so obstructed by shoals that the land waters could not pass off to the sea. In proportion as the drainage became defective in process of time, as it necessarily did under the system adopted, windmills were erected to work scoop-wheels, with a lift of 4 or 5 feet, for raising the water out of the lateral canals into the river. In 1713, Denver Sluice was undermined and blown up by the floods, and the tide recovered, to a certain extent, its ancient receptacles, and if proper measures had then been adopted, both the drainage and the navigation would have been restored to an efficient state; but the sluice was rebuilt after a few years on the old system, and the drainage and navigation became deteriorated as before. During the past century the drainage of the Bedford Level, as well as other districts, has been submitted to, and has occupied in succession the attention of the ablest engineers of the day; among whom may be mentioned the names of Perry, Elstobb, Grundy, Golborne, Armstrong, Kinderly, Smeaton, Jessop, Chapman, Page, Robert and William Mylne, Huddart, Rennie, Telford, Walker, G. and J. Rennie, Cubitt, Rendel, and others.

Amongst the most remarkable operations of this nature, may be mentioned the works upon the river Ouse, for the purpose of improving the drainage and navigation, which had become seriously affected by the accumulation of sands at its mouth, and the abstraction of the tidal waters above-mentioned. The principal defect existed immediately above the town of Lynn, where the river took an extraordinary bend almost at right angles to its general course, for a length of 5½ miles, forming almost a semicircle, the diameter of which was only 2¾ miles; independently, moreover, of this circuitous course by which so much fall or inclination of the current was lost, the channel was so irregular and disproportionate in width, and so much encumbered with shifting sands, that the tidal and fresh waters were unable to force their way through them; thus the drainage waters were penned up above, and being unable to get off, formed a tranquil pool, which during floods frequently broke the banks and inundated the surrounding country, the channel, moreover, being deprived of its natural scour, silted up in the same proportion. In order to obviate this great and growing evil, the ablest engineers of the day were consulted, and they unanimously concurred in the opinion, that the only sure means of providing a remedy was to cut off the bend in the Ouse, by making the shortest channel between its two extremities. This plan was first proposed by Bridgeman, in the year 1724, and was subsequently recommended by the various engineers of the day who succeeded him. In the year 1792, an Act was passed, after great opposition, empowering a certain body of Commissioners to carry into effect this cut, which was called the Eau Brink Cut, the expenses of which, estimated at about 80,000*l.*, were to be defrayed by a tax of 4d. per acre on the middle and south levels of the Bedford Level, comprising about 300,000 acres of land drained by the Ouse. This great work was to have been carried into effect by Robert Mylne and Sir Thomas Hyde Page; but they disagreed as to the proper form and dimensions of the cut, and referred the matter to Captain Huddart, who decided between them; so much money, however, had been spent in litigation, that the tax which was levied to pay for its execution was exhausted. In 1817, another Act of Parliament was obtained, empowering certain Commissioners to raise additional and increased funds from the lands which it was supposed would be benefitted by it, and the execution of the work with its branches was intrusted to the late Mr. Rennie, as the principal engineer. The Eau Brink Cut, which was executed according to the award of Huddart, and the works connected with it, were finished and opened on the 19th of July, 1821, and very beneficial effects, as had been anticipated, immediately followed; the extraordinary wet winter of 1821 which succeeded, proved its success beyond doubt, for soon after the cut was opened the low water line in the Ouse, immediately above it, fell five feet, which necessarily produced a corresponding increase in the fall or inclination in the current, and thus gave it increased velocity and power to scour away and remove the obstacles in the bed of the river, and to discharge a greater quantity of water in the same time, as well as a longer period for discharging it, to the great benefit of the country drained by it. The tidal waters, moreover, being freed from the shifting sands and circuitous course of the old channel, and being confined in one mass in the new direct channel, acted with greater effect; finding their way upwards, and becoming united with the fresh waters in enlarging and deepening the channel above, they kept it open to its proper dimensions, and thus both the drainage and the navigation derived benefit from this great work. The improvement was carried still further, in adding one-third to the dimensions of the cut, particularly at the upper end; by this means an additional fall of about 2 feet 6 inches was obtained, making a total increase of about 7 feet 6 inches in the fall of the current at the upper end. The effect of these improvements has been to increase greatly the produce and value of upwards of 300,000 acres of land drained by the Ouse, which otherwise could not have been cultivated. The measure, like almost all other great improvements, encountered great opposition at the time, and in order to tranquilise the fears of some and satisfy the prejudices of others, various minor interior works were provided, such as locks and weirs, for penning up the water, most of which, but for existing prejudices, it would have been better to have dispensed with, and to have removed Denver sluice, raising the banks on the various rivers above, so as to have restored them to their natural state, and thus by admitting a greater quantity of tidal water, to have scoured out their channels, and thereby have enabled them to carry off the drainage waters more effectually.

A similar operation was executed by Telford and Rennie, on the river Nene, in 1829, at the Nene outfall, which commences about five miles below Wisbeach, and terminates at Skate's Corner, a length of nearly 5 miles, where it joins the great estuary of the Wash. The beneficial effects of this work have been very extraordinary; the low-water mark has been lowered 10 feet 6 inches, and a district of above 100,000 acres has been completely drained and brought into cultivation, which formerly for the greater part of the year was little better than a stagnant marsh; the navigation has been so much improved, that the tide rises 14 feet at Wisbeach, and vessels of 200 tons are now enabled to come up to that town, where previously the river was only navigable for small sloops; and at Sutton Bridge, 8 miles lower down, vessels of above 600 tons can arrive where formerly there was only water for vessels of 200 tons.

The river Nene having been thus improved, so as to enable it to carry off the tidal and fresh waters, an extensive plan for the interior drainage was designed and carried into effect by Telford, in 1830. It consisted of one main drain of proper dimensions, with two subsidiary drains of smaller capacity, extending above 20 miles, as far as Thorney, to bring down and discharge all the water from the low fen-land districts into the upper end of the new outfall, by means of a capacious new sluice with self-acting gates, which continues to discharge the water from the drains into the Nene, so long as the level of the water in the drain is higher than that of the river; but whenever the water in the river is higher, the sluice-gates close and prevent the river water from entering. This plan of Telford's resembled one previously proposed by Rennie for the same object, but which was upon a more extensive scale, and was accompanied by the important addition of catch-water drains.

In 1806, Rennie proposed and carried into effect a complete system of drainage, for an extensive district of fen-land, called the East, West, and Wildmore Fens, bordering upon the river Witham, into which they drained, about 10 miles above Boston. Rennie at once perceived the defects of the Witham as a means of drainage and navigation, and decided that until the river was improved by shortening its course and increasing the capacity of its channel, the complete drainage could not be effected. This plan he proposed, but the opposition was so strenuous that he was obliged to abandon it, and to carry his main drains into the river below the town of Boston: he divided the drains into two classes; one set he technically termed catch-water drains, which running along the base of the hills surrounding the low lands, intercepted all the high land waters, which, descending with great velocity, would soon have overwhelmed the low lands, in addition to the water falling upon them according to the extent of their surfaces. These high land waters were conducted by the catch-water drains into a main drain, which discharged the waters, by a self-acting sluice, into the Witham immediately below Boston; the low land waters thus freed from the high land waters, were conducted by separate drains into another main drain at Hobhole, about 3 miles lower down the Witham, where there was more fall. By this means both classes of waters were discharged without interfering with each other; means were also secured of discharging all the water by the lower drain at Hobhole, in case it should be found necessary, which ultimately happened, and it was made of additional capacity for that object. The district was thus completely drained, and from a stagnant marsh was converted into corn-fields.

The Witham being left to itself, became silted up in 1827, as had been foreseen by Rennie, and the neap tides scarcely flowed above 3 to 4 feet at Boston. The channel was then improved as recommended by him, and the river is now in such a state that vessels drawing 12 and 14 feet arrive at Boston, and the whole country drained by the Witham has been proportionably benefited.

He proposed a similar plan for the improvement of the Great Bedford Level in 1811, the cost of which he estimated at 1,188,189*l.*; but unfortunately for that district it has never yet been carried into effect, although it would have amply repaid the outlay. The origin of the above system, it is believed, is due to Rennie, although it is said by some that the Romans employed catch-water drains, and the Caer-dike is quoted as an example: it is, however, by no means clear whether it was not merely a navigable canal to connect the Nene and the Witham; at all events, the system, if ever it existed, had long been abandoned, and the revival, at least in modern times, is due to him. He also proposed the drainage of the Hatfield Chase and Ancholme districts, and Romney Marsh,* Holdernesse, and other districts upon similar principles, where drainage had been tried and had only partially succeeded.

After mature consideration and experience, it appears that the safest and most certain principles of drainage and navigation are:—The improvement of the channels and outfalls of the rivers, as far as may be practicable, for the free admission and discharge of the tidal and fresh waters; with interior drains, well laid out, of proper proportion and capacity for the low land, and catch-water drains for the high land waters; and according to circumstances, the drainage and navigation may be combined or kept separate.

Steam Drainage.—Where natural drainage could not be effected, or was only imperfectly applied, recourse was had to windmills and scoop wheels, as still used in Holland; these were always adopted until 1820, when Watt's steam engine was successfully applied by Rennie to work a large scoop-wheel, for draining Bottisham Fen, near Ely. Subsequently this valuable system has been applied and extended by Glynn, Field, and others, to the great improvement of fen-lands, by draining the water lower beneath the surface than could be done by windmills, which are now almost generally superseded by steam engines; the latter can be used when required, whereas the windmills can only be employed when there is wind; and it frequently happens that calms prevail during rainy weather, at the very time when the mills are most wanted.

Whilst carrying out the improvements of the outfalls and mouths of rivers, it often occurs that large tracts of sand and mud may be converted into fine arable land, fit for agricultural purposes, by accelerating the natural accumulation of warp, or alluvial matter, held in mechanical suspension by the water, and which, from the absence of proper measures, is otherwise carried away without producing any benefit. The works for this object and for improving the drainage and navigation, if properly conducted, consist generally in regulating and confining the channels of the rivers, through the sands below high-water mark, to one channel, for both the flood and ebb waters, and accelerating gradually the accumulation of alluvial deposit, by jetties and other light works adjacent to them; in proportion as the deposit accumulates, the works are raised until vegetation appears, which generally takes place about the level of high water of neap tides, and then the land is embanked from the sea. The system of warping or artificially soiling bad land where the levels will permit, has been practised for many years along the Trent, Ouse, and Humber, with considerable success. The operation consists in admitting, through sluices and canals made for the purpose, the water charged with alluvial matter in suspension, to the lands to be warped, which are surrounded with embankments, and after having deposited the alluvial matter the waters are conducted away again to the river; this process is repeated at intervals until the lands have been sufficiently warped, and thus lands which, in some cases, are situated several miles from the rivers, and were comparatively worth little, have become extremely valuable. If these operations be judiciously conducted, the outfalls of the rivers, and the harbours and drainage and navigation depending on them, may be greatly improved, and the land gained during the operation will, in many cases, amply repay the cost of draining it. In Holland, and other countries, there is a great field open: much depends upon the situation and other local circumstances; considerable judgment and skill is required in selecting the districts, and in properly applying the system, but its consequences are so important that it is well worthy of the attention of engineers. A scheme of this kind upon an extensive scale is about being carried into effect at the mouth of the Ouse and Nene, where above 30,000 acres of land will be gained, and great improvement will be effected in the drainage and navigation of the extensive districts drained by the Ouse and Nene. The same principle is applicable, in some cases, for converting shoals into effective breakwaters.

Machinery and Manufactures.

The improvement and extension of machinery and manufactures by new inventions and applications have been immense since the time of Smeaton. Previous to that period wood was almost exclusively used in the construction of machinery. Desaguliers, Leupold, Gravesande, and other writers, have given descriptions of the best specimens of mills and machinery in use a century ago, but they were very defective, both in proportion and construction, when compared with modern machinery for similar purposes. The introduction of cast iron by Smeaton, in 1754, was a great step in advance. He began by employing cast iron for the axis of one of his earliest windmills, in 1754; then in 1769, for the shaft of a water-wheel, and the main-wheel attached to it, for boring cannon at Carron; cast iron alter-

* The difficulties here are peculiar, in consequence of the coast being surrounded with a broad belt of loose shingle, which renders it necessary to carry the drainage water through the sea banks by close tunnels, with valves at their outer extremities, so as to be forced open by the hydraulic pressure of the water. Dymchurch wall, or sea-bank, here is well worthy of remark: it was formed in the Dutch manner by stakes wattled together, and constantly required repair; it has since been faced with stone paving, at an inclination of about 6 to 1, which stands well, and resists effectually the heavy seas to which it is exposed.

wards was generally adopted for axes, but as some of them, which were improperly made, gave way, the application of cast iron in other machinery was in some measure retarded, until Watt applied his steam-engine to drive mills. The Albion Mills, constructed by Rennie, in 1784, and worked by Watt's steam-engine, may be considered as the first complete example of the employment of iron in every part of machinery, except for the teeth of some of the wheels, which were made of hard wood, for working into the iron teeth of other wheels; that example also showing the true form of teeth, with a fine pitch, and adequate depth and breadth and adjustment with each other, so as to work well together with the least friction, and the use of bevel gear, which is the perfection of modern millwork.

The great improvement effected in the design, proportion, and construction of millwork, together with the steam-engine, enabled machinery to be driven with greater velocity, increased action, and diminished friction, and thus greater effect was produced with the same amount of power.

We are indebted to our honorary member, Professor Willis, for his able investigation of the teeth of wheels, and to Whewell, Mosely, Jamieson, G. Rennie (for his new edition of Buchanan), and others, for their valuable treatises on mechanical and engineering subjects.

The Invention of the Spinning-Jenny, by Hargreaves, in 1767, and of the means of drawing out the fibres of cotton between successive pairs of revolving rollers in the water-twist spinning, by Arkwright, in 1769, followed by his system of machinery for carding and preparing fibres of cotton for spinning, in 1775, occasioned a complete revolution in the arts of manufacturing, and led to the establishment of the factory system, with its self-acting machinery. A somewhat similar system had, however, been introduced in the Silk Mills at Derby, nearly half a century before; but inasmuch as silk naturally consists of a series of fine threads, it is only necessary to twist or retwist them, in order to combine them together, which is a very simple operation, compared with forming the short detached fibres of cotton into a thread, without the aid of the hand to guide them; and to accomplish this by machinery was extremely difficult; it was, however, very ingeniously overcome by Hargreaves and Arkwright in different ways, both of which were combined together by Crompton in the mule in 1771. Arkwright's water-spinning was subsequently simplified into what is technically termed throstle-spinning, and together with his preparing machinery of 1775, was adopted for spinning worsted by Toplis, and for flax by Marshall. The carding machinery was also adopted, with suitable modifications, for preparing short wool, Hargreaves' spinning-jenny being used for spinning it into yarn for woollen cloth. The mule for a long while was only employed for cotton, but was adapted by Kelly in 1790, to be partly worked by power in aid of manual labour, and was soon after improved so as to spin extremely fine threads.

All these valuable inventions, together with a multiplicity of other ingenius contrivances connected with the factory system, were completed and brought into extensive use in the short period of 20 years. Machinery for printing calico was introduced by Peel, and perfected by others. Watt, in 1787, introduced chemical bleaching, which was afterwards carried to great perfection by Tennant. Cartwright, in 1787, invented cloth-weaving by power, although it was not brought into use until twenty years after, and, in 1790, he invented machinery for combing and preparing long wool, in preparation for being spun into worsted. Machinery for dressing woollen cloth by teazles was perfected, and Harmer invented machinery for shearing it in 1787. This has since been carried to greater perfection by Lewis. Bramah, in 1796, introduced the hydraulic press, which furnished the means of pressing cloth, books, papers, and other articles with a degree of force which could be accomplished by no other means, and its general adoption has been of great service. Self-acting machines for making button-shanks were invented by Heaton. Boulton's large manufactory at Soho contained many inventions besides those of Watt. He invented machinery for coining money by steam power in 1790, and erected a complete establishment at Soho, where, for a long time, he executed contracts for coining money for the British, and various foreign governments. His plan for stamping the pieces consisted in exhausting air, by pumps worked by a steam-engine, from vessels properly adapted for the purpose, and connected by valves with air cylinders, having pistons working the balance-beams of the coining-presses. By opening a valve, air is exhausted from within the cylinder, and the atmospheric pressure acting upon the piston, turns down the screw of the press which stamps the coin; by re-admitting air, the piston rises and with it the screw, thus producing an alternate rising and falling motion so as to strike from 50 to 60 pieces per minute; as the screw rises and falls, it works a feeding apparatus for supplying blank pieces, ready prepared for stamping, and as fast as one piece is stamped it is pushed off the die, and is replaced by another. The apparatus for cutting out the blank pieces is of a similar description; the whole is self-acting, and is a most beautiful and ingenious contrivance. These improvements were introduced into the Royal Mint, at Tower Hill, which was constructed in 1810, under the direction of Messrs. Boulton and Watt, who furnished the steam-engines and the coining machinery. The rolling machinery by Rennie, and the equalizing machinery of Barton, constructed by Maudslay, complete this magnificent establishment. At St. Petersburg, Copenhagen, Calcutta, and Bombay, Messrs. Boulton and Watt erected similar establishments, with rolling-mills by Rennie, at the two latter places.

The whole of the above ingenious and valuable inventions, except power-weaving, had been fully carried out and brought into successful practice before the end of the last century. The brilliant results which were obtained from these inventions excited, in an intense degree, the skill and ingenuity of a host of able mechanicians in the various departments above mentioned. The most minute operations were reduced to system by the use of machines, and the high profits derived from manufacturing by machinery, while the prices of the articles continued the same as those formerly produced by manual labour, occasioned a readiness before unknown to adopt all new machines, as well as to extend and improve them.

Water-Wheels.

The general introduction of self-acting machines induced the construction of more extensive mills of all kinds, and rendered necessary the use of more powerful and better regulated prime movers. Water-wheels were employed as the moving power at the early establishments of Cromford, Belper, Matlock, Bakewell, Lanark, Cattran, Deanstone, &c.; and when the governor was afterwards applied to water-wheels by Strutt, at Belper, the motion and power were regulated with a degree of uniformity almost equal to that of the steam-engine, and water was rendered as perfect a moving power as its nature admitted of. Rennie, it is believed, first applied the descending shuttle, by which the flow of water is regulated over its upper edge, so as to obtain the full benefit of the fall, instead of passing under the shuttle as formerly, whereby some of the fall is lost. He improved the construction of the wheel, increased the width and diminished the depth of the buckets, at the same time augmenting the velocity of the periphery from 3 feet to 5 feet per second. By these means nearly 75 per cent. of the power was realised. Strutt's improvements in water-wheels, executed by Hewes, consist in making them with slender iron arms and oblique tie-rods, with segments of teeth on the circumference of the wheel, turning pinions with nearly the same velocity as cranks of steam-engines, and rendering them almost equally applicable. In this department Donkin and Fairbairn have also taken a conspicuous part.

The Turbine, or a modification of the horizontal water-wheel, by Fourneyron, has latterly been introduced into this country from France, with, it is said, considerable success. The governor had been applied to windmills by Hooper, in 1789, and soon after Watt adapted it to his rotative steam engine, which was thereby rendered applicable for turning mills, and its superiority to water, and every other power then known, became manifest. The uniformity and certainty of the movement, its capability of extension to any amount, its applicability to any situation, rendered its adoption almost universal, and extended the sphere of manufacturing operations from the weaver's cottage and the banks of the lonely stream, to large populous towns, such as Manchester, Leeds, Macclesfield, and other places, wherever circumstances, independent of water, were favourable for their adoption.

The concentration of manufacturing operations, caused a number of small machines to be substituted for those formerly impelled by hand in workmen's cottages, and brought together in large buildings adapted for that purpose, and worked by one great moving power, and so combined with each other and the building, as to render a spinning-mill, with its water-wheel, or steam engine, and all its accessories, one vast and complicated machine. A new school for mechanics was thus formed, in which far greater power than had ever before been applied to machinery, was to be distributed amongst a number of delicate machines of the greatest variety of form and complexity, with some parts minute like clock-work, requiring every gradation of force to drive them, and corresponding strength in some for resisting the largest and others the smallest impulse. A new and extended field of inquiry and observation was thereby produced, which brought forward artists of every description to contribute their aid, as to one common stock of knowledge, for the advancement of the new system of manufacturing, as well for the invention of new machines and processes, as for the multiplication and improvement of those previously invented. The ingenious and valuable labours of the great mechanicians of the last century have been most ably continued by their successors, many of whom are, or have been, our contemporaries, and who with a greatly extended sphere of application, have advanced in the career of improvement with an almost unparalleled rapidity.

Many new machines have been invented, and most of those in daily use have been rendered self-acting or automatical, so as to require no further aid from man, than the mere act of presenting the materials to them to be manufactured, directing their progress through the machine, and disposing of them afterwards. The power loom, invented by Cartwright, in 1784, was afterwards improved by Austin, Miller, Horrocks, M'Adam, Lane, Bowman, and others, and its employment greatly extended.

Rope Machinery.—Machinery for making ropes and cordage was invented by Cartwright, Grimshaw, Chapman, and others, and subsequently carried to great perfection by Huddart, as exhibited in the establishment of Turner, Huddart, and Co., at Limehouse. This ingenious and valuable invention consisted in regulating and adapting the lengths of the different yarns, or threads composing the rope, so that each might bear an equal strain, which could not be done on the old system. To effect this, a series of bobbins, with the proper lengths of yarns wound upon them, were placed in a frame of a crescent form, and the yarns from these bobbins were conducted through holes in a vertical guiding plate, having those holes arranged in concentric circles; from thence the yarns passed through a vessel of liquid tar or pitch, and then through a single hole of the required gauge, on to a large reel mounted in an oblong frame, to which a rotatory motion about a horizontal axis, was communicated for twisting all the yarns together into a strand, and also a circular motion of the reel at right angles to that of the frame, for winding the strand upon the reel, as fast as they were wound off the bobbins; a guide was attached which regulated the winding. The whole was worked by one of Watt's steam engines. By this beautifully-contrived piece of mechanism, the whole of the yarns were twisted into a strand of the required dimensions. The pitch and tar employed was used either cold or warm, and derived the appellation of warm or cold register cordage accordingly. The cables were formed by a larger machine, combining three of the above-described frames together, each having one of the strands to form the cable wound upon its reel; but the axes of the three frames, instead of being horizontal, as in the first case, were vertical, and all mounted in one large frame, which received a rotatory motion, about a vertical axis of its own, and carrying round the minor frames combined within it in order to twist the three strands together. The several strands were unwound from the reels, in the minor frames, as fast as the three were twisted together into the intended cable, which was drawn upwards between pairs of grooved rollers, disposed above the centre of the main frame, and the cable was conducted away by the same machinery and coiled up for use. Nothing could be more striking than the spectacle of one of these magnificent machines, resembling a great orrery in motion, pursuing its silent yet resistless course, producing the means of securing at anchor the gigantic vessel of war against the raging tempests of the ocean. This magnificent machinery, after returning a handsome reward to its ingenious inventor, and the enterprising capitalists who erected it, was bought by Government, and erected at the Royal Arsenal, Deptford. Chapman's rope machinery, and Curr's for making flat ropes, chiefly used for mines, as well as a new machine, lately introduced at Portsmouth from France, said to be the invention of Hubert, are worthy of notice.

Dyer's machines for making cards, for cotton and wool, and others for cutting nails; Wilkinson's, for making weavers' reeds; the self-acting mules of Eaton, Roberts, Smith, and others; those for weaving bobbin-net lace, by Heathcoat, Morley, and others; Holdsworth's, Dyer's, and other improved machines for preparing cotton rovings; Marshall's, P. Fairbairn's, and other machines for flax, are all ingenious and important inventions of self-acting machinery, well calculated to improve, expedite, and economise the manufacture of the various articles for which they were intended. Amongst the same class may be mentioned the curious inventions and improvements of Didot, Donkin, Fourdrinier, Dickinson, Crompton, Towgood, Ibotson, Kœnig, Nicholson, Tilloch, Congreve, Stanhope, Cowper, Applegath, Spottiswood, and others, for making and drying paper, and printing by steam; Oldham's various contrivances for printing bank-notes at the banks of England and Ireland; Lowry's, Maudslay's, Perkins's, and other machines for engraving on metal plates; Hollingdrake's method of casting copper under pressure, for engraving; Brunel's block machinery, executed by Maudslay, at Portsmouth, by which every operation is performed, from the sawing of the rough piece of wood until the perfect completion of the block for naval purposes; his saw-mills at Chatham and Woolwich; Bramah's planing machine at Woolwich; Wilkinson's machine for boring large cylinders, are splendid specimens of machinery; neither must we omit Watt's simple operation of making small leaden shot, by pouring melted lead through holes in a cullender at the top of a lofty tower, when they assume a spherical form in cooling, as they fall through the air, and finally into cold water below. Leaden bullets are compressed into a spherical form with great solidity by self-acting machines by Napier. The manufacture of crown and plate glass has been improved, and promises great extension; in this latter branch, Green, Pellatt, Chance, and others, are making great progress. The universal and widely extended application of machinery to every manufacturing operation rendered a corresponding activity and means of supplying the increased demand for it absolutely necessary; and additional means of making machines have been invented. Self-acting turning lathes, with slide rests, planing machines for metals, also for screwing bolts and nuts, were introduced by Fox; mortising machines, similar to those of Brunel, were adapted by Sharp and Roberts for metals, and shaping machines by Penn; these have been improved by Whitworth, Nasmyth, and others, by whom also new ones have been invented. The former has introduced an ingenious adaptation of machinery for sweeping roads and streets, and which, from its efficiency, is coming into general use; and to the latter we are indebted for the steam hammer and steam pile-driving machine, which serve materially to economise and facilitate these operations. Rennie, as far back as 1801, had applied steam for driving the piles of the coffer-dam for the London Docks; it has since been applied at Sunderland for a similar purpose, and he proposed it for working the cranes there as well as at the West India Docks; but it was not adopted. Otis' American machines for excavation have been tried, but are not as yet much employed. The invention and application of these various new and ingenious contrivances, furnished the means of executing machinery with a degree of economy and accuracy which without them could never have been attempted.

With the advancement of machinery, the art of founding in iron, which commenced at Carron, soon became an indispensable part of machine making. In this department Boulton and Watt took the lead, in consequence of the demands for their steam engine, and made great improvements in it, which were afterwards followed by Maudslay, and by others. The working in metals towards the commencement of this century thus became so much facilitated, that it was generally adopted, instead of wood, for the framing and moving parts of machinery; and castings in iron, of excellent quality, could be obtained in any number exactly like each other, so as to be fitted together with great facility. In the progress of modern improvements, wrought or forged iron came into more general use, and was substituted for cast iron in many cases, such as for railways, suspension bridges, tie beams, and roofs for buildings; various parts of steam engines, mill-work, and machines of different kinds, and in some instances steel has been adopted. As the improvement in machinery for manufacturing advanced, so did the arrangement, convenience, economy, and construction of the buildings in which it was contained; fire-proof arching for floors, with cast iron beams, wrought iron ties, cast iron columns, and wrought and cast iron framing for roofs, window frames, and every other part where the introduction of metal was practicable; in these improvements, Strutt, Rennie, and others, took a leading part. Apparatus for warming buildings by heated air was adopted by Strutt and Sylvester; and by steam, which had been employed by Smeaton, for drying gunpowder, was generally introduced by Snodgrass in 1798, and improved by Houldsworth and Creighton. This system has been more recently succeeded by that of heating the air by contact with pipes or vessels, in which a circulation is kept up, as practised by Price, Manby, Perkins, Haden, and others. These and many other improvements have been introduced, and combined in the most scientific manner in the great cotton-mills of Messrs. Phillips and Lee, M'Connell and Kennedy, Houldsworth, Birley, and numerous others, at Manchester; Messrs. Horrocks' at Preston, Strutt's at Belper, the flax-mills of Marshall, and the woollen-mills of Messrs. Gott, at Leeds, and of Wilkins near Bath, the silk-mills of Grote at Yarmouth, the lace-manufactories of Heathcoat at Tiverton, Boden and Morley at Derby, and Fisher at Nottingham, Cartwright and Warner's steam power stocking-weaving manufactory at Loughborough, and many other magnificent establishments all over the kingdom. The workshops of Fox, Nasmyth, Sharpe, Roberts, Whitworth, and others, for making tools; the steam engine and machine manufactories of Boulton and Watt, Fawcett, Bury, the Butterly Company, Stephenson, Hawthorn, Donkin, Hall, Fairbairn, Hick, Napier, Miller and Ravenhill, Maudslay and Field, Penn, Rennie, Seaward, &c., are a few of the vast establishments which abound, and which fill us with astonishment at the immense productive powers of this country; we are at a loss which to admire most, the genius and skill which has designed them, the energy and talent which directs them, or the capital which has brought them into operation. For accounts of many of the numerous branches of the immense manufacturing industry of Great Britain, we are indebted to Farey's articles in the Cyclopædia of Rees, the Encyclopædia of Brewster, and the Supplement to the Encyclopædia Britannica, also to those of Babbage and Barlow in the Encyclopædia Metropolitana, and likewise to Dr. Ure.

The improvement and extension of manufactures required a constant, active, and steady communication between the several districts where they were carried on, and soon produced a corresponding improvement in the roads, railways, canals, rivers, and ports. The cost of every article was reduced to the greatest nicety, and economy was carried to the minutest degree; being so intimately connected together, the extension of the one kept pace with the other. The same may be said of the arts of mining and metallurgy, by which coals for fuel and metals for manufactures are furnished to the different establishments.

Waterworks.

In the supply of that important necessary of life—water, which was so much studied by the ancients, but so greatly neglected in the middle ages, great progress has been made in modern times. Spring water was formerly conveyed to public reservoirs in the City of London, by leaden pipes from various springs in the vicinity: viz., from Tyburn in 1236, from Highbury in 1438, from Hackney in 1535, from Hampstead in 1543, and from Hoxton in 1546. For these useful works, the citizens were indebted to the munificence of several lord mayors and other individuals, but those of Hampstead and Highgate are the only ones now remaining. The open watercourse or conduit from Dartmoor, 24 miles long, for supplying Plymouth with water, commenced by Sir Francis Drake, in the reign of Elizabeth, and the New River, for the supply of London, 39 miles long, 28 feet wide, and 4 feet deep, falling 3 inches in a mile, by Sir Hugh Middleton, in 1613, are considerable works of the kind, and were planned and executed at the cost of those distinguished individuals. Middleton was, in fact, ruined by it, and adopted the profession of an engineer and surveyor to obtain a livelihood.

London Bridge Waterworks were commenced by Morice, in 1582, with water-wheels turned by the flood and ebb current of the Thames, passing through the purposely-contracted arches of Old London Bridge, and working pumps for the supply of water to the metropolis; it was the earliest example of public water service by pumps and mechanical power, which enabled water to be distributed in pipes to dwelling-houses. Previously, water had only been supplied to public cisterns, from whence it was conveyed, at great expense and inconvenience, in buckets and water-carts. In addition to the London Bridge and New River, several minor establishments of the same kind were afterwards erected on the banks of the Thames, to supply separate districts in their immediate vicinity. Some were worked by water-wheels on the sewers which discharged themselves into the Thames; others, by horses; and one by a wind-mill. That at Broken Wharf in 1594, at Shadwell and York Buildings, worked by horses, and at Chelsea by water-wheels, may be mentioned. Early in last century, when the old cisterns had nearly disappeared, and water was supplied to the dwellings, a great improvement took place, by the application of the steam engine (which had then begun to develope its extraordinary powers) to the York Buildings Waterworks by Savery, in 1710, and afterwards by Newcomen in 1730. Newcomen's engines were subsequently applied at Chelsea, Shadwell, Stratford, London Bridge, and the New River Waterworks. As soon as Watt had brought his improvements into operation for pumping water, his engines were applied at each of the above waterworks by degrees, in addition to the old engines, thus a comparison between them could easily be made; and soon showed the superiority of Watt's engine in every respect. They were thus applied at Shadwell and Chelsea Waterworks in 1778, at London Bridge and Lambeth soon after, and at the York Buildings in 1804. The usual mode for the old engines was to pump the water into a cistern, at the top of a high tower, and from thence it descended through pipes, to the districts and buildings where it was required; the engine was thus always kept to its full load, whether necessary or not, and a waste of power ensued. Air-vessels were afterwards added to the pumps at Chelsea, and subsequently became general; the air in the vessels being compressed, acted by expansion and contraction on the water, so as to force it with regularity through the pipes, without going up to the cistern. Smeaton, who had constructed water-wheels for pumping at Stratford in 1763, and at London Bridge in 1767, where towers were employed, afterwards became the principal proprietor of the Deptford Waterworks, and in 1773 constructed a water-wheel for pumping water from the Ravensbourne without a tower. The machine is still in existence, although steam engines have been subsequently applied. About 1810, Boulton and Watt's improved pumping-engines, constructed wholly of metal, and erected in handsome substantial buildings of brick and stone, with large air-vessels for pumping direct into the pipes, became generally adopted at all the London waterworks; cast iron pipes were substituted for the old ones of wood. The new engines being more powerful, and the cast iron pipes stronger, enabled water to be distributed to cisterns on the tops of dwelling-houses, hence denominated the high service. Stone pipes were tried at the Grand Junction Waterworks, but failed, and iron pipes were substituted. Filtering reservoirs upon a large scale were constructed at Chelsea by Simpson in 1830, and subsequently at other places, with complete success, and are now universally employed. The water is now generally taken from the Thames above the town, where it is least adulterated. The old waterworks lower down the river, viz., York Buildings, London Bridge, the Borough, and Shadwell, have been abandoned, and new places chosen at Hammersmith and Brentford, higher up the river, and at Old Ford upon the river Lea; the river water is received into capacious settling, or filtering reservoirs, and distributed by steam engines to the respective districts. Latterly, powerful condensing steam engines, very similar to Watt's, but worked by high-pressure steam with great expansive action, on the system introduced by Woolf, in Cornwall, for deep mines, were introduced by Wickstead, in 1840, at the East London Waterworks,[1] and have since been adopted by other Companies with advantage in saving fuel. The double cylinder high-pressure condensing engine, with great expansive action, on the system of Hornblower, have also been introduced by Woolf, Hall, and Rennie, and applied to work mills with success. Waterworks, similar to those in the metropolis, have been erected at Edinburgh, Glasgow, Dublin, Manchester, Liverpool, and all the principal towns in the kingdom. At Glasgow, one of the last engineering efforts of Watt was to suggest the idea of laying a pipe under the Clyde, to bring water to the city from the opposite side of the river; this was to have been effected by making the pipe with flexible ball and socket joints, uniting the whole together in one piece, and closing it at each end, floating it to its position, and sinking it.[2] Rennie effected a similar operation at York Buildings in 1810. The increased means for the supply of water, and the economy and punctuality with which it is distributed, has occasioned a greater consumption, and induced a degree of cleanliness throughout all classes, which has tended to augment the comfort and health of the community. Still the system is capable of improvement: larger reservoirs and more copious supplies are necessary.

Artesian Wells, which appear to have been known to the ancients, and have been common in France and Italy, were introduced into this country about the year 1790, it is said, by Vulliamy, near London. The system consists in boring holes or wells through the superincumbent strata, impervious to water, until they reach the porous strata where water abounds, the pressure then acting according to the level from whence the water is derived, forces it upwards through the holes, frequently to some height above the surface; these have since been multiplied all over the kingdom during the present century, and latterly in Trafalgar-square,[3] for supplying the first public fountains which have been erected in the metropolis. These fountains, though upon a small scale, are a beginning; and it may be hoped that this example will be generally followed for the ornament of this great city; which, although perhaps the best supplied with water in the world, has not been adorned with fountains, which are so general, and are constructed upon such a grand scale at Paris,[4] Rome, and almost all the other great cities in Europe, adding so much to their magnificence and salubrity. In carrying out the improvements above mentioned for the supply of water, the names of Smeaton, Watt, Mylne, Rennie, Telford, Simpson, Bateman, Anderson, Clark, Wickstead, Walker, Martin, and others, must not be forgotten; and we shall no doubt witness efforts upon a still greater scale in future. Projects for bringing a large supply from the Thames, above Windsor, by Rennie; also from the Colne and Wandle, and Darenth, and elsewhere, by Telford, Rennie, and others, have long been in agitation, and sooner or later may be effected with advantage to the metropolis.

[1] See C. E. and A. Journal, Vol. 3, 1840, p. 65. [2] Vol. 2, 1839, p. 451. [3] & [4] Vol. 8, 1845, p. 133.

Sewage.

Connected with the supply of water for domestic purposes, we must not omit the important subject of sewage, or surface drainage, upon the due operation of which the health of the community so much depends. Sewers appear to have attracted notice at an early period, and during the reign of Henry VIII. commissioners were appointed with extensive powers to levy rates for, and to see them properly carried into effect; but until under ground or covered sewers were adopted, all the surface water from the adjacent hills and country, as well as the refuse from the buildings, was discharged into open ditches and street gutters, which, passing through the centre of the town, accumulated, and occasionally remaining stagnant for a considerable period, produced a degree of effluvia and malaria extremely prejudicial to the health of the inhabitants. This was remedied to a certain extent, by covering over the open drains; but the bottom of these were not low enough, and the want of surface drains continued. By degrees, covered sewers, of enlarged capacity, entirely of brickwork, were introduced; the importance of the subject then became duly appreciated and studied; sewers were laid out upon a general and enlarged system; main, subsidiary, and surface drains, and cesspools of a proper form, construction, and capacity, adapted to each other, and to the several districts they were to drain, were designed, and, in many cases, carried into effect. The subject is still under consideration, and improvements are being daily effected, although much still remains to be done in the form, capacity, inclination, distribution, and arrangement of sewers, not only in the metropolis,* but in almost all the principal towns of the kingdom, before the system can be said to be complete. The removal of Old London Bridge, by which a fall of about 5 feet at low water has been gained, has been of immense advantage in improving the drainage of the metropolis; and it only remains for this great improvement to be carried out further, by removing the shoals and regulating the high and low water channel of the river, by dredging and other means, but to be cautious in contracting the width. It is greatly to be desired that this important work should be speedily carried into effect, upon a general scientific system, which, if properly done, would confer the greatest benefits upon the extensive and populous districts, draining into and bordering upon the Thames, as well as the navigation of this noble river, upon the proper maintenance of which the immense commerce, health, and prosperity of this great metropolis, and its adjoining populous vicinity, depends. In the improvements of sewerage, Cubitt, Barry, Donaldson, Gwilt, Hardwick, Nash, Smirke, Soane, Walker, Rennie, Roe, and others, have been conspicuous.

Gas.

It is difficult to point out with accuracy the date of the invention and introduction of that invaluable substitute for daylight, or artificial lighting, carburetted hydrogen gas. It is generally believed, however, that it may be attributed to William Murdoch, soon after he succeeded to the management of Boulton and Watt's steam engine works at Soho, although the inflammable properties of that gas had been long known. Murdoch's first apparatus was erected at Soho, and he successfully illuminated that establishment with it in 1802, in celebration of the Peace of Amiens; he afterwards constructed similar apparatus on a large scale at Leeds, for lighting Messrs. Gotts' woollen manufactory, and for Messrs. Philips and Lee, at Manchester, and published an account of it in the "Philosophical Transactions" for 1808. Clegg, who was brought up at Soho, also published an account of it in the "Transactions of the Society of Arts" in the same year. It was subsequently, by degrees, introduced into several large manufactories in Lancashire; Winsor afterwards exhibited it in Pall Mall, where it excited a good deal of attention; but the general application of gas for lighting towns was for some time retarded, in consequence of the failure of several attempts by inexperienced persons, which prejudiced the public against it, so that it was not until the year 1813, that apparatus of efficient and proper construction was made, and erected in London by Clegg, Farey, and Manby, upon the same principle as originally introduced by Murdoch. The employment of gas for lighting towns and buildings has now become almost universal here as well as on the Continent. It is manufactured by distillation from coal in cast iron or clay retorts, and collected in immense gasometers, some of them 100 feet diameter, 44 feet deep, and capable of containing 390,000 cubic feet; thence it is distributed through cast and wrought iron pipes, under properly regulated pressure, many miles from the place where it is made; and self-acting meters, invented by Clegg, are applied at each building and district, in order to ascertain the amount consumed. It is purified by lime, sulphuric acid, &c., and its brilliancy is augmented by naphtha. In the various contrivances and details of the apparatus, and in the processes for manufacturing it, as well as in the economy of management, many improvements have been made by Clegg, Lowe, Manby, Philips, Croll, Crosly, Hedley, Edge, and others. When we compare the present mode of lighting towns and public buildings with gas, with the old system of oil lighting thirty years ago (even allowing that to have been a vast improvement upon the custom of our ancestors), we are astonished at the amelioration, and can scarcely comprehend how we could have gone on so

* There are nearly 500 miles of covered sewers in the metropolis.

long without it. Thus we find that the general adoption of every great improvement creates a refinement and fastidiousness of taste which stimulates others, so that we can no longer tolerate those imperfections which in a less advanced state of civilisation were passed over unnoticed. The introduction of oil gas by John Taylor, and by Taylor and Martineau; Gordon's system of condensing into close vessels for rendering it portable; and resin gas by Daniell, must not be forgotten, on account of the superior light produced from those substances, although it has been superseded by the more economical coal gas, and when naphthalized on Lowe's plan, its light appears so pure as scarcely to be susceptible of improvement. Gas for lighting on an extensive scale was introduced into France by Manby in 1820, and has since become general on the Continent. The use of gas-light in private dwelling-houses is gradually extending, and as the objections of smoke, bad smell, and risk of explosion, are fast disappearing before the exertions of the modern improvers, it will become more general; the ingenious contrivance of Faraday, conveying away by pipes all the products of combustion, is worthy of notice.[1] Clark and M'Neil's, and other burners, which insure more perfect combustion, are decided improvements.

The employment of gas for Lighthouses promises important results; for there, almost any reasonable degree of cost and trouble in perfecting the light, so that it may be rendered more distinctly visible at greater distances at sea, will be amply repaid; in this class may be mentioned with praise the oxy-hydrogen light of Drummond, and the Bude light by Gurney. Latterly, the catoptric and dioptric system of Fresnel, which consists in an ingenious and scientific construction of the lenses, and an adaptation of the compound argand burners to suit them, has been introduced into several of our light-houses with advantage, but further experience is necessary to decide which is the best,—the system of Fresnel above mentioned, or the old argand system with the parabolic polished silver reflectors; both plans have been well executed by Wilkins and by Deville.

In the construction of Lighthouses since Smeaton, Messrs. Stevenson's and Walker have done much, and recently Gordon's cast-iron Lighthouses[2] appear, for certain situations, to merit attention.

ROADS.

In proportion as the wealth and commerce of the country increased in the latter half of the last century, so it became absolutely necessary to improve the communication by roads and wheel-carriages, between all the different towns and districts of the empire, for supplying them with provisions, fuel, and the necessaries and luxuries of life, with greater facility and economy, as well as for expediting commercial and general intercourse, in fact, the one followed as the necessary consequence of the other, and the public seeing and feeling the beneficial effects of what had been effected, and convinced of the practicability and advantage of proceeding further in the cause of improvement, would not rest satisfied until those improvements were made; accordingly, the improvements of roads attracted general attention. Originally, roads were mere footpaths, or horse tracks, across the country, in the most convenient and shortest direction between the desired places, but wholly unadapted for wheeled carriages; by degrees they became practicable for the rude carriages of the times, and were maintained in a very defective state by local taxes on the counties or parishes in which they were situated; nevertheless, nothing in the way of effectual improvement was attempted, until turnpike trusts were established by law, for raising or levying tolls or taxes from persons travelling upon the roads. Several Acts of Parliament for these trusts were passed previous to 1765, but in the early part of the reign of George III. many more were passed, notwithstanding violent opposition was made to the tolls. They subsequently became general, and penalties were recoverable at common law, against the trustees, for not keeping the roads in proper repair; a long period, however, elapsed before any good system of road-making was established. The old old crooked horse tracks were generally followed, with a few deviations to render them easy; the deep ruts were filled with any materials which could be obtained nearest at hand, and were thrown upon them in irregular masses, and roughly spread to make them passable: the best of these roads would in our time be declared intolerable. Road-making as a profession was unknown, and scarcely dreamt of, and the parties employed to make and keep the roads in repair were ignorant and incompetent to do their duties; but inasmuch as travelling was uncommon, and the funds at the command of the trustees were scanty, we cannot be much surprised at it, as they could not command higher talent. Engineers, except in cases of great difficulty, such as making a bridge over a deep and rapid river, cutting through a hill, or embanking across a valley, where more than ordinary skill was required, considered road-making beneath their consideration, and it was even thought singular, that Smeaton should have condescended to make a road across the valley of the Trent, between Markham and Newark, in 1768. The great activity and prosperity, however, which resulted from the modern manufacturing system, convinced people of the value of time, and that easier and more rapid means of communication than the old roads permitted were required; hence, the acclivities were partially reduced by cutting down the hills and raising the intervening valleys; improved bridges were built with easier ascents, and in some cases cuts were made to shorten the distance; still, however, the general line of the old road was preserved. The roads were certainly improved by these means, but still there was no general system; they were parcelled out into small districts under separate trustees, without any common concert or harmony in working together, and but little effectual progress was made. The importance of forming good roads was but imperfectly understood, the legislation connected with it was equally short-sighted, and many of the improvements in cutting down hills and levelling valleys were frequently repeated, from want of proper skill and foresight at first. The rebellions in Scotland, in 1715 and 1745, induced the government of that day to turn their attention to the subject, and several roads were constructed by military engineers for military purposes.

Telford, previous to his being employed to construct the Caledonian Canal, had turned his attention to road-making, and was appointed by the government to lay out new lines of road, both for the purpose of employing the then poor and thinly scattered population of the Highlands, as well as to improve the districts by more general intercourse with the rest of the kingdom; he evinced a skill and knowledge which had not hitherto been bestowed on this important subject, but which was afterwards developed upon a greater scale in Ireland, and lastly in England, in his great works, the Holyhead, Liverpool, and Great North Roads, formed in consequence of the increased communication with Ireland after the Union, and which were excellent models for roads throughout the kingdom. Telford set out the roads according to the wants of the district through which they were made, as well as with a view to more distant communication, and the acclivities were so laid out, that horses could work with the greatest effect for drawing carriages at rapid rates. The road was formed by a substratum of large stones, with sufficient interstices between them for drainage; the materials laid on this foundation were hard and angular, broken into small pieces, decreasing in size towards the top, until they formed a fine hard surface, whereon the carriage-wheels could run with as little resistance as possible. The transverse section of the road had no greater convexity or rise, than was sufficient to cause the water to run steadily into the side-drainage channels; by this means, the carriages not being inclined laterally, the weight was more equally divided on the wheels, whereby they moved more easily and with the least wear and tear of the roads. The surface of the road was always kept even and clean, by the addition of proper fresh materials where necessary, and distributed equally in thin layers immediately after rain, in order that the new materials might bind and incorporate properly with the old. Telford's system was afterwards extended by his assistant, Macneill, and is fully described by our late honorary member, Sir Henry Parnell, afterwards Lord Congleton, who, by his perseverance and support of Telford, mainly contributed to its extension and success. About the year 1816, M'Adam introduced his system, and brought it into general use in the vicinity of Bristol. It resembled in some respects that of Telford, but differing from it by making no foundation in the first instance; it consisted in simply laying a stratum of flints, or other hard materials, 10 or 11 inches thick, broken equally into small pieces about two inches diameter, and spread equally over the intended road; this soon became so consolidated together by carriages passing over it, that they could travel with great facility and expedition. The section and the mode of applying fresh materials and keeping it clean, resembled that of Telford. M'Adam, professing to be a road-maker only, devoted his whole time and attention to the propagation of his system, which was greatly superior to the old, and became very generally adopted. Its introduction and extension was in a great degree due to our honorary member, the Earl of Lonsdale, who is ever alive to improvement; and to his lordship's exertions we are indebted for the present system of metropolitan roads, which has proved of great advantage to the public.

Carriages.—The great improvement in roads, which was accompanied by a corresponding improvement in the carriages and breed of horses, produced an extent of travelling commensurate with the increased facilities afforded. Coaches were first introduced into England in 1580, about the time of Elizabeth. Public, or hackney-coaches, were only established in London in 1625; and stage or public travelling coaches, not until a much later period: in fact, there were few roads upon which they could pass; and for fear of being robbed by highwaymen, or of being overturned or stuck fast in the mire, and other accidents of the road, they seldom or ever travelled during the night. In 1666 (the year of the Fire of London), a coach was established, which travelled between London and Oxford in two days; and another, called the Flying Coach, afterwards started to perform the journey in thirteen successive hours, or at the rate of 4 miles an hour, but only ran during the summer months. The journey between London and Edinburgh by stage coach, which was begun in 1712, took thirteen days to perform the journey: in fact, so great was the difficulty and danger of travelling, that, before setting out on a long journey, people made their wills, as if they never expected to reach their homes again. After the roads had become sufficiently improved, mail-coaches, upon an improved construction, to carry passengers and letters, were first introduced by Palmer in 1784, and the journey between London and Edinburgh was reduced to three days and nights by this conveyance. At the first appearance of this extraordinary novelty, the inhabitants of the rural districts crowded the roadside to see the royal vehicle, with its gaily apparelled horses and scarlet liveried coachmen and guards, galloping by at the accelerated speed of 7 or 8 miles an hour; but, when it was increased to 10 and 11 miles an hour, by further improvements in the roads, carriages, and axles, by Vidler, Collinge, and others, ameliorating the breed of horses, and shortening the stages, and the distance between London and Edinburgh was performed in 42 hours, it was considered that this could not be exceeded—and so far it was true; for animal strength and endur-

[1] See C. E. & A. Journal, Vol. 6, 1843, p. 196. [2] Vol. 4, 1841, p. 388.

ance had reached its utmost limits, and, if any improvement was to be obtained, it was requisite to obtain it from a different source. In the race of improvement, the stage coaches were not behind the mails; and we have only to mention the Brighton, Oxford, Cambridge, Southampton, Shrewsbury, and other coaches, to prove that the system was carried to the highest degree of perfection of which it was capable.* In 1821 there were 24,581 miles of turnpike roads in England and Scotland, and 8,000 miles in Ireland; and since that time they have much increased.

Paving.—When the turnpike-road system was introduced, the pavement of the metropolis was improved by the substitution of square blocks of granite, in place of the rounded boulders, or large irregular pebbles, which had been previously used. Blocks of granite of various dimensions, have, by way of experiment, been laid on concrete, with the joints grouted with lime and sand, in order to insure the greatest stability amongst the blocks. M'Adam's system was introduced in some streets where the traffic was light, but it did not equal the granite paving. Wood blocks in different forms, hexagonal prisms, or cubes, or rhomboids, with the grain placed vertically, or nearly so, have been introduced for paving, the blocks being either connected by wooden pegs, or merely laid upon a bed of concrete. This system was borrowed from Russia, and patents have been taken out by Stead, in 1839, and many others, for different forms of the blocks; it has the advantage of diminished noise and friction, but its great defect is that of being dangerously slippery in particular states of damp weather, and it appears in consequence likely to be abandoned. Asphalte, a natural brittle, bituminous substance, found in volcanic districts, was introduced from France for foot pavements, in 1836; it is brought to a semi-liquid state by heat, then mixed with sand and gravel, and spread over a bed of concrete, and when cold, forms a compact and durable pavement. Flats, or flat gritstone paving-blocks have been used in larger blocks, and better laid, so that paving has been improved; the great difficulty, however, in keeping it in order in London and great towns, is occasioned by its being constantly broken up, to lay and repair the numerous gas and water-pipes; and it is desirable that separate tunnels or subways should be employed for receiving them, as was suggested by Williams and others, a few years since.

* The transport of goods was equally defective as to speed, and was comparatively as costly as that of passengers; at times, goods were from four to five weeks, and seldom less than thirty-six hours in going from Liverpool to Manchester, at a cost of forty shillings per ton; whereas at present they are conveyed in three or four hours, for three shillings per ton.

(To be continued.)

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

SOCIETY OF ARTS, LONDON.

February 3.—W. F. Cooke, Esq., V.P., in the Chair.

Mr. Digby Wyatt read an Essay *"On the Art of Mosaic, Ancient and Modern."*—The author commenced by stating that the most cursory glance at the subject must convince that this art, taking the form of either pavement or mural decoration, has been connected with most of the noblest efforts of architectural genius at all ages; and as it is the wish of many at the present time to effect the revival of this art, he would endeavour to convey as clear an idea as possible of the nature, history, and condition of this graceful handmaid to the science of decoration.—The first positive notice of the existence of such an art occurs in the 6th verse of the first Chapter of the Book of Esther, wherein an account of the riches and luxury of the Palace of Ahasuerus is mentioned, and that passage clearly establishes the fact that the Persians were acquainted with the art, and it is supposed communicated it to the Greeks, from whom the Romans obtained their first specimens. Ciampini divides the art into four principal varieties, called tesselatum, sectile, figlinum, and vermiculatum. The first, the opus tesselatum, probably the most ancient; this kind of mosaic consisted of small cubes of marble, seldom averaging more than ⅜ of an inch square; the best specimens of this description of tessela occur at Pompeii, in the Vatican. The second division of the art, the opus sectile, was also applied to pavements, and it is in this description of mosaic that the simple yet magnificent pavement of the Pantheon at Rome is executed. This variety of mosaic was formed of thin slices of different coloured marbles, cut into slabs of a given form. The opus figlinum was more generally employed in mural decoration, and according to Pliny, was first used in the decoration of the baths of Agrippa, behind the Pantheon; it consisted of figures, fruits, ornaments, &c., by means of small cubes of vitreous composition, composed of allumine and some metallic oxide to colour it. No specimen of this description of mosaic has ever been discovered in England. The fourth description of mosaic, or opus vermiculum, is subdivided by Ciampini into three varieties. The opus major generally employed in large pavements or ceilings, to represent the figures of gods, centaurs, &c. The opus medium was a much finer kind of work, and was generally applicable to walls. The third division, opus minor or opus vermiculatim, was the finest and most elaborate of all the ancient Roman mosaics, and consisted of the most delicate patterns, formed entirely by mosaic pieces of marble and fictile work, many of the stripes being only the 20th of an inch across. The most beautiful specimen that has been presented to us is the one usually known by the name of Pliny's doves (a copy of which in mosaics was exhibited). There is one kind of mosaic which the author has observed in Pompeii, and which he considers may not be inaptly termed the opus uncertain of mosaics, composed of all sorts and kinds of marbles put together in singular shapes, and when united into a mass with cement and laid on the floor prepared to receive it, it is reduced to a polished face by friction. In completing the sketch of this art under the Romans, the author stated that the preparation ordinarily made by them for the reception of the mosaics, consisted in their first placing a layer of large stones or flints, but with very little cement, on the ground; upon this was placed a course of concrete composed of smaller stones and lime beaten and rammed with great care; upon this a third layer of cement was placed, the tessaræ or mosaic were then placed, and over the whole was poured liquid cement, to perfectly fill up the interstices between the cubes.—During the reigns of the twelve Cæsars this art rose to an unexampled popularity; during the reign of Hadrian, (A.D. 138) to that of Caracalla, the arts appears to have lost in quality; after the year 220 it became obscured by the clouds which swept the Roman empire.

From the time of Constantine three varieties arose, which obtained universally in Italy from the 4th to the 14th century, and during nearly 1000 years changed but little either in principle or design. The Emperor Alexander Severus (A.D. 222 to 235) brought with him from Alexandria great quantities of porphiry and sepentine, which he caused to be worked into small squares and triangles, and variously combined, thereby laying the foundation of this art which formed the pavement of all the rich Italian churches. We have an interesting specimen in Westminster Abbey referred to the year 1260.

The author, after tracing the history to its decline, and giving some account of the encaustic tiles, proceeded to state the circumstances which had of late years led to its partial revival; he also gave a detailed description of the processes of manufacture employed by Messrs. Singer and Pether, and Messrs. Minton and Co., and concluded by urging on architects and the public generally the applicability of the manufacture to the purposes of decoration.

The meeting adjourned after passing a unanimous vote of thanks to Mr. Wyatt for his communication.—The rooms were filled with beautiful specimens of ancient and modern works of art in mosaic. There were some fine Florentine mosaics contributed by Mr. Brown; modern glass mosaics of exquisite workmanship executed by Mr. Pether and Mr. Singer; encaustic tiles by Mr. Blashfield; mosaic tesseræ by Messrs. Minton; and a large collection of elaborate coloured drawings contributed by Mr. Blashfield, Mr. Wyatt, and Mr. Owen Jones.

ROYAL SCOTTISH SOCIETY OF ARTS.

Jan. 25.—David Maclagan, M.D., F.R.S.E., President, in the Chair.

The following communications were made:—

"Description of Pottery made by the Ojibbeway Indians, with an account of a Chemical Analysis of fragments of it." By John Macadam, Esq.

The Pottery exhibited before the Society, and referred to in Mr. Macadam's paper, was obtained from the neighbourhood of Peterborough, Canada West. It is of a brownish black colour, the outer surface being reddish It is exceedingly hard and difficult to fracture. The vessel is ornamented around the edges with a design evidently copied from nature, and somewhat resembling a pinnate leaf, besides which the surface is almost totally covered with a scratched-like net-work; indeed, the design as a whole resembles much that which exists on the pottery occasionally found in the Druidical tumuli of our own country. There are small crystal-like particles distributed throughout its mass, which vary in size from one-fiftieth to one-twentieth of an inch in diameter. These particles are pure silica, and were probably obtained by pulverising quartz or some other natural variety of silicic acid. The pottery also contains organic matter to a considerable extent, which is of vegetable origin, and was added, no doubt, to this with the same intention as straw was added to the Babylonian and Egyptian varieties of sun-burnt pottery, viz., for the purpose of increasing the adhesiveness of the particles. A portion of the pottery submitted to chemical analysis gave the following results:—

Water	1·86
Organic matter	5·92
Silicic acid	64·80
Sesqui-oxide of iron	14·80
Alumina	9·95
Lime	4·39
Magnesia	1·43
Potash and Soda	traces.

The amount of oxide of iron stated is rather high, as the iron present, though calculated as the sesqui-oxide, does not exist as such in the pottery, but is there, almost totally, as the protoxide, except in those parts of the pottery which possesses a red colour.

From the results of the investigation made on this interesting piece of manufacture, some conclusions were drawn to the following effect:—First, that the pottery had probably not been made by the use of any one material found native, but was manufactured from a mixture of pulverised silica, ferruginous clay, and organic matter; secondly, that the heat employed for baking the pottery, when made, was one of no high temperature, as, had it been so, the protoxide of iron would have been thereby converted into the sesqui-oxide; and, moreover, all the organic matter would have been destroyed. The red appearance on the outside of the vessel indicated its having been baked at a common wood or other fire, the influence of which being in contact only with the outer surface, had confined its chemical action to that part.

Description and Drawing of a Sluice made by Mr. James Macdonald. The sluices commonly in use are raised from the bottom, thereby causing a rush of water, which injures the puddle of the pond, or aqueduct, and are raised and shut with difficulty. Those of a better construction are expensive, and can only be made by skilful persons. This sluice can be made by any carpenter, never disturbs the puddle, and may be made of any size and strength by increasing its proportions. The coarsest undressed timber may be used, except the edges of the planks and their ends, where they fit into the frame. A strong frame of wood is built into the sides of the water way, tapering from the bottom, where it is narrowest, to the top. Planks are let in, one above another, to the required height; and if it be wished to increase or diminish the height of water in the pond, it is only necessary to put in, or to remove a plank at the top; the water thus always escaping from the top of the sluice in place of from the bottom.

Feb. 8.—George Tait, Esq., V.P., in the Chair.

The following communications were made:—

Description of Four Portable Apparatus for Inhaling the Vapour of Sulphuric Ether; with some remarks on its effects, so far as they have been observed in this early stage of its application, as an anodyne to relieve the pain of surgical operations.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

Feb. 8.— Bellamy, Esq., in the Chair.

A paper on "*the Interior forms of Buildings with reference to the Laws of Sound,*" by Mr. Scott Russell, was read.—Mr. Russell, in commencing his remarks, said, in excuse for interfering with what might be considered not his province, that although extreme division of labour might, and did, carry science forward, yet, by confining particular departments to classes, it induced narrow views. He thought much good resulted from the professors of different sciences mixing together and interchanging opinions. It was difficult to excel in more than one, still there were many examples of those who had done so,—as Michael Angelo, Leonardo da Vinci, and others. If in anything extra-professional aid was needed by architects, it was in the arrangement of buildings with reference to the transmission of sound, where all were avowedly at fault. All architects admitted that nothing was more difficult. Mathematicians, when applied to, gave widely different forms as the best. Even an ear-trumpet was no better made by the most profound mathematician than by the merest rule of thumb; and if it were so difficult to arrange an instrument by which sound might, with every advantage, be conveyed to one individual, how much more so must it be to arrange a room so that every one in it might hear what was said. The problem was to enable 1 or 1,000 to hear equally well. The waves of sound were generally thought to be like the waves of water: he had been led to investigate the latter, and, in so doing, had arrived at some conclusions not generally entertained. He proposed to divide the subject into five parts. The first principle to be mentioned was this, that sound travels in straight lines: light and sound are the same in this respect. Sound does not easily go round a corner; and this should be remembered in arranging buildings. The question was how to make the greatest number hear and see well. In the theatre of the Royal Institution in Albemarle-street this had been successfully worked out: he thought that from every seat in it the lecturer could be most distinctly seen and heard. This was arranged by Count Rumford and Sir Humphrey Davy. The human voice, the lecturer remarked, could be heard 500 feet with ease; and he believed that a building might be arranged to seat 20,000 persons where all would hear: the fact that Wesley, preaching in a natural amphitheatre of hills, was heard by that number of persons, justified his opinion. He had noticed that a reader in the choir of Canterbury cathedral could be heard 200 feet off distinctly, and afterwards making the experiment himself with a friend, had found that he could be heard that distance when he spoke in a clear whisper.

Mr. Russell then proceeded to explain a curve which he had discovered, and recommended for the sectional arrangement of the seats, and the mode of obtaining it, but which we find it difficult to convey without diagrams. It was first necessary to fix the position of the speaker, and to decide how much of the voice and sight of the speaker each auditor should have; he thought an area 18 inches high and 3 feet broad sufficient. Drawing then a series of radial lines from the mouth of the lecturer to points decided by these dimensions, a curve was obtained for the rise of the seats, which was found in practice of good effect.

The second principle he would allude to was the spontaneous oscillation of air in a chamber, which was the source of much trouble, but might be turned to good account. A long chamber of air, if caused to oscillate, continued to do so, and would produce a tone depending on the length, as in an organ-pipe. Thus a gallery, 64 feet long, would produce the note C; and if 32 feet long, it would be an octave higher. Every chamber, in short, has a voice. A speaker should find out the key-note of the room, and speak in it if possible. This fact opened the question whether we could improve rooms for hearing by attention to the dimensions and proportions. Length, breadth, and height should be in harmonious proportions, or the sounds produced would jar. There was a more intimate connection between music and architecture than is now generally admitted. Simple multiples for the proportions were desirable; as, for example, 48 feet long, 24 feet wide, and 16 feet high, and so on. Incongruous sounds, he said, neutralise each other, and produce dead points, or points where the speaker could not be heard. Care was necessary in this respect. Harmonious arrangement of an apartment might sometimes be obtained by means of pilasters, or partition with doors. The choirs of our cathedrals usually approximated to simple multiples in their proportions, and bore out his view, he thought, by their effects. Incongruous forms made the worst apartments for hearing. The lecturer was then proceeding to speak of the third division of his subject, reflection of sound, but was invited to postpone the consideration of it till the next meeting.

Feb. 22.—S. Angell, Esq., V.P., in the Chair.

The following Report of the Council on the Designs and Essays submitted for medals was read:—

Report of the Council to the General Meeting of the Members on the Designs offered in competition for the Royal Medal of the Institute, for the Soane Medallion, and on the Essays submitted for the Medals of the Institute for the year 1846:—

The Council have to report that for the Royal Medal, the subject being a building suitable for the purposes of the Royal Institute of British Architects, eleven designs have been received. They deem it proper in the first instance to advert to the printed conditions prepared for the guidance of the competitors, and which were issued in May last.

Her Majesty the Queen having been graciously pleased to grant to the Institute an annual medal for the promotion of architecture, it has been resolved, that it shall be applied to the encouragement of the junior members of the profession by a competition in designs, composed in a style calculated to promote the study of Grecian, Roman, and Italian architecture, and further, that the designs shall be judged of, not only with reference to their merits as works of art, but likewise as to the knowledge of construction they may exhibit.

In order to secure, as far as possible, uniformity in the conditions under which the designs are submitted in competition for the Royal Medal, it has been determined that the age of the competitor shall be limited to twenty-five years, and that with this limitation the competition shall be open to the profession in general.

The successful competitor will be further intitled to draw upon the Treasurer of the Institute for the sum of £50 after his arrival in Rome in the pursuit of his professional studies, at any period within five years from the time of the medal having been awarded to him, upon sending to the Institute a satisfactory study of some existing building, either ancient or modern.

The Royal gold Medal for the year 1846, will be awarded to the best design for a building suitable to the purposes of the Royal Institute of British Architects; comprising a room for general meetings and lectures, with seats for 350 persons, arranged with a view to the reading of papers, the exhibition of drawings and diagrams explanatory thereof, and for facility of discussion; a council room for twenty-five members; a library for 10,000 volumes, with suitable depositories for drawings, prints, medals, &c.; a gallery for models, casts, fragments, &c.; an exhibition room for architectural subjects, and suitable residences for a secretary and a curator.

The cost of the building not to exceed £20,000.

The design to comprise not less than one plan of each story,—two elevations, two sections, and a perspective view.

The scale of the drawings to be one-eighth of an inch to the foot, and to be tinted with Indian ink or sepia only.

The Council will not consider themselves called upon to adjudge the medal, unless the designs and drawings be of sufficient merit to deserve that distinction.

In detailing thus minutely the accommodation to be provided in the building, to render it suitable for the purposes specified, and by fixing a limit to the proposed expenditure, it was obviously intended by the Institute to impress the candidates with a feeling that in forming their designs they were expected to treat the subject practically, and direct their efforts to the production of a design adapted to the requirements of an existing working Institution.

They observe, with much regret, that the well considered and clearly expressed conditions of the Institute have been almost entirely disregarded, and that in consequence of the uncalled for magnitude of the rooms, halls, staircases, and other approaches, together with the lavish and injudicious introduction of columnar and other extraneous decoration, (in some instances actually unfitting the rooms for the purposes demanded), not more than one of the designs, possessing the slightest pretension to consideration as an architectural composition, could be properly executed for less than *double the sum specified.*

When the Council reflect on the enormous amount of injury occasioned to the public and to the profession, from competitors so frequently disregarding the conditions given with respect to the proposed expense of an intended structure, and consequently presenting designs of much higher pretension than could be produced with an honest and conscientious adherence thereto. And when they likewise reflect on the strong reprobation the Institute has had occasion more than once to express on this most irregular and improper practice, they feel that it would ill become the Council to recommend to their fellow-members of the Institute to countenance such dereliction from honourable professional practice, even in a competition like the present one, where the public interests are not directly affected. The fact being so apparent, entirely precludes the Council from recommending to the members of the Institute the awarding of the Royal Medal to either of the designs presented this year.

They regret to be compelled, on grounds which they consider too important to be disregarded, to come to this decision, especially on the first occasion of a competition for so high a distinction as the Royal Medal, and the more so, since the design marked "Quanto rectius hic qui nil molitur inepte," possesses a high degree of merit, and displays much taste and artistic talent.

The Soane Medallion for the year 1846, was offered for

the best design for an edifice, suitable to the congregational worship of the Church of England, and capable of accommodating 1,600 persons, without galleries.

The design to be Roman or Italian, expressive of its purpose both internally and externally, presenting as little obstruction to sight as possible. The chancel to be properly marked in plan and decoration, with reference to its Protestant uses. All the windows to be charged with stained glass.

There must be a conspicuous belfry, but the body of the church is not to be surmounted by a dome.

The drawings of the elevations and two sections, to be to a scale of one-quarter of an inch to a foot,—the plans and perspective view to one-eighth of an inch to a foot, and shaded with India ink or sepia only.

The competition is not confined to the members of the Institute, and the Council will not consider themselves called upon to adjudge a premium, unless the drawings be of sufficient merit to deserve that distinction,—

and for which, two Designs have been received. The Council most reluctantly observe that they do not consider either of them as deserving of the reward offered.

Three Essays have been received "on the adaptation and modification of the orders of the Greeks by the Romans and moderns."

The Council are of opinion that the Essay marked by the motto "Hæ tibi erunt artes," is distinguished by considerable research and knowledge of the subject—the style is clear and unaffected, and the reasoning good. The Council consider that the treatment of the subject is somewhat too historical, and that not sufficient attention has been paid to the various social causes which operated in effecting the modifications of the orders. The Council are of opinion that this Essay stands first in the order of merit, and is well deserving the Medal of the Institute.

The Essay marked ⊖, evinces considerable study and able treatment of the subject, the Council therefore recommend that a Medal of Merit be awarded to this production.

For the medal offered by the Institute for the best Essay on Drainage, viz.:—

On the best system to be adopted with regard to the arrangements for the thorough drainage of a town house, and of a nobleman's mansion and offices in the country, respectively. Comprising the general arrangement for carrying off the waters and sewage, the sizes and most convenient forms for the drains or conduits, the requisite fall, the description of material to be employed, and the several precautions for the prevention of damp, smell, and passage of vermin;—to be accompanied by block plans and details,—

one Essay only, accompanied by two plans marked "Hygeia," has been received.

On a careful perusal of the Essay, it appears that the author has not treated the subject in the terms of the programme; that he has neglected the main subject proposed, and altogether omitted those details to which his attention was directed by the published particulars. The writer has shown much diligence, and some knowledge of the matter on which he has treated, but this also is in too general a manner, and upon points not properly within the scope proposed by the Institute.

Under these circumstances the Council cannot recommend the medal to be awarded to this production.

The sealed papers being opened, the chairman declared the names of the successful candidates: for the Silver Medal, W. John Woody Papworth, of 10, Caroline-street, Bedford-square, Fellow; for the Medal of Merit, Mr. James Bell, Associate.

The Essay which gained the Medal of the Institute was then read by the author; it commenced by arguing that Hellenic Art, when introduced by Cossutius at Rome, was corrupted by the influence of a previous style, in the same manner that the architecture of Alberti was degraded, through a Gothic feeling, into the Elizabethan, the Renaissance, and the Tedeschi variations. Treating of the remains of the Etruscans in art, he repudiated the testimony of their vases, and held that they exercised little influence on the early style of the Romans, which he considered to be Alban or Latin; he used that term to denote the simplest order of Classic Architecture, which was gradually superseded in Rome by the Ionic and triglyphed Doric. In justification of an original table which dictated the employment of Corinthian columns only when in height exceeding fifty feet, and gave average heights to each order, ending with only eleven feet allowed to the Latin Tuscan, the author appealed to several tables of calculations, which showed that according to his formula, passages of equal widths between pairs of columns, of each order, of one diameter, demanded lengths of architraves not exceeding the powers of the simplest mechanical construction; and greatest when capping the highest columns: whereas the usual acceptation of the directions of Vitruvius absurdly tended to show that the greatest lengths of architraves would seem most consistent with the lowest columns, although the ancients always expected narrowness of intercolumniation and slimness of pillar to accompany each other.

The most important modifications made by the Romans, while retaining the scientific conventionalities of the Greeks, and adopting the Eustyle intercolumniation, and the pseudodipteral and hypæthral arrangements, consisted in the proportions of their plans and in the positions of their columns; in the proportions of their entablatures, and in the contour of the mouldings; in the use of square columns, often allowed to be predominant, and in debasing the circular pillar to a mere pilaster, and to the practice of supercolumniation.

Reference was made to a drawing exhibiting a moiety of the same building in each style, entering into a comparison of the different results accompanying various coincidences, and stress was laid upon the sentiment of a rectangular and statuesque simplicity visible in nearly all Greek edifices, in opposition to that of curved and picturesque grouping in the enlarged sphere of action of the Roman imperial artists.

The author defended the revivalists for establishing a standard for each order, on the ground that they were justified in suspecting all the antiques (of which they really saw very little) to be barbarous, and in trying to bring them to a correspondence with Vitruvius,—each publishing his own idea of perfection, in which the great masters were wonderfully agreed: and exposed the fault of making their illustrations formulæ—to be applied without change on any occasion, at any height, in any situation, for any purpose. He examined the practice of the great masters and the pupils in the several modern schools, and mentioned, in a list of their additions to the store of the architect, the use of the niche, of pedestals, of balustrades, of sculpture (of all sorts) as mere decoration, of the aræosystyle disposition, of the basement and attic stories as features, of spires and steeples and bell towers, and of an extraordinary luxury of internal and external architecture.

The paper closed with the observations that, with Chambers, Mylne, Dance, Holland, and Soane, expired the race of architects in one style only—but in a style of which they were masters; their successors being condemned, by exposure to the caprice of patronage for a command, to summon up the resources of any style—to clothe even an impracticable idea; and that the current of taste was undeniably tending towards an art altogether different from that of Greece in its construction, or else to that of Palladio and Chambers.

INSTITUTION OF CIVIL ENGINEERS.

Feb. 2.—Sir John Rennie, President, in the Chair.

The Institution met for the first time in the new theatre, and a paper by Mr. W. E. Newton was read, giving a description of the method employed by Mr. Herron "*for the construction of the permanent way of the Philadelphia and Reading, and other railways in the United States.*" The method was a deviation both from the systems of the longitudinal and the transverse sleepers, crossing each other and spiked together at the intersections with wooden trenails or iron pins, acording to circumstances, forming an extended platform, upon which their longitunal bearers were laid, supporting bridge-shaped rails with wrought iron chairs. The paper gave an account of several deviations from the general system, such as making the trellis-work of iron laid in bitumen, &c., and also a detail of the amount of traffic conveyed along the railway; whence it appeared, that within one year and five days from its being opened for general use, 1,400,000 tons of goods had been conveyed along it, without any prejudicial effect, and, in fact, with less wear and tear than was usual upon railways in the States. The cost of a single line of permanent way was about £850 per mile. From the discussion that ensued, it appeared to be the opinion, that although the system might succeed in a country where timber abounded, it was inapplicable for English railroads; and exceptions were taken to the general features of the construction for high speed, as the rails, which weighed only forty-four pounds per yard, and which were of a bridge form, could not resist the impact of the wheels at great velocity: the junction of the diagonally laid sleepers would become loosened, and there would be too much deflection between the bearing points.

Feb. 9.—Sir John Rennie in the Chair.

A paper was read on the "*Helder or Great North Holland Canal,*" by Mr. G. B. W. Jackson, Associate. This canal was constructed by the late Mr. J. Blanken, engineer, during the six years between 1819 and 1825, for the passage of frigates and first-class merchantmen, and extends from Amsterdam to Nieuwediep in the Texel. The state of the navigation through the Zuyder Sea, in the early part of the 17th century, having become so defective, in consequence of accumulated sand-banks and shoals, that camels were necessarily made use of to lift the vessel over the shallows at Pampas, thereby incurring both extreme loss of time and inconvenience, the Dutch Government deemed it necessary to consult Mr. Blanken on the possibility of remedying the evil. That engineer accordingly projected the above canal, which has three divisions, the summit level being only 3 feet 8 inches above the outlets. Its length is fifty-one miles. It is 123 feet 7 inches broad at top, 30 feet 10 inches at bottom, and 20 feet 6 inches deep. The pile-driving and boring experiment undertaken by him to ascertain the probability of success, show that the original sea shore, being the only really hard ground in the north of Holland, is to be met with at 48 feet under the present surface of the ground; and as the foundations of the locks were laid nearly at that depth, the result of the experiment was considered to afford sufficient guarantee for the stability of the works. The character of the soil in that part of Holland is exceedingly treacherous, and it reflects great credit on our foreign neighbours that they were able to overcome the various difficulties with which they had to contend.

The constructions generally consist of floating and swingbridges, tide-locks, passage-locks, &c. The floating bridges are peculiar on account of their flexibility, consisting of two platforms, one fixed to each shore on piles, the end of each of which is worked by sets of double levers and resting on two boats, so that when the bridge is required to be opened, both boats are withdrawn, one towards each shore. The Willem lock is 297 feet 8 inches long, 51 feet 5 inches wide; the height of the lock walls being 32 feet 6 inches, and the gates being each 29 feet 5 inches by 29 feet 4 inches.

The total cost amounted to one million and a half pounds sterling. The time required by vessels to make the passage from Amsterdam to the Helder varies according to their size, and the means of haulage; fly-boats, with six relay of four horses each, making it in ten hours, whilst large East Indiamen require two, three, and four days, according to the wind. The details of construction of the whole of the works were given very freely and with illustrated drawings. In the discussion which ensued, it was stated that the only canal in this country which could be contrasted with that of the Helder, was the Caledonian canal, which was projected upon a report by Watt, commenced by Jessop, and in a great part constructed by Telford, a few years previously to the Helder canal. The principal difference between the two consisted in the nature of the ground through which they were cut, the former being excavated entirely out of alluvial deposit, whilst the latter had to be cut out of hard gravel, and in some cases rock. An interesting account was given of the mode of forming the spot for the entrance-lock at the Inverness end of the Caledonian canal. The object was to carry the work out into deep water. A large mass of earth was deposited in the sea to the full extent intended. Upon this mound, a heavy load of material was laid to consolidate the mass. After settling for a considerable time, the upper mass was removed, the excavation was made for the lock-pit, and the construction was effected with comparative facility, and had endured much rough weather since, without any symptoms of failure. The superincumbent weight which was removed, being greater than any subsequent strain, there was no danger of the lock ever sinking.

On the 16th inst., this paper was continued, and treated principally of the art of building with fascine work, as practised in Holland and Germany.

The usual construction of these dykes was described to be, by sinking successive layers or beds of fascines or faggots of almost 30 inches thick by from 8 to 16 yards in width, and of proportionate length, weighted with gravel and stones mingled with clay, sea-weed, and silt. These layers were continued until they reached above the sea level, when the top was constructed of more solid materials, and sometimes capped with brickwork, as the public roads were formed upon them.

The slopes of the faces of the dykes vary considerably: some of the low dykes are in section of the form of an arc of a circle of 6 to 10 feet chord and 10 inches to 1 foot versed sine, covered with fascine matting, staked down upon a clay-bed. Others have a base of 19 feet wide and 5 feet of a triangular section, also made up of fascines and stakes, secured by hurdles and wattling, with clay, peat, sea-shells, and sand, well rammed in, and then covered with turf. Others are formed with rows of piles, 16 feet long, with their heads 6 or 7 feet above the shore, joined longitudinally and laterally by waling timber, filled in and around with fascine beds and weighted with stone. Baskets filled with sand are also used in certain situations, as well as various modifications of all these kinds of protections. It was stated that these constructions were found to succeed better and last as long as stone, being at the same time about half the cost.

ON GUNPOWDER.

Dr. Faraday, in a lecture delivered at the Royal Institution, gave some account of the "*Composition and Qualities of Gunpowder.*"—Its composition contains 75 parts of nitre, 15 parts of charcoal, and 10 parts of sulphur; which, converted into equivalents, give 1 of potassium, 1 of nitrogen, 6 of oxygen, 3·4 of carbon, and 0·85 of sulphur, in a state of mechanical mixture.

The Action of Gunpowder.—Gunpowder is a solid body, in which a source of enormous power is locked up, capable of being brought into immediate operation whenever wanted: the action thus elicited being itself regulated by human skill with wonderful precision. The enormous quantity of gas generated by the combustion of gunpowder, irrespective of heat, was exhibited. It was remarked that, on the ignition of gunpowder, though the sulphur begins the combustion, it is not itself burned by the oxygen of the nitre, but unites chiefly with the potassium of that salt to form sulphuret of potassium, a substance which assists in giving to the flame of gunpowder an intense heat. If gunpowder and steel filings be dropped together through four or five inches of flame, the latter will burn, though the former will not. A flame from gas was made to play for several seconds on a heap of gunpowder, without lighting it; but when actually lighted, it evolves very great heat. It is to the immense heat produced on the solid products of the combustion of gunpowder, that the certainty of its complete combustion is greatly owing. In this respect gunpowder differs characteristically from gun-cotton. The latter fires at a heat which would not affect the former; but produces, by its combustion a degree and condition of heat much less communicable to other bodies. The effect of the heat generated, independent of the chemical change from the solid to the gaseous or vaporous state, was illustrated by the violence with which a mixture of one volume of oxygen with two of hydrogen gas bursts the vessel which contains it, solely in consequence of the heat elicited during their combination. This is manifest from the fact that the space occupied by the uncombined gases is greater by one-half than that taken by the resulting steam.

Granulation.—Prof. Faraday laid great stress on the effect of the granulation of gunpowder. To this condition of gunpowder, presenting, as it does, a number of separated surfaces of size just sufficient to become surrounded with flame at the same instant of ignition, much of the disruptive or projectile effect of gunpowder was ascribed. It was shown that, without that porosity which its division into grains imparts to a mass of gunpowder, the explosion of the whole could not be instant nor simultaneous. This was proved by bringing a piece of mill-cake successively into the condition of grain powder and of meal powder. The slow combustion of the solid meal powder fuse was compared with the quicker inflammation of the hollow rocket and the instant inflammation of the charge of a gun. All these effects are related to the condition of the interior of the gunpowder in respect of its permeability by the flame of the first particles ignited. Then, as to its exterior condition, it was shown that the tardy burning of the miner's fuse is due to the granular state of the powder in its case being counteracted by the pressure of the strands of rope wrapped very tightly round it; while, on the other hand, in the cracker of the firework-maker, a similar train is instantly fired throughout, because it has a loose jacket all over it, and, in the burning of the common cracker, an alternation of these effects is produced.

The great importance of Time in producing the effects of Gunpowder.—Contrasting the action of gunpowder with that of fulminating mercury and silver, or of those still more fearfully explosive compounds, the chlorides of nitrogen and of iodine, Prof. Faraday showed, that, if the explosion of gunpowder were really instantaneous, it would be useless for all its present applications. As it is, however, whenever gunpowder is fired in the chamber of a gun, it does not arrive at the full intensity of its action until the space it occupies has been enlarged by that through which the ball has been propelled during the first moment of ignition. Its expansive force is thus brought down and kept below that which the breach of the gun can bear, whilst an accumulating, safe, and efficient momentum is communicated to the ball, producing the precise effects of gunnery. This manageable action was contrasted with the effect of a morsel of iodide of nitrogen put on a plate, and exploded by being touched by the extremity of a long stick. The parts immediately in contact with the iodide were shattered,—*i. e.*, the end of the stick was shivered, and the spot in the plate, covered by that substance, was drilled as if a bullet were fired through it, yet no tendency to lift the stick was felt by the hand; whereas the comparatively gradual action of gunpowder lifts and projects those weaker substances, wadding and shot, which give way before it.

ORNAMENTAL GLASS.

Mr. Apsley Pellatt delivered a lecture at the Royal Institution on Feb. 12, "*On the manufacture of ornamental glass.*" He explained that the refractive pellucid colourless brilliancy of flint-glass was owing to the presence of lead; and that flint-glass, or more properly glass of lead, most resembled rock-crystal or the diamond; and in this branch of the trade, especially as regarded table and chandelier glass, the British glass-manufacturers were pre-eminent, and superior to their continental rivals. The entire manipulation in the making of a wine-glass, jug, barometer-tube drawing, patent pillar moulded vase, were explained in detail both from large diagrams and from the practical exhibition of these processes by two workmen; a furnace having been fitted up by Mr. Pellatt in the theatre of the Institution for the express object; also salt-cellars were pressed by machinery, bottles blown and moulded, spun-glass drawn, &c. During these operations Mr. Pellatt explained the conditions of whetting off by the application of the sudden contraction of the cold iron tools, so that a slight blow would separate the bowl of a wine-glass from the glass adhering to the blower's crow; that a punty might be applied to the reverse end for shearing and finishing the bowl. The punty is a solid iron cane, with a little hot glass adhering to it for handling glass pieces; which, by partial melting of the glass in the course of manufacture, is again removed by a tap when it is no longer required. The peculiarity of glass welding by contact (impossible if the slightest film of sulphur intervene), and various manipulations, were detailed, particularly the projecting moulded pillars which possessed the refractive and brilliant effect of cut glass; and although invented and introduced a few years since by Mr. James Green as a novelty, it was found, on comparison with a Roman specimen of glass dug up in the city of London, the property of Mr. Roach Smith, apparently to have been manufactured by means of the same appliances as the ancients, the fragments having a perfectly even interior, with a projecting pillared exterior.

The difference of glass made by hand and in moulds was stated by the lecturer, as well as the distinction between moulded blow-offs with cut scolloped edges, which were far superior in the interior polish, as contrasted with articles, such as dishes and salt-cellars, pressed in moulds by mechanical power, as introduced by the American system, whose interior surfaces were uneven and ruffled, by the metal plunger not always being kept sufficiently hot. An ingenious cylindrical vial mould, for blowing bottles without seam, of uniform sizes, was used; and bottles were manufactured both from it and the ordinary open and shut moulds, which will be polished and clean blown, provided the inside of the moulds are kept at nearly the same heat as the temperature of the glass blown in them. The elasticity of glass was exemplified by glass balls of about three inches diameter rebounding from a polished iron slab three-fourths of the height from which they were dropped, as well as by blowing glass so attenuated as to be sustained some short time floating in the atmosphere; this is technically called glass frost. Annealing and its effects were briefly stated. The process of casing (called by the French *doublé*, *treble*, &c.) colours upon white glass was then practically shown by the workmen, who covered a white glass toilet-bottle with blue, about the thickness of an egg-shell; and Mr. Pellatt displayed a vase of the exact size and shape of the Portland vase, manufactured at the Falcon Glass-works with a thick interior coating of dark blue glass, upon which a thin white enamel of glass casing was laid; his engraver had cut away parts of the white, leaving masses of blue in the neck and upper part of the vase exposed to view, and had chased out at the lathe, with the engraving tool, a portion of the bas-relief.

A full size drawing of a double-handled vase, without foot, now in the Museum of Naples, was exhibited, made of blue glass, and cased with white enamel, with handles, from which were engraved in relief, an elaborate arabesque subject, with a group of Bacchanalian boys under each handle. In design and artistic power it is considered by Zahn as second only to the Portland vase. This vase was found in Pompeii in the year 1837. Mr. Pellatt stated that Mr. Wigel, the celebrated gem-engraver, had expressed a desire to make an exact copy in glass of the Portland vase, provided he could set apart adequate professional time for the object; and Mr. P. expressed his determination to aid this patriotic intention, pledging his Firm to its execution, so far as regarded the manufacture of the crude vase. This species of engraving in relief, probably took its rise among the Greek and Roman artists, in imitation of real bas-relief gems. Many rough and unfinished specimens are to be seen in the British Museum. Modern engraving of rough patterns upon transparent glass cannot be traced earlier than the Venetians. A lathe, a copper wheel and emery-powder for the rough grounds, and a lead wheel for polishing, are the engraver's tools. Specimens were on the table, as worked by the lathe. Glass-cutters' iron wheels for cutting, used with wet sand; stone wheels, used for smoothing with water, and wood wheels for polishing with pummice, and afterwards with putty powder, were slightly explained from the specimens exhibited. Flint-glass decanters, roughed, smoothed, and polished, were shown; also four polished cut decanters, of one uniform shape and size, but varying in strength, to exemplify the difference of brilliancy; that with ten faces of flutes on the cylindrical body being least refractive, and that with six faces or fluting being most refractive; and the eight fluted and ten fluted ranging between the two extremes in refractive effect; the condition of pellucid refractibility depending upon the greatest projection of angle, in proportion to the greatest quantity of flat surface cut away from the exterior of the cylinder (the interior remaining circular). The last glass manipulation of the workmen was drawing Venetian filigree cane. Threads of white and coloured glass were placed vertically around the extremity of the interior of a brass mould; a solid flint-glass ball was blown into the interior of the threads, welding the latter to the outside of the ball, and drawn as tube and cane is usually drawn, except that each workman twisted in an opposite direction, as they retired from each other to lengthen and attenuate the filigree cane; which, being whetted off into such lengths as may be required, is afterwards used for wine-glass stems, or made up into vases, pateras, and other filigree objects of taste. Specimens of mosiac glass were also shown and explained, by which, pictures, as described by Winkelman, were made, by welding lengths of small cane to each other, the patterns being previously sectionally arranged to required variety of colour, &c.; so that when massed together by fusion, the whole shall appear homogenous. These are cut off into slabs at right angles to the length; so that the subject or pattern is repeated on each slab. Venetian millefiore glass was explained to consist of single canes of filigree glass, cut off into small lozenges, and placed side by side, and welded to white flint-glass, forming a sort of mosaic work. The manner of making schmeltz and *vitro de trino* was slightly alluded to, and Mr. Pellatt stated that he had tried to imitate the projecting crystal forms divided by concave fissures of the Venetian frosted glass, and had failed, as he had plunged the manufactured article while hot into cold water, which only dislocated the interior particles of the glass, leaving the surface nearly smooth; whereas his friend Mr. Green had chilled the glass in water in the earlier process of the manufacture, which being afterwards rewarmed at the furnace and expanded by blowing, separated the crystals from each other, leaving the fissures between identically with the Venetian; apparently full of fractures, but really whole and entire. The enclosing of cameos in shut-up pockets was explained. A beautiful specimen of pedestal, with a caryatides enclosure in solid glass, also bricks of glass, with written and composition inscriptions incrusted, were on the table.

Mr. Pellatt concluded by bearing public testimony to the workmen for their willingness and success, notwithstanding the short time of fusion, and the comparative incompleteness of the furnace; and by sincerely thanking the possessors of ancient glass who had kindly lent him specimens, or given him access to their collections.

ON THE NATURE OF HEAT.

Mr. Grove gave a lecture at the Royal Institution, Feb. 5th, on "*some Considerations of the Nature of Heat.*"—After a sketch of the existing theories of heat—the emissive, the ethereal, and the dynamic—Mr. Grove announced himself an advocate of the last, viz. that which regards heat as molecular motion of ordinary matter. The phenomena of what is called "latent heat" have always been considered a stumbling-block in the way of this theory, and a strong argument for the materiality of heat. Mr. Grove considered that all the phenomena of latent heat might be accounted for more simply by the dynamic theory, and that the greatest difficulty in applying this theory was the necessity of excluding ideas associated by long usage with the phenomena, and also of employing terms which had become engrafted by custom on the expansive effects of heat. Thus, in expounding a new view, although more simple in itself than the received ones, we are obliged to avail ourselves of received terms, to which, while we use them, we object. Excepting the case of certain substances which expand in freezing, and which expansion is accounted for by their crystallisation, making the body occupy more space, by leaving interstices between the crystals, Mr. Grove stated that all the phenomena in which the so-called latent heat is concerned were mere expansions and contractions; and that what, according to that theory, would be called absorption of heat, was mere extension of the substance said to absorb the heat. Thus, suppose a given quantity of water to be heated by a given quantity of mercury; the first effect is, that the water expands, the mercury contracts; at a certain point, viz. that at which the water is said to have reached its boiling point, the attraction of the molecules of water is so conquered by the repulsive force, heat, that the water bursts into vapour; here its molecules being more separated, and having consequently a less attractive force, are so much more readily expanded, and exhaust much more expansive force from the heated mercury: this, therefore, loses expansive force, *i.e.* contracts or shrinks; and the more so in proportion to the readiness of expansibility of the substance which robs it of its expansive force. So, if the calorific force be supplied by other means, such as ordinary combustion, say of coal and oxygen, *i.e.* chemical action, the expenditure of fuel will be in proportion to the expansibility of the substances heated; so that the same quantity of water will require the same quantity of heat to convert it into steam, whatever the pressure.

If, again, the same source of heat be applied to the two substances, water and mercury, say to a thermometer immersed in water, both gradually expand, but in different degrees; at a certain point the attractive force of the molecules of the water is so far overcome that the water becomes vapour; at this point the heat or force, meeting with much less resistance from the attraction of the particles of steam than from those of mercury, expends itself upon the former: the mercury does not expand, or expands in an infinitesimally small degree, and the steam expands greatly; as soon as this arrives at a point where circumambient pressure causes its resistance to further expansion to be equal to the resistance to expansion in the mercury of the thermometer, the latter again rises; and so both go on expanding in an inverse ratio to their molecular attractive force. Again, if the steam be not allowed to expand, as by confining it by a less expansive body, say a metallic chamber, then the mercury of the thermometer immediately rises. Thus heat is regarded as a purely mechanical effect; and indeed it can be made to reciprocate with mechanical action. If by mechanical pressure we cause a substance to contract, this gives out heat, *i.e.* causes surrounding bodies to expand; and, *vice versâ*, if we mechanically rarify or expand a substance, cold is produced, *i.e.* contraction in surrounding bodies. The theory was also applied to the increase of specific heat in bodies as their temperature increases, and to many other points; and the whole subject was experimentally illustrated.

Mr. Grove next passed to the consideration of the effects of heat, viewed as repulsive force, upon another mode of molecular attraction, viz. chemical affinity. A vast number of compound bodies are decomposed or resolved into their constituent elements by heat; and these effects may be accounted for by supposing that heat so far separates their molecules as to remove them from the spheres of their affinity. In other substances, however, chemical combination is produced by the application of heat; and though by certain hypotheses these latter effects may also be accounted for by the repulsive action of heat, Mr. Grove seemed to consider these hypotheses rather strained. Water has, up to a recent period, been considered not only undecomposable by heat without the aid of some other powerful chemical affinity, but the elements of water are united by the action of heat; and in pneumatic analyses heat has hitherto been employed to combine the elements of water with each other, or with other gases. Mr. Grove however has proved, and experimentally showed on this occasion, that water is capable of being decomposed by heat; thus forming no exception to the general antagonism of heat and attractive force.

STAINED GLASS.

At a meeting of the Decorative Art Society, on the 27th Jan., Mr. Fildes in the chair, Mr. E. Cooper, "*On Stained Glass Windows*," observed, that a combination of the Italian, or Renaissance, with Gothic embellishment, took place during the reign of Henry VIII., as seen in the chapel of Bishop West, at Ely, and in Wolsey's hall, at Hampton Court, whilst, indeed, the pure Italian architectural design by Torregiano, in the tomb of Henry VII., as well as the windows, carved stalls, and organ-screen, in King's College Chapel, Cambridge, belong to this period. Some fine examples of Italian decorations, in the paintings by Holbein, at Hampton Court, were also referred to. He enlarged upon these circumstances, lest he might be supposed to have anticipated by a century the introduction of the revival more usually attributed to Inigo Jones. A detailed description of the windows at King's College, Cambridge, followed; and the east window of Saint Margaret's church, Westminster, was, in his opinion, designed by the same artist: an examination of this window will convey a correct notion of those at Cambridge. It was said, that this had been executed at Gouda, in Holland; at which place may be seen some of the finest examples of stained glass in existence: they are in the style of the revival, with a considerable portion of white glass in the background, and were painted towards the end of the sixteenth century. Some elaborate engravings of them, just completed by Mr. Weale, were referred to. The eastern window of Saint George's, Hanover-square, is also of this period. Much of the detail was said to be valuable, although a confused effect arises from the ornamental portion overpowering the figures.

Mr. Cooper then remarked, that the windows of the sixteenth century have a peculiar character in the imperfectly attained perspective effects, and the attempts to represent distances by painting; hence exhibiting a departure from the true principles of the art. He observed, that all figures should be supported by draperied or diapered back-grounds, admitting depth in colour. The windows of King's College chapel might be considered beautiful, rather from the rich colours of the glass than from the artistic merit in the application of colours to the design, which can only be made out after some little study. During the 13th, 14th, and 15th centuries, one uniform tone of colour pervaded the back-ground; and as one of the finest examples of this class, the window of the north transept of Canterbury Cathedral was referred to. It displays a glowing brilliancy not subsequently attained.

In the reign of Elizabeth, stained glass was largely introduced in mansions, exhibiting heraldic devices and mottoes. The 17th century led to a notice of several windows by Van Linge, that in Lincoln's-inn chapel being a good example of this artist's productions. Others were enumerated, which belong to the 18th century, but they were not considered worthy of commendation, having been, for the most part, treated as an oil-painting, and with a preponderance of shadow on a transparent medium. At the present day, Mr. Cooper observed, there is a return to the practice of mediæval glaziers, in the employment of flashed glass and pot-metals together with minute lead-work. The east window of Saint James's Church, Piccadilly, he thought creditable in respect of glazing and richness of tone in the colours; but a higher degree of artistic merit might have been readily obtained. A proper gradation of colour in the composition had not been observed; the most elevated figure, viz., that of the Saviour ascending, being inconsistently clothed in scarlet, and which, the reader argued, should have been represented in drapery of the most aërial description. Much controversy and criticism had taken place upon the the character of this window. He said that he could not detect any Gothic details in the window as executed; that the borders are Italian, from works by Raffaelle, G. Romano, and others, and may be seen in Gruner's work. The borders of mosaic-work impart a Byzantine feeling, whilst the various symbols and emblems introduced were commonly employed by the early Italian Christians. He considered that we may expect success in direct imitations of the mediæval works, as seen in new windows in the Temple Church, where the colours and glazing are alike good, and the tableaux, or subjects, being small, do not render any impropriety of intensity conspicuously objectionable.

The east window of the new church in Wilton-place was next noticed as a misunderstanding of this kind of decoration. It is not yet completed; but in the lower portion a failure was said to be clearly indicated. The intention of the designer, the writer supposed to be akin to those prevalent during the transition period, when the introduction of a series of small and separate subjects illustrative of history was aimed at; but omitting the principal charm arising from the harmonious and rich glow emanating from a combination of full-toned colours. The figures in this window were then described as small, on light or white grounds, producing a spotted effect from their size, and also precluding the possibility of readily making out the subject; added to which, each figure, or group, is surmounted by tabernacle-work in pale yellow glass, feebly contrasting with the stone mullions of the window. He then argued, that one of two rules should be observed,—either a rich general effect should be produced (the design or subjects being subordinate), or the subject should be well defined, and sufficiently large to be well understood in any part of the building. Neither of which had been regarded in this last instance.

One great cause of failures at the present day was attributed to the art being regarded as a mere trade; and it was contended, that were artists of eminent talent to devote attention to the principles which regulated the application of colour to this material, we might soon realise our brightest expectations. Much might be hoped for from the great advance taking place in chemical information. The writer suggested improvements that he believed had not yet been applied to stained-glass windows. One was, to introduce "lights" in the representation of objects. Shadow had been freely used, but he argued, that dark shadowing constitutes a great fault. The best effects in a picture generally arise from the lights. By using flashed glass and a partial removal of the coloured surface these might be produced. Another plan by double glazing was mentioned, using two plates of flashed glass of different colours, and subjected to certain modifications by grinding or acid. Specimens illustrating these considerations were exhibited.

By these and other means that might be suggested, together with an avoidance of aërial perspective, a superior pictorial effect would result; and he concluded his paper by a brief recapitulation of the leading characteristics of the design and colouring peculiar to each of the centuries which had been passed under review.

CENTRAL SUN.

At the Royal Irish Academy, Sir W. Hamilton announced the presumed discovery, by Prof. Madler, of "*a Central Sun*," and exhibited Prof. Mädler's essay on the subject (*Die Central Sonne*, Dorpat, 1846). The following report, containing a sketch of the results arrived at, and which were briefly stated to the meeting, we take from the *Dublin Evening Post*:—

"By an extensive and laborious comparison of the quantities and directions of the proper motions of the stars in various parts of the heavens, combined with indications afforded by the parallaxes hitherto determined, and with the theory of universal gravitation, Prof. Mädler has arrived at the conclusion that the Pleiades form the central group of our whole astral or sidereal system, including the Milky Way and all the brighter stars, but exclusive of the more distant nebulæ, and of the stars of which those nebulæ may be composed. And within this central group itself he has been led to fix on the star Alcyone (otherwise known by the name of Eta Tauri), as occupying exactly or nearly the position of the centre of gravity, and as entitled to be called the central sun. Assuming Bessel's parallax of the star 61 Cygni, long since remarkable for its large proper motion, to be correctly determined, Mädler proceeds to form a first approximate estimate of the distance of this central body from the planetary or solar system; and arrives at the (provisional) conclusion, that Alcyone is about 34,000,000 times as far removed from us, or from our own sun, as the latter luminary is from us. It would therefore, according to this estimation, be at least a million times as distant as the new planet of which the theoretical or deductive discovery has been so great and beautiful a triumph of modern astronomy, and so striking a confirmation of the law of Newton. The same approximate determination of distance conducts to the result that the light of the central sun occupies more than five centuries in travelling thence to us. The enormous orbit which our own sun, with the earth and the other planets, is thus inferred to be describing about that distant centre—not indeed under its influence alone, but by the combined attraction of all the stars which are nearer to it than we are, and which are estimated to amount to more than 117,000,000 of masses, each equal to the total mass of our own solar system,—is supposed to require upwards of 18,000,000 of years for its complete description, at the rate of about eight geographical miles in every second of time. The plane of this vast orbit of the sun is judged to have an inclination of about 84 degrees to the ecliptic, or to the place of the annual orbit of the earth; and the longitude of the ascending node of the former orbit on the latter is concluded to be nearly 237 degrees. The general conclusions of Mädler respecting the constitution of the whole system of the fixed stars, exclusive of the distant nebulæ, are the following:— He believes that the middle is indicated by a very rich group (the Pleiades), containing many considerable individual bodies, though at immense distances from us. Round this he supposes there is a zone, proportionally poor in stars, and then a broad, rich, ring-formed layer, followed by an interval comparatively devoid of stars, and afterwards by another annular and sterry space, perhaps with several alternations of the same kind, the two outmost rings composing the two parts of the Milky Way, which are confounded with each other by perspective in the portions most distant from ourselves. Professor Mädler has acknowledged in his work his obligations, which are those of all inquirers in sidereal astronomy, to the researches of Sir William and Sir John Herschel."

Draining with Engine Ashes.—On the farm of Daldorch, the property of Archibald Buchanan, Esq., of Catrine Bank, Scotland, there are drains made 28 years ago, and filled with engine ashes, which are still in full and efficient operation. The depth of drain is 26 inches, and the width between each 12 feet. The bottom of the drain is cut three inches wide, and the depth of ashes used in filling them is about 10 inches. The soil is a firm clay. These drains promise to be as efficient half a century hence as they are at the present time.

LIST OF FOREIGN BOOKS LATELY PUBLISHED.

Civil Engineering, Architecture, and their Collaterals.

FRENCH WORKS.

Czynzki, J., Kopernik—Copernicus and his Works. Paris: 8vo. 6s.

Leroux de Lincy, Hôtel de Ville—History of the Paris Guildhall. Paris: 4to., plates. 25s.

Vignente, B., Irrigateur—Practical and Law Handbook of the Irrigator Paris: 12mo. 2s. 6d.

Bourdat, J. M., Théorie—Theory of Eclipses, and the annular eclipse of Oct. 9, 1847, visible on the ancient Continent. Paris: 12mo.

Granjean de Montigny, Architecture—Tuscan Architecture, Palaces, and other edifices, measured and designed by. Second Edition, with an addition on the Tombs of Italy. Paris: fol., 134 plates. £2 15s.

Klée, F., Déluge—Geological and Historical considerations on the last Cataclysms of the Globe. Paris: 12mo. 3s. 6d.

Palenceron, A. R., Les Eaux—Practical Treatise on Water. Paris: 12mo., plates. 3s.

Roy de Morande, Examen—Critical Examination of the Cosmos by Humboldt, with a new system of the Universe. Paris: 8vo. 2s. 6d.

Vanauld, A., Genie—The Genius of Art; Studies on the most celebrated Painters, Sculptors, &c. Paris: 8vo., plates. 9s.

Batissier, L., Histoire—History of Monumental Art in the Ancient and Middle Ages, with an Essay on Glass Painting. Paris: gr. 8vo., plates. £1 1s., [A very important work.]

Thierry, Jun., Méthode—Graphic and Geometric method of Linear Drawing. Second Edition; corrected by F. C. M. Marie. Paris: oblong 8vo., plates. 10s. 6d.

Chazallon, M. R., Marées—Annuary of the Tides on the Coast of France in 1847. Published at the Depôt of the Navy. Paris: 18mo.

Richard, Chemins de Fer—The Great French North Line, from Paris to Ostend and Cologne. Paris: 18mo., 2 charts on steel. 2s. 6d.

Annuaire—Annuary of the Ecole polytechnique, up to the year 1846. Paris.

Andraud, Système—Atmospheric Railways, after the system of,—Paris: 8vo., plates.

Minard, M., Cours—Course of Hydraulic constructions at Sea-ports, delivered at the College of Roads and Bridges. Paris: 4to., Atlas. £1 5s.

Mignard, B. R., Traité—Treatise, Theoretical and Practical, on Construction. Paris: 8vo., Atlas in folio.

Fontenay, T., Notice—Notice on the Construction of the Tunnels of St. Cloud and Montretout, with general observations on subterranean passages, and the dimensions and prices of sixty-six tunnels in France, England, and Belgium. Paris: 8vo., plates. 5s.

Vicat, L. I., Etudes—Studies on the Artificial Pozzolanas, composed of the natural ores of Italy, and their use in buildings in fresh and salt water. Paris: 4to., pl. 8s.

Prus, C., Tables—Tables on the tracing of Converging Curves (*t. de raccordement*). Paris: 12mo. 5s.

Richard et Quetin, Guide—The Traveller's Guide through Monumental France. Paris: 12mo., chart. 10s.

Montfalcon et Polinière, Traité—Treatise on the Salubrity of large Cities. Paris: 8vo.

Application of the Properties of actual Celerity to the different conditions of Stability of Vaults and Dressings, by General Count L. Paris: 4to.

St. Claire Déville, Etudes—Geological Studies on the Islands of Teneriffe and Fogo. Paris: 4to.

Adhemar, J., Perspective—Perspective of distant objects, being a Supplement to the Treatise on Perspective. Paris: 4to. Atlas in folio.

Sommerard, F., Arts—The Arts in the Middle Ages, Roman Palace at Paris, Hôtel de Cluny, &c. Paris: Five volumes, 8vo.

Normand, Modern Paris—Villas and Rural Constructions about Paris; plans, elevations, and general outline of their architecture. Paris: 8vo., plates. Each Part, 2s.

France.—Caen, Feb. 2.—A basin for the accommodation of shipping is in progress at this port. To render it of more service, a canal from the town to the sea (which are eight miles apart) will, it is hoped, be completed during this year. At present, ships have to thread the shallow and serpentine Orne to reach the town. A harbour of refuge is also in course of construction at Port-en-Bersin, which will be invaluable, not only to French, but to English shipping, there being now no place of refuge between Havre and Cherbourg. The proposed harbour is nearly opposite to Chichester, in Sussex, and, when complete, will be capable of floating men-of-war.

AMERICAN PATENTS.

Improvements in the portable forge. C. V. Queen, Peeksville, New York. The forge is provided with shutters, which slide around to enclose the fireplace when not in operation. The forge fan is provided with a pipe which communicates with the bellows, and from this pipe there is a branch provided with a valve, so that air can be admitted to the fire, when the bellows is not at work.

Improvement in the method of letting down and raising propellers. R. F. Loper, Philadelphia, Pennsylvania.

It consists in attaching two screws to cog wheels on the deck of the vessels, which mash into a large cog wheel on the drum of a capstan, the threads of the screws taking into nuts formed in the sliding frame of the propeller, the sides of which frame are bored out cylindrically to a certain depth, to admit the screws to pass therein, and to protect them from the action of the salt water deposits and rust, which would otherwise prevent their working.

Improvements in water wheels, William Dripps, Coatsville, Pennsylvania, consists in making the apertures in the wheel, for the introduction of the water to the buckets, to extend through the outer or cylindrical perimeter thereof, near the top, and then spirally down through, between the buckets, to the bottom thereof, in the manner described, in combination with the funnel-shaped inner rim and curved buckets; and also the combination of the sliding frame, and segment valves connected therewith, by rods or stems of unequal lengths, for letting on the water by degrees.

Improvements in truss frames of bridges, Nathaniel Rider, South Bridge, Massachusetts, relates to the mode of producing the camber of the truss, by distension wedges, or apparatus, applied between the ends of the bars of the upper stringer, or chord, in *combination* with the contractile and cambering chain, made and applied to the lower or other suitable part of the truss. The wedges are applied at the junctions of the pieces composing the upper stringer of the arch, and below the arch there is a chain made in two parts, and connected by a swivel screw, for the purpose of shortening the chain which supports the arch.

Improved method of indicating the height of water in steam boilers, George Faber, Canton, Ohio; consisting simply in attaching a magnet to the axis of motion of a wheel or lever, to which the float is suspended or attached, to communicate motion by attraction and repulsion, to an index needle turning on an axis outside the boiler, and separated from the magnet by a steam-tight plate.

Improvement in the steam engine, R. F. Loper, Philadelphia, Pennsylvania; consisting in rotating two crank shafts with equal velocities and in opposite directions, by means of a connecting rod, extending from the cross-head of a steam engine to the two crank shafts, the centre of vibration of the cross-head being centrally between them. The claim is for connecting the cross-head of a reciprocating engine with two crank shafts on opposite sides of, and at equal distances from, the centre of vibration, by means of a connecting rod or lever turning on the cross-head, and reciprocating with it, and taking hold of the cranks on the two crank shafts, by which they are caused to turn in opposite directions, and with equal velocities, as herein described.

Improvements in the steam engine, William A. Lighthall, Albany, New York; consisting of the arrangement and disposition of the steam chests, side pipes, condenser, exhaust pipe, bed plate, and air pump, in combination with the cylinder lying horizontal upon the solid keelson or frame, said cylinder being in the hold of the vessel, below the deck beams. Second, the mode of working the valves whole and half stroke, by the combination of the eccentric wheel, eccentric hook and branch hook, the heart cam and cam hook, together with the hollow rock shaft, substantially as described, in combination with the cylinder in the aforesaid horizontal position.

Improvement in the water wheel, William Lamb, Whitestown, New York, consists in the construction of water wheels designed to run under water, with one, two, or more floats so placed in relation to the shaft and body of the wheel as to form a short transverse section of a screw of one, two, or more threads respectively—to be made of any suitable material, and of a shape that may be moulded and cast whole, or to be made of wood, or part of each—in combination with a coiled or scroll trunk, so made as to bring the water in contact with one side of the wheel, and conduct it around the wheel in the direction the wheel runs (except what is discharged in its passage) the trunk being diminished in size gradually by drawing in the side or sides, or by gradually raising the bottom, or both, so that the size of the trunk at any given point, shall be adapted to the quantity of water remaining undischarged at that point, in its passage around the wheel under the floats; said trunk to be made of metal or wood, or part of each, and of a size and form best adapted to the circumstances.

REGISTER OF NEW PATENTS.

SMELTING COPPER ORE.

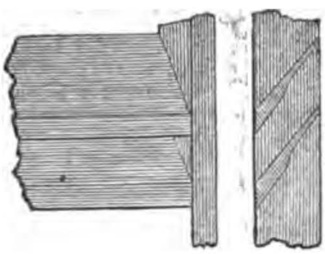
Thomas Bell, of Don Alkali Works, South Shields, for "*Improvements in smelting copper ore.*" Granted July 23, 1846. Enrolled Jan. 23, 1847.

These improvements relate to obtaining sulphuric acid from copper ores during the roasting, by placing the ore in powder on the shelves of a common roasting furnace, to which a roasting kiln is attached by a flue, which enters two feet from the bottom, from 150 to 200 feet in length; in this kiln copper ore, in lumps, is put; near the end of the flue there is a jet of steam, which increases the draught; coke, anthracite coal, or charcoal, may be used instead of bituminous coal. The top of the kiln is arched over, and a flue passes through the top into a vitriol chamber. Near the end of this flue also there is a steam jet. During the roasting of the ore, sulphurous acid is formed, which, in passing through the flues, is mixed with the aqueous vapour, and partly becomes condensed into sulphuric acid; in this state it passes into the vitriol chamber, and collects on the floor; at the same time, the uncondensed sulphurous acid gas and steam, on passing into the vitriol chamber, meet with nitrous acid gas, produced by acting on saltpetre, or nitrate of soda, by strong sulphuric acid. But that portion of the sulphurous acid which escapes condensation is afterwards condensed in columns of coke, previously exhausted, as described in a former patent (Nov. 3, 1845), "for improvements in the manufacture of sulphuric acid," or by means of a high chimney.

AREA GRATINGS.

Richard Marvin, of Portsea, Southampton, gentleman, and William Henry Moore, of Southsea, gentleman, for "*Improvements in gratings of metal or wood, for the fronts of houses and general purposes, for the admission of light and ventilation.*"—Granted May 28; Enrolled Nov. 28, 1846.

Fig. 1. Fig. 2.



This invention relates to constructing gratings of wrought or cast metal, or wood, as shown in the annexed engraving; fig. 1 is a plan of part of a grating, and fig. 2 a section. The bars are fixed in the frame in such a manner that the top of one bar shall cover the bottom of the next bar. The length of the frame is regulated by the number of bars; it is 2 inches deep, and $\frac{5}{8}$ inch thick. The length of the bar depends upon the size of the required grating; the depth of each bar is 3 inches on the top side, and $3\frac{1}{8}$ inches on the under side; the thickness is $\frac{5}{8}$ inch on the top edge, gradually reduced to $\frac{3}{8}$ inch in the middle, immediately beneath which it is reduced to $\frac{3}{16}$ inch, and then gradually reduced to $\frac{1}{8}$ inch at the bottom. The distance from one bar to another is $1\frac{1}{4}$ inch at the top, which is increased to $1\frac{3}{8}$ inch at the bottom.

HOUSE PAINTING.

Harold Crease, of Brixton-hill, Surrey, paper stainer, for "*Improvements in the preparation of paints and colours for decorative and other similar purposes.*"—Granted July 23, 1846; Enrolled January 23, 1847.

The invention relates to the preparation of colours, whereby they are rendered suitable for painting "flatting or dead white;" the colours so prepared will be free from any offensive smell, dry quickly, and be ready to receive a second coat within an hour after the application of the first. The improvements consist in combining shellac, gelatine, and animal or vegetable oil, with an alkaline base, and incorporating this mixture with ordinary paint, in the following manner:—Boil $2\frac{1}{2}$ lb. of well-bleached shellac and $\frac{1}{2}$ lb. of borax, or other suitable alkaline base, in five quarts of water until dissolved; the boiling to be continued until the solution is reduced in bulk to about one gallon. To one quart of this solution, from half a pint to a pint of pure gelatine, according to its strength, and four drachms of alcohol are added, and gradually incorporated therewith by the application of heat. The mixture is then added to the remaining portion of the solution, together with the requisite quantity of white lead to give it a body, and a small quantity of well-bleached oil; the latter ingredients being added in the proportion of 9 lb. of white lead and two ounces of oil to each quart of the solution. This mixture is ground in an ordinary paint mill, and afterwards thinned with a solution of shellac: it is then ready for use. The preparation is applicable to all colours used by painters, excepting a few containing iron.

GAS APPARATUS.

Augustus William Hillary, Esq., of Chelsea, gent., for "*Improvements in the manufacture of gas.*"—Granted July 23, 1846; Enrolled Jan. 23, 1847.

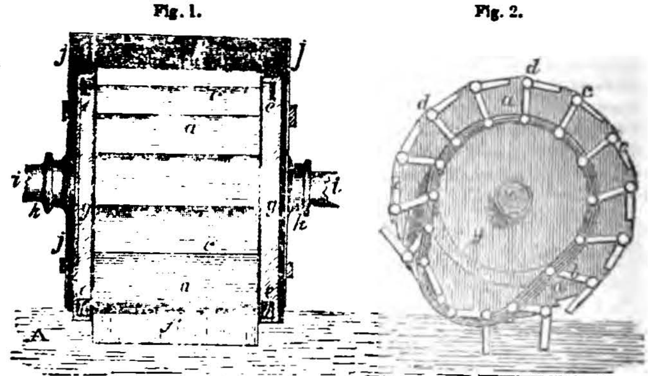
The objects of the improvements are, first, for separating the condensible matters from the gas at one operation; secondly, for converting bituminous matters into gas; thirdly, for decomposing the condensible matters, by passing steam over them in the heated tubes; fourthly, the obtaining from the pitch, tar, &c., matters capable of enriching the gas. These objects the patentee proposes to obtain by the arrangement of apparatus, consisting, first, of a retort, which is of an oval form in front, with one end rounded, and within which are placed, lengthwise, three parallel tubes, reaching nearly the whole length; the ends of the tubes towards the back are open. The tubes contain, to about three quarters of their length, twisted plates of metal or other suitable material. From the centre one of these tubes, which is larger than the other two, a tube rises to a considerable height, and then turns downward again in the ordinary manner of refrigerators, the end dipping into a condenser. This condenser is a rectangular receiver divided into eight compartments. The tube above mentioned dips into the first of these compartments, from this again another tube passes to an equal height with the first, and dips into the second compartment, and so on throughout the several compartments to the last in the series; from which a tube passes into the hydraulic main. From the ends of the two latter tubes above described, two smaller tubes rise and enter the front of the condenser; these tubes have such a form that by a bend in the horizontal portion, it acts as a syphon, and prevents the gas rising from the retort by these channels into the condenser. From the back of the condenser there is a syphon, which can be opened or shut at pleasure; this syphon, if required, will conduct the tar and ammoniacal liquor to the furnace.

When the charge of coal in the retort is being decomposed, the gas and vapours formed pass (by the middle tube above described) up and down the series of pipes in the refrigerator, depositing the tar and other condensible matter in the condenser, from which the fluid matters, viz., water containing ammonia and sulphurous acid, and tar, flow by the two syphons first above mentioned, into the two tubes within the retort; here, coming in contact with the heated metal plates, these waters, the patentee states, are decomposed; the metal becoming oxide of iron by the decomposition of the watery vapour, at the same time that the free hydrogen unites with the carbon of the pitch and tar, it forms a superior gas. Coal contains besides sulphur, ammonia; the steam in passing over the oxide of iron formed in the tubes, enables it to absorb a larger quantity of sulphur. In this manner the metal is converted into sulphur of ammonia and iron, and the gas sufficiently purified for ordinary purposes; but if it be used in private houses, it is to be further purified by passing it through sulphuric acid, diluted with three proportions of water, and then through lime before entering the gasometer.

PROPELLERS FOR STEAM VESSELS.

Peter Claussen, of Leicester-square, Middlesex, gentleman, for "*Improvements in methods of an apparatus for propelling and exhausting and compressing air and aeriform bodies.*"—Granted July 23, 1846; Enrolled Jan. 23, 1847. (Reported in the *Patent Journal.*)

Fig. 1. Fig. 2.



This invention relates to propelling vessels from the stern. With this view, the patentee employs horizontal propeller shafts, attached to the pistons of two steam cylinders; the ends of these shafts, which pass through stuffing-boxes into a watertight casing, are affixed to frames or chases, subdivided into twelve or more compartments, for the reception of an equal number of swing floats, which open one way, to admit of little resistance to the return stroke. These propellers, which move in a line vertical with the rudder of the vessel or boat, are thrust or driven, by the action of the steam piston, forward in the direction with the line of motion of the vessel or boat; the mode of reversing being the alteration in the direction of the float boards to the required direction. The patentee claims under the first head of his specification the mode of, or apparatus for, propelling boats or vessels from the stern by suitable means hereinafter described.

The second part of the specification relates to the mode of an apparatus for propelling vessels or boats by the means of circulatory revolving paddles. In constructing float wheels according to this invention, instead of applying float boards to hollow frame wheels, the patentee attaches them to cylindric drums having suitable recesses formed in their peripheries for their reception. Fig. 1 represents an end view of the improved wheel, and fig. 2 a sectional side elevation taken through the dotted lines, A B. *a a*, is the cylindrical drum which may be of metal or any other light substance, such as cork, wood, or otherwise. *b b*, are float motion rods, attached at right angles by the hinge or joint *d*, to the float boards *c c*. *e e*, are small friction rollers, which turn on centres at the ends of the motion rods *b b*, for the purpose of directing the position of the float boards; *g g*, are slottled bridles or guides, in which the friction rollers *e e* travel; these, rollers, when moving concentric with the drum *a a*, remain stationary, but when they diverge into the eccentric channel *h h*, they cause the free use of the float boards to move outwards, till, on arriving at a point coincident with a vertical line drawn through the centre of the drum, they present the whole of their surfaces to the water, as seen at *f*; *i i*, is a crank shaft passing through stuffing boxes, *k k*; *j j*, is a water-tight casing, enclosing the paddle-wheels. The inventor states that wheels so constructed are to be placed in the hold of a vessel or boat, on each side of the keel, transversely, and driven by steam or other motive power engines; and he claims under this second head of his invention, the mode of, or apparatus for, propelling vessels or boats, by circulatory revolving paddles, as hereinbefore explained.

The third part of the specification relates to the construction of vessels or boats formed with bottoms of double curves and double bilges, the object of which is to enable those on board to ballast the vessel or boat when necessary; for this purpose the patentee employs an air-pump in connection with a bulk-head, or longitudinal channel in the hold of the vessel or boat; each boat or vessel having double curved bottoms, with double bilges, are formed like two boats or vessels placed side by side; these double curved bottoms are boarded over, forming the floor of the vessel or boat, and between which an air-pump and suitable apparatus is employed to drive the bilge water out, or let other in: the action of valves opening outwards as well as inwards causing the water (by a pressure of air from the air-pump, on the surface of the same, between the bulk-head or longitudinal chamber) to be driven out through the bilge at the bottom of the vessel. The inventor claims under this third head of his invention, the method of, or apparatus for, constructing vessels with double curves and bilges, for purposes of ballasting, or driving the bilge water from the vessel or boat, through suitable valves in the bottom of the vessel or boat.

The fourth part of the specification relates to the mode of, or apparatus for, propelling boats, vessels, barges, carriages, and vehicles, by the means of pulley wheels attached to the vessel, or carriage, to be propelled, and driven by steam or other motive-power, by fixing a rope or chain at each end of the road, or canal, and passing it over the pulley wheels in a suitable manner to be acted upon.

The patentee claims lastly, the mode of, or apparatus for, propelling vessels, boats, barges, carriages, carts, agricultural implements, and vehicles, by the application of wheels, pullies, ropes, or chains, for the purposes herinbefore described.

TESSELLATED WORK.

Henry Austin, and Thomas Webster Rammell, of 10, Walbrook, London, civil engineers, for "*Improvements in wood mosaic, and tessellated work.*"—Granted June 20; Enrolled, December 20, 1846.

The improvements relate, first, in the application to wood mosaic and tessellated work of an elastic and easily-compressible material, surrounding each separate square or tessera. Second, to the mode of putting together and forming such work when the tessera is square, with such elastic and easily-compressible material surrounding each square or tessera, as shown in figs. 1, 2, 3, 4, 5, and 6.

Fig. 1, shows a block of wood mosaic, and tessellated work, in its final state of preparation, with a full design or pattern running through it, and merely requiring to be cut into sheets of the required thicknesses, for use in the manner after described. Figs. 2 to 5 represent five different blocks of the various coloured woods, forming part of the design or pattern in fig. 1. Fig. 7 represents a block of the wood mosaic, and tessellated work, showing the introduction into the design or pattern of diagonal work.

Planks of convenient thickness, of well-seasoned woods, of the colours and descriptions desired, and as to colour, either naturally coloured or to be produced artificially, are to be taken at the stage of the manufacture hereinafter pointed out, and cut into separate pieces of a convenient length and width (say 9 in. by 4½ in.) They are planed to an exact thickness, corresponding with the size of the square or tessera of the intended mosaic, these pieces being regulated according to the design intended. Then sheets of cork are taken and carefully cut or prepared to a thickness in proportion to the size of the square or tessera, (about $\frac{1}{16}$th); the cork is then trimmed or fitted to the length and width of the before-mentioned pieces of wood; and pieces of wood and sheets of cork are then glued or cemented alternately together, forming them into different blocks, such blocks being regulated in number by the number of the compartments into which

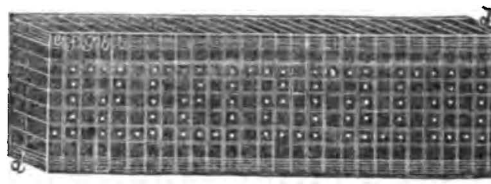


Fig. 1.

Fig. 2.

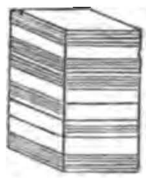


Fig. 3.

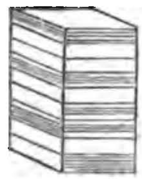


Fig. 4.

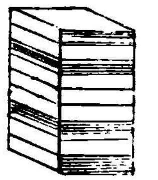


Fig. 5.

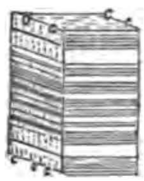


Fig. 6.

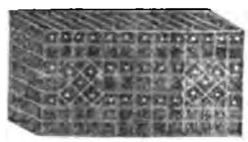


Fig. 7.

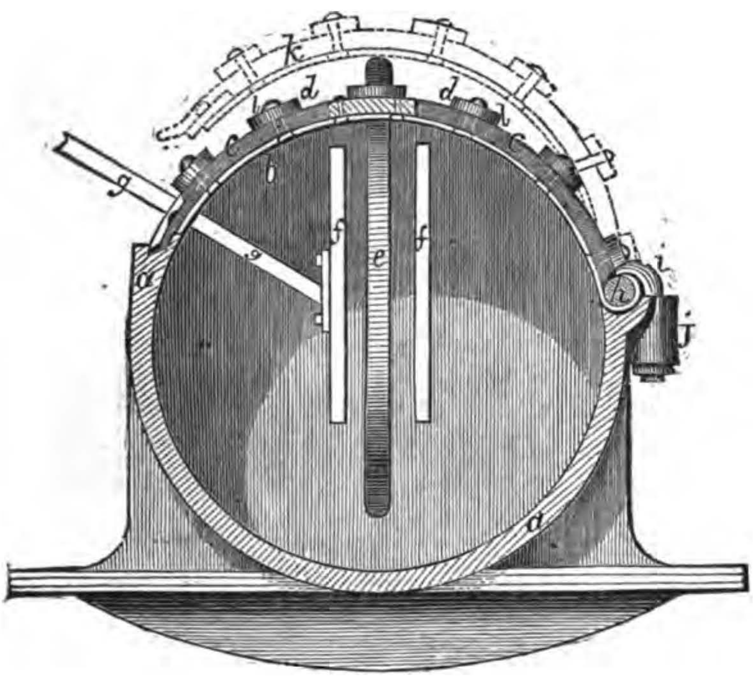
the intended design or pattern may be divided; for instance, in the design or pattern shown at fig. 1, the full design or pattern, it will be seen, is divided into, or consists of, five compartments, and there are, consequently, five of these blocks, similar to figs. 2 to 6, each block being confined to its distinct compartment of the full design or pattern, as shown at *e, f, g, h, i*, in fig. 1; and in forming and making up these blocks, the different coloured and description of pieces are to be arranged in the order required to form the pattern. These blocks are next cut up, arranged, and prepared, after the following manner, viz.:—when it is desired that the mosaic should be prepared with the grain or fibre of the wood vertical, or nearly so, first cut the blocks so arranged, in half, in the direction of the dotted line, *d* fig. 2, and then cut each of the halves into separate planks, or pieces of the required thicknesses, in the direction of the dotted lines, *b, b, b*, as shown in fig. 2; and when it is desired that the mosaic should be prepared with the grain or fibre of the wood horizontal, then cut the blocks so arranged across, in the direction of the dotted lines, *c, c, c*, as shown in fig. 6. Afterwards plane these separate planks or pieces to the exact size of the square or tessera of the work, and then proceed to make up the block of the full design or pattern, as shown at fig. 1, in the following manner:—take the plank from each of the separate blocks, 2 to 6, and then glue them together, in the order of the pattern and of the numbers of the blocks, with other sheets of cork cut and prepared, and of the thickness as before described, alternately together; then continue on as before, repeating the making up of the full design to the desired length of the block, as shown at fig. 1, as to which, about thirty inches will be found a convenient length. The block thus obtained is then to be sawn in the direction shown by the dotted line, *d, d, d*, into sheets of the thickness desired (say $\frac{1}{16}$ths of an inch), and each sheet will present precisely the same design or pattern, and each square or tessera be surrounded by the cork so introduced in the work as before mentioned, and be in a state for use according to the purpose for which it is intended, excepting that, in cases where wood to be artificially coloured is used, these sheets, or such parts of them as are intended to be artificially coloured, will first require to undergo that process, which is well known, it being at this stage of the manufacture that it is preferred to colour the wood when it is artificially coloured.

This mosaic and tessellated work is applicable to flooring, panelling, and veneering, for building purposes; also to all purposes of cabinet work, furniture, and useful and fancy articles for which veneers are now commonly used, and in the finer sorts, where the square or tessera does not exceed three-fourths of an inch, may be used as a loose covering. When used for the purpose of making floorings and wainscotings, or panellings against walls, it is preferred, before fixing it, to fasten each sheet of the mosaic, so prepared, upon a separate suitable ground-work or foundation; for this purpose a double set of thin boards, glued or cemented together transversely to each other as to grain, does extremely well.

When used as a loose covering, it is fastened on to a thin surface of papier maché, or felt, or a preparation of india rubber and cork, known by the name of kamptulicon, or other suitable material. The material we have named throughout the description already given of this invention, as the surrounding material for the square or tessera, has been confined to cork, and which is the material preferred by the patentees; but any other material which may be of an elastic or easily-compressible character, such as caoutchouc in its various states of preparation, or soft leather, papier-maché, felt, gutta percha, and other materials partaking of the like properties, will answer the purpose; some of the materials here referred to for surrounding each of the squares or tessera, may also be applied in a fluid, or soft, or plastic state, and poured or pressed in between the squares or tessera, instead of being applied in the way described.

In diagonal work, where the tessera of the mosaic is otherwise than square, it is to be made up in the usual way of preparing and forming inlaid work when made up into blocks, except that the elastic and easily-compressible material before described all round each tessera, is introduced; and where combined with work in square tessera, as shown at fig. 7, the principle of making up the pattern is applied, when formed of square tessera as already described, as far as it may be practicable.

Fig. 1.



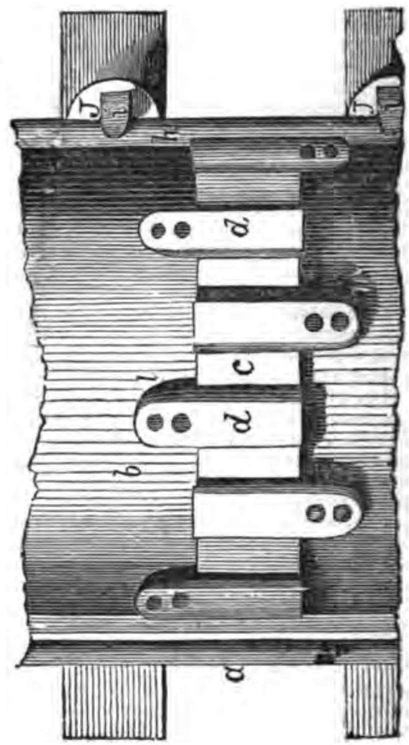


Fig. 2.

ATMOSPHERIC RAILWAY TUBES.

William Warcup, of Ashton-terrace, Coronation-road, Bristol, civil engineer, for "*certain Improvements in the manufacture and arrangement of parts and apparatus for the construction and making of atmospheric railways.*"—Granted Aug. 11, 1846; Enrolled Feb. 11, 1847. (Reported in the *Patent Journal.*)

This invention relates to an improved method of manufacturing the traction tubes for atmospheric railways, in which the driving pistons work these tubes, which are of cast iron or other suitable metals, made in the ordinary manner, but differ only in the construction of the longitudinal valve, which is formed of different segments (answering a double purpose, by forming the top portion of the traction tube as well as the longitudinal valve), each segment being formed by layers of flexible material, such as india-rubber, leather, or other elastic substance, placed between metal plates of given lengths, admitting by its flexibility a free passage to the piston rod. Fig. 1 represents a transverse vertical section, and fig. 2 a plan view of the top, showing the longitudinal valve; *a a* is a cast iron tube, or traction pipe; *b* is a metal segment of the longitudinal valve; *c c* is the outer segment or flexible portion of the same; *d d* are four lifts, two of which are attached by their ends to one side of the segment, *l*, and the two alternate ones to the other, *m*, by which it will be seen that, as they press upon the flexible substances, *c c*, they keep the joint, indicated by the dotted lines, hermetically sealed; *e* is a lifting valve wheel, which travels with the piston on the frames, *f f*; *g* is a piston motion rod, which is attached to the carriage, when motion is given to the piston by an external atmospheric pressure; the wheel *i* raises, as the piston advances, the alternate segments of the valve, shown by the dotted line *k*, forming an open channel for the transmission of the arm *g*; *h* is a circular bar or hinge, on which the valves turn; *r r* is a belt or loop, passing through the semicircular bearing *j*, and over the rod or hinge, *h h*. The inventor states that he does not confine himself to the whole of the details herein given, so long as the important peculiarity of his invention be retained; but he claims the use of an atmospheric tube, divided longitudinally into two parts, whether connected by hinges or not, and forming a complete tube, ready for exhaustion when closed, the longitudinal connection and joint between the top and bottom parts of the tube being effected without having recourse to the elasticity of the material of which the tube is composed, or the intervention of an elastic or flexible material, to form a hinge, as at present used in the construction of Clegg and Samuda's, closing entirely by the weight of the upper parts, without the assistance of springs or other mechanical contrivance. He claims also the longitudinal ribs forming the abutment for the top valve, or the other half of the tube.

METAL ROLLERS.

Thomas Payne, of Handsworth, near Birmingham, gentleman, for "*Improvements in the manufacture of rolls, for rolling iron and other metals.*"—Granted August 4, 1846; Enrolled February 4, 1847.

This improvement relates to the mode of rolling iron and other metals. Heretofore the rolls have been cast with necks or axles at their ends, which are liable to be broken when in use; and it has also been attempted to cast rolls on to bars of iron, to strengthen the axles or necks; but in such cases the inventor states that bars of iron so used are much injured, and being weakened, are unfit for such purposes. The patentee proposes to cast the rollers of any given size required, hollow, so as to admit of the shaft or axis being passed through, and fixed therein by keys or otherwise; care being taken in casting that the hollow space within a roller is cast or formed truly, so that the shaft when introduced shall fit accurately, allowing spaces for driving in wedges or keys at the end of the roll, which keys should be securely retained from moving by shrinking wrought iron collars on the shaft or axles; the working journals are turned in the wrought-iron shafts, after keying on the rolls, and the surfaces of the rolls turned; by which means of manufacturing rolls for rolling iron and other metals, the inventor is enabled to obtain them with stronger necks or axles. The wrought-iron shafts or axles are passed through hollow rolls, which the inventor prefers to be cylindrical openings in the cast iron rollers, but he does not confine himself thereunto, as other shapes may be used. The claim is for the manufacture of hollow cast rolls for rolling iron and other metals, and fixing thereunto wrought-iron shafts or axles, as described.

GAS METERS.

ALEXANDER ANGUS CROLL, of Suffolk-street, Clerkenwell, for "*Improvements in gas-meters.*"—Granted May 13; Enrolled November 13, 1846.*

The improvements relate to the use of a tumbler apparatus for actuating the valves of dry-gas meters with one partition, which approaches to and recedes from the plane of attachment to the side of the meter, but does not pass through the same; so that the flexible material whereof the diaphragm is partly formed, is bent only in one direction. The improvements consist in the application of an apparatus for working the valve, which depends for its action upon the use of a tumbler, so formed, that on being moved to a point just beyond the horizontal or central position, the tumbler will fall over and instantly change the position of the valve.

Fig. 1, Plate VI. is a vertical section of the improved meter; fig. 2, a vertical section, taken at right angles to fig. 1; fig. 3, is a horizontal section, taken on the line A, B, of figs. 1 and 2; and fig. 4, is a plan, top plate removed; *a*, the central part of the diaphragm, formed of metal, and *b*, the flexible material, fastened to the edge of the part *a*, and to the side of the meter at *c*, *c*; the part *a*, is so large that it cannot pass beyond the point *c*, where the outer edge of the flexible material is secured, but simply advances to and recedes therefrom; hence the bending of the flexible material will only be upon one surface. The diaphragm is supported in a vertical position by the frame *d*, *d*, which is jointed to it, and to the upright rod *e*, supported by the arm *f*, which is fixed on the vertical spindle *g*; the diaphragm is guided in its movements by the rods *h*, *h*, the lower ends of which are connected by short links to the part *a*, and their upper ends are suspended by a horizontal rod *i*, (inserted through them), from two arms *j*, *j*, fixed to the upper side of the cylindrical portion of the meter. Upon the top of the spindle *g*, is fixed an arm *k*, carrying a roller, which, being moved to and fro within the inverted arch *l*, on the tumbler tube *m*, will cause either end of that tube, alternately, to be raised from a depressed position to a point beyond the horizontal, when the weight, preponderating at the other end, will occasion the instanstaneous descent of that end, and this movement is communicated to the valve by the means hereinafter described;—the tumbler-tube falls on a spring *n*, at either side, and thus any shock is prevented. The tumbler-tube contains quicksilver, but shot may be substituted, and the tumbler apparatus may be otherwise varied, and yet retain the same character of action.

o, is an arm, fixed to the tumbler, and provided with a fork *p*, which acts on a plate or arm *q*, on the axis of the valve *r*, and by this means the position of the valve is changed at each movement of the tumbler, which, as will be readily understood, derives its motion from the reciprocating action of the diaphragm, communicated to it through the agency of the parts *d*, *e*, *f*, *g*, *k*, and *l*. The valve *r*, is contained in a valve-chest *s*, (to prevent the gas from coming into contact with the works in the upper part of the meter) into which the gas enters from the supply pipe through the passages *t*, *u*; by the movement of the valve, the gas is alternately admitt d on either side of the diaphragm, and, after acting upon it, proceeds through the passages *v*, *w*, to the pipe leading to the burners. The motions of the diaphragm are registered by means of a detent or driver *x*, on the upper part of the spindle *g*, taking into a ratchet-wheel *y*, connected with an ordinary registering apparatus or index.

* The description of this patent was accidentally omitted in last month's Journal; the engravings are there given.

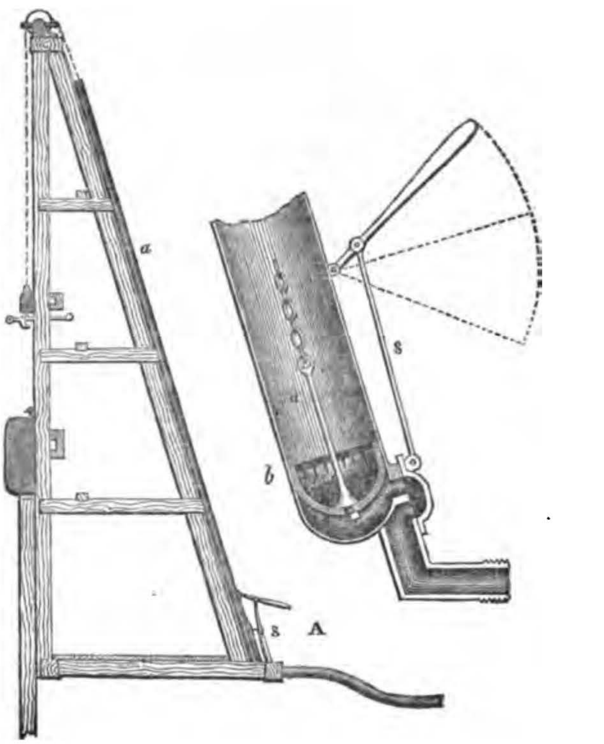
IMPERMEABLE SOLUTION FOR STONE.

FRANÇOIS TEYCHENNE, of Red Cross Square, Cripplegate, feather merchant, for "*Improvements in treating stone, to render it hard and impermeable, and in colouring the same.*" (A communication.)—Granted Aug. 6, 1846; Enrolled February 6, 1847.

The improvements relate to rendering soft and porous stone impermeable to moisture, and coloring the same by immersing the stone in a boiling solution consisting of coal tar, pitch, bitumen, tallow, and other fatty substances, in the proportion of 85 parts tar, 10 bitumen, 3 tallow, and a small portion of linseed oil. The ingredients are boiled in a suitable vessel, and when they boil the stone is placed on a frame, and lowered into it. The period allowed for the stone to be soaked through is from 8 to 48 hours, according to the size, or if it be only desired that the solution should penetrate the surface, two hours will be sufficient for every inch in depth. Some description of very porous stone will not become filled by a long continued boiling: for such stone there is to be added to the above mixture carbonate of lime, such as chalk or marble, iron rust, granite, and potters' clay, in fine powder; this latter mixture is to be applied to the surface of the stone with a hot iron. If it be required to have the stone of a light colour, instead of tar apply resin of the lightest colour, mixed with turpentine, oils, and all kinds of gum, in the proportion of 15 parts resin to 80 of turpentine, and if the stone is to be of a clear white colour, add white lead, zinc, and carbonate of lime—if any other colour is desired, add to the last compound the dyes usually employed by painters.

CLARKE AND VARLEY'S PNEUMATIC PILE-DRIVER.

The pneumatic pile-driver, which has been erected on the premises of the inventors, is of the full working power, being 36 feet high, the air tube *a* 17 inches diameter, and the monkey weighing 16 cwt. The engine and



air-pumps at present in use are very inadequate to the proper working of this powerful machine, and the air-pumps are only 10 inches diameter—still, even with these, a vacuum is obtained, sufficient to raise the monkey to the summit in one minute; and, by opening a valve *s* below the piston *b*, for the admission of air, it instantly descends; yet such is the perfect control under which it is held, that it can, by the operator at the valve, be arrested in its descent at any part of its fall. There is no time lost in the descent of a catch, as in the old plan—the chain connecting the monkey with the piston being constantly attached, and can be, of course, lengthened or shortened, according to the height of the fall required. The diameter of this tube being 17 inches, the area is nearly 227 inches; and thus allowing only 10 lb. pressure to the inch, this diameter of piston, *b*, would raise a monkey of considerably greater weight.—*Mining Journal.*

The Art of Glass Painting has sustained a loss by the death of M. S. Frank, who died lately at Munich, aged 77. He was one of the first who made experiments for resuscitating several ancient methods of glass staining, which had been lost during the lapse of centuries. Thus, he had been called, in 1818, to Munich, to assist the establishment of the Royal Institution for Glass Paintings.

PROGRESS AT THE NEW HOUSES OF PARLIAMENT.

Our readers will be glad to know what is the actual position of these works; and we are enabled to satisfy them, having recently had occasion to make a hasty survey for ourselves. The fittings up of the House of Lords and of the adjacent apartments proceed apace; and the House itself begins to assume its finished appearance. The details are most gorgeous. No works of modern times can compare with them; yet the impression is one of subdued magnificence. The wood-work is nearly completed and fixed, and the heraldic painter is busy. He is now chiefly employed in inserting the arms of the Lord Chancellors, which are in process of being painted on the upper parts of the pannels along both sides of the chamber. The blank spaces of the walls, to be hereafter painted in fresco, are temporarily hung with crimson drapery, powdered with golden crowns, roses, &c. The reporters' gallery fronts the throne, and is almost as prominent and ornamental an object as her Majesty's seat. The brass railings of the gallery are fitted. This leads into the corridors for Lords and Commons. The many doorways ingeniously form part of the lower panelling of the jambs of the windows. Mr. Barry seems to have heated the rooms without Dr. Reid's aid. We found them of a very agreeable temperature. No stained glass has yet been permanently fitted. Some has been tried;—and the effect is said to have been excellent. It is, we believe, in preparation by Mr. Hardman of Birmingham. The antechamber of the House of Lords, next the throne end, is almost completed:—so is the public hall at the opposite end. In the first, the style of decoration is almost as elaborate as that of the House of Lords itself. Above a fire-place, we observed a large pannel of sculptured wood-work, representing Queen Philippa pleading for the burgesses of Calais. It did not impress us very favourably, on a rapid glance. The position of Edward III., with his crossed legs, looked graceless. In the public hall, we were struck with the magnificence of the floor; on which Minton's Encaustic Tiles—in colours of red, yellow, and cobalt—are in process of laying down. In the centre is a red and white rose of marble, surrounded by brasswork enamelled: and the borders of the tiles are judiciously marked by lines of black Derbyshire marble. The outer gates of the House of Lords are visible from this hall. They are of brass,—and very beautiful is their workmanship. Here, too, the windows are to be of stained glass—but none is yet fitted. These are the only parts of the building which give an idea of what the whole will be when finished.—The House of Commons is very backward—not even roofed in. The central tower is beginning to be seen above the surrounding buildings; and the groining of the arch of the Victoria Tower is turned.—*Athenæum.*

REVIEWS.

First Series of Railway Practice; a collection of working plans and practical details of construction in the public works of the most celebrated engineers. By S. C. Brees, C.E. Third edition, with additional examples. London: Williams & Co., 1847. 4to, pp. 164. Plates.

Of the former editions of this work we have already given favourable reviews. The present edition has had its value considerably increased by numerous improvements and additions. It is a thick quarto volume, handsomely printed and illustrated by seventy folio steel plates, which occupy the greater part of its bulk. These illustrations are not merely showy useless specimens of steel engravings, but have been got up with regard to direct practical utility as well as clearness and neatness of execution.

It might have been of advantage, perhaps, to have made the letter-press explanations more copious. They contain notices of the construction, cost, dimensions, &c., of the different railway structures represented. There are 42 drawings of works on the Birmingham Railway, consisting principally of bridges, retaining walls, and details of tunnel works. Among the subjects of the plates for the Grand Junction Railway, is the aqueduct for the Bridgewater Canal; for the South Eastern Railway, the timber pier in Folkestone Harbour, and the reservoirs and tanks at Tonbridge; for the Greenwich Railway the large 26 feet turnplate at Greenwich with details.

As another series of illustrations of "Railway Practice" is promised, one or two hints for slight improvements may, perhaps, be allowed. In the present work many of the engravings are insufficiently explained, and of several no explanation whatever is given. The specifications for contractors, from which copious extracts are made, are not always trustworthy, as alterations in the plan of operations sometimes occur during the progress of the works. At all events, it would always be more satisfactory to state what had been actually carried into effect, and the difficulties encountered in the undertaking, than to copy out the specification. The latter plan is the easiest, but not the most useful. Lastly, there ought to be a good index, referring not only to the plates, but to the letter-press also. In reality, however, these drawbacks are very slight, for the work is indeed admirably illustrated, and quite worthy of the expense and labour bestowed upon it. To the practical engineer, so large a collection precedents of railway construction must be of great and permanent utility.

Select Writings of Robert Chambers. Vol. I. Essay I. London: Orr, 1847. 12mo.

This book does not fall within the scope of our Journal, but from what we can see, seems to contain some well written familiar and humorous essays, by the well-known Edinburgh writer, Mr. R. Chambers. The essay on English ingenuity and enterprise, in a new point of view, is particularly good.

Algebra made Easy. By T. Tate. London: Longman & Co., 1847. 12mo.

This is a small work by the Mathematical Master of the National Society's Training College, Battersea, and is intended to lead the pupil, by an easy transition, from the principles of arithmetic to those of algebra, and is the best adapted for the purpose intended of any that we have seen.

An Introduction to the Present Practice of Surveying and Levelling; with an Appendix. By a Civil Engineer. London: J. Williams & Co., 1846. 8vo.

The author has treated the subject in a clear and simple manner; his method of keeping the Field book is good. The Appendix might have been left out, as it adds to the bulk of the work, without any adequate advantage. The method of getting up a survey is well explained. The work is illustrated with nine plates.

NEW CORN EXCHANGE, BIRMINGHAM.

It has been determined to erect a new Corn Exchange in Birmingham, immediately behind the St. George's Coach Office, in High Street, between Carr's-lane and Castle-street. The plans have been prepared by Mr. S. Hemming, architect; the building will consist of a hall, 110 feet long by 40 feet wide, lighted by a semi-circular roof, surmounted by a lantern, extending the whole length of the hall. The room will be 50 feet in height, and will be divided into side compartments by pilasters, between which stands and tables, intended to be let to farmers and dealers, will be placed. It is to have a glass roof of semi-circular shape, as the best suited to admit the greatest quantity of light. According to a local paper, this spacious room will have two doors, one leading from a vestibule, with columns and ornamented ceiling, at the entrance of St. George's-court, in High-street, the other with a still larger vestibule at the Castle-street entrance. A porch, ornamented with pilasters of the Roman Doric order, will form the High-street entrance; that by Castle-street, which will be the principal front, will be enriched with eight columns, and ornamental recesses leading to the vestibule and to the floor beneath, which it is proposed shall be appropriated to the exhibition of agricultural implements. The building is of the Roman Doric order, in cement. The extreme length of the building will be 167 feet, the width varying from 37 to 40 feet. The builder is Mr. Briggs, and the cost will be 5,000*l.*

MOULDED BRICKS.

"In a county like ours," says a correspondent of the *Bury Herald*, "where there are no quarries and so many clay pits, and where consequently stone is so dear and scarce, and bricks, both red and white, so common, I rather wonder that brick is not more used for the finer mouldings, in the place of stone. In former times, and it might be equally so now, mouldings of all kinds were highly ornamented, frames to windows, porches, chimneys, &c., were made of brick. Besides being much cheaper, and quite as durable as stone, they had this advantage,—that the most intricate patterns could be made nearly as cheap as the plainest; and also that any colour might be used, if not in the brick itself, yet on the outside and burnt in. White brick round the windows, or at the corners of houses, proves a good foil to shaped flints; red brick to white, and *vice versa*. I shall mention one or two instances of the use of moulded bricks. Westhorpe hall, one of the first buildings of this class, was erected by Brandon, Duke of Suffolk, about the year 1500, who resided there with his wife, a king's sister and widow. Though hardly a remnant even of the ruins remains, yet fragments turn up which show the beauty of the brick mouldings. They are of a very hard and compact white brick, which retains its original sharpness, and some of them, having the Duke's crest in relief upon them, still ornament a bridge of the same date as the hall. The other example is West Stow Hall, built by the same duke, the gatehouse of which is a noble specimen of brick building. As an example of the use of brick mouldings in churches, I may name Ixworth Thorp, a doorway of which church has its mouldings and circular arch, formed of red brick."

NOTES ON FOREIGN WORKS.

State of the Gallery of the Louvre, and of French Art in general.—M. Clarac, conservator of the antiques of the French national gallery, has lately died—a loss much to be regretted. The count was the author of the catalogue of antiquities, most valuable also, on account of the fine and accurate description of the materials (metals, stone, &c.), of which the ancients constructed their buildings and ornaments. It is true, that M. Clarac owed much to the notes of his predecessor, M. Visconti—still, the digestion and arrangement are his. The French press blame much the choice of his successor, attributing it to court influence and his seat in the House. They complain also that no care is taken of securing new acquisitions to the Gallery, and speak of antique bronze Silens, &c., purchased lately by either millionaires or Englishmen. These general complaints have become the more pungent, as the works and ideas of Winckelmann seem to acquire great influence in France, and the public naturally expect, that persons so well provided for from the public purse, should be those to continue the researches of that great German art-critic.—A still greater opposition and schism is observable in the department of painting, where a most mediocre catalogue (analogous to that common-place index of the British Museum), is placed in juxta-position with that of the lamented M. Clarac. The very exhibition of the Royal Academy, and still more its prize decisions, are threatened with a most determined opposition; and the first painters have resolved on submitting no more to such a tribunal, and not to send any more pictures to the exhibition. It has been a matter of surprise, that men like Ary Scheffer, Delacroix, Decamps, &c., should have quailed under the dictates of a secret tribunal; and it is quite natural that they, and other painters and sculptors, have resolved on forming an exhibition of their own—that of the artists of Young France. Amongst the most telling members of this opposition is one, of a strong and original mind—M. Barye, the sculptor. His groups in bronze, candelabras, &c., are highly spoken of—and it is much to be regretted, that he is not in the position for exerting himself on some larger work, being neither a knight, nor a F.R., or R.A.

The Paintings and Carvings of St. Bavon, Ghent.—This celebrated ancient edifice seems to have become, of late, a sort of *art-stones*, out of which anything was sold to the highest bidder. In consequence of which, the Belgian legislation have decreed, that no *public* establishment should be allowed to *sell* their objects of art! It is said, that a speculator had, at first, sold some Van Eycks to a German museum for 400,000 francs.—One of the most celebrated Flemish carvers was François Flamand, whose bronzes, terra-cottas, and carvings in wood, are admired in many collections. The two famous altar-pieces of St. Bavon are now in Paris. They also had become the object of judicial litigation between the sellers and the public authorities. They resemble, rather, small chapels, being 12 feet by 15 feet. They are crowded with ornaments of architecture in the Flamboyant or the Florid Gothic style. The one is of 1504, and represents the Life of the Virgin, in four episodes. Most of the figures are worked out in *ronde-bosse* or alto-relievo. The second altar-piece represents the Life of St. Bavon, or St. Benoit, consisting of six very complicated compositions. The style of these carvings, enveloped in festoons and garlands of flowers, and thousand-fold foliage interwoven and interlaced, is very interesting, combining the stern style of Catholicism with the more lively forms of the Renaissance.—The present state of wood carving in France is not encouraging. Except the chair of St. Vincent de Paule, executed by M. Duseigneurs, no other real artistic work of the kind is to be met with. It is not the fault of art, as France possesses some superior statuaries,—but of the public, who have become, it seems, insensible to all but the most flimsy and tawdry productions of art.

M. Violet Leduc, the Restorer of Notre Dame, Paris.—This gentleman, to whom the thorough restoration of that huge building has been intrusted by government, at an expense of one million francs, has been attacked in various ways, of late, by the opponents of Gothic architecture. To this, he has answered in a most triumphant way—asserting, very justly, that *every* real and genuine style of art is good, *if* properly, judiciously, and gradly carried out. The lovers of Gothic architecture have, moreover, lately gained another triumph, in consequence of the municipality of Paris having decreed the erection of the church of Ste. Clotilde in the Gothic style, whose piles are rapidly rising, and promise to be a new ornament to the French metropolis.

Cornelius and Humboldt.—It is now certain that M. Cornelius was obliged to decline the offer of undertaking the frescoes for the internal decoration of the Houses of Parliament at London; previous engagements at Berlin left him, indeed, no alternative in this respect. He has just completed the sketch of a medal, which the King of Prussia intends to present to M. Humboldt as a token for his great work *Cosmos*. The drawing represents the Genius of Science lifting the veil of Nature, personified under the image of a beauteous maiden. The different branches of natural sciences are appropriately represented, and to show clearly that much yet remains unrevealed, a sphynx is seen, to which the Genius points as the object of future inquiries. On the reverse, a likeness of M. Humboldt will be engraven.

Restoration of the Cathedral of Speyer.—This *mummyary* of the old German Empire is to be restored, by order of the King of Bavaria. The cathedral, one of the oldest in Germany, bears some traces of the Byzantine style, and vies in size even with that *ne plus ultra* of mediæval buildings, the Dome of Cölln. The German press speaks highly of the grandeur of the style in which the restoration is contemplated: the architect is the well known Gärtner, of Munich. The frescoes are entrusted to M. Schraudolf, who has already exhibited his vocation for works of high art, in the St. Boniface and All Saints chapels at Munich. Beside him stands Schwarzmann, for the ornamental decoration of the cathedral. The paintings of the vaulted ceiling of the huge choir are already sketched, and the gold ground of Byzantine style completed; and the rich ornamental work of Schwarzmann shows, how this thinking artist knows judiciously to co-ordinate himself and his work to the great *ensemble* to be achieved. The spring will see the completion of the tower, and the lateral choirs and nave will follow in due succession. The principal painting will represent the Life of the Virgin Mary, and that in the southern choir the Life of St. Stephen; the northern choir will be adorned by the deeds of St. Bernard, who preached, in the 12th century, in that very same cathedral, the second Crusade! The figures will be either painted on the gold ground, or be separate fresco paintings. This restoration will add much to that wreath of nature and art beauties, by which the banks of the Rhine are so attractive to every sensible mind.

A New Rudder for Large Ships.—M. Fouque, magazineer of the French navy, has submitted to the minister of marine the plan of a new rudder, which has been applied on board the corvette *La Recherche*. The commander of this vessel having certified to the secretary of state, that it was preferable in several instances, and also on account of its solidity, to those in general use, his excellency has given orders to apply M. Fouque's rudders to two vessels of the Port of Toulon, destined for long voyages, in order to try their effect under different climes and latitudes.

Haven of Swinemünde, Prussia.—The government are doing everything towards making this harbour convenient to their own and foreign shipping, as its situation is most advantageous. A large dyke has been constructed, by which the hitherto shallow and sandy embouchure of the Swine has been deepened to upwards of 20 feet, and made accessible even to ships of war. Of late, the bed of this river also has been deepened to 16 feet, from Swinemünde to Stettin. Fortifications, also, in case of war, are contemplated.

Gas Lighting at Nüremberg.—We extract the following as a curious specimen of German tenders and contracts: "The gas-manufactory to be completed within the space of a year, so as to supply 300 lanterns—fine for each week of delay in completing contract—£30. The persons hitherto employed in the lighting of the city, to be retained by the new company. The city will require, in all, 530 lights, and a length of pipe of 75,000 feet; the sixth part of the lights to be employed as candelabras, each to cost £7; the lanterns, £3 10s. Each light for public use to be calculated to burn 1,400 hours a-year, and 5,000 cubic feet of gas to be kept in reserve. The conducting pipes, which will be subject to a pressure of ten atmospheres prior to being used, are to be calculated for 6,000 lights, at 4½ English cubic feet of gas to be consumed per hour. Each flame of that size has to possess (as ascertained by Rumford's photometer), seven times the strength of a ½ lb. wax candle. Each of such flames is to be paid for at the rate of 23 fl. 30 xr. (£2), for the yearly calculated burning space of 1400 hours. Private individuals pay for 1000 cubic feet of gas for 25 years, 6 fl. 15 xr., and quantities of gas are also to be had by the gas meter. If purchased without contract, any number not exceeding five lights costs 37 fl.; not exceeding ten, 47 fl.; from forty to sixty, 100 fl., and so on." It is said that the burgomaster of Nüremberg is a very *good calculator*; and so it would appear from this contract, of which we have only given the most important part.

Over-Zeal of Art Collectors.—A very considerable theft of Pompeiian antiquities, frescoes, and bronzes, has been of late discovered in the Museo Borbonico, at Naples. This questionable acquisition was destined for the London market, and was already on board ship for exportation. The throng of travelling collectors, however, throughout Italy is quite astounding, and antiquities are much dearer in Rome and Naples than they are in the Strand or Wardour-street.

The Moving Mountain near Unkel on the Rhine.—Prof. Nöggerath, of Bonn, has delivered a lecture on this curious phenomenon (*ante* p. 63),

by which he has proved that no volcanic agencies—fire or hot vapours—have occasioned the fall of the mountain. It is merely a land-slip, occasioned, however, by very complicated causes, resulting from the upheaving of mountains or hills composed of basalt or basaltic conglomerations. Large sections were exhibited by Prof. Nöggerath, which he will, no doubt, publish.

Neapolitan Railways and Steamboats.—The activity and progressive tendencies of these have been very great of late. Even ancient Nola is now reached by a side branch of the great Apulian line. An especial communication with Calabria has been established; so much so, that the fine gulf of Palicastro, Cosenza, Catanzano, and the bay of Squilace, become acccessible to the curious. All this greatly advances the commerce of the country, and not only taverns and inns, but clubs and festivals, increase; and last but not least, agrarian, historical, and archæological societies, and the latest works on Calabria by Spinelli, Grimaldi, &c. are very reputable productions.

Materials of Ancient and Modern Structures.—Ancient: basalt—syenite—porphyry—granite—marble—freestone—alabaster—lapis lazuli—verde antico—agate—jasper—pozzolana—cedar—oak—sycamore—Corinth brass—copper—gold ...... For which the *Moderns* have substituted, in most cases—deal—reeds—cows' hair—paper and papier maché—canvas—glue—paste—pasteboard—plaster of paris—leather—glass—loam—sand!—[Isis of Oken.]

NOTES OF THE MONTH.

Gradual Elevation of the Land at Plymouth.—Attention has recently been drawn to elevations or depressions of the land, with reference to the medium sea level. "In our own immediate neighbourhood," says the *Plymouth Herald*, "proofs of these elevations may be seen. If we land upon the N.E. point of the Mewstone, there is a bank of debris resting upon a stratum of rolled pebbles of all sizes; this raised beach being sheltered from the breakers, remains as an evidence of a change of the relative levels of the Mewstone and sea having taken place. Passing from the Mewstone to the mainland, and coasting round the Sound, we find a succession of these beaches in the cliffs, about 15 or 20 feet above high-water mark; they may be seen at Bovisand, under the Hoe, near Redding Point and Cawsand. But we have other evidence of elevations,—submarine limestone rocks are every where perforated and honeycombed by *Pholades*. About low-water mark and downwards they are every where found alive, but higher up we find them dead; and as high as high-water mark their cells may in some localities be seen. These animals can only live below the mean level, requiring to be altogether under water, or at least covered by every tide. Now, when we find the empty cells of these creatures in the solid limestone rocks under the citadel, but at such a height as would preclude the animals from living in them, we can only infer that the rocks have been raised, or that the sea level has been depressed. Many of these cells may be seen in our locality. The writer had occasion to land a few days ago near the Blockhouse, and directly under the battery at Devil's Point; here he observed that there had been a fissure in the limestone, and a portion of the rock had been removed, leaving a vertical surface of the solid limestone exposed to view. This part of the rock is covered with the cells of the *Sexicava Rugosa*, and above the ordinary high-water level, thereby leaving proof that our shores have been rising slowly and imperceptibly; the place is easily accessible, and anybody may see the spot referred to. If the land be still rising, our harbours will become more shallow; the system now pursued of observing and recording tides and soundings will ultimately settle the point, if engineers will only have the liberality to admit the possibility of former as well as future observations being made correctly."

Thermogenic Drawing.—A scientific correspondent of the *Liverpool Journal* has given the following ingenious mode of transferring the forms of natural objects or the patterns on ribbons to paper:—Saturate common writing paper with porter, coffee mixed with sugar and cream, or a solution of achill, then place the object whose form is to be transferred on the prepared paper and expose them to the action of the sun's rays or those of a common fire. Various other solutions may be used for the same purpose, as bicbromate of potash, yellow chromate of potash, &c. When figured satin ribbons are saturated with such solutions and exposed to the sun's rays, the raised patterns are given in beautiful relief in a lighter tint of the same colour as the ground. The principle is capable of a very extended application.

Powerful Voltaic Battery.—Mr. J. Goodman, at the Royal Society, stated that he had succeeded in constructing a voltaic arrangement of some power by fixing a piece of potassium to the end of a copper wire, placed in a tube containing naphtha, and bringing it in contact with a small quantity of mercury, held by a layer of bladder closing the lower end of the tube, which was itself immersed in acidulated water immediately over a piece of platinum, and then completing the circuit by establishing a metallic contact between the copper wire and the platinum. This battery acted with energy on the galvanometer, and effected the decomposition of water. A series of twelve pairs of similar plates exhibited a sensible attraction of a slip of gold leaf. Thus it appears that the substance which possesses the highest chemical affinity manifests also the greatest power of electrical tension.

The Wave of Translation in connexion with the Northern Drift.—Dr. Whewell, in a memoir lately read at the Geological Society, after referring to the northern drift, and the causes that had been suggested for explaining its phenomena, and stating the meaning and properties of the wave of translation, proceeded to discuss some of the results of its operation. He assumed for this purpose a certain quantity of material to be distributed within a given area, and showed by simple calculation different expressions for the amount of paroxysmal force that would be needed. He considers, however, that paroxysmal force is necessary; but that a movement, although small, will, if sudden, produce effects resembling those to be accounted for. He concluded by observing, that a wave of translation differs but little from the *débâcles* assumed by earlier geological speculators.

A good Non-Conductor of Heat.—Mr. J. Nasmyth stated lately, at the Geological Society, an instance of the low conducting power of clay and sand, in which a thickness of half an inch of such matter intercepted the heat of a mass of eleven tons of white-hot melted cast iron for twenty minutes, without the heat on the outside of the vessel being sufficient to pain the hand.

Professor of Mechanical Engineering.—The Council of University College, London, have instituted a professorship of the Mechanical Principles of Engineering, and appointed Mr. Eaton Hodgkinson to the chair.—J. Sowerby, B.A., of Trinity College, has been appointed to a mathematical tutorship in Bishop's College, Calcutta.—Robert Thwaytes, B.A., of Christ's College, Cambridge, has been appointed Professor of Mathematics and Natural Philospby at Hooghly College, India.

Rouen.—The beautiful ruins of the Abbey which was built at Jumièges, near Rouen, by Robert, one of our early Archbishops of Canterbury, it is stated have been lately purchased, for the purpose of preventing their destruction, by an architect named De Caumont, a relative, we believe, of the M. Adolphe de Caumont, of Caen, who some years ago bought the Abbey at Savigny, near Avranches, for the same good purpose.

Aerial Locomotion—At the Paris Academy of Sciences. Feb. 1., M. Babinet, in his own name and that of MM. Poncelet and Séguier, read a paper recently presented by M. Van Hecke, of Brussels, on a new system of aërial locomotion. M. Van Hecke formally renounces the idea of seeking for a *point d'appui* in the air to navigate against the wind. His system consists, like that of Meusnier, in seeking, at different heights, currents favourable to the direction which he may wish to take. Meusnier thought he should be able to effect this by compressing or dilating the air in his balloon. M. Van Hecke has found a more simple means of ascending and descending without loss of ballast or gas. He has invented an apparatus analogous to wings, and which he has placed under the eyes of the committee. With this he has an ascending or descending force equal to from 2 to 3 kilogrammes; but with four of these motive powers applied to his car he would have a force of from 10 to 12 kilogrammes,—and with a large apparatus he might reach 100. The report of the committee is favourable to the principle of the discovery.

New System for Propelling Vessels.—Extract of a letter from Boulogne, in the *Herald*, announces that "a considerable degree of interest has been excited here by certain experiments made upon an entirely new system for propelling vessels; which, if capable of being carried out upon a large principle, must not only supersede paddle-wheels, but also the Archimedean screw. It has long been considered a matter of impossibility that the principle of the paddle-wheel could be rendered of any useful effect when totally submerged. The present invention has demonstrated to a certainty that such a disadvantage can be overcome. The experiments were effected by hand labour; the motive force being fitted into the stern of a pilot boat.—The principle is based on the well-known properties of the parabola as respects light, and the same properties are proved to be true as respects hydrostatics. The blades are sections of a parabola; and are so constructed as to impinge on the concave surface, whereby the water is grasped and compressed to the centre of the axis, and thrown off in a direct line with the plane of the vessel's course,—thereby rendering the propulsion superior in efficiency to the common paddle-wheel, being uniform and continuous without drawback in respect of back-water. Another advantage exists in the area of surface as compared with the screw; as less than one-half of parabolic areas will work more efficiently with the same power."

Hamburg.—Dec. 19.—"Mr. George Giles, who during the last eight years has been actively engaged in constructing the Hamburg-Bergedorf railway, the new sewage and water works, the navigation locks, canals, bridges, &c., quitted us on the 16th inst., to enter on a more extended field of professional occupation in England. Previous to his departure, he had the gratification of experiencing the high estimation in which he is held by all branches of our government and a large circle of friends. Our Senate presented to him a decree of that venerable body, expressive of their unanimous thanks for his zealous exertions on their behalf; this was accompanied by the large honorary medal, intended as a special token of their grateful recollection of Mr. Giles's heroism, energy, and skill in conducting a series of explosions at the dreadful fire of the 5th to the 9th May, 1842, which devastated nearly the one-fourth part of our ancient city. On the 14th inst., a large meeting of gentlemen, comprising senators, members of the board of works and board of exchequer, the directors of the Hamburg-Bergedorf railway, and several other of our most influential citizens, invited Mr. Giles to a grand dinner at Streit's Hotel, on which occasion they presented him with a handsome piece of plate, and an address, testifying their high appreciation of his professional and private worth; expressing at the same time their deep regrets at his retirement from among them."—*Hamburgh Paper.*

King's College Engineering Society.—A Society has been instituted by the students of the Department of Applied Sciences, King's College, London, for the purpose of the reading of Essays, the taking in of the various scientific publications, and forming a library of works connected with the Department. There is at present a small library, quite inadequate to the purpose, and we are surprised the Council of the College have not provided the students with a better one. The students have been much assisted in the formation of the Society by the Rev. M. O'Brien, M.A., Dean of the Department, and by the other Professors.

The Royal Academy.—In the Architectural department the Gold Medal and the Discourses of Reynolds and West, will be given for the best design for a Gothic church, the whole comprised in one general and regular composition. The design must be as large as an entire sheet of double elephant will admit, and to consist of a plan, elevation, section, and perspective view. A Silver Medal will be given for the best figured drawing of the entrance and interior of the Temple Church.

Photographic Portraits.—Continued improvements are being made in photography. The latest which we have to record is the work of Mr. Kilburn, who has opened an establishment in Regent-street, where the specimens on view are among the most perfect that we have yet seen. The principal improvement is in colour, which, in Mr. Kilburn's portraits, has not the prevailing defect of faintness, but possesses the depth and body of a finished painting. This quality renders a portrait valuable as a work of art, which is otherwise rarely the case—the likeness being generally the only recommendation. Indeed, the process of colouring requires the same care and skill as in an ivory miniature. Nor is this attention ill bestowed, for the distinctness thus given to the subject has hitherto been a great desideratum, the polished surface of the picture in most cases requiring a peculiar direction of the light in order to distinguish its details.—*Daily News.*

Westminster Abbey.—It is stated that the Dean and Chapter of Westminster have very laudably determined on restoring to the tombs of Queen Eleanor and King Henry V. the rich old contemporary iron-work, taken down on the recommendation of Sir Francis Chantrey, sold at so much a cwt. to an ironmonger in Westminster, and subsequently rebought by the Dean and Chapter, and allowed to rust in an adjoining vault. This iron-work forms an integral part of each monument—the sculptor and smith generally working, in mediæval times, in the same spirit and to the same end. Chantrey's reason for recommending the removal of the whole of the iron-work throughout the Abbey was, that it too often served as steps or ladders to the Westminster boys to mutilate noses, &c., merely from wantonness; and to over curious collectors to climb to portions of monuments otherwise beyond their reach. In many of the modern monuments the iron-work was erected merely for protection, and not unoften disfigured the monument it was placed before. Here the recommendation was judicious, but when it was extended to mediæval monuments, a piece of barbarism was committed not likely, we think and trust, to occur again.—A paper on the same subject was read at a late meeting of the Freemasons of the Church, by Mr. John Brown. He stated that in the Blaize chapel, in the Abbey, is deposited the iron canopy which formerly surmounted the beautiful tomb of Queen Eleanor. Neale, in his "History of Westminster," mentions that "since the coronation, a considerable improvement has been effected in the interior appearance of the Abbey Church, by a general cleaning of the monuments and the removal of the iron-work which screened them." Now, at this coronation, which must have been that of George the Fourth, the iron-work not only of the tomb of Queen Eleanor, but that of Henry V., were placed in the dark recesses of the Blaize chapel, where they have been seldom viewed by parties who have visited the Abbey. The tomb of Henry V. is at the east end of the chapel; the head of the king, which the vergers say was made of silver, was taken away in the time of the troubles. Neale says "*all the damage in the Abbey was not done in the time of the troubles.*"

OBITUARY.

We regret to record the death of the distinguished artist, William Collins, R.A., which took place on the 17th ult., at his residence, Devonport-street, Hyde-park-gardens. Mr. Collins was in his 59th year. Critics in art associate the name of Collins with everything that is pleasing in rural life. "Children picking Hops," "Children gathering Blackberries," and "Children examining the Contents of a Net;" with everything that is connected with the life of a fisherman on the sea coast, "Fishermen coming Ashore before Sunrise," "Fishermen on the Look-out," and "Fishermen getting out their Nets." Mr. Collins was the son of a picture dealer and cleaner—a man of ready wit—but best remembered by his "Life of Morland, the Painter." His son William was born in 1788, and exhibited for the first time at the Royal Academy, in the year 1809, at the age of twenty-one. In 1815, he was elected an associate of the Royal Academy, and in 1829 a royal academician. A very considerable alteration was made by Mr. Collins in his style and manner of painting after his visit to Italy in the years 1837 and 1838. Like his friend Wilkie, he became ambitious of greater efforts, and visitors at the Academy were surprised to see an old favourite quitting his sea-shore scenes, his muscle gatherers, and shrimpers, for "The Two Disciples of Emmaus," and "Our Saviour with the Doctors in the Temple." The latter picture is now at Bowood, the seat of the Marquis of Lansdowne. The head of Christ is uncommonly poor—the heads of the doctors finely painted, but rather vulgarly conceived. The colouring is very powerful and harmonious. But it is not by his more ambitious efforts that Mr. Collins will be tried; some of his sea-shore scenes are exquisitely true to nature: and his "Rustic Civility," (boys opening a gate,) and his "Happy as a King," (a boy swinging on the top of a gate,) are incidents happily conceived and charmingly painted. His "Fetching the Doctor," in the exhibition of 1845, possesses a quiet humour different altogether from any of his former efforts. Mr. Collins received a large price for his pictures.

RAILWAY INTELLIGENCE.

Trent Valley.—The works on this line are fast advancing towards completion. The tunnel is driven through, and nearly all bricked, and in a few days will be finished. All the cuttings are done, as are also all the bridges, and the whole of the line will be completed in a few weeks; but as it will be necessary to let the works consolidate, the 1st of May has been named by the directors for opening.

Dundalk and Enniskillen.—The works on this line are in such a forward state that it will be opened for passengers in November next.

Londonderry and Enniskillen.—This line, between Strabane and Derry, is nearly completed, and about to be opened.

Communication between Trieste and the Rhine.—The governments of Austria and Bavaria have come to an agreement for establishing direct railway communication from Trieste to the Rhine. The agreement is to extend to Salsburg the line from Trieste to Vienna, on which the Austrian government is actively employed, and afterwards carry it as far as Munich.

Cost of constructing Railways in France.—The financial reports presented to the French government by the engineers charged with the construction of the three railways in the centre of France, give the following estimate of the expense. The section between Vierzon and the confluence of the Allier and the Loire, the length of which is 32,194 metres, will cost 5,600,000f., or 173,945f. per kilometre. The section from Vierzon to Chateauroux, of the length of 59,691 metres, will cost 8,260,000f., being 138,379f. per kilometre. The section from Chateauroux to Limoges, the length of which is 76,419 metres, will cost 15,000,000f., or 196,286f. per kilometre. These three sections will therefore cost 28,860,000f., including the compensation for ground, works of art, guard-houses, &c.

Railway from the Adriatic to the North Sea.—Extract of a letter from Vienna: "The establishment of a railway from the coast of the Adriatic to the North Sea will probably meet with no other obstacles than those presented by the immense extent of the line and the nature of the soil. At present it is difficult to decide whether this line will be finished sooner than that from Marseilles to the Dover Straits, We, however, think that the German line will be the first completed, from the fact that several large sections are already constructed, viz.: from Cilley to Bruck, from Munich to Augsburg, from Bruchsal to Manheim, from Bonn to Cologne, and from Cologne to Ostend. Bavaria displays the greatest activity in uniting its railways with those of Austria by the frontier of the circle of Salsburg.

Amiens and Boulogne.—Opening of the Abbeville Section.—This line, which will offer such facilities for intercourse between Paris and London, as it unites with the Northern line at Amiens, is in such an advanced state that the opening of the Amiens and Abbeville section is fixed for the 1st instant. This section is 45 kilometres in length, and is divided into seven stations, viz.: Amiens, the point of departure, Aily, Picquigny, Hangest, Longpre, Pont Remy, and Abbeville. The company has just submitted to the superior administration its rate of charges for passengers, parcels, fish, merchandise, &c.

Rouen and Havre.—The council of *ponts et chaussées* has not yet come to a decision respecting the further tests which are to be applied to the viaducts on this line to determine the solidity of the works. In the meanwhile, however, the company is making active preparations for opening the line in the beginning of this month. The intended rate of charges has been submitted to the authorities. The length of the line is 95 kilometres, and there will be the following 11 stations:—Rouen, Maromme, Malawnay, Barentin, Panilly, Mollivile, Eyvetat, Alvimare, St. Romain, Harfleur, and Havre.

London, Brighton, and South Coast.—The Lords of the Admiralty have given their sanction to the proposed alterations in connexion with this line at Newhaven harbour. The works on the line are rapidly progressing in several parts, and the works at the harbour will commence immediately.

The Birkenhead and Chester Extension will, it is said, be opened on the 31st of March.

Reading and Hungerford.—The branch line of rail from Reading to Hungerford, through Newbury, is rapidly progressing, and it is expected will be fully completed for the general traffic by the first of June. The branch line will be 26 miles in length.

Ipswich and Bury.—Extension to Norwich.—Mr. Locke has completed a re-survey of this line, by which it has been much improved, and the work and time for completion has been diminished. The contract for the entire line has been let to Messrs. Brassey. Active operations upon the heaviest part of the line will commence immediately.

Waterford and Limerick Railway.—The Treasury minute has been received, authorising the above company to construct 30 miles of earth-works. Thus will many thousands be employed immediately on a truly reproductive work, and the labour-rate will cease on the baronies through which it passes—at least in a great measure. Twenty-eight miles of this railway opens from Limerick to Tipperary on the first of May. The engines and carriages are ready; the latter were all manufactured in Ireland.

Aberdeen.—The greatest activity prevails at the present time on nearly all the contracts taken of this line. From Aberdeen to the south a commencement has already been made. The contractors for the bridge to be erected over the Manse of Fellresso have already broken the ground, and a strong muster of workmen have been placed on the works. On the contract extending from Glennery distillery to Black-hill, there are at the present time nearly 200 labourers employed, and four of the cuts are nearly ready for the wagon-work. On the contract extending from Black-hill to Elsick, there are a great number of men employed; and, on what is termed Forbe's contract, there are upwards of 1,000 men engaged.

Leeds and Bradford Extension.—The railway between Shipley and Keighley is progressing rapidly, with the exception of that part near Bingley Church, called the Bingley Bog. Sixty tons of earth and stones are cast into this bog every hour of the day. The earth and stones on the east end are conveyed by steam from the Nobwood, and from the west by horses. Notwithstanding this immense quantity being dropped into the gulf at both ends by three lines of rails, all is swallowed up every morning; the heavy matter sinking thus, forces the lighter up, and makes a black spongy embankment on both sides.

German Railways.—The *Deutsche Allgemeine Zeitung* of the 27th of January, contains a review of the statistics of German railways, of which the following is an abridgment:—At the commencement of the present year, the entire length of all the German railways which are regularly open to circulation was 592 geographical German miles, of which 26 are tram-lines, 173 belong to various governments, and 419 to private companies. Out of the 173 miles of state lines, Austria possesses 64¾; Baden, 35½; Bavaria, 31¾; Brunswick, 15¾; Hanover, 12¾; Hesse-Darmstadt, nearly 6¾; Wurtemberg, rather more than 5; and Frankfort, somewhat more than ⅔. The private lines are possessed by 29 companies. The longest is the Lower Silesian one, which is 51·44 geographical miles, and runs from Berlin to Breslaw, with a branch line to Hennersdorf. The next in length is the Emperor Ferdinand North Railway (40·92 miles), extending from Vienna to Brunn, Olmutz, Leipnik, and Stockerau. The Berlin and Hamburg line is 36·89 miles; the Upper Silesian (from Breslaw to Myslowitz), 36·98 miles; the Budweis Lints and Gmunden Korse line, 26·13 miles; the Berlin and Stettin, with a branch line from the latter to Stargard, 22·63 miles; the Berlin and Cothen, 20·51 miles; the Berlin, Potsdam, and Magdeburg, 19·63 miles; the Vienna and Gloggnitz, with branch lines from Modling to Laxenburg, and from Vienna to Bruck, on the Leitha, 16·14 miles; the Magdeburg and Leipsic, 16·1 miles; the Leipsic and Dresden, 15·48 miles; the Altona and Kiel, 14·29 miles; the Saxo-Bavarian (from Leipsic to Reichenbach, with a branch line to Zwickau), 14·13 miles; the Rhenish (from Cologne to Aix-la-Chapelle and the Belgian frontiers), 11·57 miles; the Thuringian (from Weissenfels to Weimar), 11·50 miles; the Saxo-Silesian (from Glogau to Sagan), 9·67 miles; the Breslaw and Freiburgh, 8·96 miles; the Cologne and Minden (from Deutz to Duisburg), 8·84 miles; the Magdeburgh and Halberstadt, 7·84 miles; the Taunus (from Frankfort to Mainz and Wiesbaden), 5·85 miles; the Rendsburg and Neumunster, 4·41 miles; the Dusseldorf and Elberfeld, 3·57 miles; the Anhalt and Bernburg, 2·33 miles; the Cosel and Ratibor, 4·25 miles; the Bonn and Cologne, 3·95 miles; the Gluckstadt and Elmshorn, 2·92 miles; the Hamburg and Bergedorf, 2·17 miles; and the Nuremberg and Furth, 0·81 mile. Twenty out of the 36 states of Germany have railways at present. There are only two railways which are completely finished, and provided throughout their entire length with double lines—the Leipsic and Dresden and the Magdeburg and Leipsic. The number of tunnels on the German lines open to circulation are 16, of which 5 are on the Rhenish Railway, 2 on the Wurtemberg; 4 on the South Austrian (between the Gratz and Cilley); 3 on the North Austrian (between Olmutz and Prague); 1 on the Bavarian state line (at Erlangen), and 1 between Leipsic and Dresden. The longest is on the Rhenish, at Konigsdorf, between Cologne and Aix-la-Chapelle, being 5,160 feet.

Italian Railways.—The section of the railway from San Giuliano to Pisa has been opened, and the whole line from Pisa to Lucca is thus open to traffic. The average number of passengers between San Giuliano and Pisa was computed at 512 daily. The company of the Lucca and Postoja Railway held a second general meeting on the 30th October. The report of Engineer Pohlmayer was read, who has been appointed by a Bolognese company to study the continuation of the Appennine railway between Poretta and Bologna. According to his report the works between Lucca and Altopascio, a length of 13,700 metres, are in an advanced state, and this section will probably be thrown open to the public next spring.—The works are also going on actively on the Sienna Railway.

Whitehaven and Maryport Railway is open for goods, and to be opened for passenger traffic on the 1st of March.

German Railways.—On the 6th ult. an experimental train went from Hanover to Harburg, situated on the left bank of the Elbe, nearly opposite to Hamburg. The line will be open to the public on the 1st of May next. The section from Hanover to Minden, which will complete the Berlin and Cologne Railway, is also expected to be opened this year. As soon as this line is completed, there will be railway communications between Paris, Berlin, Hamburg, Breslau, and the Austrian frontier.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM JANUARY 21, TO FEBRUARY 19, 1847.

Six Months allowed for Enrolment, unless otherwise expressed.

William Breynton, of the Inner Temple, London, Esq., for "certain Improvements in rotatory engines."—Sealed January 21.

Francis Preston, of Ardwick, near Manchester, spindle-maker, for "certain Improvements in machinery or apparatus to be used in the preparation of cotton and other fibrous substances for spinning."—January 23.

Frederick William Jewett, of Burton-upon-Trent, Stafford, engineer, for "certain Improvements in telegraphic communications."—January 23.

Clemence Augustus Kurtz, of Manchester, Lancaster, manufacturing chemist, for "a new manufacture of a certain colouring matter; to be used in the dyeing or in the printing of woollen, cotton, silk, and other fabrics."—January 26.

Richard Walker, of Rochdale, Lancaster, cotton spinner, for "certain Improvements in the apparatus for the manufacture of gas for illumination, which said improvements are applicable to the manufacture of other products of distillation."—January 26.

William Phillips Parker, of 48, Lime-street, London, gentleman, for "Improvements in bell machinery." (A communication.)—January 28.

Thomas Webster Rammell, of 12, Dorset-place, Dorset-square, Middlesex, civil engineer, for "Improvements in the preparation and application of cork for linings and other useful purposes."—January 28.

Elizabeth Oudinot Latel, of Addle-street, London, for producing a certain texture elastic in some parts." (A communication.)—January 28.

James Taylor, of Furnival's Inn, Middlesex, gentleman, for "an Improved apparatus for boring into the earth." (A communication.)—January 28.

Peter Armand Lecomte de Fontainemoreau, of 18, New Broad-street, London, for "certain Improvements in the process and apparatus for treating fatty bodies and the matters producing them, such process and apparatus being equally applicable to the treating several other substances, and also for the process and apparatus necessary for the useful applicable of all those products."—January 28.

John Law, of York-place, Portman-square, Middlesex, gentleman, for "Improvements in yarns, and the machinery by which the same are manufactured." (A communication.) —January 28.

John Braithwaite, of 39, Bedford-square, Middlesex, civil engineer, for "certain Improvements in heating, lighting, and ventilating."—January 28.

Thomas Barnabas Daft, of Birmingham, gentleman, for "Improvements in constructing inkstands, and in fastenings to elastic bands."—February 1.

Richard Albert Tilghman, of Scott's Yard, Bush Lane, in the city of London, for "Improvements in the manufacture of certain acids, alkalies, and alkaline salts."—Feb. 1.

Edward Newman Fourdrinier, of Cheddleton, in the county of Stafford, paper manufacturer, for "Improvements in apparatus to be used for raising and lowering weights from mines and other places."—Feb. 1.

John Thompson Carter, of Drogheda, in the county of the town of Drogheda, in Ireland, flax-spinner, for "Improvements in machinery for crushing, bruising, and preparing flax, hemp, and other fibrous materials requiring such treatment."—Feb. 1.

Marco Henry Fransoni, of Carrara, but now residing at Pelham Place, Brompton, Middlesex, sculptor, for "Improvements in obtaining and applying motive power."—Feb. 1.

Benjamin Dawson Morton, of Cranford Bridge, Middlesex, gentleman, for "certain Improvements in cranes, and other hoisting and lowering machinery."—Feb. 1.

Uriah Clarke, of Leicester, in the county of Leicester, and Henry Barber, of the same place, fuller and dresser, for "certain Improvements in the manufacture of looped and woven fabrics."—February 1.

William Pidding, of Bernard-street, Middlesex, gentleman, for "an Improved mode of exhibiting and protecting certain coloured fabrics, ornamental inscriptions, and other designs."—Feb. 2.

George Grundy, of Manchester, manager, for "certain Improvements in furnaces, and in flues and tiles used in the construction thereof."—February 8.

Christopher Vaux, of Frederick-street, London, gentleman, for "Improvements in storing and supplying beer, ale, and porter."—February 8.

Thomas Brown Jordan, of Belvidere-road, Surrey, for "certain Improvements in machinery for working mouldings."—February 8.

Thomas Du Boulay, Esq., of Sandgate, Kent, and John Du Boulay, Esq., in the county of Dorset, for "Improvements in fitting up granaries and warehouses, and of getting into condition and preserving therein grain, pulse, seeds, malt, and other perishable articles." —February 8.

William S. Kennedy, of Burslem, porcelain manufacturer, for "Improvements in attaching plain or ornamental surfaces of earthenware, china, or glass, to articles made of metal, wood, or other materials."—February 8.

John Loach, of Birmingham, brass founder, for a "certain Improved fastening, or certain improved fastenings, for windows, shutters, doors, and tables; applicable also as a fastening or fastenings generally."—February 8.

Alexander Doull, of Euston Grove, Middlesex, civil engineer, for "certain Improvements in railway, steamboat, and other signals."—February 8.

Stephen Geary, of No. 10, Hamilton-place, New-road, Middlesex, for "certain Improvements in obtaining and applying motive power."—February 8.

John Gedge, of 4, Wellington-street, Strand, Middlesex, for "certain Improvements in the machinery or apparatus used for watering grain."—February 8.

Enoch Wilkinson, of Oldham, in the county of Lancaster, overlooker, for "certain Improvements in looms for weaving."—February 9.

William Eaton, of Camberwell, Surrey, engineer, for "Improvements in machinery for twisting cotton or other fibrous substances."—February 9.

Stephen Moulton, of Norfolk-street, Strand, gentleman, for "Improvements in wearing caoutchouc with other materials to produce elastic and impermeable compounds."—(A communication.) February 9.

Charles Hancock, of Grosvenor-place, Middlesex, gentleman, for "Improvements in the preparation of gutta percha, and in the application thereof, alone, and in combination with other materials, to manufacturing purposes, which improvements are also applicable to other substances."—February 10.

Alfred Brett, of Holborn-bars, gentleman, and George Little, of High Holborn, electrical engineer, for "Improvements in electric telegraphs, and in the arrangements and apparatus to be used therein and therewith, part of which improvements are also applicable to time-keepers and other useful purposes."—Feb. 11.

Egbert Hedge, residing at No. 7, Howard-street, in the parish of St. Clement Danes, Middlesex, gentleman, for "certain Improvements in rails for railways, and in the manner of securing them."—Feb. 12.

William Edward Newton, of No. 66, Chancery-lane, Middlesex, for "Improvements in aerial locomotion." (A communication.)—Feb. 15.

Solomon Leatham, of Leeds, York, overlooker, for "Improvements in roving and spinning flax and other fibres."—Feb. 15.

Francis Henry Waller, of Harrington-square, Middlesex, surgeon, for "Improvements in apparatus for making and filtering infusions of coffee and other articles."—February 16.

Robert Stirling Newall, of Gateshead, Esq., for "certain Improvements in locomotive engines."—February 16.

Phillip Henry Holland, of Chorlton-upon-Medlock, Manchester, for "Improvements in applying manure to land." (A communication.)—February 16.

Nathaniel Card, of Manchester, twine manufacturer, for "certain Improvements in machinery or apparatus for twisting, twining, or manufacturing cords, bands, and other similar articles from cotton, flax, hemp, silk, and other fibrous yarns or threads."—Feb. 16.

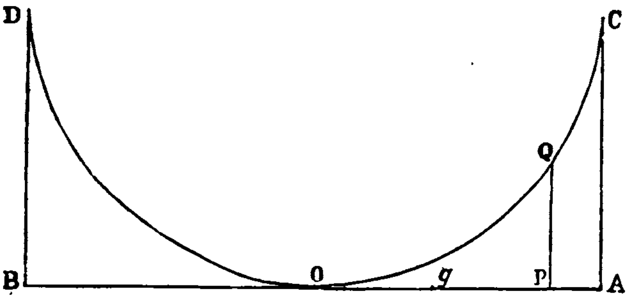
Francois Stanislaus Meldon De Sussex, of Millwall, Middlesex, for "Improvements in the manufacture of chlorine, hydrochloric acid, and nitric acid, and obtaining several products therefrom."—February 19.

Alexander Bain, of Upper Baker-street, Middlesex, electrical engineer, for "Improvements in clocks and time-keepers, and in apparatus connected therewith."—Feb. 19.

Thomas Breamwell, of Newcastle-upon-Tyne, manufacturing chemist, for "Improvements in furnaces and apparatus to render atmospheric air available in producing cyanides and certain other compounds, which improvements in furnaces and apparatus may also be employed for other purposes."—October 8, 1846.—[This patent was opposed by caveat sealed on the 31st January, 1847; but dated 8th October, 1846, the day the patent would have been sealed, if not opposed by caveat, by order of the Lord Chancellor.]

STRAIN ON THE PLATFORM OF A SUSPENSION BRIDGE.

In the following paper it is proposed to examine the nature and amount of the strain to which the platform of a suspension bridge is subjected, by its connection with the chains and piers, and a load equally or unequally distributed throughout its length. We shall assume that the platform is rigid, the curve of the chain a catenary, the links indefinitely short compared with the length of the platform, and the rods indefinitely close to each other and inextensible.



Let O, the centre of the platform, be taken for origin; the axis of the platform, which we suppose horizontal, for axis of x; and a vertical through O, for the axis of y. Let $d t$ be taken to represent the tension of the rod applied at point $(x\, y)$ of the chain; T the tension of the chain at that point; l the weight of a unit's length of chain,—then we shall have

$$d\left(\mathrm{T}\frac{dy}{ds}\right) = dt + l\,ds;\quad d\left(\mathrm{T}\frac{dx}{ds}\right) = 0.$$

$$\mathrm{T}\frac{dy}{ds} = t + ls;\ \text{and}\ \mathrm{T}\frac{dx}{ds} = c;\ \therefore \frac{dy}{dx} = \frac{t+sl}{c}.$$

But in the common catenary,

$$\frac{dy}{dx} = c's,\ c'\ \text{being an arbitrary constant;}$$

$\therefore t$ must $= \mu s$, where μ is some constant. Consequently, the resultant of all the tensions of the rods, attached to any portion of the chain, passes through the centre of gravity of that portion. If, now, the platform be supposed uniformly loaded throughout, and perfectly rigid, it would be impossible to determine whether its weight were wholly supported by the chains, or wholly by the platform,—or how it might be divided between them; but as the nature of the materials we are considering is only so far rigid, that neither the flexibility of the platform, nor the extensibility of the rods and chains, are supposed to be sufficiently great to affect the curve which the chains assume, a very little consideration will be sufficient to show that the weight of the platform will be so distributed, that the tendency to bend it will be a minimum. When the platform is unequally loaded, if we suppose the load not sufficiently great sensibly to deflect it, it will be hereafter shown that a pressure will be generated on that pier nearest to the centre of gravity of the platform. In practice, however, if the load were much increased and unequally distributed, the platform would bend, and the curve assumed by the chains would be modified; the point where the resultant of all the vertical tensions of the rods meets the platform, approaching nearer to the centre of gravity of the platform and load, and, in case disruption ensued, actually and suddenly coinciding with it.

To find the strain on any point of a platform equally loaded throughout:—

Let P be a point in the platform, and P Q vertical thereto; $AP = x$; $AO = OB = a$; $CQ = S'$ $QD = S''$

$W =$ weight of platform and load; $T' =$ tension of rods from P to A; K distance of the centre of gravity of CQ from P.

Let $T' = V\,S$, where V is determined from the equation $VS' + VS'' = W$.

Then the moment tending to turn AP about P, which measures the strain at P, is given by the equation—

$$\text{Moment of strain} = VS'K - W.\frac{Cx}{4a}.$$

If the load be unequally distributed,—

Let G be the centre of gravity of load and platform; S the whole length of the chain.

Then a pressure will be exerted where the platform rests on the pier nearest to G. Let $X =$ this pressure.

Taking moments about O, if $OG = h$; $Wh = aX'$; $W = X + VS$;

$$\therefore V = W\left(\frac{a-h}{aS}\right).$$

And for the strain at P, if $W' =$ weight of platform, AP, and its load,—

p the distance of its centre of gravity from P;

Moment tending to turn A P round P =

$$W\frac{h}{a}x + VKS' - W'p = W\frac{h}{a}x + W.\frac{a-h}{a}\frac{S'}{S} - W'p.$$

Deductions from the above formulæ:—

1st. When the platform is equally loaded throughout, the strain will be least when the chain has but a slight depression; for then, $V'S'K$ will most nearly, *cæteris paribus*, equal $W\frac{Cx}{4a}$.

2nd. The strain of a load, unequally and unsymmetrically distributed, will always be greater than the strain produced by the same load equally distributed.

J. H. R.

[In the remarks appended to Sir Howard Douglas's paper in our last number, it was observed that several topics were passed over for the sake of brevity. Lest it should be inferred that there were still wide differences of opinion (which is not the case), it may be remarked that the topics referred to were not of a controversial nature, and that this question of the strain on the platform of a suspension bridge was one of the most important of them.]

ON THE MOTION OF FLUIDS.

The discrepancy between theory and experiment in all problems concerning the flow of water has been universally acknowledged. This extraordinary fact has hitherto been accounted for on the supposition of the imperfect character of the fluidity of that liquid; whereas, as we shall presently show, it is not the water but the analysis—not nature but the philosophers who are at fault. In the present paper we shall point out some of the fundamental errors of analytical hydrodynamics, and endeavour to show how theory and practice can be reconciled. Some time since, one of the most eminent of living mathematicians pointed out to us the incorrectness of certain analysis connected with the motion of a wave along a canal, in which, as he clearly proved, the hypotheses adopted were inconsistent with themselves; that is, parallel motion and perfect continuity were assumed to co-exist. Our attention has since been more recently directed to the subject, and having taken Professor Miller's work as a text-book, we were astonished to find the same two assumptions vitiating the whole of the chapter on fluid motion.

In section V. of Miller, the first sentence runs thus—

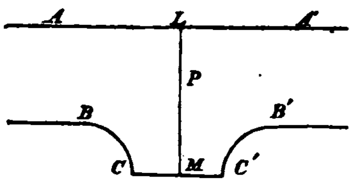
"When an incompressible fluid flows through a tube, the velocities of the fluid at any two points, are inversely proportional to the areas of the perpendicular sections of the tube at those points; supposing the tube to continue always full, and the velocities at all points in the same section to be equal to one another, and perpendicular to the section."

The two hypotheses with which this paragraph concludes are inconsistent. Let the tube be of variable bore and its axis straight, let this axis be the axis of x, and let u, v, w, be the velocities of any fluid particle parallel to the axes of x, y, z, respectively; then, by the equation of continuity for incompressible homogeneous fluids, we have

$$\frac{du}{dx} + \frac{dv}{dy} + \frac{dw}{dz} = 0$$

Now v and w both $= 0$, by the hypothesis; $\therefore \frac{du}{dx} = 0 \therefore u = c$, —which is absurd.

In determining the motion of water issuing from a *very* small orifice in the bottom of a cylindrical vessel, it is clear that the tube may be considered of unequal but continuous bore, how then can we find the quantity discharged from the orifice? This we shall endeavour to do approximately. We shall first however seek for the maximum velocity of the issuing stream near the orifice.



Suppose B B′ the orifice, A A′ a horizontal section of the fluid above B B′, taken at such a height above B B′, that all the fluid beyond A A′ may be considered at rest. L M the axis of the stream. P any point in L M. Then the motion at P may be supposed wholly vertical. Since L M is the axis of the stream, if then L P $= x$, v be the velocity at P, the density of water 1, and g the measure of the accelerating force of gravity, and p the pressure at P, we shall have

$$v\frac{dv}{dx}=g-\frac{dp}{dx}\;\therefore\;\frac{v^2}{2}=gx-p+\mathrm{C}.$$

Let now h be the depth of B B′ below the surface of the water in the vessel, the distance between B B′ and A A′ $= \delta h$, then we have

$$0=-g\,\{h-\delta h\}+\mathrm{C}-\pi,$$

because if $\pi =$ atmospheric pressure, $\pi + g\{h-\delta h\} =$ pressure at L

$$\therefore\frac{v^2}{2}=\pi+g\,x-p+g\,\{h-\delta h\}.$$

So far as p is concerned, the velocity will be greatest when p is least. Let k be the value of x when p has its least value, which is clearly π.

$$\therefore\frac{v^2}{2}=g\,\{h-\delta h+k\},$$

k and $d\,h$ being both extremely small. This expression becomes $\frac{v^2}{2}= g\,h$. This, as far as it goes, apparently agrees with the method of finding v, given in the books. We may remark, however, that in all demonstrations we have seen, the great error is committed of estimating the motion from the surface of the fluid, and assuming all particles in the same horizontal section to have the same vertical velocities. Now in fact p becomes discontinuous near the orifice, and when the orifice is indefinitely small passes suddenly from $p=g\,h+\pi$ to $p=\pi$, and consequently the equal number for v, which assume the continuity of p, cannot be applied without further adaptation.

To determine the velocity and quantity emitted at the orifice, requires an altogether different kind of investigation.

We shall here suppose that the tube is full, and that the fluid is vertically at rest within the vessel, even close to the opening; this, although not strictly correct, will be found near enough to give tolerably accurate results.

Let A $=$ area of orifice. At time t from the commencement of the motion,—suppose that if the jet had moved with a velocity in all its parallel sections equal to its mean velocity of projection at BB′, it would have extended to a small distance, x, from B B′. At time $t+\delta t$, let x become $x+\delta x$, then an additional quantity, $\mathrm{A}v\delta x$, has been shot out from the orifice in the time δt. Let R be the internal force that effected this; p the pressure on the jet;—then, since the only external force is $\mathrm{A}gh$ (neglecting $\mathrm{A}g\,x$ as extremely small),—

we have $p+\mathrm{R}=\mathrm{A}gh$;

and $\mathrm{R}\,\delta t=\mathrm{A}\,\delta x\,v$;

also, $\mathrm{A}x\delta v=p\delta t=(\mathrm{A}gh-\mathrm{R})\,\delta t=\mathrm{A}gh\delta t-\mathrm{A}v\delta x$.

$\therefore \mathrm{A}x\dfrac{dv}{dt}=\mathrm{A}gh-\mathrm{A}v\dfrac{dx}{dt}$. When the motion is steady,—

$$\frac{dv}{dt}=0,\text{ and }v=\frac{dx}{dt}.$$

$$\therefore v^2=gh.\quad\therefore v=\sqrt{gh}.$$

This is very near to the results of experiment,—If Q be the quantity discharged in time t,—

$$\mathrm{Q}=\mathrm{A}t\sqrt{gh}.$$

To determine the motion in a pipe of uniform bore:—

Suppose the tube inserted into a shallow reservoir of water kept constantly full; let the tube be straight, its diameter $= d$, and length $= l$; let $h =$ height of surface in reservoir above the point of efflux. When the motion is steady, let the mean vertical velocity of the particles in the reservoir, just above the point where the tube enters, be μ times the velocity in the tube. Now, it is found that the resistance of the tube varies as the square of the velocity, and that this resistance arises from the inequalities of the interior of the tube. If, therefore, $l =$ length of tube, and d the diameter, the absolute resistance will vary as $l\,d$; but the mass of fluid varies as ld^2.

Let now x be the distance of any point of fluid in the pipe from the point where the pipe enters the reservoir; then, by the time that x becomes $x+\delta x$,—a mass of fluid, $\pi\delta x d^2$, has had its velocity changed from μv to v.

Therefore, if R measure the force which accomplishes this—δt the time of x becoming $x+\delta x$—we shall have

$$\mathrm{R}\,\delta t=(1-\mu)\,v.\,\pi\delta x d^2;$$

$$\text{and, }\pi ld^2\delta v=\pi gh d^2\delta t-\mathrm{R}\,\delta t-e\pi ld\,v^2,$$

e being a constant determined by experiment;

$$\therefore\pi ld^2\frac{\delta v}{dt}=\pi ghd^2-(1-\mu)\,v\frac{\delta x}{dt}\pi d^2-e\pi ldv^2.$$

Therefore, when the motion is steady, and $\frac{dv}{dt}=o$,

$$v^2=\frac{g\,h}{1-\mu+e\dfrac{l}{d}}=\frac{\dfrac{g\,h}{1-\mu}}{1+\dfrac{e}{(1-\mu)}\dfrac{l}{d}}$$

If $1-\mu=\frac{2}{3}$, or $\mu=\frac{1}{3}$, and $\frac{e}{1-\mu}=\frac{1}{57}$ nearly, this becomes Eytelwein's formula.

If the water had first passed through a tube, length l and diameter d, and then through a tube l', diameter d', we should have had

$$v^2=\frac{g\,h}{1-\mu+e\dfrac{l}{d}+e\dfrac{l'}{d'}}.$$

Eytelwein's formula in inches is $v^2=23\tfrac{1}{2}\sqrt{\dfrac{h}{1+\dfrac{l}{57\,d}}}$

Example.—Water flows through a 9-inch main of 5000 feet, and then through a pipe of 4000 feet long and 5 inches diameter, the height of head being 100 feet, what is the velocity of the discharge?

$$v=23\tfrac{1}{2}\sqrt{\frac{h}{1+\dfrac{l}{57\,d}+\dfrac{l'}{57\,d'}}}$$

$$\begin{aligned} l &= 12\times5000=60000\\ l' &= 12\times4000=48000\\ h &= 12\times100\;=1200\\ d &= 9\qquad d'=5\\ 57\,d &= 513\quad 57d'=285\end{aligned}$$

$$v=23\tfrac{1}{2}\sqrt{\frac{1200}{1+\dfrac{60000}{513}+\dfrac{48000}{285}}}$$

$$=23\tfrac{1}{2}\times\sqrt{4\cdot2},\text{ nearly; or 47 inches per second nearly.}$$

We may remark that the value we have obtained for the mean velocity of the discharge at a small orifice, $\sqrt{gh}$, is rather greater than the velocity derived from experiment: this does not arise from any fault in our hypothesis of the mean vertical velocity of the particles in the vessel being $= 0$, but from the resistance of the sides of the orifice. It is probable, that the mean vertical velocity just over the orifice, is some small fraction of the velocity beyond it;—this, if considered by itself, would give v something greater than $\sqrt{gh}$. But the resistance is more than sufficient to counterbalance the effect of the interior velocity: v would properly be represented by the expression $\sqrt{\frac{gh}{1-\mu+\epsilon}}$, where ϵ is rather greater than μ.

J. H. R.

A NEW THEORY OF THE EARTH, THAT FULLY ACCOUNTS FOR MANY ASTRONOMICAL, GEOGRAPHICAL AND GEOLOGICAL PHENOMENA, HITHERTO UNACCOUNTED FOR.

By Oliver Byrne.

Although the sciences of mathematics are coeval with man, and have been cultivated with the greatest avidity by the greatest minds of every age, in every civilised nation; although their extent and application are at present very great—considered by some to be capable of little further advance—yet it may safely be asserted that they are only in their infancy: as long as we continue to improve, so long will the bounds of mathematics continue to extend, till all other human inquiries become subject to its simple and unerring principles. The theory which is here promulgated, and which we shall endeavour to exemplify and explain in the simplest terms possible, is capable of being submitted to the most exact and rigorous mathematical scrutiny. Yet in this place we prefer establishing it by a general concurrence of facts which are known to almost every observer, rather than by an abstruse and elaborate mathematical process; because, by proceeding on the former plan, the subject will be understood by the many, while the latter, which is given in the proposer's new work "On the theory of the heavens and earth," about to be published, would only be understood by the few, who at present know enough of the uncertainty and dissatisfaction which have attended former attempts to establish the point in view by such a procedure.

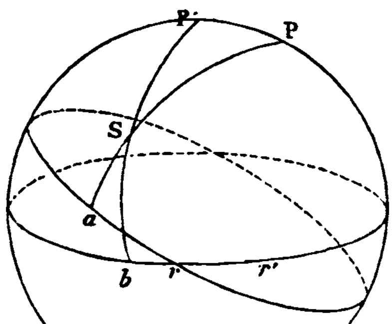
By observing the apparent motions of the fixed stars and of the sun and planets, the true motions of the bodies in our solar system were discovered,—not before the attention of man was for a considerable time engaged by their appearances and changes, and many theories respecting them advanced and confuted: but this, like other subjects capable of being submitted to mathematical investigation, was ultimately set right. The motions of the earth on its axis and round the sun were discovered in the same manner, by observing the apparent motions of the fixed stars. Seeing that all the stars rise and set in the course of a day, the stars must move round the earth, or the earth must revolve on an axis in that time: the truth of the latter motion was finally established. It was also observed that the stars which appeared to set with, or immediately after the sun, gained an advance on him till they were lost in his rays, then appeared to pass him and return to their former position with respect to the sun, in the course of a year. This fact shows either that the stars moved round the sun, which stood still, while the earth with revolving on its axis would possess a wabbling motion, or what might be called at the present day a great nutation, to effect the change of the seasons; or that the earth stood in the same position revolving on its axis, while the sun made a circuit of the heavens in the course of the year; or lastly, which was ultimately found to be true, that the sun nearly remained in the same relative position, as well as the fixed stars, and that the earth moved round him in the course of a year, and that also in such a manner, the changes of the seasons were produced.

At present here it would be useless, as well as a laborious task, to give even an outline of the several theories and conflicting opinions which have prevailed, before the true theory of the solar system was established. We regret that our present limits will not permit us to give such an outline; as it might at the same time give a caution to many not to condemn, censure, or approve, before they have investigated and understood. This theory of the earth, which likewise shows the cause of many astronomical phenomena, is not introduced and promulgated for the purpose of confuting any of the well established laws of the solar system. The great difference between what is here advanced and other theories, is that only two of the motions of the earth are admitted, namely, the annual and diurnal. The other apparent or imaginary motions known by the terms "the precession of the equinoxes," "solar and lunar nutations," and "the decrease in the obliquity of the ecliptic, or rather, the collapsing of the planes of the equator and ecliptic," are rejected; and the true cause of such apparent motions substituted in their stead, which we shall in future call the right motion or change of the earth's axis. Many, as well as those who propose anything new, be it ever so true, must be well aware of the fact, that the proposer or inventor of any new scheme, be it ever so important or useful, no matter how willing and well prepared he may be to verify his claims, even in these enlightened times, frequently struggles in vain to gain attention, much less to obtain belief: facts, it is true, are stubborn things, but prejudices are far more stubborn.

This difficulty mainly arises from the confidence of mankind being so often deceived and grossly abused by imaginary improvers and visionary inventors. However, the inventor or proposer of a new theory, who can establish his claims by strict mathematical arguments, no matter how uncommon they may at first appear, places beyond all doubt their certainty; and although he cannot induce people to study or think for themselves, yet he defies all efforts to confute one single tittle of anything which may be thus established. Before proceeding further we beg to acquaint general readers, that few technicalities are used, and those retained are explained in the simplest manner possible; this remark was considered necessary, because subjects of the like nature are too often unnecessarily encumbered with technical terms. Although this theory of the changes, nature, and form of the earth, is here established without the use of x's, y's, Greek characters, or many technical terms, the reasoning employed is strictly mathemacal; not that we object to this plan of proceeding, but that the work, as we have before observed, may be generally understood. To accommodate the profound mathematician, as well as the general reader, this theory is established by the plan objected to here in the proposed new work before alluded to.

To return to the leading principle of this theory, which is substituted for what is called "the precession of the equinoxes," "solar and lunar nutations," and "the collapsing of the planes of the equator and ecliptic," one motion, which is here termed, the right motion of the earth's axis. In the first place, we shall define or rather explain the meaning of these terms. The points where the planes of the equator and ecliptic intersect are called the equinoctial points; they have a retrograde motion, which is called the precession of the equinoxes. This apparent motion was observed long before the Christian era; it could not remain for any long time undetected, as the latitudes and longitudes, as well as the right ascensions and declinations of the stars were reckoned from one of these points,—Aries.

The declinations and right ascensions of the stars are reckoned in a manner similar to the latitudes and longitudes of places on the earth, only the first meridian is supposed to pass through the equinoctial points; this reckoning commences at the equinoctial point, Aries. The longitude is reckoned from the same point along the ecliptic, and the latitude on great circles passing through its poles.



Let P be the pole of the equinoctial $r\ a$, and P the pole of the ecliptic $r'\ r\ b$; r the first point of Aries where they intersect; and s, a star. Then $r\ a$ is called the right ascension, and $a\ s$ the declination, of that star; $r\ b$, $b\ s$, the longitude of the same, respectively. If these planes were to intersect at r', the effect would be, that the longitudes of the stars, which are always estimated from the intersection of the planes of the equinox and ecliptic, or from the first point of Aries, must continually increase; and by comparing the longitudes of some of the stars at different times, the mean motion of the equinoctial points, or the precession of the equinoxes, may be discovered. M. Lalande, in his astronomy, has computed the precession by comparing the longitude of Spica Virginis, as assigned by Hipparchus, with the longitude of the same star computed in 1750.

128 B.C. Longitude of Spica Virginis	5s	24°	0′
1750 A.D. Ditto	6	20	21
Increase in 1878 years	0s	26°	21′

From this it appears that the annual mean precession is equal to $50''\cdot 5 = \frac{26^\circ\ 21'}{1878}$. By a number of like comparisons, the same author fixed the secular precession—that is, the amount of accumulated precession for 100 years—to be 1° 23′ 34″; the mean annual precession corresponding to this is 50″·34: and the sum of such annual precession amounts to 1° in 71½ years. If we suppose the precession to be 50″·1, then, in 25,869 years $\left(\frac{360\times 60\times 60\times 10}{501}\right)$, the first point of Aries will have retrograded through an entire circle. The quantity 50″·1, which is the mean value of the precession, is obtained from the differences of the longitudes of a great many stars (three or four hundred, for instance), computed at different epochs. This mean quantity may not agree with the mean quantity derived from the observations of a single star, however many, or accurately made, these observations may be. It will be found the case with Pollux, the second star in the following table. The differences, however, between the mean quantities of the precession as they result from three hundred stars, or from a single one, is in all cases very small.

Longitudes.

Stars.	1815.				1756.				Difference of Longitude in 59 years.		Mean Annual Increase.
	s.	°	′	″	s.	°	′	″	′	″	″
α Arietis	1	5	4	41	1	4	15	3	49	38	50·47
Pollux	3	20	39	48	3	19	50	55	48	53	49·70
Spica Virginis	6	21	15	31	6	20	26	20	49	11	50·10
α Aquilæ	9	29	9	53·8	9	28	20	6	49	47·8	50 80
α Pegasi	11	20	54	31	11	20	5	19	49	12	50·10

Yet the difference which is found to exist, points out some peculiarity in every star. For instance, Pollux cannot be like most of the other stars, apparently entirely fixed, but must have what is called, or what we are obliged to call, from default of a knowledge of its cause, a proper motion. However, the comparison of the longitudes of the stars, computed to the epochs of 1756 and 1815, establishes, as we have before observed, the important fact of the precession of the equinoxes. Because the mean longitude of a star is not altered solely by the precession of the equinoxes, astronomers employ the term *annual variation*, comprehending under it the effects both of *precession* and of *annual proper motion*.

We shall now compare the latitudes of the stars mentioned in the above table, at the same epochs.

Latitudes.

Stars.	1815.			1756.			Difference for 59 years.
	°	′	″		′	″	″
α Arietis	9	57	37·4 N.	9	57	3·2	+ 5·4
Pollux	6	40	18·4 N.	6	40	3	+ 15·4
Spica Virginis	2	2	24·8 N.	2	2	6	+ 18·8
α Aquilæ	29	18	35·5 N.	29	18	44	− 8·5
α Pegasi	19	24	44· N.	19	25	44	− 4·0

It appears from this table that the changes of the latitudes are very small, in no case amounting to 0·4″ annually. "The astronomical fact is," says Woodhouse, "a minute annual change of latitude, and a considerable change of longitude. With regard to the former change, we may conjecture that it arises either partly from the precession of the equinoxes, and partly from other causes, or that it is altogether independent of the precession." The succeeding tables show the *variation* both in right ascension and declination of the stars whose latitudes and longitudes we have just compared. These variations more clearly point out the general apparent change produced in the heavens by *the right motion of the earth's axis*, than those of the latitudes and longitudes, as the declinations and right ascensions of the stars are reckoned in a manner similar to the latitudes and longitudes of places on the earth. Yet they are not in complete accordance with the *right motion*, as the latitudes of places have been supposed to remain fixed and from the dissatisfactory theory of corrections, of which we shall speak hereafter.

Right Ascensions.

Stars.	1843			1817			Difference in 26 years.	Mean annual variation.
	h.	m.	s.	h.	m.	s.	s.	
α Arietis	1	58	20·06	1	56	52·67	87·39	+ 3·36
Pollux	7	35	42·09	7	34	6·06	96·03	+ 3·69
Spica Virg.	13	16	55·80	13	15	53·79	62·01	+ 2·38
α Aquilæ	19	43	7·34	19	41	51·05	76·29	+ 2·93
α Pegasi	22	56	56·64	22	55	38·95	77·69	+ 2·98

Declinations.

Stars.	1843			1817			Difference in 26 years.		Mean annual variation.
	°	′	″	°	′	″	′		
α Arietis	N 22	43	4·14	N 22	35	33·1	7	31·04	+ 17· 34
Pollux	N 28	23	58·81	N 28	27	31·7	3	32·89	− 8·188
Spica Virg.	S 10	26	23·55	S 10	12	6·5	8	17·05	+ 19·117
α Aquilæ	N 8	27	26·37	N 8	23	37·6	3	48·77	+ 8·779
α Pegasi	N 14	21	41·97	N 14	13	26·0	8	15·97	+ 19·075

Of the Collapsing of the Planes of the Equator and Ecliptic.

The angle contained between the plane of the equator and ecliptic is what is denominated the obliquity of the ecliptic; which is shown, from repeated observations, to be variable. In this place it will be sufficient to show the results of a long succession of such observations by different astronomers, taken from the "Encyclopedia Metropolitana":—

Eratosthenes,	230 B.C.,	made the obliquity to be	23°	51′	20″
Hipparchus,	140 „	„	23	51	20
Ptolemy,	140 A.D.	„	23	51	10
Pappus,	390 „	„	23	30	0
Albatenius,	880 „	„	23	35	40
Arazachel,	1070 „	„	23	34	0
Prophatius,	1300 „	„	23	32	0
Regiomontanus	1460 „	„	23	30	0
Waltherus,	1490 „	„	23	29	47
Copernicus,	1500 „	„	23	28	24
Tycho,	1587 „	„	23	29	30
Cassini, sen.,	1656 „	„	23	29	2
Cassini, jun.,	1672 „	„	23	28	54
Flamstead,	1690 „	„	23	28	48
De la Caille,	1750 „	„	23	28	19
Bradley,	1750 „	„	23	28	18
De la Lande,	1768 „	„	23	28	0
Pond,	1816 „	„	23	27	50
"Oliver Byrne,"	1843 „	„	23	27	34

The observations of Albatenius and Arazachel are here corrected for refraction: those of Waltherus, De la Caille, De la Lande, computed. The obliquity of Tycho is put down as correctly computed from his observations; also the obliquity as determined by Flamstead, is corrected for the nutation of the earth's axis: these corrections Lalande applied. It is manifest, from the above observations, that the obliquity of the ecliptic continually decreases; and the "irregularity which here appears," says the writer, "in the diminution, we may ascribe to the inaccuracy of the ancient observations, as we know they are subject to greater errors than the irregularity of this variation. If we compare the first and last observations, they give a diminution of 70″ in 100 years. If we compare the observations of Lalande with that of Tycho, it gives 45″. The same compared with Flamstead gives 50″. If we compare that of Dr. Maskelyne with Dr. Bradley's and Meyer's, it gives 50″. The comparison of Dr. Maskelyne's with that of Lalande, which he took as the mean of several results, gives 50″, as determined from the most accurate observations. The observations of Pond, compared with those of Bradley, give 44″ for the variation of the obliquity in 100 years, or 0·44″ annually."

Of Solar and Lunar Nutation.

(See "Woodhouse's Astronomy," page 353, chap. xv.)

The two inequalities that give title to the present subject are immediately, or rather intimately, connected with that of the preceding (on the precession of the equinoxes). Woodhouse says,—"For the purpose of pointing out the connexion, we must look at the physical causes of these inequalities; and, in the inequable action of the cause of precession, we shall be able to trace the cause of solar and lunar nutations." The actions of the sun and moon on the excess of the earth—which Woodhouse assumes to be "an oblate spheroid, above the greatest inscribed sphere,"—produce the retrogradation of the equinoctial points, or, as it is technically called, the precession of the equinoxes. The natural circumstances in the production of these phenomena are—the excess of the matter just spoken of. The other circumstances, scarcely less material, and indeed essential to the phenomena, are—the inclination of the sun's orbit to the equator, and the inclination of the moon's orbit to that of the sun's, and, consequently, to the earth's equator. If the sun and moon were constantly in the plane of the equator, there would, notwithstanding the earth's spheroidical form, be no precession. When either luminary is on the equator, its action in producing precession is nothing. Twice a year, therefore—namely, at the two equinoxes—the sun's force in causing precession is nothing; and twice a year—namely, at the solstices—it is the greatest. It must, therefore, be of some mean value in the intermediate times. The retrogradation, therefore, of the equinoctial points, inasmuch as it arises from the sun, cannot be equable, since the cause producing it on no two successive days of the year is exactly the same. There arises, therefore, an inequality of precession. In consequence of such inequality, the precession in right ascension of α Arietis (taking one of the instances mentioned in Woodhouse's 14th Chapter, p. 352) on May 20th, will not bear that proportion to the annual precession (3·34″) which the number of days between January 1 and May 20 bears to 365 days; and generally the precession for 50 days, whether it be in right ascension or in north polar distance, will not be necessarily equal to $\frac{50}{365} \times P$, p representing the precession. The exact portion of the annual precession (in right ascension or north polar distance) to which it is equal, or the correction necessary to be made to the mean portion, will depend on the season of the year to which the 50 days belong. The precession, therefore, after being used as a correction itself, requires to be corrected. This, however, is easily effected by altering the number by which (see p. 349, "Woodhouse's Astronomy") it is necessary to multiply the annual precession, in order to obtain its proportional part. Thus, of the star Serpentis, the annual precession in right ascension of which is 2·935″, the mean proportional precession on April 30th would be $\frac{120}{365} \times 2{\cdot}935 = {\cdot}328 \times 2{\cdot}935$, and $\dot{3}28$ would be the multiplier: but this is too large, the actual precession generated from January 1st to April 30th being less than the proportional part of the mean. It may be made duly less by merely lessening the multiplier, ·328: in the present instance, it would be reduced to ·300, which number, and like numbers in like instances, are furnished by proper tables (see "Woollaston's Fasciculus," Appendix, page 42). This, however, it is to be noted, is not the sole method for correcting the precession. The inequable retrogradation of the equinoctial points, or the inequality of the precession, is not the sole effect produced by the unequal action of the sun on the earth's excess of matter above its greatest "inscribed sphere. The obliquity of the ecliptic, which, were the precession uniform, would not be affected by the cause producing precession, is subject to a semi-annual equation: since, as in the inequality of precession, the force causing a change in the obliquity arrives twice in a year to its maximum. Thence two effects, one an inequality of precession, the other an oscillation of the plane of the equator, constitute what is called the solar nutation." "There is also, as it may be conjectured from the arguments just alleged, a lunar nutation. The precession of the equinoxes is produced by the joint action of the sun and moon. As the sun not being in the equator, causes that part of the precession which is due to his action to be inequably generated, so the moon, continually altering her declination, is continually causing precession with an unequal force. But the period of the inequality of its action, from an evanescent state to a state of maximum, is different from the period of inequality of the sun's action. It is no semi-annual period. The lunar period depends, however, on principles the same as those that regulate the solar. When the moon's orbit, which is continually changing its position, returns at the end of any interval, to the same position which it had at the beginning, the interval so circumstanced is the period required. Now, this is regulated by the motion of the moon's nodes. The moon's orbit is inclined to the ecliptic, and its nodes retrograde in about 18 years and 7 months. At the beginning, suppose the moon's node to have been in the node of the equator and ecliptic; then, at the end of 18 years and 7 months, the same node will have described 360 degrees contrary to the order of the signs, and returned to the first point of Aries; and during this retrogradation of the node, the lunar orbit will have occupied every position which it can occupy relative to the equator. The inequality of the moon's action, then, in causing precession, will have passed through all its vicissitudes. But, as in the former case, this is not the sole effect of the inequality of the moon's force. The plane of the equator will be made to oscillate: so that, according to the longitude of the node of the moon's orbit, it will be necessary to correct the mean obliquity on account of lunar nutation." Woodhouse continues to say, in reference to another part of his book,—"We have seen, in pp. 192, 193, that the phenomena of the precession can be accounted for, by supposing the pole of the equator to describe uniformly a small circle round the pole of the ecliptic in a period of 25·869 years. But these new phenomena of precession render some modifications necessary in the preceding hypothesis. By reason of the solar nutation, the pole of the equator will oscillate during half a year about its mean place in the above-mentioned small circle, and the retrogradation of the pole will not be uniform. There will be a like oscillation, and a like inequality of precession, from the lunar nutation, but for a longer period. From both causes, then, the north polar distance, and the right ascension of the stars will be changed. In order to make the former the true precession, we must correct them both for solar and lunar nutation."

We have in the preceding pages described the cause of solar and lunar nutations. But lunar nutation, which is by far the most considerable, was not found out from a previous persuasion or belief of the existence of its cause. Bradley, soon after the discovery of aberration of light, noticed it as a phenomenon, and then assigned its cause, and the laws of its variation. But the solar nutation has never appeared to astronomers as a phenomenon. It could scarcely be expected to be noticed as such, since its maximum is less than half a second. Its existence and quantity are derived from physical astronomy; and on such authority, it is introduced as a correction of astronomical observations." Woodhouse concludes this account by saying—"It has been proved, in confirmation of Bradley's conjecture, that the phenomena of nutation are explicable on the hypothesis of the pole of the earth describing round its mean place (that place which it would hold in the small circle described round the pole of the ecliptic, were there no inequality of precession,) an ellipse, in a period equal to the revolution of the moon's nodes. The major axis of the ellipse is situated in the solstitial colure and equal to 19″·296: it bears that proportion to the minor (such are the results of theory) which the cosine of obliquity bears to the cosine of twice the obliquity: consequently, the minor axis will be 14″·364. These are M. Zach's numbers; Bradley's are 18″·16; Maskelyne's, 19″·10; Laplace's, 19″·16 (see 'Mecanique Celeste,' lib. v., p. 351)." Now, *the right motion, or change of the earth's axis*, is effected by the combined actions of the sun and moon on the excess of the earth over its greatest inscribed sphere, which excess will be shown hereafter to be in a continual state of change. Former theorists ascribe to this influence of the sun and moon, upon the excess above mentioned, the effects which we have just summed up from "Woodhouse's Astronomy" and the "Encyclopædia Metropolitana,"—namely, "The precession of the equinoxes," "Solar and lunar nutation," and "The collapsing of the planes of the equator and ecliptic." Here there is but one effect ascribed to this combined action of the sun and moon.

(To be concluded in our next.)

[As far as we can understand the purport of the above paper, it is to show that the variation of the angle of the obliquity is not oscillatory, as has hitherto been supposed, and partially demonstrated by some of the most eminent of modern mathematicians. We trust Mr. Byrne will in the next number favour us with his analysis, and justify the view he has taken of the subject.]—EDITOR.

ON THE COMBINATION OF THE TELESCOPE WITH THE DAGUERREOTYPE.

(*From the Transactions of the Royal Society of Bohemia*, 1846.)

Professor Doppler, of Prague, says, that for the ascertaining of the diameters of fixed stars, the telescope has been hitherto mainly depended upon, and that the instrument has been so far improved as it possibly ever can and will. The susceptibility of the human eye for the minutest objects has been hitherto considered paramount; but M. Doppler asserts, that the susceptibility of the human retina is surpassed many thousand times by that of a prepared (iodized) Daguerreotype plate. Physiological experiments have shown, that objects, which appear to us under an angle of vision *less* than 50 or 40 inches, are no more seen *in extenso*, but as *amorphous* simple points. On the other hand, physiological researches of such men as Müller, Weber, &c., have shown, that the diameter of one of the nerve-papillæ of the retina is no more than $\frac{1}{2400}$ or $\frac{1}{3000}$ of an inch. But, comparing the susceptibility of the retina papillæ with the microscopic experiments made with Daguerre's plates, it will follow that the single globules of mercury are of such extreme minuteness, that they become only visible by a 800-fold magnifying power; and, therefore, that on the space of a Daguerre plate, equal to one retina papilla, more than 40,000 single minute globules of precipitated mercury are to be met with. Each of these is capable of producing the image of well defined objects—which would merge on the human retina in single, indiscernible luminary points. Thence, Prof. Doppler argues, that Daguerre's plates are 40,000 times more susceptible for impressions than the human eye.

Considering, moreover, that a great improvement in microscopes is very probable, M. Daguerre thinks that instead of telescopes,—microscopes will come into use. At the exact point, therefore, where the image of a celestial body is formed before the object-lens of a telescope of considerable length, an apparatus is to be placed, whereby a silver plate (iodized, brome-iodized, or otherwise prepared) can be securely inserted. As the place of the images is the same for all celestial objects, a plate of a well defined, constant thickness, can be inserted with great accuracy. In this way, Daguerreotype images of all, even of the smallest, fixed stars can be obtained, if (as is to be supposed) the light will be sufficient to affect the plates. It is also to be taken into account, that the images of the fixed stars, obtained by an object-lens of from 10 to 12 inches, will possess a light, 10,000 times stronger than they present to the naked eye. Plates thus affected, are to be treated with mercurial vapours and laved (*lavirt?*), and then viewed by a good microscope. As these images will have been magnified (through the action of an object-lens—say of 110 inches focus length) to the extent of 14 times their natural appearance; and being again magnified 1,200-fold,—the angle of vision under which they are now to be viewed, will have been increased 16,800-fold.

J. L——y.

REVIEWS.

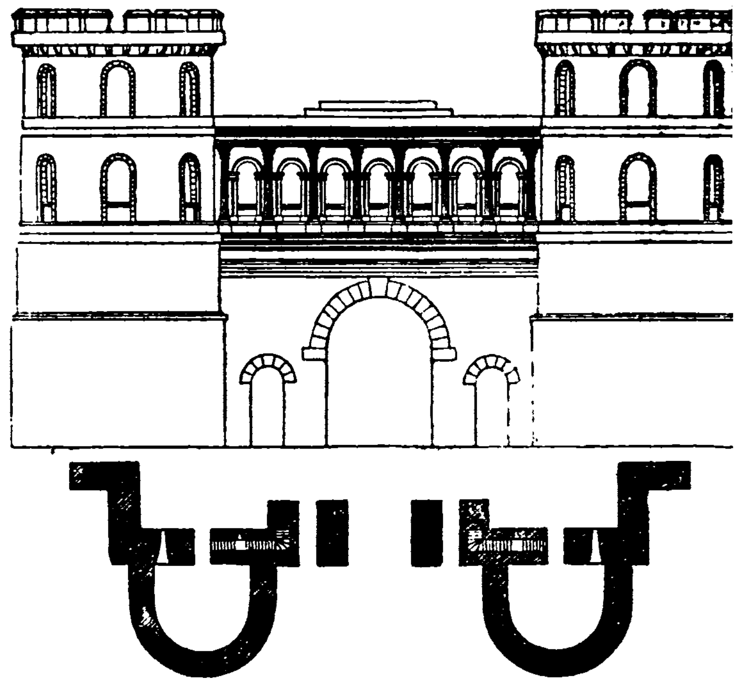
Encyclopædia of Civil Engineering,—Historical, Theoretical, and Practical. By Edward Cresy. Royal 8vo. London: Longman and Co. 1847.

Mr. Cresy's long expected Encyclopædia of Engineering has at length made its appearance, much to the credit of its indefatigable and talented author, who after three years of compilation has produced a work which forms a vast octavo volume, consisting of rather more than 1600 closely printed pages, and upwards of 3000 well executed wood engravings by Branston.

The work is divided into two parts—the one entitled "The History," the other "The Theory and Practice, of Engineering." The first division might with more propriety have been termed the "History of Engineering and Architecture," as a considerable portion of it is devoted to the description of merely the external forms of edifices.

To the History of Engineering we shall for the present confine our remarks, reserving for another opportunity the consideration of the second and more practical division. From this our æra of "the railway and the steam-ship, and the thoughts that shake mankind," Mr. Cresy transports us to a period coeval with the first rude attempts of Ætheopian architecture, and starting from that point exhibits, step by step, the gradual progress of structural science. The principle of the arch, which, according to the authorities quoted in the Encyclopædia, must have been known to the early Egyptians, is lost sight of in a marvellous manner by the Greeks; its employment even by the Egyptians, seems to have been very limited. The trabeate was apparently more consonant than the arcuate style to the severity of ancient ideas of beauty. The repose, the grand simplicity, and oneness of effect of early Grecian architecture are due, mainly, to the exclusion of all curved lines and tracery, and seem to us impossible to be developed in any construction that admits the arch as a prominent feature. For our part, we believe that the contrast between the vast simple masses of ancient masonry, and the clear deep unclouded blue of an eastern sky, must have produced an effect infinitely more sublime than the most gorgeous of English arcuate cathedrals, viewed as *they* are against the clouded sky, and through the smoky medium of our dull climate. The vault of Mycenæ, to which reference has been made in a former number, is a curious instance of the form, without the properties, of the arch.

From Grecian, Mr. Cresy conducts us to Roman architecture, a division of the work containing some highly interesting information, of which we shall proceed to give an analysis. It commences with an account of the walls, towers, and other military defences of the important city of Rome: we have engravings of the wall of Sevrus Tullius, which surrounded the entire city; the bold severity of the outline, the battering of the lower portion of the wall, and the capping formed by an embattlement, show at once its object—that of a defensive boundary;—next we have the Aurelian Wall and Gate of St. Paul, then the Gate of Spello, of Aosta, approaching in design to our Norman style of architecture. The Gate of Perugia is another example of an early gate, marked by the boldness of its outline. The Gate of Augustus, at Fano, is of a more ornamental character:—



THE GATE OF AUGUSTUS AT FANO.

"The lower portions of which are of great antiquity. Fanum Fortunæ was the name the city formerly bore, which, from its sumptuous buildings, was greatly admired. There are three entrances, flanked by circular towers, which rise to a considerable height, the two upper stories being lighted by semicircular-headed openings, and crowned with a bold projecting cornice, over which is the battlement. Immediately over the three entrances was a gallery, formed by seven arches, between Corinthian pilasters, and surmounted by a regular entablature. The repairs these walls underwent during the reign of Constantine somewhat changed their character, and since that period the upper story was destroyed by a cannonading which took place when this town opposed Julius II. Various inscriptions remain amid the several works of restoration."

and lastly, we have the Gate of Autun, one of a triumphal character.

The work then proceeds describing the materials used in the edifices of Rome. Burnt bricks came into general use for public buildings about the time of Augustus, when they were made less than an inch in thickness, of a triangular shape; sometimes the brickwork was formed of a mixture of red and yellow brick; at a later period a mixed construction was formed of brick and tufa, as in Caralla's circus. With the decline of Roman institutions, we are told that the art of construction lost its excellence, and that no care was taken in the selection of the materials. Various descriptions of stones were used,—the tufa of a reddish hue, and of a volcanic production, much used for the interior of walls, and in reticulated and rubble walls;—pepperino, another stone much used, also of volcanic production, but harder, and resisting the action of fire and the weather better than the tufa;—and the travertine, a stone much used in public edifices, calcareous, hard, and of a yellow tint. The most ancient edifices of Rome were constructed of Albano stone, put together in squared blocks and united by metal cramps; it was also used in conjunction with the travertine stone, which from its greater hardness was used in those parts of an edifice most liable to injury, as arches, architraves, cornices, &c. Marble of various countries was also largely introduced in the public edifices of Rome. The Romans devoted much attention to pavements, which—

"When used for floors, were highly decorated, much attention being required to prepare the soil to receive them, and to select the material of which they were formed. When on the ground, it was carefully examined, and rendered solid throughout, after which it was spread over with some dry material. When laid upon a timber floor, walls were not built under it, but a space left between it and the floor, that the drying and settling should be equal throughout. Holm timber was preferred to oak, being less likely to split and warp, and thus cause cracks. After the joists were laid, thin boards were fastened down to them by two nails, driven through the edges of each, which prevented their rising. Fern or straw was then spread over the whole, to prevent the lime coming in contact with the timber, which would have immediately caused it to decay. Over this was a layer of rubbish, the stones of which were as large as would lie in a man's hand: on this layer the pavement was afterwards laid. New rubbish required that every three portions should be mixed with one of lime; and old, five parts to two of lime. Wooden beaters were employed, which by repeated blows reduced it to the thickness of nine inches. An upper layer, composed of three parts of potsherds and one of lime, was spread over this to a depth of six inches, on which was laid the slabs of marble, stone, or tesseræ, care being taken that the whole should lie in a proper inclination: it was then rubbed off, and the joints or edges of the ovals, triangles, squares, hexagons, or other figures, made perfectly smooth. After rubbing and polishing, marble dust was strewed over; then lime and sand run into the joints.

Pavements in the open air had over the first flooring another layer of boards crossing them, properly secured by nails, so that the joists were doubly covered. The pavement first laid was composed of two parts of fresh rubbish, one of potsherds, and two of lime. After the first layer, a composition was spread over it, pounded into a mass, not less than twelve inches thick. The upper layer being spread, the pavement, consisting of tesseræ, each about two inches thick, was laid on, with an inclination of two inches to ten feet, to prevent the frost from injuring it at the joints: before the winter it was saturated with dregs of oil. When great care was required, the pavement was covered with tiles two feet square, properly jointed, having small channels an inch in depth cut in the edge on each side. These, filled with lime, tempered with oil, had the edges rubbed in and pressed together. The lime in the grooves or channels growing hard, neither water nor anything else would pass through. After this precaution, the upper layer was spread and beaten with sticks; over which, either large tesseræ or angular tiles were laid with the proper inclination."

Mr. Cresy has given us some architectural descriptions of the public buildings of Rome. Although they do not strictly belong to engineering, the examples afford data for construction;—we have engravings of the Basilica at Fano, the Amphitheatres of Castreuse and the Coliseum.

For the purpose of covering in the arena of these amphitheatres, and to protect the spectators from the rain or sun, a *velarium* or covering was used:—

"Lampridius (in Com. a Militibus, Classiariis) informs us that the management of the vela was left entirely to sailors, as they were more expert in going aloft amidst ropes, and understood the tackle which regulated the spreading of it better than others. There can be no doubt that it required considerable dexterity on the part of the engineer to keep steady an awning containing 113,345 superficial feet, which would be required for the amphitheatre at Nismes, and for the magnificent Coliseum nearly 250,000 superficial feet, or more than double; the weight of which, at only one pound per foot, comprising the ropes and tackle, would amount to 112 tons or thereabouts. So vast a weight disposed and upheld by tension alone creates our wonder and admiration.

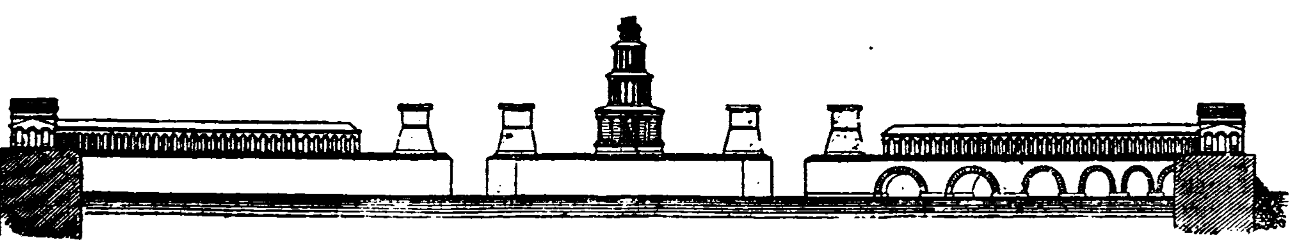
At the level of the attic story are 120 projecting consoles, each having a circular hole about 10 inches in diameter, corresponding with a circular mortice of the same size, and 6 inches in depth, made in the projection of the cornice of the second order. The upper opening of the hole in each console has externally a groove 2 inches in height, destined for an iron collar, to which was attached a tie, which secured it to the wall of the attic at the level of the top of the console: the holes which contained these have some portions of the iron run with lead remaining.

The whole of each console received a round mast, which, passing through it rested in a hole sunk in the cornice below, the iron collar preventing it from acting against the sides of the console and fracturing it. The masts alone would not be sufficient to support the weight of the vela, extending over an elliptical area, the axis of which, in one direction, was 436 feet, and in the other, 331. To aid in the support, other posts were introduced through mortices about 10 inches in length, placed opposite each console, at the projecting part of the moulding which crowns the interior of the attic; on each side, 4 or 5 inches from the edge of the attic, are holes still containing the lead which secured the iron ties that held these latter posts in their places. Under the mortice holes are others, 8 inches square, and 2 feet in depth, made in the upper step of the attic to receive the second posts. The two posts were afterwards securely braced.

Over the centre of the arena was an oval covering, permanently fixed, which in the Coliseum was ornamented with an immense golden eagle. Round the edge of this oval covering was attached a large cable. 120 pair of cords, of equal length, stretched from the masts on the exterior to this cable, were worked by pulleys; thus forming as many compartments. Each pair of cords was furnished with rings, to which the covering was attached, so that it could be drawn backwards and forwards at pleasure. The whole of these were called the vela or velaria, and each single compartment velarium. The distance between the ropes on which the velarium ran was greater towards the attic than at the centre; consequently, to make the velarium run freely on its rings, it was necessary that it should be of an equal width throughout: when spread, towards the attic it was stretched, whilst towards the centre it sagged, and formed as it were a fold. To prevent the sun passing through the opening thus made by the sagging, an internal hanging was attached around the fixed permanent oval."

The Romans devoted great attention to the construction of baths which were generally used by all classes of citizens. At one time, there were more than 800 baths in Rome; the most complete contained six principal apartments,—1st. *The Apodyterium*, for undressing; 2nd. *The Frigidarium*, or cold bath; 3rd. *The Tepidarium*, used to prevent, by the temperate air which it contained, the dangerous effects of too sudden a transition from the extreme of cold to that of heat; 4th. *The Laconium*, an apartment warmed by a stove, to send forth a dry heat; 5th. *The Balneum*, or warm bath; 6th. *The Eleothesium*, or *Onctuarium*, where the oils and perfumes used by the bathers were kept.

We now come to that portion of the work which may be strictly considered as connected with engineering—harbours and buildings in water. It will be seen by the construction of these works that the Romans devoted vast talent to their formation and construction. In our Journal for January last, we gave a highly interesting paper on the Harbour of Ostia near Rome, by Sir John Rennie, together with a plan of the harbour. We are now, through the labours of Mr. Cresy, enabled to give engravings showing a section through Claudius' Port, and the elaborate Pharos.



SECTION THROUGH CLAUDIUS' PORT, OSTIA.

PHAROS, AT OSTIA.

"The port constructed by Claudius, in advance of that of Trajan, was amongst the boldest executed by Roman engineers:—an oval sheet of water, enclosed from the ocean by broad and spacious moles, affording a safe haven for vessels which navigated the western shores of Italy: an artificial island lay between the horns of these two moles, with towers at each extremity, containing machinery and tackle of various kinds, by which the boatmen could at all times enter safely. These constructions must have been a work of prodigious labour; their solidity is attested by the writers of the time, particularly by Pliny. In the middle of this island stood a pharos, before which was the colossal statue of the emperor Claudius. Fire was placed, at the approach of night, in the upper story of this lofty structure, which could be seen from a considerable distance. Orders of the purest architecture decorated three of the stories, and ingeniously-contrived rooms and staircases served for the use of the officers and men to whom this part of the port was entrusted. Covered galleries and porticoes standing high above the sea, and stretching far into the ocean, invited mariners to enter, and produced an imposing effect to all who navigated these seas.

The port of Claudius united to that of Trajan gives us an idea of the arrangements in use during the reign of these emperors; magazines for stores of all kinds, docks, slips, and other buildings usually found in a modern port, were here executed in a manner equal to those of the imperial city. Temples, triumphal arches, rostral columns, and trophies, occupied the spaces not used by the mariners, and noble roads conducted the merchandise and warlike stores from thence to every part of the empire."

Descriptions and engravings are given of the harbours at Naples, Cuma, Pozzuoli, Spezzia, Genoa, Ancona, Antium, Tarentum, and Brundusium,—all of them possessing considerable interest; then follows some account of the Roman roads and the celebrated Appian way, which is succeeded by

The Bridges of the Romans.

These bridges are generally constructed with semicircular arches of stone of the hardest quality; they were remarkably solid and well proportioned, and formed fine specimens of Roman architecture as applied to bridge building;—the Ponte Sisto and Bridge of St. Angelo are two fine examples. The bridge and aqueduct of Spoleto consisted of 10 Gothic arches, 70 ft. 3 in. span; the centre arches stood 328 feet high above the river Moragia.—*Trajan's Bridge*, over the Danube, the most magnificent in Europe, built A.D. 120, consisted of 20 semicircular arches, 180 ft. 5 in. span; the springings were 46 feet above the river, and the piers 64 feet thick by 85 ft 3 in. wide: the stones used were enormous, but it was destroyed a short time after its construction.—The *Bridge near Terni*, on the Nera, consisted of 17 arches, 131 ft. 3 in. span, and 111 ft. 6 in. high up to the springing; the piers were 27 ft. 6 in. thick, and the total length of the bridge 2592 feet, by 32 feet wide. The dimensions of the few examples we have selected show that the Romans were quite equal to the modern engineers in the stupendous character of their works. We shall close this account with some particulars of the *Bridge of the Trinity*,—one of more recent date. (See Engraving, *Plate* VIII.)

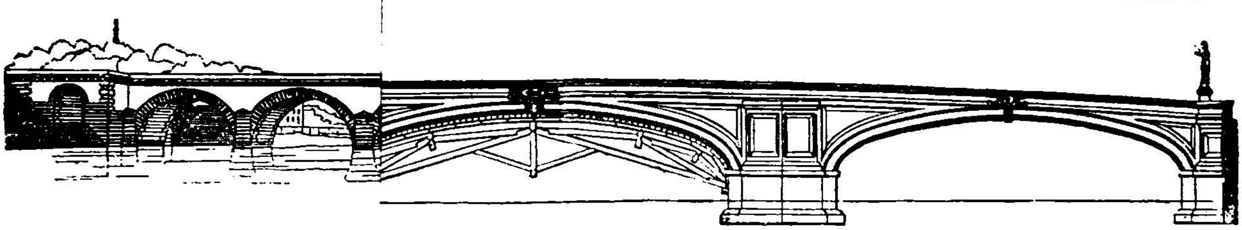
"The Bridge of the Trinity, at Florence, was constructed in 1750, by Ammanati, a celebrated architect. This bold work consists of three arches, nearly elliptical, the curve being portions of two parabolic arches, whose angle at the top is masked by an escutcheon. The span of the arches is from 87 feet 7 inches to 95 feet 10 inches; the springings are 7 feet 10 inches above low water, and the rise is one-sixth of the span; the arches are 3 feet 2 inches thick. The breadth of the piers is 26 feet 3 inches, and that of the bridge 33 feet 9 inches. The facings of the piers are worked stone, with well executed mouldings. The other parts of the structure are of rubble; the foundations rest on a general framework, surrounded and crossed by several rows of piles. A defect which occurred under one of the piers of the bridge was repaired in 1811 by the elder Goury."

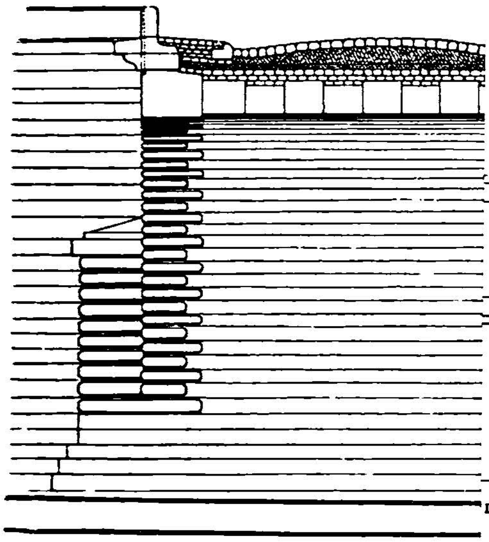
The architectural character of the Bridge of the Trinity at Florence is particularly worthy of attention, because it is a rare instance of pure arcuate construction, executed subsequently to the decay of Pointed architecture. The "Revival" (or as it ought to be called the "Ruin") of architecture had no more hideous or conspicuous characteristic than that of sticking upon arches ornaments of a totally inappropriate character. The taste which promoted this fashion was precisely that of the Indian squaw or African savage, who stick bits of finery in their ears and nostrils. The Florence bridge, however, is singularly free from these faults, though erected at a period when the subservience of decoration to construction was utterly disregarded—it has not the slightest vestige of trabeate construction.

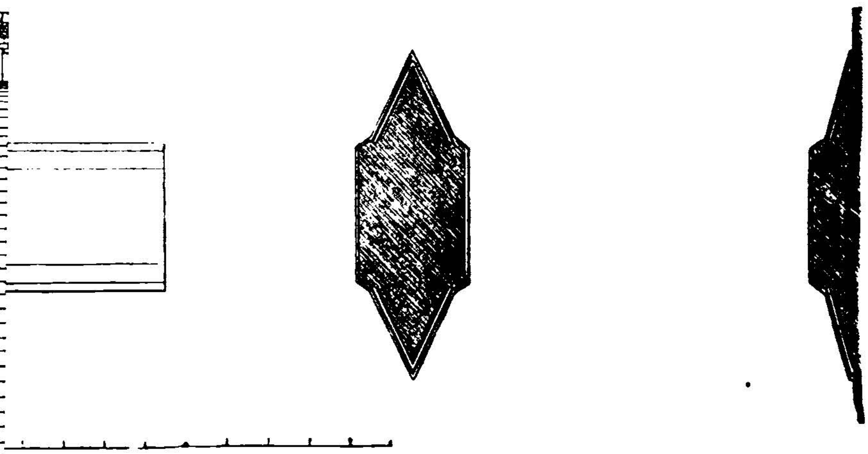
Except in the Pointed period, this merit is extremely rare. Previously to that period the Romans, and subsequently to it the Revivalists, treated the arch as a thing to be ashamed of. They endeavoured to disguise its real character as much as possible,—absurdly overloading it wth the forms of Greek temple-architecture, and producing a nonsensical combination which would appear irresistibly ludicrous, had not a multitude of examples familiarised our eyes to the incongruity. Let the reader compare Blackfriars or Waterloo Bridges, with their foolish unmeaning columns, with this Bridge at Florence or London Bridge; and then, if he can so far overcome the prejudices of education, ask himself which is the purer and more sensible architectural design.

We now come to a very interesting portion of Roman engineering—that is, the supply of water. The Romans devoted great zeal and attention to the obtaining of a good supply of pure and wholesome water,—not like the Londoners, who are content with obtaining their supply from the polluted river, because the whole district of the metropolis is under a monopolising combination.

The supply of Rome with water required seven aqueducts, until the time of Caligula, when two others were commenced. The most remarkable were, the *Aqua Julia* and the *Tepula*, the length of the two being 17,126 paces, 7,000 of which were above ground, and 6,472 on arches.—The *Anio Vetus*, length 43,000 paces, 221 of which were subterranean, to convey the water from the Anio, above Tivoli; at a subsequent period, the water was brought from the river at a greater distance, 20 miles beyond Tivoli, for the purpose of obtaining the water of the Anio in a purer state; the length of this last aqueduct was 61,710 paces, 7,463 being above ground, and the remainder subterranean.—The *Aqua Appia*, the first aqueduct constructed in Rome, was 11,190 paces in length; the whole, excepting 60 paces, was carried underground and arched over.—The *Aqua Virgo*, 14,105 paces in length,—12,865 underground, the remainder above, on 700 arches.







D PLAN OF THE BRIDGE OF THE TRINITY AT FLORENCE.

FIG. 3.—SECTION THROUGH ARCH—

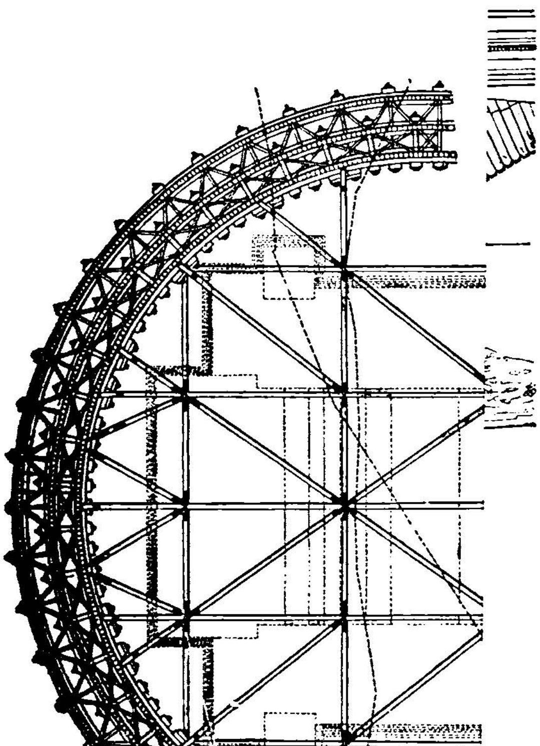


FIG. 5.—PLAN OF COFFERDAM.

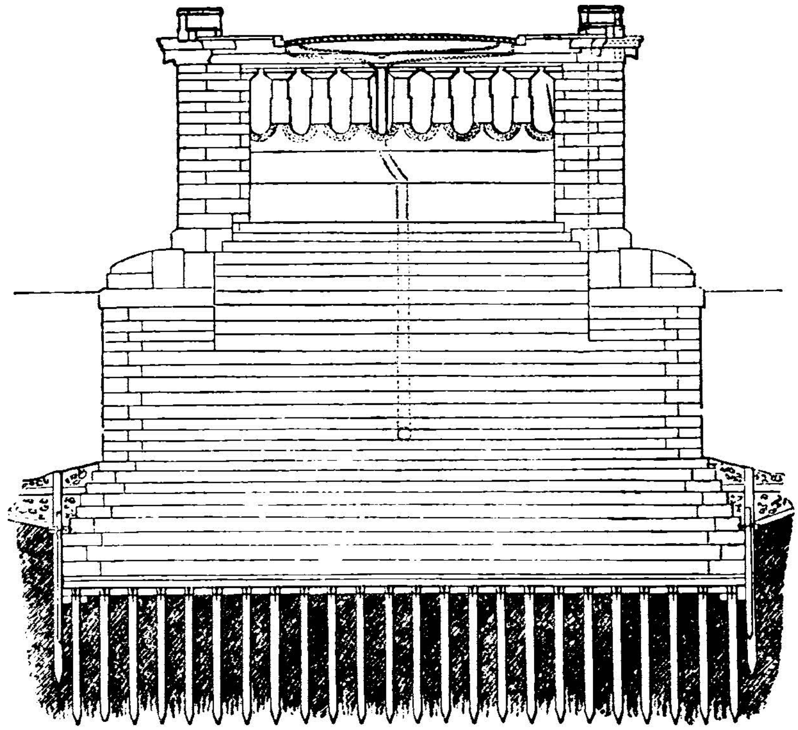


FIG. 1.—SECTION OF PIER.

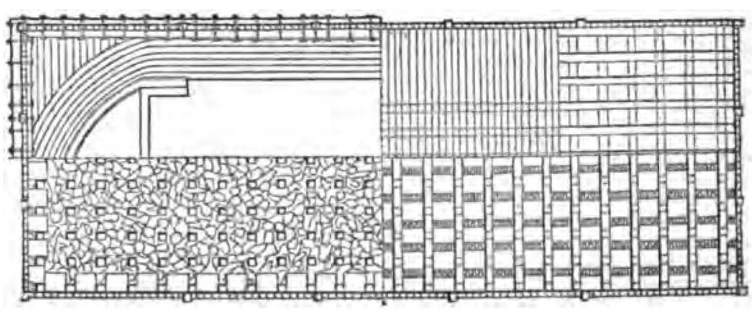
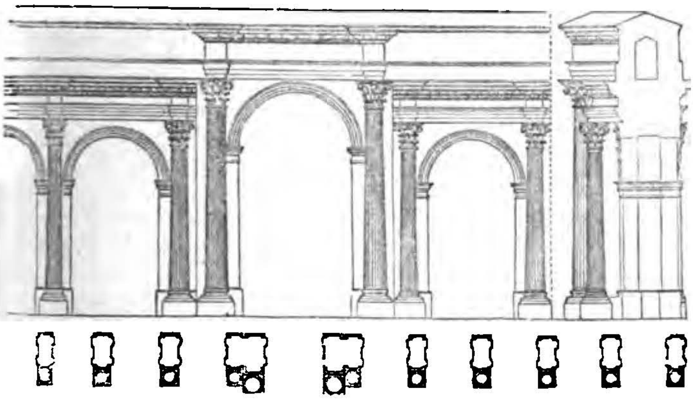


FIG. 2.—PLAN OF PIER AND FOUNDATION.

"The arches which decorate some portion of this aqueduct are not only well proportioned, but receive further embellishment from a regular order of Corinthian columns: where the passage is preserved through the line, the elevation is increased by an additional height. The section at the side shows the channel for the stream, which flowed in the attic, built above the order, covered in by a vault carefully worked and well tied together: here every precaution seems to have been taken to guard against leakage, which, if it ever happened, would be immediately discovered, by the pouring out of the water at the defective place; and along the whole line of aqueduct, materials were deposited, that there might be no delay in the work; there would be also less to perform than to take up a whole length of mains laid under a solid and hard pavement, rendered impassable during the progress. Such an inconvenience in crowded streets, the Romans wisely avoided, and continued to prefer the system of raised aqueducts to those buried in vaults under ground."



AQUA VIRGINE.

The engravings of this viaduct, and also of the Gate of Augustus, at Fano, show a combination of the Trabeate and Arcuate architecture, so much adopted by the Romans; although it is highly ornate, the combination of the two do not appear to form one construction:—the Trabeate looks like an accessory to the Arcuate, and put up after the latter had been erected. This barbarism of attaching idle, unmeaning columns and entablatures to useful, effective arches, is compared by Hope, in his Architectural Essay, to the barbarous treatment of his subjects by the tyrant Mezentius, who tied living men to dead corpses. Many a modern architect would do well to think over this comparison.

Drainage was also well understood by the Romans, as may be shown by the great drainage of the Pontine Marshes, 26 miles in length, and the Cloaca Maxima, a sewer 14 feet in width and 32 feet high, for the drainage of the Imperial City. The drainage of the lakes Albano and Fucino may vie with any of our modern works.

We must, however, abruptly terminate our extracts from Rome, or we shall trespass too far for the length of our review; and proceed at once to France. It is necessary, however, to make the preliminary remark, that Holland and Germany are briefly dismissed in two pages, without a single illustration: this conciseness is to be regretted, as those countries afford some noble examples of engineering; particularly Holland, in its canals, sea walls, and works of drainage.

ENGINEERING IN FRANCE is very fully noticed, with ample illustrations. Mr. Cresy has availed himself of the numerous treatises on engineering which form so valuable a portion of French scientific literature;—he has given detailed accounts of all the principal ports and harbours of France. The description of the celebrated breakwater at Cherbourgh, formed by truncated timber cones, 150 feet diameter at bottom, 60 feet at top, and 70 feet high, is highly interesting. The lighthouses and canals are next given, and are followed by engravings of numerous bridges erected in France, one of which we have selected as a good specimen of French bridge-building:—

"The Bridge of Sevres, over the Seine, on the road from Paris to Versailles, was designed by M. Becquey de Beaupre, and executed by M. Vigoureux; it was finished in 1820, and consists of nine principal semicircular arches, 59 feet in span, and two lesser 16 feet 4 inches in span for the towing path. The thickness of the piers is 11 feet 5 inches; the width of the bridge 42 feet 7 inches. It occupies the situation of an old wooden bridge, and the axis is in the direction of the dome of the Invalides. The piers were founded by means of caissons. The arches were constructed on trussed centres, which did not change their form during the placing of the voussoirs.

All the arches were keyed in July, 1815, except the first on the right bank, where there still remained fourteen courses of voussoirs to place, when orders were given to break down the bridge, and the centre of this arch was first set on fire, and the fourth blown up by two discharges, which caused the rupture of some of the inner voussoirs of the arches, and it was afterwards discovered that settlement had taken place in the third, fourth, fifth, and sixth piers, the greatest of which was 2¾ inches. In 1818, the sixth pier was loaded with 112 tons, without any movement resulting; it was thought fit, however, to discharge the weight by means of arches in the piers. The foundation piles were 3 feet 11 inches apart, and each carried a weight of 52 tons; the voidings, however, diminished this weight by about 5½ tons. A general foundation was also constructed by throwing in rubble. The settlements are attributed to the effect of the explosions; but they would not, perhaps, have taken place had the piles been less loaded, or the intervals between them been filled in with hydraulic masonry to a height of 6 or 8 feet between the ground and the tops of the piles, instead of with masonry laid in common mortar, which does not harden under water.

In this beautiful example, the roadway is kept perfectly level throughout, and the arches are all of the same span; this was rendered necessary, as the banks on each side of the river were low, and it was not deemed advisable to raise the crown of the roadway, which might have been done on the Paris side, but towards the town of Sevres it would have been more difficult to accomplish, as the houses on each side of the street, and the entrance to the royal park, would have been equally inconvenienced. The piers, all of the same dimensions, are of great strength, their width being nearly equal to a fifth of the span of the arch.

The faces of the voussoirs, which are rusticated and rounded, increase in depth towards the springing; the effect is improved by this arrangement, and we have an additional strength given where it is most required. For the piers, abutments, and arch stones, the best stone which could be obtained was made use of, and apparently the atmosphere has produced little change upon it: as the stones laid in the quarry, so are they bedded, and their dimensions and proportions are well defined for their respective situations. In the spandrils and wing-walls, there does not appear to have been sufficient attention paid to the backing, and inferior material is said to have been used.

This bridge, which has a decidedly Roman character, of which fig. 1, Plate VIII., is a general view, is one of the best where semicircular arches have been preferred to the elliptical; the same centre would serve for all the arches, and there is some economy in such an arrangement; but the piers occupy together upwards of 90 feet, while the breadth between the abutments or water-way does not exceed 622 feet: by the adoption of a flatter arch, fewer piers would have been required, and consequently more water-way would have been obtained: but the whole is deservedly much admired, and its design seems in harmony with the scenery around, and with the character of the river: over a stream where the tide rose considerably, or the navigation was more important, a bolder design might have been introduced.

The elevation and section through the piers (figs. 2 and 3, Plate VIII.) show its solid construction, and the form also of its starlings: over the arch are well contrived drains, which lead off the waters that fall upon the roadway, and conduct them behind the spandrils into the stream below: the blocking course, which forms the parapet, is supported upon a bold block cornice; and the absence of all balustrade and railing greatly adds to the effect of the structure. The roadway is paved throughout, and at the sides beyond the water-channel is a footway laid with a gentle inclination."

The works of the United States occupy a few pages, but no illustrations are given of the numerous engineering works with which America abounds.

ENGINEERING IN GREAT BRITAIN next occupies a considerable portion of the work, which we must pass over until next month, giving now only the description of London Bridge, which we may boast as being one of the finest specimens of bridge-building in the world, and one of the noblest edifices of the City of London.

"When the committee of the House of Commons had determined upon the erection of a new bridge, Mr. George Rennie, at the desire of his father the late Mr. Rennie, made the design as it is now executed; and as the country lost the services of Mr. Rennie by his death in 1821, the execution of this important undertaking devolved upon his sons, and Mr. George Rennie holding at that time a situation under the government, his brother, Sir John, who was his junior, was named the acting engineer. Messrs. Joliffe and Banks were the contractors, and the cost, including the approaches, amounted to £1,458,311 8s. 11¾d. The first pile for the cofferdam was driven on the 15th of March, 1824, and the dam was finally closed on the 1st of April the following year, and after the water had been pumped out 29 feet below low-water mark, it was found remarkably tight.

On the 27th of April the workmen commenced their excavations in a stiff blue clay, after which the sills and planking were laid ready for the foundations, which were commenced on the 15th of June: the first stone laid was a piece of Aberdeen granite, 5 feet ⅜ of an inch long, 3 ft. 6¾ in. broad, and 2 ft. 10 in. deep, containing 50 ft. 7 in. cube, and weighing 4 tons.

The cofferdam for the second pier was completed soon after, and pumped out by the 24th of August; in 1826 the foundations on the Southwark side, comprising the abutment and wing-walls, were carried up, and the second pier was commenced.

The cofferdams of the first and second piers being no longer required, a portion of the piles were cut off on both sides, to prepare them for the support of the centres; and after the horizontal wedges were fixed on the heads of the cofferdam piles, on the 30th September the first rib was set up by means of large sheer poles and powerful hoisting tackle, and by the 10th November, the whole ten ribs were placed.

When the masonry of the second pier was sufficiently advanced, the centre, which had been framed in the Isle of Dogs, was floated up the river, and being hoisted upon a large double barge, was raised into its place by means of screws, assisted by the tide. The cofferdam of the third pier had by this time advanced, and soon afterwards that of the fourth pier, when it became necessary to provide more water-way by removing the pier between the fifth and sixth locks of the old bridge, and forming a wooden tressel frame of whole timbers for the traffic to pass. This was performed at the cost of £8000, by demolishing one half of the arch at a time, after which the pier below was taken away 4 feet below low-water mark. By the 4th of August, 1827, the first arch was completed; by the end of the year the second arch was keyed in, the foundation of the third pier completed, and that of the fourth laid. In 1821, the water being pumped out of the north abutment dam, and the excavations made, the first pile was driven on the 1st of February, and the entire foundations completed on the 1st of March following; the masonry was then carried up to the springing of the arches.

The first arch turned having now stood the entire winter, the wedges were struck 2 inches back on each side, and the crown lowered ⅜ of an inch; the wedges were driven back 4 inches on the following day, when the crown of the arch sank another half inch. On the third day they were driven back 6 inches, when the crown of the whole arch was clear, and shortly after the wedges were entirely driven back, when the soffite of the arch was accurately examined, and found to have preserved its form entire, although it had lowered 1¼ inch. By this time the centres of all the other arches were placed, and the masonry considerably advanced: in 1829 and 1830 the centres of the middle, fourth, and fifth arches were shifted back, and when released of their load, the middle arch sank 2½ inches, the fourth 2¼ inches, and the fifth 1⅜ inch.

The centre arch is 152 ft. span, and rises 29 ft. 6 in. above Trinity House water mark; the arches on either side span 140 feet, and rise 27 ft. 6 in. above the same line, and the abutment arches span 130 feet each, and rise above the same line 24 ft. 6 in. The entire water way being 692 feet, the total length of the bridge 1005 feet, its width from out to out 56 feet, and its height above low water 60 feet. The two centre piers are 24 feet in thickness, and the two others 2 feet less.

The general depth at which the foundation of the piers is laid below low water is about 29 ft. 6 in., and the total quantity of stone used in constructing the bridge and its abutments was 120,000 tons; the number of piles of 20 feet in length under the piers and their abutments was 2092, and the total number for the cofferdams 7708. There were four sets of timber centres, each weighing on an average 800 tons. The amount of Messrs. Joliffe and Bank's estimate for the bridge alone, including an extra set of centres, was only £425,081, 9s. 2d. The bridge was opened to the public on the 1st of August, 1831, with great pomp, after having been in progress seven years and three months."

The engravings are accompanied by the contract specification, from which we make the following extracts (See Plate VIII.):—

The cofferdams of the abutments were of a circular form, and those of the piers of an elliptical form, as shown in fig. 5, Plate VIII, composed of two rows of Baltic timber piles, not less than 12½ inches square, five feet apart, connected together by three rows of double whole timber waleings; the top of the piles 5 feet above Trinity House water mark; there was also a third row of piles placed 6 feet from the second row; the heads were level with half tides, or 7 feet below Trinity House water mark; the spaces between the piling was filled with tough, well beaten clay, thoroughly puddled; the piling, it will be seen by the engraving, was well secured by diagonal struts, besides wrought iron tie-bolts.

Foundation (Fig. 2).—The platforms of the abutments were laid 34 ft. 6 in. below Trinity House water mark in the front, and 34 ft. 6 in. at the back; the two side piers 40 feet, and the middle piers 43 feet; over the whole surface, piles of elm, fir, or beech, 12 inches diameter and 20 feet long, were driven into the clay 18 feet below the platform, in rows, 4 feet asunder. All the piles were cut off to a level, and a space of 9 inches deep below the pile-head excavated and filled in with Kentish ragstone, well beat down, and racked in with five parts of sharp gravel and one part of lime; after which, sills, 12 inches square, were spiked on the pile-heads transversely; the intervening spaces were filled in with brickwork, excepting at the extremities, which were of stone. Above these sills there was laid longitudinally another row of sills, spiked down to the first row of sills with 18-inch jagged spikes, and the spaces between filled-in level with Bramley-fall stone. On these sills and stones was laid a platform of 6-inch beech, elm, or fir planks, bedded in mortar, and spiked down with 12-inch jagged spikes, and upon this timber platform the masonry was built. Round the abutment, sheet piles 6 inches thick and 18 feet long, and round the piers, 12 inches thick and 20 feet long, were driven in; the whole planed, ploughed, and tongued at the edges.

The masonry of the piers and abutments is formed on the exterior faces with granite ashlar, 2 ft. 3 in. to 3 feet thick, with headers 5½ feet long, and the interior filled in with Bramley-fall, Painshaw, or Derbyshire stone.

The five arches are semi-ellipses, the centre arch 152 feet span and 29 ft. 6 in. rise; the arch stones are of granite, 4 ft. 9 in. deep at the crown, and increasing to 10 feet at the springing. The two arches next the centre are 140 feet span and 27 ft. 6 in. rise; the arch stone 4 ft. 7 in. deep at the crown, and increasing to 2 feet at the springing. The two side arches are 130 feet span and 24 ft. 6 in. rise; the arch stones at the crown are 4 ft. 6 in. deep, increasing to 8 ft. 6 in. at the springing. All the stones are 18 inches thick at the intrados, and increase in thickness to the extrados, and each arch has four connecting bars of wrought iron.

The centres consisted of eight ribs of Baltic fir, excepting the springing-pieces, which were elm and the wedges oak; the covering of the centre was of timber 7 inches thick. The spandrils over the piers are filled up solid to the underside of the inverted arches, the depth of which is 6 feet in the middle of the two centre piers, and 5 feet for the two side piers.

Roadway.—The interior spandril walls to carry the roadway are of brick, three bricks thick, and on the top are stone corbels 18 inches deep, projecting 12 inches, over which are laid 9-inch Yorkshire landings, and then the whole surface of the bridge is covered with puddled clay 15 inches thick; over this, broken stone 12 inches thick, is laid; and then granite paving, for the footpaths and road.

Next month we shall resume our review of this valuable work; and in closing our present notice, we most strongly advise our professional readers to procure the work itself.

A Treatise on the Principles relating to the Specification of a Patent for Invention. By William Spence. London: royal 8vo. V. and R. Stevens and G. S. Norton.

The abstract conception of a patent is perhaps one of the simplest of legal ideas. The jealousy with which property is guarded in all civilised states, and especially in this country, takes cognizance not merely of each individual's right of possession to his goods, chattels, and estate, but even of his claims of peculiar advantage derived from his ingenuity and contrivance, especially when his exertions tend to promote the general interests of the community. The poet who exalts the moral and intellectual condition of his countrymen, and the mechanist who enlarges their amount of physical happiness, have equally a reward secured to them by the law of the land; the publisher who pirates a copyright, or the manufacturer who infringes on a patent, are amenable to the same system of legal retribution that guarantees to every man that which is his own.

Simple and intelligible, however, as is this theory of patent right, its application to individual instances is beset with innumerable difficulties. The question immediately arises, what is the nature of those claims that demand the protection of a patent? Is it sufficient that the claimant should merely have discovered some new and useful principle, or must he, by an actual invented mode of application, have shown how that principle is to be rendered available? To take an example—would the first person who discovered the mechanical power of steam have been entitled to a patent unless he had likewise invented a steam engine? To this the reply is easy. A patent is the remuneration which the State accords to an individual for having realised or *done* something useful—not for having merely projected it. For the man who discovers a principle without applying it, cannot be said to have benefited his species; so far as he himself is concerned, his discovery is useless—he lacks either industry or talent to turn his knowledge to account; all he has done has been to enlarge the means of usefulness of other men, and to them, not to him, is the credit due of all that may result from the opportunities he has afforded them. The laws observed by Kepler, in his hands, might for ever have remained barren isolated facts, had not Newton applied them, and thus given value to what previously were worthless details.

It is clear then that patents are only due for inventions, whether they be modes of carrying out new and useful principles, or improvements on the methods of carrying out old and recognised principles. The next question that presents itself has reference to the absolute originality of the invention. Suppose an invention to have been made and not distinctly announced, nor so widely promulgated as to have been generally known, and suppose that a discerning individual, having by some means become acquainted with this invention, had discovered its merit, has he a right to a patent? Or suppose that another individual, without having been aware of its previous existence, had, so to speak, re-invented that invention, can he claim a patent? The answer to these questions involves all that is complex in the law of patents; the degree of promulgation necessary to invalidate the claims for the re-invention being so difficult to determine, that only persons accustomed to the niceties of law, and versed in the precedents of the courts, can in any particular instance venture to give an opinion. As a guide for patentees through the tangled mazes of the law we know no better work than Mr. William Spence's Treatise on the Specification of a Patent for Invention. Mr. Spence has divided his volume into two parts, which together occupy about 180 pages. The first division treats of the defects of claims by which a patent is invalidated; the second of the conditions necessary to establish the specification secure against all attacks. The first division is prefaced by an introduction, in which Mr. Spence gives the following definition of a patentable invention:—

"It must be remembered that every invention has its birth at a given period in the progress of manufactures: that it takes up certain defects and proposes a plan for their remedy. This is the meaning of a patentable invention. In defining the true scope therefore of a particular subject matter of a patent, due attention must be paid to this its essential characteristic, viz.: that it leads us a step on the road to perfection in the branch of manufactures to which it belongs. Hence the necessity for clearly determining in the specification the exact position which the invention occupies in the march of improvement."

This definition appears to us too limited, inasmuch as it excludes all inventions founded on an entirely new principle; a patentable invention must be either something tangible, or some specified method of manufacture, the object of which is to produce something useful to society.

"Public user," is generally the claim advanced against patent right: on this subject Mr. Spence is particularly clear and copious. In a country like Great Britain, where the minds of men are constantly on the stretch to perfect the various departments of manufacturing art, inventions the same nearly in substance will often occur simultaneously or in succession to various persons. The question how far an invention for which a patent is sought has been previously employed is consequently often extremely difficult to be settled; experiments instituted for the purpose of obtaining a result which another, and perhaps, more lucky individual has at once arrived at, are frequently so like "public user," that the jury is deceived by their resemblance. Mr. Spence has extracted from the Reports one or two instances of the kind, and his comments upon them are worthy the attention of all patentees. Previous publication in a printed work of general circulation is another disqualifying fact—and the second treated of in Mr. Spence's work. Lastly, previous specification, on which subject we extract the following observations.

"But in applying this principle to practical cases, it is easy to see that the question mainly turns upon the legal sufficiency of the said specification: so that although evidence of public knowledge and public user is not required (as we have seen) in principle, yet in practice it is found essential from its bearing upon the question of sufficiency; for if the description of an invention contained in an inrolled specification be unintelligible or impracticable, there is no disclosure of a perfected invention. Now public ignorance and non-user are some evidence of this; inasmuch as they give rise to the supposition that the specified plan did not answer its purpose, and for that reason did not come into use, nor become publicly known. Hence it usually occurs that when a patent is alleged to have been anticipated by a former specification, the patentee rests his case upon his evidence of public ignorance and non-user, unless he is quite satisfied that there is no material correspondence between the two inventions, the latter consideration in such case affording ample grounds of defence against such attack. It is a source of increasing difficulty to the patentee that specifications are constantly being inrolled which may not attract public attention; there are also many in years past which are not known to the public in any practical sense, and are probably by no means easy of reference, owing to the vagueness and unsuitableness of their patents' titles: and yet these specifications when discovered are to be assumed as publishing to the world whatever they contain. According the legislature, sensible of the discrepancy between the principle of law that the inrolled specification renders public whatever it contains, and the actual fact, sensible also of the occasional hardship to which such discrepancy exposes the patentee, has devised measures for his relief, with the view, it would appear, of maintaining the said principle in its general applicability, but preventing it from pressing with undue weight in individual cases. The measures for relief specially alluded to are those contained in the act 5 and 6 Will. IV. c. 83."

In the next division, we find good faith insisted on, as the first and most necessary qualities of the specification. As, by the nature of a patent, the public are restricted from benefitting themselves by an invention, without duly recompensing the inventor, it is but just that the exact extent of the invention should be clearly known, lest the inventor be rewarded for more than is his due. There is another reason, too, why the specification should be clear and accurate—and that is, that the public may not be deceived as to the value of the thing protected, and thus be deluded into combining with the patentee to carry out an useless project. The next point to be observed is the order of the specification;—on this subject, as a remarkable instance of the perspicuity of our author, we shall quote, from p. 78, the following passage:—

"But we come now to that part of the specification which in a sense may be said to be the most important of all: the part referred to is the claim. It is here that the essence, principle or spirit of the invention is stated in the most distinct terms. The whole of the foregoing matter is here summed up and resolved into its one idea. All the previous description of circumstance comes now to be seen only as affording a clue to the right interpretation of this final definition of the essential character of the invention. The claim rightly understood is in fact the specification: but then in order that it may be rightly understood reference must be had to the antecedent matter: and it may indeed be said that the intelligibility of the whole specification greatly depends upon the particular interpretation of the claim which is suggested by such reference. It would be comparatively easy to discover what construction to put upon the claim provided all the former portions of the specification plainly referred to the main idea contemplated by the invention, but such construction becomes a difficult matter when inconsistencies are found to exist on a comparison of some statements with others. So far as difficulties of this kind can be overcome, they are sometimes obviated by stating the claim first in a negative form. It is well to calculate upon every objection being raised to the specification that human ingenuity can devise: and accordingly it may be foreseen that the true, distinct nature of the invention is left open to misconstruction by a mere statement of what it is, since it may appear to be not only that, but something more also, (probably of a prejudicial character) unless guarded from such construction by a suitable negation. This course is particularly advisable when the patent is for a new combination of materials or processes, which in their separate form are old or not open to be claimed. Crane's patent is a case in point. It is described as consisting in 'the application of anthracite or stone-coal, combined with a hot-air blast in the smelting or manufacture of iron from iron-stone, mine or ore.' Now the patentee in this case, feeling that the ground to be occupied by his invention is narrow, proceeds in his specification very carefully to lay such a foundation as will lead to a right apprehension of his real subject-matter. He shows, that is, the importance in a commercial point of view of using the stone-coal in the manufacture of iron: and thence infers that the abandonment of the article after use (which he cites as a known fact) was owing to some imperfection in the means employed to adapt it to the purpose. He accordingly gives instructions as to a practical mode of applying it to this use, the essential feature in which is the adaptation thereto, and combination therewith, of the hot-air blast. And after describing the mode by which he had actually accomplished his purpose, he says:—'I would have it understood that I do not claim the using of a hot air blast separately in the smelting and manufacture of iron, as of my invention, when uncombined with the application of anthracite, or stone-coal and culm: nor do I claim the application of anthracite or stone-coal in the manufacture or smelting of iron, when uncombined with the using of hot-air blast. But what I do claim as my invention is the application of anthracite or stone-coal and culm, combined with the using of hot-air blast in the smelting and manufacture of iron from iron-stone, mine or ore, as above described.'

"The claim being in this form anticipates any objection that might be raised on the ground of interference with the hot-air blast patent of Neilson, except that Crane must take a license from him to use that part of the combination. It also avoids the objection of including what was known to be old in the manufacture of iron, so far as a series of (it would appear unsuccessful) efforts to make stone-coal available for the purpose could render it so. But it likewise sets at rest all uncertainty as to the real subject-matter of the patent by the positive form in which the claim is stated. So that the whole effect of the claim may be stated as follows:—'Although the patent is not for the use of hot-air by itself (that is Neilson's) nor for the application of anthracite or stone-coal without the use of hot-air blast (that has been tried and has failed), yet it is for the application of anthracite or stone-coal combined with the use of hot-air blast for the manufacture of iron.' And the only question that arises on the claim so stated is whether the subject-matter of a patent can stand upon such narrow ground. To this question the Court of Common Pleas answered in the affirmative—such opinion, in this case, resting upon the fact that the balance of evidence at the trial showed a substantive effect to have resulted from the combination, viz., an improved quality of iron at a diminished cost of production. It would seem that before the date of this patent the application of anthracite or stone-coal to the manufacture of iron was felt to a desideratum, but one which was not attained: the patentee, however, succeeded in producing better iron at a cheaper rate by the use of this article. To what cause then is his success attributable? The essential difference between his mode of operation and that practised by his predecessors was, that whereas they used stone-coal uncombined with a hot-air blast, he used it in combination therewith, and this being the only essential distinction between the two modes, to such is ascribed the difference of result."

The next two chapters, on the language and description of the specification, have reference to subjects of scarcely less importance than that on the order of the specification. We shall conclude our notice of the work by quoting from the final and recapitulatory chapter, the following admirable piece of advice, which all patentees would do well to consider:—

"The argument of the section of good faith is as follows: the general form and constitution of society, with its laws and orders, have come down to us through past ages with the authority of divine sanction; it is therefore the duty (as well as interest) of all who enjoy the protection of the law to uphold its integrity by honest compliance with its enactments in the spirit as well as the letter—departure from which principle for private ends is wrong, and, because wrong, inexpedient in the long run.

"On this ground it is contended that those who purposely exaggerate or diminish, or otherwise distort the real facts which are proper to be introduced into the specification defeat their own ends and greatly injure themselves by blunting their sense of rectitude."

Treatise on Mechanics. By J. F. Heather, B.A. London: John Weale, 1847; royal 8vo. No. I. pp. 48.

To detect and expose error—no less than to supply correct information on all subjects connected with mechanical science—is the constant endeavour of the conductors of this Journal; and in no instance are we more forcibly reminded of the responsibility of our position, than when called upon to analyse the merits of educational works professedly adapted to further the ends we have in view. Mr. Heather's treatise is peculiarly of this character;—his claims on public attention rest mainly on a profession of elementary preciseness of style, as will be seen by the following quotation from his preface—which will likewise serve to indicate the general nature and plan of the publication:—

"In putting forth a work in parts, it is not usual to make any prefatory remarks, until the whole be completed; but as I shall introduce into the treatment of the subject, in its earliest stage, some new enunciations of important principles, and shall endeavour to show that considerable improvements can be made upon the manner in which this subject has been handled, by even its greatest masters, I have thought it more courteous to my readers, thus early to call their attention to the influence which these principles will exercise throughout the subject.

My endeavour has been, in the first place, to attempt, with what success my readers must judge, to give clear and distinct definitions of the terms thereafter to be employed; and, in the next, to confine their use, on all occasions, strictly to the sense in which they have been originally defined."

In reply to all this, we are sorry to be compelled to state that the success of Mr. Heather has been in an inverse proportion to his pretensions, that his definitions are not clear and distinct, and that he has lamentably failed to prove—so far, at least, as he himself is concerned—that "considerable improvements can be made upon the manner in which this subject has been handled by even its greatest masters." We do not deny that Mr. Heather may be capable of clearly apprehending physical principles; but we do most positively assert, that he is utterly incapable of putting forth his conceptions either correctly or in a manner intelligible to those among his readers who may have taken up the subject of mechanics for the first time. His phraseology is inaccurate in the extreme;—terms constantly occur to which no definite meaning has previously been assigned;—his definitions are either old and well-known forms clothed in a new and looser garb,—or when original, generally incorrect.

Lest, however, we be accused of undue severity, we proceed to give extracts from the number before us,—pointing out the various inaccuracies and fallacies as they occur.

The first four paragraphs of the introduction being purely metaphysical, are, perhaps, not strictly within the province of a physical critique. We must, however, object to the assumption of the immutability of the law of nature, as derived from the immutability of their Divine Author. The same face that was smiling and beautiful at fifteen is wrinkled at fifty;—the same leaf that was green in June is brown in November;—the universe is in a continual state of change. Why, then, should the laws that govern this varying world be themselves unvarying? Why might not the purposes of Creation demand that they too should be subject to time, and *that* by an immutable decree of the Creator?

"While a certain determinate point with respect to a body, always preserves the same distances from the objects which surround it, the body is said to be at rest; and, when these distances undergo successive variations, it is said to be in motion."

This definition is neither new nor complete: it is incomplete because it is purely geometrical, and excludes all idea of the mechanical consequences of motion. Suppose the earth the only body in space—neither sun nor planets existing, to which to refer its motion;—then, according to the above definition, any point on its surface may be said to be at rest. But the variation of gravity at that point (supposed neither of the poles), arising from the centrifugal force, demonstrates that there must be a motion of rotation of the earth about an axis, and, consequently, that the point in question is absolutely moving, though, relatively to the other parts of the earth, at rest.

"Bodies, however different in volume, upon which the same force produces the same effects, are said to contain the same quantity of matter. The quantity of matter in a body is called its mass. Also, the greater the mass of a body, the greater the number of particles it is said to contain."

This definition is sheer nonsense. What are we to understand by the word effects? Are statical or dynamical effects here alluded to? If statical, behold the consequences of this certainly new definition. Suppose one pound of coals supported by a scuttle, and another by the surface of the earth;—then the weight of the coals "produces the same effects"—that is, the same pressures—on the scuttle and the earth,—*ergo*, the mass of the scuttle is equal to the mass of the earth. What Mr. Heather probably means is this:—Any two bodies are said to have equal masses, when equal velocities are generated in them in the same time, by equal, single, and invariable impressed forces, where by equal impressed forces we mean forces that would cause the bodies when at rest to exert equal pressures against fixed plane surfaces perpendicular to the direction of the forces.

From this definition of the word mass—combined with the fact, that the dynamical measure of gravity is the same for all bodies—we infer that the masses of bodies vary as their weights. As this definition cannot be understood by the tyro until he be conversant with the various measures of force, and the third law of motion, it ought to be deferred until those are explained. In the next number of the Journal, we hope to lay before our readers a short account of the measures of force,—the laws of motion,—and the meaning of the word mass, or quantity of matter. At present, we shall content ourselves with stating where we believe Mr. Heather to be incorrect, without any attempt at emendation—from which, indeed, the limits of a cursory review preclude us.

"12. Any two forces which are in equilibrium, when applied to the same material particle of any body, in the same right line, in opposite directions, are called equal forces.

13. A force which produces the same effect as two equal forces, applied at the same point in the same direction, is said to be twice one of these forces: a force which produces the same effect as three, is said to be three times one of them; and so on.

14. We are thus enabled to measure all kinds of forces, by units selected from the effects produced by forces of any one kind; and it is found most convenient to select these units from the effects produced by the attraction of the earth upon bodies near its surface. We find, in fact, that all bodies near the surface of the earth have a tendency to fall towards its centre; and when they do not so fall, we are enabled, in all cases, to trace out a sufficient cause which counteracts, and thus holds in suspension, the effect of this tendency; but the moment we remove the counteracting cause, the body begins to fall, and continues to do so, until it meet with some new obstruction.

15. When this effect is entirely uncounteracted, the same velocity is always generated in the same time in all bodies, whatever be their figures, volumes, and masses. This force, then, is called gravity, and is measured by the velocity generated in a second of time; and this measure is taken for the unit of measure of all other forces which are not in equilibrium, and when our object, consequently, is to find the relations between the forces and the motions produced.

16. When, however, we apply a force to a body in the opposite direction to gravity, so as to be exactly in equilibrium with it, and thus keep the body at rest, in which case it is said to support the body, we find that the force so applied must be in exact proportion to the mass of the body. The effect, then, of gravity in counteracting the effects of the other forces applied to a body, when it is kept at rest, is called the weight of that body; and, in the investigation of the relations subsisting between the magnitudes and circumstances of action of forces in equilibrium, the forces are measured by the weights of the bodies which they will support."

This is a jumble of inextricable confusion;—the explanation of measures of force—a subject of the first importance—is disposed of in about forty lines. One kind of force is described as producing effects two or three times as much as another; while the nature of the effects, and their susceptibility of measurement, are left entirely to conjecture. There are many causes followed by effects, which are not capable of being measured. Alcoholic liquors produce effects which are not capable of being measured. We cannot say that A is three times as drunk as B.

"Gravity, in fact, must be considered as acting upon every particle of which a body is composed, and generating in each of these particles, in the same time, precisely the same velocity; and thus these particles neither accelerate nor retard the motion of one another."

—Another instance of the inaccuracy of our author. This assertion, applied to rotating bodies, is absolutely untrue.

We have now arrived at the end of the introductory chapter;—the remainder of the number contains nothing very original or very incorrect. There is a fierce attack, near the conclusion, on Poisson,—founded on a misapprehension of his meaning; and an improvement on the second part of Duchayla's proof of the parallelogram of forces—which consists in omitting it. On the whole, we think we have fully justified our opinion of Mr. Heather's merits as an author. We think it possible, as we have observed before, that it is to Mr. Heather's inability in writing—not thinking—that his deficiencies are due;—to whatever cause, however, they be assigned, we shall conclude by solemnly declaring, in old-lady-phraseology, that—A Treatise on Mechanics, by J. F. Heather, B.A., is a very improper work to put into the hands of young persons.

The Great Britain, Atlantic Steam-ship. Twenty-five folios of Engravings. London: John Weale, 1847.

Mr. Weale has at length produced this long-promised work, but not in the state he at first intimated: his reasons for not doing so he gives in his preliminary advertisement. "The *author*," he says, "had undertaken to provide accurate drawings, with a descriptive text, which he has totally disregarded, although repeatedly urged, during a period of two years." For our own part, we are at a loss to know who has the right to be called the author, or who the engineer of this vessel. Perhaps Mr. Weale can hereafter explain,—or we may be induced to say a word hereafter.

The plates are got up in Mr. Weale's usual good style, and possess sufficient interest to make it a work desirable for the engineer. We have views of the engines, the boilers, the screw, and some portions of the iron-work of the vessel, showing the joinings of the iron ribs and plates.

CHAPEL OF JESUS COLLEGE, CAMBRIDGE.

The following account of the recent restorations in this beautiful edifice is given by a correspondent of the *Athenæum*, with the subscription "D. S." The fellows of the College have done wisely in entrusting the restorations—not to a mere mason—but a very competent architect (Mr. Salvin), and it is to be hoped that no alteration will be made in the arrangements:—

"It is now more than a twelvemonth since I transmitted to you an account of the discoveries which have been made, during the last year or two, in the Chapel of Jesus College, Cambridge; in the progress of which so much of the beautiful architecture of the ancient Church of the Nuns of St. Rhadegund, which had been concealed for the last 350 years, has been once more exposed to the admiring eyes of the lovers of ancient Art. Since that time, further research has brought more of the original features of the church to light; so that, at the present time, sufficient data have been obtained from which to determine the plan, and in great measure the architectural character, of the entire building as it stood before Bishop Alcock (thereby setting an example followed, a few years later, by Wolsey at St. Frideswides, Oxford) pared off the excrescences to adapt it to the more moderate requirements of a College chapel. This interesting work has been done, with his usual ability, by Professor Willis. It is said of Cuvier that, 'give him a single bone, and he would reconstruct the skeleton;' and those who have heard or read the Professor's Lectures on the Cathedrals of Canterbury and Winchester will at once have discerned the same talent in him. Give him a few feet of original walling here—a broken shaft there—the fragment of a base or a bit of a string-course in some out of the way corner, where no eye less keen-sighted than his would have discovered it,—and in due time he will show you what the whole building must have been. The results of his investigations in the present instance have been laid before the Cambridge Antiquarian Society,—and will appear as one of the numbers of their Transactions. Meanwhile, I may state that this, which till within the last two years seemed to be a plain cross church without aisles or chapels, now proves to have been originally a spacious and magnificent edifice—an example of the purest early English style. The nave, which is now short and perfectly plain, is shown to have had aisles, the piers and arches of which were built up into the present walls, and are now partially uncovered; and to have extended much further westward, into the Master's lodge—one of the piers being actually discovered *in situ* in Dr. French's oven. The transepts had aisles or chapels opening eastward; and the gable wall of the northern transept was lighted by a large round-headed triplet, which has been blocked by the College buildings abutting against it. On either side of the choir, were two arches opening into aisles or chapels; and the east wall was pierced by a triplet of lancet windows with black pannels between. The shattered remains of the original architecture are of such exquisite beauty, that even had Bishop Alcock's alterations been in the purest taste of his day we could scarcely have forgiven him the act of mutilation; but when we glance at the meagre, low-browed windows, flattened ceilings, and other inelegancies perpetrated by him, it must be admitted that the good prelate was almost as much devoid of taste as any whitewashing churchwarden of the last fifty years. Of course, it is vain to hope to restore all the fallen glories of the church of St. Rhadegund. We cannot expect that the Master should give up his house and his oven to reconstruct the nave—useless as it would be for the purposes of the chapel of a by no means large college; nor, however gladly we should watch the restoration of so interesting an architectural monument, can we desire it. Still, it is cheering to see that what is practicable is being done, and that more is in contemplation. The eastern aisle of the northern transept and the northern aisle of the choir have been rebuilt under Mr. Salvin's directions; and the arches opening into them—which were discovered built up in the wall with scarcely a moulding injured or a point of the dog's-tooth broken—carefully restored. More beautiful early English arches than those in the choir it would be hard to discover; and the pier supporting them is a most graceful combination of four cylinders, contrasting very remarkably with the sturdy little dwarf column brought to light in the transept. When the no less beautiful arches on the south shall be also opened (a work which I trust is only deferred for a short time), the present poor flat ceiling be replaced by the original high-pitched roof, the wiry Tudor tracing of the east window make room for the triple lancet—both of which latter alterations will, it is understood, take place in the course of the ensuing summer—and the paltry fittings of painted deal shall have given way to the rich oak stalls which are already being carved after the original model (one having been, fortunately, preserved in the Lodge when the chapel was 'repaired and beautified' in the dreary last century),—I know not where we shall be able to find a more exquisite example of the pure and graceful architecture of the thirteenth century, or a college chapel (with the exception of King's as beyond all comparison) more beautiful and interesting. By the munificence of the Master, Dr. French, the four lancets to the north will be filled with stained glass by Wailes,—and the eastern lancets will be similarly decorated. The glass in the present east window will be removed to the large window in the south transept, which is well calculated to receive it. It is also gratifying to be able to state that the spirit of improvement has extended from the fabric to the services of the chapel: an individual member of the College having offered to present an organ, and to train and endow a choir, which will be accommodated in the aisle recently constructed. The same generous benefactor has presented the college with a statue of Bishop Alcock,—which now fills a niche in the tower over the great gateway. The improvement, both in effect and in meaning, is immense. I trust that the college will carry on the good work of restoration by banishing the sash windows and replacing the mullions, at least in the tower windows, if not in the whole front. It is too much to hope for the restoration of the original proportions of the façade by the removal of the upper story;—which, as may be seen from Loggan's View, is a later addition, sadly interfering with the dignity of the tower gateway. Much, however, has been effected in a most praiseworthy manner; and it is to be hoped that those to whom their college is an object of affectionate pride will come forward to aid in the completion of a work so interesting as the restoration to its original dignity and beauty of the chapel in which Cranmer and Pearson once worshipped."

CANTERBURY CATHEDRAL.

At the *Archæological Institute, March* 5, Prof. Willis delivered a lecture "*On the Conventual Buildings attached to the Cathedral at Canterbury,*" when that beautiful edifice was the church of the Benedictine monastery there. He had given, he said, to the Cathedral, on another occasion, an entirely separate examination; and it was not his intention to allude to it at all, but he should confine the observations which he had to offer to the remains of the conventual buildings. These were interesting, though, unfortunately, concealed, for the most part, in the gardens and private apartments of the canons; but every opportunity had been afforded him for making a careful survey of what remained. The result of his examination was now before them; and, though interesting in itself, he should not have engaged the attention of the meeting on this occasion, but for the curious elucidation which the existing remains receive from an ancient drawing in a Psalter preserved in Trinity College, Cambridge. This drawing was engraved, but not very well engraved, in the second volume of the "Vetusta Monumenta." It has hitherto gone without a name (for none is given); but the result of his researches would show that it was meant for the Benedictine monastery at Canterbury, and made some time between the death of Anselm and the fire described by Gervase the Monk, in 1174. Of this drawing he had made an enlarged and accurate copy; and his object was, to show the extreme fidelity of the drawing and the interesting illustration which it receives from the scattered ruins that still remain. It would be observed, that the drawing in the Psalter was a kind of bird's-eye view; and that the monk by whom it was made was no great master of the rules of perspective—for some of the buildings are drawn upon their heads, and others upon their sides; but still, it was easy to understand it. Here, in the monk's drawing, is the church of the monastery; —here the outer walls and principal entrances;—here the chapter-house, cloisters, refectory, dormitory, necessarium, kitchen, brew-house, bake-house, granary and infirmary;—here the prior's house, the apartments of the guests, the hall or refectory for guests, the cemetery and the castellum aquæ,—by far the most curious part of the whole drawing, because it informs us of the ingenious and admirable contrivances of the monks for the thorough supply of the whole monastery with water. The Norman gateway, the principal entrance to the monastery,—represented in the drawing of the monk—still remains: and he did not know a more beautiful example, though somewhat altered in the upper story and disfigured by minor additions. The gate of the cemetery no longer exists. The cloisters in the drawing are Norman, though now Perpendicular, and with some traces of their Norman origin. The dormitory running from the cloisters was 145 feet by 80; and the Norman piers of the substructions, with some of the Norman windows, still remain. In a private garden belonging to one of the canons is a Norman cloister, very little known, but a beautifully simple piece of architecture, more like an Italian church or one of Wren's or Inigo Jones's constructions,—and a curious example of the slight separation between the Romanesque and the style from which it was immediately derived. The necessarium (now the site of the house of one of the minor canons) was 130 feet long, with fifty stone seats on each side, and a drain under each of the aisles. The place was most ingeniously drained and ventilated; for the monks were in advance of the rest of the world not only in learning, but in the conveniences and comforts of domestic life. Of this necessarium certain Norman traces remain. Of the refectory, only two sides are at present standing; but traces exist of a fine octagon kitchen, of a brewhouse, bakehouse, granary and infirmary. The infirmary was a building complete in itself; having a chapel, hall, refectory and necessarium. This was generally the case; and he would remark, in passing, that the whole establishment of the sick at Ely has been called the early church of the Cathedral,—when, in truth, it was nothing more than the infirmary of the sick.

Of the prior's house every portion has been swept away except a cloister under the prior's chapel. This house would appear to have been so ingeniously situated and contrived that the prior could see from his own house the principal altars of the church. Of the rooms set apart for the guests a Norman gateway still remains; and the hall, or the refectory for the guests, has been floored and fitted up as a residence for one of the minor canons of the Cathedral.—He would return to the subject of the distribution of the water; and would first direct attention to the number of straggling lines running about the drawing of the monk—some green, some red, and some yellow. These were water-courses—for the drawing would appear to have been made to show not the elevations of the monastery, but the machinery used for the distribution of the water. The canons of the Cathedral are still supplied by wooden pipes from the reservoir in use when the drawing was made. The reservoir was about a mile out of the town; and the water-course led to a circular building at the end of the beautiful Norman cloister to which he had already referred. This circular building has hitherto been called the baptistery—but it really is nothing more than the castellum aquæ of the drawing; and on a minute examination he discovered, on clearing the rubble out, the hollow pillar in the centre (represented in the drawing) by which the castellum aquæ was supplied with water.

REVULSION IN THE MANUFACTURE AND TRADE OF COPPER.

The copper mines of Cornwall and Wales have, hitherto, yielded 16,000 tons of copper annually; for which, however, 170,000 tons of ore were required, as they do not yield more than an average of 9½ lb. per cwt. These mines will no longer be able to compete with those of other countries, discovered or even worked at the present moment. We allude chiefly to the South Australian mines; the more so, as their riches seem inexhaustible, and lay so close to the surface, that their working will require little skill and expense. In 1845, the first year these ores were brought to England, their value scarcely amounted to £16,000, while last year it had extended to £100,000. It would, perhaps, have far exceeded this sum, had not the simultaneous discovery of gold diverted attention and capital therefrom. It is to be expected that the great influx of emigration to that quarter in general, as well as the aid of German (Freyberg) miners, will soon enable the colonists to have their own furnaces, and supply the markets of India and China, which hitherto have been partly supplied with copper from England.

The mines of North America are next to be alluded to, which were known even so far back as when the Jesuit Charlevoix visited these places, where (the north-west lakes) he says copper was made into candlesticks and other church implements for the use of the missions. In 1773, a British copper-mine company was formed, but the succeeding revolutionary wars and territorial disputes rendered it ineffective; but, of late, more than a hundred mining companies have been formed on Lakes Huron and Superior. The American press is full of the praises of the riches of these parts in silver and copper; large masses have arrived at Boston, where extensive smelting works are being established, which will make this place the Cornwall of New England. In other parts of the United States also, as in New Jersey and Missouri, vast layers of copper have been discovered, at which latter place, the mine of Buckeye yields already 15 tons of ore daily, containing 37 lb. per cwt. of copper.

The prospects of Canada are equally cheerful, and the strata of this part of Lakes Huron and Superior are very profitable, and companies have been formed both in Montreal and Quebec, whose surveyors were very active last season. The Quebec society have begun operations at Maimaase, and the first samples of ore yielded a gross average of 30 lb. per cwt. of copper. The society of Montreal have begun the construction of furnaces and pounding engines on a large scale. Their surveyors have found large lumps of copper, one of which weighed two tons, and seams of that metal 60 feet wide by 70 feet deep. The ore is conveyed through the lakes and canals to the St. Lawrence, and it is intended to cut a new canal at the Sault Ste. Marie, where the communication between the Huron and Superior takes place. As the mine district is a very barren one, profitable employment will thus accrue to the surrounding corn-growing lands.

J. L——Y.

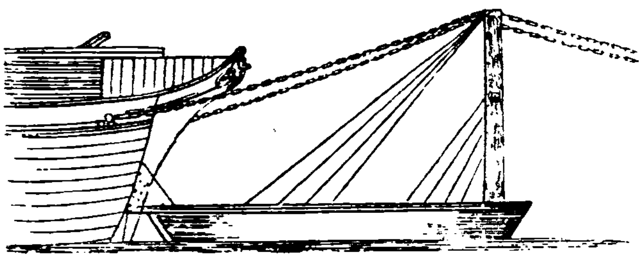
THE CENTRAL SUN.

Although it has been *known* that the sun is merely the central body of *our* planetary system—yet, it seems that it is Mädler's discovery, which will bring us somewhat nearer to the elucidation of the form, extent, and the *stratification* (altogether—*organisation*) of our whole *cosmic* system, —such, at least, as it is accessible to human ken, present or future. The discovery of Mädler has already done so much, as to afford us some fixed point from which the form, extent, and *stratification* of this huge system of star-molecules can be ascertained, measured, and laid down;—although it is obvious, that *if* any one had, by means of mere speculative induction, begun to extend the hitherto calculation or construction of our common orreries—that is, constructed an orrery of all the known fixed stars—the central sun in the Pleiades would have been arrived at, *ipso facto*. But, Prof. Mädler's central sun is (by his own statement), *not* the real central sun, as he *excludes* from his system the *Magellanic clouds* and other numerous star-nebulæ. Then, therefore, only when these vast accumulations of milky ways will have been properly observed and studied, the true central star of the *cosmos* will be ascertainable. But, even now, the calculation and construction of a world's-orrery is becoming a great desideratum. The scale, certainly, as we have to deal with 34,000,000 of parallaxes of the sun—will be a difficult task; still, it is not so much the laying down of single stars (evanescing in such spaces), than the configuration and stratification of what Mädler calls "rings and layers" of stars, which will be the most important. It is impossible, in viewing these subjects, not to think of the *macro-cosmos* of the ancients, or still more of what Pliny conjectured on this huge world-system, in saying—"Mundum —seu quod alio nomine Deum nuncupari fast est." Lib. II. 1.

J. L——Y.

THE RECOVERY OF THE SPHYNX STEAM SLOOP.

The recovery of the Sphynx steam-sloop from the fate which was generally predicted for her, has reflected much credit on Captain Austin, C.B., Commander Caffin, Lieutenant Thompson, of the Victory; Mr. Bellamy, assistant master attendant of Portsmouth Dockyard; Mr. Biddlecomb, master; and Mr. Mallard, second master of the St. Vincent, and the officers and men of the royal navy, and Mr. Watts, assistant master shipwright, of Portsmouth Dockyard, to whom was entrusted the task of recovering this fine steamer from off the coast at the back of the Isle of Wight, where she stranded in February last, during a fog. It is impossible to commend too highly the exertions of all engaged in the arduous task, and the cheerful manner in which they endured all sorts of privations. Commander Caffin, of the Scourge steam-sloop, was first sent to assist in getting off the Sphynx. He at once saw the necessity of mechanical help, and immediately applied to the Portsmouth dockyard, when Rear-Admiral Parker ordered Mr. Watts to go to her, taking 50 mechanics of different departments; and no time was lost in consulting on the best means to be adopted. It occurred to Commander Caffin that they should avail themselves of the paddle beams and framing to apply buoyant vessels of some kind underneath, and Mr. Watts thought a raft of casks or of tanks might answer the purpose. The difficulty, however, of lashing or uniting them together sufficiently securely to withstand the immense force of the rollers and breakers, so common off that part of the island, was seen, and Commander Caffin then suggested the London barge, decked over and applied as camels underneath the paddle-boxes. On this the framing was immediately planned, and Mr. Watts's designs were received at Portsmouth-yard, where it—together with the barges—was prepared. In the first attempt with these barges they failed, in consequence in part of one of them having received injury for want of sufficient security. Unfortunately it forged ahead, and the pump, which projected up through the deck, came in contact with one of the bearers of the framing, and ripped up a portion of it, which caused it to fill. But even if this accident had not happened, the change of weather would have defeated them. They profited by this experience, and Commander Caffin having left, Mr. Watts went to work to remedy and improve on the first attempt; and Captain Austin having arrived, determined on carrying out the plans agreed upon. The barges were found not to possess sufficient buoyant power, and consequently they were raised upon so as to bring them up to about 140 tons. Mr. Watts found that the nose of the vessel, instead of being lifted over the reef of rocks or banks, was rather forced into it by the downward action of the cables when hove upon; to obviate this he had a third barge or camel prepared, with a framework at the extreme end sufficiently high (as shown in the annexed engraving), that when the cables, hawsers, &c., were carried over it, this downward action, instead of depressing the vessel, should produce the contrary effect. To accomplish this he placed at the opposite end of the camel, firmly secured to its deck, two strong pieces of timber, kept sufficiently asunder for the stem of the vessel to pass between them, so that they forked the stem. Attached to the stem, immediately over this fork, was a strong cleat on each side. By the depressing of the end on which the frame was placed the end next the vessel was raised, and an upward pressure on the cleats resulted therefrom. Beyond this a great portion of the buoyant power of the camel came into operation. The undulations of the sea also contributing to increase its effect.



The Sphynx, cleared of everything except her engines, drew upwards of ten feet of water; and the reef over which she was ultimately carried had not more than six feet on it at the time. She had twice before been brought up to this point, and could not be got over it; but on the 3rd ult., by the joint effects of the camels under the paddle-boxes—the one against the stern, nicknamed the dromedary, and the two tiers of casks (alias bolls), under the bottom, and main strength in heaving, she effected the passage. The outer shoal or reef, on which there was only about six inches more water than on the inner, brought her up again. The purchases having been perhaps prematurely detached from the vessel, not expecting that they would be further required, they impeded the progress of the vessel over the intermediate flat, and would perhaps have prevented her reaching the outer reef in time to get over in that tide, so that the result would have been the same in either case; thus she was not got entirely over these reefs before ten o'clock on Thursday morning, the 4th ult.

The "recovered" Sphynx was then taken into the Angle Dock at Portsmouth, on Saturday afternoon, the 6th ult., when it was stated that the vessel was much strained, inasmuch as the bed-plate and condenser of the engines were both broken, the former in several places. The kelson bolts were also several of them started up by her thumping on the rocks. The engines and boilers have to be entirely removed to repair the injuries sustained by the keel and bottom planking. The lower part of the knee of the head was carried away on the 14th of February, by the chain cable, when the vessel went broadside on the shore.—The Sphynx was afterwards brought round to Woolwich, where she is undergoing repair, and the engines are in the hands of Messrs. Penn, of Greenwich, who recently constructed the engines, which are of the oscillating principle.

THE NEW PLANET.

At a meeting of the *Astronomical Society*, February 12,—Capt. W. H. Smyth, R.N., President, in the chair,—The Report for the past year was presented by the Council, and read.—On the motion that it be adopted, an amendment proposed by Mr. Babbage, and seconded by Dr. Fitton—That this meeting express their deep regret that the Council have not awarded the Society's medal to M. Leverrier, for his publication of the greatest astronomical discovery of modern times—was negatived. A second amendment proposed by Lieut. Raper, and seconded by Capt. Bethune,—That it is the opinion of the meeting that the unprecedented discovery of a new planet by theoretical researches, and the acknowledged title of M. Leverrier to the honour of that discovery, demand for him some special mark of the approbation of this Society; and it be recommended to the new Council to convene a Special General Meeting of the Society, on as early a day as may be convenient, for the purpose of suspending Articles 2, 3, and 4, of Section 16 of the Bye-laws; and that the printing of the Report be deferred till the subject shall have been brought under the consideration of such Special General Meeting—was negatived. A third amendment proposed by the Rev. R. Sheepshanks and seconded by Mr. Drach—That a Special General Meeting be called to consider the propriety of granting a medal to M. Leverrier, for his researches respecting the planet exterior to Uranus, and a medal to Mr. Adams for his researches on the same subject—was also negatived. A fourth amendment proposed by the Astronomer Royal and seconded by Dr. Lee—That a Special General Meeting be called after the ordinary Meeting of March 12, to consider the following resolutions:—That so much of the Bye-law as relates to the number of medals which may be adjudged in any one year, the time of giving notice of the proposal for a medal, the time of adjudging the medal, and the time of presenting the medal, be suspended *pro hâc vice*; That the Council be authorised to award two (or more) medals, if they shall deem it expedient to do so; That the award of the Council be communicated to the Society, and that the medal or medals be presented at the ordinary meeting of April 9—was carried.

BUDDHIST ARCHITECTURE.

At the *Royal Asiatic Society*, Colonel Sykes read an extract from a letter received from Captain Kittoe, who has been making some recent antiquarian researches about Gyah, anciently one of the seats of Buddhism, described by Dr. Buchanan Hamilton, in the second volume of the Society's *Transactions*. Capt. Kittoe states that he has found and copied a number of inscriptions, some of which he promises to send to Col. Sykes; and that he has heard of others, some miles inland, never yet seen by any European, which he intends examining. He was unsuccessful in his search after remains of Buddhist architecture, having met with but four or five fragments; but he found a great number of small sculptured stones, which he thought were miniature chaityas or shrines, a sketch of one of which he forwards in his letter; the base being a cube, the upper plane surmounted by a hemisphere, from the apex of which rose an obelisk. In each of the four vertical faces was a compartment, containing a figure of Buddha, the figures in different attitudes; and he states that such stones are found, not in Behar only, but in Cuttack also, where he has seen several. He remarks that they resemble closely the pagoda at Rangoon, where five hairs of Buddha are kept as relics. Many of these are of elaborate workmanship; and some have images of Buddha in various postures in the different compartments; generally sitting with the hands folded, but sometimes erect; and a few seated on a bench. One of them, which he has in his possession, is inscribed with the usual Buddhist formula, *yedharma hetu prabhava*, which is decisive of its appropriation. Col. Sykes observed that these chaityas in all probability are representations, or the identical shrines seen by the Chinese traveller, Fa-hian, at the beginning of the 5th century of our era; and afford a valuable attestation to his truth respecting the then existing belief in the four Buddhas, the *predecessors* of Sakhya.

Captain Kittoe believes the present temple at Gyah to be less than 600 years old, and to have been built for the joint worship of Siva and Buddha. He thinks he shall be able to trace the amalgamation of the sects by their sculpture; and he is preparing to make drawings of the most interesting of these relics. Captain Kittoe states that he has discovered another of Asoka's pillars, at Bukrowe, the site of an ancient city of the Buddhists, on the banks of the Lilajun. It was broken, many years ago, into three pieces, one of which was brought to Gyah by Mr. Bodham, and set up in the bazaar, where it goes by the name of Bodham's Folly, an apt illustration of the light in which the natives of India, and too many of our own countrymen, regard the preservation of such remains of past ages, from which alone the recovery of any portion of the ancient history of the country can be expected. The Raja there suggested to Captain Kittoe that he should make rollers for the roads of the fragments of the pillar! One piece of the pillar, the base, is almost entirely buried beneath the surface. Captain Kittoe is about to dig it out, with a view to its preservation.

Colonel Sykes remarked that this discovery affords another proof of Fa-hian's trustworthiness, as it has brought to light another of the pillars mentioned by him, but which had hitherto escaped notice.

LITHOGRAPHIC STONE IN ARABIA.

At the *Royal Asiatic Society*, the secretary read a paper which had been furnished by the Hon. East India Company, containing an account of the discovery of a quarry of good lithographic stone on the southern coast of Arabia, which will be available for our presses in Bombay, and other parts of India, which at present import a considerable quantity of that kind of limestone from the quarries of Germany. The discovery is due to assistant-surgeon H. J. Carter, who is employed in the survey of that coast. In the course of his duties, to the N.E. of Aden, Mr. Carter found that much of the land was of calcareous formation, of various series; the limestone was of a very fine grain, which induced him to gather some specimens, and forward them to Dr. Buist, of Bombay, for the purpose of trying their quality in lithography. The stratum composing this fine-grained stone lies three or four miles inland, and close to the summit of a descent, down which the blocks might be rolled, with very little trouble, close to the water's edge, where they might be immediately shipped. The inhabitants of the country, though somewhat fierce, are easily managed by proper treatment, and would readily protect persons employed to work the quarry; and Mr. Carter suggests that means should be taken to ascertain the quantity of produce the quarry is capable of yielding,—an investigation which his duties on the survey did not allow him leisure to pursue.

The report of Dr. Buist was very favourable to the quality of the stone. It was repeatedly tried, with some disadvantages, upon the native presses, and found to take the drawing with perfect facility, and to print with a purity not surpassed by the very best stones imported from Munich. Dr.

Buist gives some account of the native presses, of which there are above a dozen in Bombay alone; with details as to the expense of quarrying and freight, and the probable price and consumption in India; and is of opinion that the stone might even be advantageously carried to England. He concludes with recommending the Indian government to direct a few tons to be brought to Bombay for the purpose of making the experiment on a larger scale, by the first vessel in their service which may chance to be in the neighbourhood of the rock.

COPPER MINES IN ARABIA.

A paper from Mr. Carter was read at the *Asiatic Society*, "*On the Copper-mines in the island of Masseera, on the coast of Arabia*," which he had been induced to search for in consequence of receiving information that the Persians had formerly wrought copper-mines in the island. He had made several attempts to find the mines, but without success; the natives denied all knowledge of their existence; and he was about to relinquish the search, when, landing one morning in the month of February, 1846, on the westernmost part of the island, he accidentally fell in with some patches of blue carbonate of copper,—a specimen of which was laid upon the table. Mr. Carter, now confident of success, at once proceeded to search the neighbourhood. He soon fell in with some old smelting places; and immediately after found the vein itself, with the mineral *in situ*. After describing the nature of the mine, which appears to have been little worked, Mr. Carter states that he afterwards found copper in other places; and that the inhabitants, finding concealment no longer possible, discovered to him, of their own accord, other veins and smelting places, which they said had been built by the Feringhees. Mr. Carter states, that the inhabitants, though at first fiercely opposed to the landing of the surveying party, were soon conciliated; and that the utmost goodwill subsequently prevailed among them during the whole time the vessel remained in the neighbourhood. They are very steady and industrious; and their habits are in decided contrast with those of the Bedowins on the main land; and he is quite satisfied that any attempts to work the mines would meet with every assistance in the power of the natives to afford.

TYRE AND SIDON.

A paper by Capt. Newbold was read at the *Royal Asiatic Society*, "*On the mountainous country between the coasts of Tyre and Sidon and the river Jordan*," a part of Palestine hitherto almost a complete blank in our maps. Captain Newbold proceeded in 1845 from Tyre to Banias, and returned from Hasbeia and the castle of Shukif to Sidon. He thus traversed the country in two directions; and brought back with him a copious list of geographical names in the original orthography, most of which are wanting in Mr. Smith's valuable catalogue. The country is divided into the districts of Esh-Shukif and Beshareh; it comprehends an area of 468 square miles, being about 26 miles from north to south, and 18 from east to west. The shore district is the celebrated Phœnician Plain; it rarely exceeds two miles in width; and in many parts the mountains come down close to the sea in bold precipices. The maritime tracts are undulating, and vary in elevation from a few feet to 100 yards. The inland portion is about 200 feet high; reaching in some places to near 4500 feet, and separated by very narrow valleys, which are extremely deep and precipitous. Two rivers, the Litani (the ancient Leontes), and the Lohrani, pass through it to the sea; and a number of small rivulets, running to the Jordan, drain it towards the west. The principal rock is the marine limestone of Lebanon, penetrated by extensive dykes of basalt, accompanying lines of fracture, which appear to be connected with the fearful earthquakes of which the country has so frequently been the theatre. The crater of an extinct volcano, with its steep and rugged sides of lava, and evident traces of former action, were seen by Messrs. Robinson and Smith, and described in their work. Much of the country is cultivated; wheat-fields are numerous; and the vine flourishes in the volcanic soil: cotton also grows, but the staple productions are wheat, millet, beans, tobacco, and lentils. The population amounts to 15,000,—about thirty to the square mile; and is composed of Greeks, Druses, and Arabs. Captain Newbold examined the cavities in the coast which have been taken for the dye-pots of the Tyrians, and found them to be nothing more than natural rock basins, excavated by the action of the tide. He says they occur all along the coast of Syria, from Gaza to the Orontes. The old city of Tyre is buried under the sands; and forms an inexhaustible quarry whence materials are drawn to build and enlarge the cities in the vicinity. Captain Newbold saw a beautiful marble torso of Minerva, as large as life, recently found among the ruins, and now in the possession of a native of Tyre. He communicated the circumstance to our consul at Beyrut, with the hope of preserving it from further injury. Some interesting accounts of remarkable spots in the interior, which were visited by Captain Newbold, concluded the paper.

OF THE SUCCESSIVE PHASES OF GEOLOGICAL SCIENCE.

Abstract of lecture delivered at the *Royal Institution*, March 5th, by Prof. Ansted.—The lecturer stated that he proposed to give something of a psychological view of geological history,—tracing the successive ideas that seem to have chiefly contributed towards the advancement of the science,—and pointing out how far these ideas involved truth, and how far errors of exaggeration, although they were useful as suggesting new views and observations. After reviewing the philosophy of the ancients and the cosmogony of the Middle Ages—which latter he described as without the true aspect of philosophic investigation—the lecturer referred to the discoveries of Werner as being the first which distinctly created geological science. He stated that these discoveries induced three important assumptions:—first, that the whole crust of the earth had been deposited mechanically from water; secondly, that the newer deposits were generally horizontal; thirdly, that there was an invariable order of superposition of similar mineral types. The idea thus involved was that of "the universality of formations," and a perception of order in the arrangement of the materials of which the earth's crust is made up; and the idea was described as useful and suggestive, although the conclusions were in many important respects unsound. While Werner was thus laying the foundation of geology by observations and speculations on mineral structure, William Smith, the father of English geology, had obtained an insight into an important fact concerning the distribution of fossil bodies; and at the same time Dr. Hutton, in his "Theory of the Earth," had recognised a succession of worlds and a history of the nature of the succession by the agency of causes not different from those still in action. The idea involved in the discoveries of Smith was, that "fossils are characteristic of formations;" while Hutton first appreciated the importance of existing causes. The next step in geological discovery was described as the result of Cuvier's investigations in palæontology, and the establishment of the law of the adaptation of structure to habit in all animals. This law, however, is combined with another, also of great importance—that there is in all nature a permanence of typical peculiarities. Modified and brought to bear on fossils in this way, the "law of universal adaptation" was described as the suggestive idea in this step of geological progress;—while the law afterwards made out concerning the *representation* of species in time as well as space was mentioned as affording important accessory aid in applying palæontology to the determination of geological problems.—After referring to the subject of geological classification, and describing it as the result of the working out of these various laws, the lecturer briefly stated the actual results of observation in descriptive geology, and the nature of the most remarkable speculations in physical geology;—but the latter were rather indicated in allusions to the desiderata in that department than dwelt upon or described directly. Among these desiderata he particularly referred to the condition of knowledge with regard to metamorphic rocks,—and their relations with rocks of distinctly igneous origin, on the one hand, and the fossiliferous stratified rocks on the other. He stated that much yet remains to be done in connecting the present with the immediately antecedent condition; but expressed grounds for belief that investigations actually in progress may lead to some satisfactory and fixed conclusions. The making comparative observations on a large scale was mentioned as an important means of advancing geological science: and in conclusion, Prof. Ansted spoke of the necessity of distinguishing in all cases the true objects of geology—and stated his firm conviction that geology would soon occupy a very important place as an inductive science, leading to great practical results.

RAISING AND SHAPING METAL BY STAMPING AND PRESSURE.

Abstract of lecture delivered at the *Royal Institution*, March 19, by Mr. Carpmael.—The lecturer's purpose was to show how objects of extreme perfection of workmanship and of great use in daily life are produced by simple manipulation. Having adverted to the old process of stamping sheet metal, and remarked that this process generally required that the article stamped should have a flange or rim, and that the process was inapplicable to any ornamental work which required undercutting in the sculptured part, Mr. Carpmael proceeded to describe the improvement lately introduced by *spinning* (i. e. burnishing to form), which is performed by fixing the object in a lathe and pressing its surface with a blunt tool; and explained how, by means of a divided mandril, undercut forms could be obtained. He then pointed out that this burnishing to form could be alternated with *casting*, and that the flange was rendered unnecessary in the casting process—the metal being driven through a conical mould much on the principle on which pipes, &c. are drawn: the difference being that in the process which he was describing, the object was forced through the gradually-contracting aperture by the blow of a heavy weight falling on its lower surface. Mr. Carpmael presented an example in a tea-pot, made of tinned iron plate by the joint process of casting and burnishing to form. This article, which is of the best fabric, is sold (wholesale) for 1s. 8d. Mr. Carpmael also exhibited the machines by which tin is shaped into boxes and bottles for holding colours, perfumes, &c., by squeezing a small ingot of this ductile metal by a powerful pressure.

HISTORY OF ENGINEERING.

By Sir J. Rennie, President of the Institution of Civil Engineers.

(*Continued from page* 81.)

Railways.

Whilst the turnpike road and coach system was rapidly advancing towards perfection, numerous active and inventive spirits, aspiring after better things, were busily employed in racking their brains to invent a mode of travelling, or locomotion, which should far exceed its predecessors; great difficulties however presented themselves—and amongst the agents which were thought of, none appeared so well adapted for the object as steam, the success of which, in the hands of Watt and others, had proved so triumphant, wherever it had been applied; but, in order to attain the wished-for velocity, a different kind of road was required to that which had hitherto been used: and at length the railway system was introduced.

Railways, formed with wooden rails, or parallel pieces of wood, with carriages having wooden wheels to run upon them, had been in use at Newcastle as far back as 1681, for the purpose of conveying coal down from the mines to shipping-places on the banks of the Tyne; Labelye, in 1743, described improved carriages, used by Allen in stone quarries at Bath, having wheels with flanges of cast iron, adapted to run on wooden edge-rails; being an improvement upon those at Newcastle; afterwards, the wooden rails were plated with iron, which made the carriages run more easily with a greater load; cast iron rails, or plates, were brought into use for the first time by Reynolds of Colebrook Dale in 1767; and more completely by Curr at Sheffield, with wagons having cast iron wheels without flanges, the rails being in the form of tram plates; and in 1769 Edgeworth introduced three or four wagons drawn in a train, by one horse. These iron tramways, laid upon stone blocks, with the carriages above described, having smooth-tyred wheels without flanges, came into general use, for drawing coals, stone, and other minerals, from the mines and quarries underground, and at short distances from canals; but no lines of any great length were made for general traffic. The first line of any any extent, it is believed, was that at Loughborough, by Jessop, in 1789; also between Cardiff and Merthyr Tydvil, the act for which was obtained in 1794; this was followed by the Croydon and Surrey railway between Wandsworth and Merstham, in 1804: for the periods, all these were considerable works of the kind. About this time railways were used by the contractors during the execution of great works, at the London, the East, the West India Docks, and other places, where the transport of vast masses of materials was required; when the works were completed, the rails or plates, which were made with side flanges to keep the wheels in the places, were generally sold, and were occasionally used for constructing short lines to canals and shipping places. The only power applied to draw the wagons was that of horses. These railways were considered inferior to canals, and were seldom used, except when the traffic was chiefly descending, so that the empty wagons could return with facility.

Locomotive Engines.—The application of steam power to the propulsion of carriages might, it would seem, have naturally commenced with carriages on the common roads; but so many difficulties intervened, that the attempt was not made until after it had been effected on railways. Dr. Robison proposed it to Watt in 1769, and Darwin mentions it in 1796; but the application of Newcomen's or Watt's engines, for propelling carriages, could not be attempted with any probability of success, as they required copious and constant supplies of cold water for condensing the steam, which would have rendered the machine so cumbersome and unwieldly as to be unmanageable. Watt's practice was to condense the steam at a comparatively low temperature: for although he tried it in almost every state, from high to low pressure, he ultimately, under all circumstances, preferred employing steam at about 3 lb. above the pressure of the atmosphere. Amongst his earliest investigations he made a model of a high-pressure engine, which acted very well; and he described a high-pressure locomotive engine in his specification of 1784; but he considered steam at such a high pressure to be unsafe, and did not make any use of it. His assistant, Murdoch, afterwards made a working model of a locomotive engine which acted very well, but he did not pursue it further. Leupold had proposed a high-pressure engine in 1725; and one was made by Cugnot at Paris in 1770 for propelling a carriage, but it failed entirely, and was never used.

Trevithick and Vivian obtained a patent in 1802, for high-pressure engines, in one of which locomotion was to be produced by the adhesion of the wheels, propelled by the engine working on the road. They also proposed ribbed wheels with nails or bosses, for the purpose of enabling the engine to ascend steep places. In 1804 they made a locomotive engine, which travelled upon the Merthyr Tydvil railway; it consisted of one high-pressure cylinder, with a fly-wheel, and four bearing-wheels, two of which were turned by the action of the piston, and produced a velocity of five miles an hour, drawing after it several wagons, containing a load of about 15 tons. This locomotive worked by adhesion alone. The experiment was not continued, because the weight of the engine, with its cast iron boiler, was considered too great for the rails, and might have occasioned considerable damage to them, and if the weight of the engine had been reduced sufficiently, it would have been too light, and the wheels would have slipped upon the rails. Thus we see, that the great principle of adhesion, for producing locomotion, was clearly understood at the outset, and was only abandoned in consequence of the cast iron plate rails at that time in use, being unfit for carrying it into effect. In addition to the objection on the score of the weight of Trevithick's locomotives, more serious opposition arose against them in consequence of one of them having exploded in 1803. This objection was made to all Trevithick's locomotive engines, although ultimately they came into use. He had made an attempt to propel carriages on common roads by steam in 1806, and constructed a carriage worked by steam, which was exhibited publicly, in the neighbourhood of Bethlehem Hospital. To that ingenious and able man the origin of the locomotive system may be said to be due. In 1811 Blenkinsop took out a patent for using rails, having teeth like a rack in them, into which wheels, having corresponding teeth, were worked by the engine, thus securing the engine against the chance of slipping. This was brought into use for conveying coals from the Middleton Colliery, near Leeds, which may be said to have been the first practical employment of locomotive engines; but the expense, friction, noise, and slowness of the motion, which scarcely exceeded four to five miles an hour prevented it from being generally adopted. In 1813 Brunton took out a patent for producing locomotion by levers, worked by the engine, resembling a good deal the motion of a horse. This however failed, and a serious accident occurred by the explosion of the engine attached to it. Chapman followed, and patented an invention for producing locomotion by means of chains laid along the line of road, passing round the wheels of the locomotive, and thus travelled forward. In 1813 Blackett resumed Trevithick's original plan, and constructed an engine which worked by adhesion alone, upon the rails at the Wylam Colliery, at Newcastle.

George Stephenson in 1814 improved upon all the former locomotives, and took out patents in conjunction with George Dodd in 1815, and with Losh in 1816. The locomotive, in his hands, soon became sufficiently perfect to be brought into general use on railways, for drawing coal wagons at a greater rate than could be performed by horses. The weight of the engine was sustained on the axles of the carriages, by means of small pistons working in cylinders, supplied with water from the boiler, which acted like so many springs. Two steam cylinders were employed, and all the four wheels were impelled by them; the engine was followed by a tender carrying water and fuel. Here was a grand epoch in the history of railways, which were destined at no very distant period to effect such a complete revolution in the whole system of international communication, and to realise such extraordinary results, as even the most sanguine minds never anticipated. James, who had examined the machines, published a letter in 1815, proposing railways as a general system for travelling. The general introduction, in 1816, of the cast iron edge rails, and the flanged wheels, which are said to have been invented by W. Jessop, long before, on the Loughborough railway, instead of the cast iron tram-plates with which the earlier railways had been laid, was soon followed by the introduction of wrought iron rails, in long pieces, at first, in plain rolled bars, and afterwards rolled with projections on their upper edges, in order to give breadth for the wheels to run upon, as well as to increase the strength of the rails and enable them to bear greater weights without yielding. This was the patent invention of Birkenshaw, who made them in 1820. The above were great improvements in the system, and by degrees, all the details were worked out more effectually at the different collieries near Newcastle, and in the North, until the locomotives were so far improved, as to enable them to travel at the rate of seven to eight miles per hour, drawing considerable loads behind them. The Hetton and the Stockton and Darlington railways, by Stephenson, which were opened about 1825, contained all the improvements made up to that time; and the last act of parliament of the latter line authorised the use of locomotive engines.

The Liverpool and Manchester Railway Company obtained their first act in 1826, under the Messrs. Rennie, but the kind of tractive power to be employed was left open for future determination. The railway works, however, proceeded, and considerable progress was made before it was decided what power should be employed. The company employed Messrs. Walker and Rastrick to investigate the different means employed in the North as tractive power on railways, and to report which, in their opinion, they considered best adapted for the railway; upon the whole, they reported in favour of using stationary engines to draw the wagons and carriages. Stephenson and Rennie were in favour of locomotive power. The directors took up the matter with considerable spirit, and offered a reward of five hundred guineas for the best locomotive engine. The competitors for this premium were, Stephenson, Braithwaite and Ericson, and Hackworth and Brandreth. The weight of the engines was restricted to 6 tons, including the water in the boiler, and the load was limited to three times that weight, to be conveyed at the rate of at least 10 miles an hour. A trial of the engines of the three competitors was made on a part of the Manchester and Liverpool railway, in 1829, and the extraordinary speed of between 20 and 30 miles an hour was realised by Stephenson's engine 'Rocket.' So long as the motion upon the rails was produced by the rack and pinion, the greatest velocity attained scarcely exceeded 4 or 5 miles an hour; this was only adapted for the transport of heavy goods, and the expense, except in few situations, precluded it from being extensively brought into use; but the principle of adhesion being established, and 7 and 8 miles an hour obtained, the success of this great invention became evident, and it was predicted that its adoption would be general. Still, however, doubt and prejudice prevailed with many, and amongst them were some men of no ordinary ability and experience, and it was not until the triumphant success of the great experiment in 1829, that the most sceptical were convinced of the application of the system eventually becoming universal. The scientific world beheld with amazement this extraordinary result, the consequences of which could hardly be foreseen. Springing at once from a velocity of travelling of 10 miles, the greatest speed of coaches, to 25 miles an hour, so far exceeded even the most sanguine expectations of its promoters, that they saw no bounds to its extension.

Stephenson's engine for the competition was upon an improved plan; the boiler contained numerous small tubes, through which the flame, or rather heat, from the fire-box or furnace, was made to pass, thus exposing a greater surface of water for the heat to act upon, and increasing its powers of evaporation. Booth, the indefatigable secretary to the company, has the credit of this great improvement, which is now universally adopted, not only in locomotive, but also in marine boilers. The engine had two cylinders which impelled the wheels, and the waste steam from the cylinder was discharged through a small tube or blast-pipe into the chimney, with a vertical jet, thus increasing the draught of the fire, and enabling it to produce the desired heat in the fire-box. This blast-pipe was a most simple, ingenious, and important invention, which has contributed very materially to the improvement and perfection of the locomotive. The merit of this is claimed by both Stephenson and Hackworth. The boiler and apparatus were supported on the frame by springs, in the same manner as in ordinary wheeled carriages, thus preventing the concussion to which the different parts would otherwise have been subject, and enabled the machine to work with greater effect. The 'Novelty,' by Braithwaite and Ericson, was also a very ingeniously contrived engine. The 'Sans Pareil,' by Hackworth, was an improvement upon previous engines, but did not fulfil the conditions required so well as that of Stephenson, to whom the premium was awarded. Looking back at the result of these experiments, and what has occurred since, it appears injudicious that the weight and size of the engines should have been thus limited; for inasmuch as the power of traction of a locomotive engine depends upon the force of adhesion, which could only be produced by weight, and its capability of generating steam by increased dimensions, by limiting these two elements the power of the engine was necessarily reduced. Upon reflection, however, we cannot be surprised, for nothing but experience could have pointed out beforehand the present extraordinary results.

The Manchester and Liverpool railway was opened in September, 1830, with great ceremony by the Duke of Wellington, Sir Robert Peel, Mr. Huskisson, and an immense concourse of spectators; but unfortunately this great event in the mechanical, commercial, and social world was clouded by the death of that great man, Huskisson, in consequence of a locomotive engine passing over him, thus becoming one of the first victims of that extraordinary invention, of which he entertained so high an opinion. The first engines for this line were made by Stephenson, after the plan of the 'Rocket,' but improved; and in other engines made soon after, he introduced a better arrangement of the parts, giving a greater number of tubes to the boiler, and adapting cranked axles to work the wheels; the first of these was the 'Planet,' which afterwards served as a model for the locomotives on other railways. Great improvements have since been made; heavier engines, weighing from 18 to 30 tons, capable of evaporating 200 to 300 cubic feet of water per hour, instead of 60 cubic feet, as in the early engines, with tenders capable of carrying 1000 to 1600 gallons of water; straight axles, with outside cylinders, like those of the 'Rocket,' have been again introduced, in order to increase the power and to obviate the objections raised against the cranked axles, as to their liability to break; engines, with six wheels instead of four, are now generally approved, as being safer; and those with coupled wheels have been made to increase the adhesion on steep planes. Improvements in the slide valves and working gear have been made for using the steam expansively in the cylinders, and rendering the engines more manageable either for backward or forward movement. The increased size and power of the engines have enabled them to ascend planes of 1 in 37, as on the Gloucester and Birmingham railway, drawing after them heavy loads at considerable velocities, which, at the first introduction of the locomotive, would have been impossible. On that line, at the Lickey incline, engines made in America were at first used.

Laying the Rails.—The mode of making and laying the rails of the permanent way has also partaken of the improvements in the engines; the original rails of the Manchester and Liverpool line weighed only 30 lb. per yard, of the form termed 'fish-bellied,' and, for the most part, were laid upon stone blocks, after the plan of the colliery railways, on which the speed rarely exceeded 2 to 5 miles per hour, but when it was increased to 20 or 30 miles per hour, greater strength was necessary. The concussion produced by such heavy engines and trains, weighing from 50 to 300 tons, travelling at the rate of 20 miles and upwards per hour, soon deranged the light rails, and the concussion produced by the stone blocks rendered the employment of some more elastic medium desirable. Accordingly, heavier rails, parallel in depth, with a rib at top and bottom, were adopted, after the form suggested by the experiments of Professor Barlow, with as much weight as the art of rolling iron could give, until it reached 75 lb. per yard; instead of stone blocks wooden sleepers have been preferred; heavier and improved chairs for supporting the rails, with side keys of hard compressed wood to keep them in their places and resist the concussion, have been adopted; in this latter department Ransome and May have introduced great changes; the sleepers have been steeped in preparations from the patents of Burnet, Kyan, and Bethell, for the purpose of securing greater durability. A variety of plans for making the rails and laying the permanent way on improved methods, have been proposed and tried, such as the bridge or hollow rail screwed down to longitudinal sleepers, which again are screwed to transverse sleepers below them, as adopted on the Great Western railway; the solid rail secured by screws to longitudinal sleepers alone, as adopted on the Greenwich and Croydon lines; the parallel rail fixed to transverse sleepers, as adopted on the Dublin and Drogheda line, and others, all of which require the test of experience before any correct opinion can be formed as to their respective merits. Rails of prepared wood, patented by Prosser, have been proposed for insuring the adhesion of the wheels on steep inclines, but have not been much adopted.

Stone railways or trams, which have been in use in the streets of Milan for a long period with considerable advantage, were employed at the Dartmoor railway, to bring down granite from Dartmouth to Plymouth, a distance of 20 miles; also one of 12 miles in length for a similar purpose from Haytor to Newton; and a more perfect example was completed by Walker between the West India Docks and London, on the Commercial-road, a distance of two miles, in 1826. The tramway is composed of blocks of granite, 4 to 5 feet long, 16 inches wide, and 12 inches deep, nicely squared, bedded, and jointed, and laid in a bed of concrete; it has been found of considerable service in reducing the friction, and enabling horses to draw heavier loads with facility, in ordinary cases.

In addition to the adoption of wooden sleepers, it has in some cases, where great speed is employed, been considered advisable to introduce a layer of india-rubber, or elastic felt, between the rail or chair and the sleeper, in order still further to reduce the concussion, and to render the motion more easy; for now that the extraordinary speeds of 40 to 50 miles per hour have been effected, and are daily employed on the Great Western and other railways, too much care cannot be taken in constructing the works of the railway, and particularly in laying the permanent way; and until this be done it is scarcely prudent to exceed the present high velocities.

Gauge of Railways.—Before leaving this subject, it may perhaps be necessary to make a few remarks upon the width of gauge. This important question comprehends so many elements, that the determination of it is involved in considerable difficulty, and experience alone can afford it satisfactorily. Stephenson, who has taken such a prominent part in the introduction and extension of the railway system, adopted the gauge of 4 feet 8½ inches. Messrs. Rennie proposed 5 feet for the Manchester and Liverpool railway before it was commenced; this, contrary to their advice, was afterwards made 4 feet 8½ inches. Brunel proposed, and carried into effect, 7 feet on the Great Western. The Eastern Counties was originally laid at 5 feet 6 inches, and afterwards altered to 4 feet 8½ inches. The Dublin and Drogheda is 5 feet 3 inches; and the Ulster lines are laid at 5 feet 6 inches. Cubitt now proposes a uniform width of 6 feet throughout the kingdom; the object of all being to ensure the greatest perfection in the engine; as to speed, power of traction, economy of working, and safety in transferring passengers and goods. Taken in the abstract, a broad gauge would appear to afford the means of making more powerful engines, which can draw greater loads with greater speed and safety than a narrower gauge; but then it involves a greater first outlay, and a commercial question arises, is this necessary, when already, upon the narrow gauge, a speed of 60 miles an hour has been obtained with a tolerable load? A greater velocity appears not to be advisable, until the mode of making the road has been improved; and in the mining and manufacturing districts, the narrow gauge is stated to be more convenient and less expensive. Uniformity of gauge, however, is generally admitted to be desirable, in order to avoid the delay, expense, and inconvenience of a change of carriage for both passengers and goods, and it is to be regretted that a broader gauge had not been adopted on the Manchester and Liverpool railway, which might have served as an example to all subsequent lines, and have prevented the difference of opinion which has since prevailed. The gauge of the Great Western is probably greater than is necessary; but as it has already been adopted to a considerable extent, and has certainly realised very extraordinary results, and as it is impossible to foresee what further improvements may result, so as to obviate any inconvenience arising from a break of gauge, it would seem not to be desirable to stop the progress of improvement by altering it now, when it may be the means of creating further improvements in itself, as well as in the narrow gauge system, which might otherwise never be thought of.

Progress of Railways.—The traffic on the Manchester and Liverpool railway far exceeded the most sanguine expectations, and the passenger traffic, which was scarcely reckoned upon as a source of revenue (goods alone being relied upon), increased to such a degree, that it soon superseded every other conveyance between Liverpool and Manchester, and produced a large additional revenue. Notwithstanding, however, its brilliant success, the great cost of the railway, and the remnants of old prejudices against innovation, combined to keep alive the doubts and fears as to the profits which might be expected from other railways, less favourably situated than between two such large manufacturing and commercial towns, depending so entirely upon each other. Hence the numerous projects which were first brought forward met with a great deal of opposition, and did not receive that encouragement which subsequent experience has proved them to be entitled to.

After much delay, several acts of parliament for new lines of railway were obtained, notwithstanding the most strenuous opposition of the existing interests of canals, roads, land-owners, &c., which was only overcome at enormous costs. Amongst the first of these may be mentioned the London and Birmingham, the Grand Junction, the Great Western, Bristol and Exeter, Southampton, Brigton, Dover, Leeds, York, and others. The prejudices against them have now vanished, and the mania for new lines has of late exceeded all former precedent. 1901 miles have been already executed on the narrow gauge, 274 on the broad gauge: 614 miles are in progress of construction, and projects for 20,687 miles were actually introduced into parliament last session, representing a capital of £350,000,000. Of these projects, acts of parliament have been passed for 3573 miles, requiring a capital of £129,220,767.

In most parts of Europe, railways have already been constructed, or are in progress, or in contemplation, after the plan of those executed in this country. The following names must be borne in mind as associated with the invention and propagation of the railway system,—Barnes, Birkenshaw, Bidder, Blenkensop, Blackett, Booth, Brandreth, Braithwaite, Brunel, Buck, Buddle, Cubitt, Curr, Dodd, Ericson, Giles, Good, Hackworth, James, Jessop, Leather, Losh, Locke, Lambourt, M'Neil, Rastrick, G. and J. Rennie, Reynolds, G. and R. Stephenson, Trevithick, Vignolles, Vivian, Watt, Walker, Wood, and many others.

Steam Coaches. — Great efforts have been made to perfect steam-coaches, so as to enable them to travel upon turnpike roads, but hitherto without much success. The idea was suggested by Robison to Watt, in 1759, and Watt patented it in 1784. Symington proposed it in 1786. Trevithick's patent of 1802 was the first high pressure engine that was actually made, and patents for improvements upon it have been numerous. Bramah constructed a steam-coach in 1822 for Griffiths, which was not successful. Gordon tried one in 1824, and Gurney, who was more successful, constructed some with boilers, having very small tubes; he attained a speed of 10 miles an hour on good turnpike roads, and ascended the steepest hills near London; he went from London to Bath and back, in 1831, and his steam carriages ran for four months between Cheltenham and Gloucester; but it was extremely difficult, and too expensive, to keep them in order. Hancock constructed several with boilers composed of thin metal chambers; they ran for some time, with apparent success; but there were so many difficulties that they did not get into use. Dance, Field, Hill, Macerone, Russell, Cayley and others, also attempted it, with varied success; but the system is inferior to that of railway travelling, and it is now generally given up as hopeless. It has been proposed to employ highly compressed air in place of steam for propelling locomotive engines, first by Medhurst, in 1799, and since by others, but without any trials being made beyond mere models.

Fast Canal Boats.

Attempts were made by Grahame, and others, to accelerate the passage-boats on canals; the mode was extremely ingenious, and at one time was brought into use on the canals in Scotland, the north of England, and other places. The mode was as follows:—A beautifully-constructed boat, whose length was about ten times as great as the breadth, and drawing very little water, was drawn by two horses, commencing at a trot, and soon increasing their pace to a gallop; the boat once put in motion required very little effort to maintain its speed, which was 10 miles an hour, and formed a considerable improvement in canal navigation; increased expedition was also given to the boats for goods, and general speed and economy of charges and improvement in management prevailed. All this, however, came too late, for although it would have been readily acknowledged at an earlier period, and might perhaps, for a while, have retarded the railway system, yet when once the latter was established, its superiority became manifest, and its progress became irresistible. The railway system also gave increased stimulus to improvement in steam-boats, which had been previously in use, and which I shall presently notice more at length.

Taken simply at the velocity of 2½ miles per hour, the resistance or friction offered to the tractive power by a given load is in favour of the canal; but as this resistance increases with the velocity at a far greater ratio on the canal than on the railway, the advantage with increased velocity becomes decidedly in favour of the railway, and inasmuch as the value of time in everything has become more important, so railways must necessarily increase in superiority; besides, as in any case having a large profitable traffic in passengers, which a canal cannot have, the extra power for conveying goods is comparatively very little, so that the competition even in heavy goods, in many cases, is in favour of the railway also. Some canals are now being amalgamated with, or converted into railways, being unable to withstand the competition with the railway.

Stationary-Engine System.

Of the numerous other systems or projects, in addition to locomotive engines and horses, which have been suggested for propelling carriages along railways, two only worth mentioning have been brought into operation, viz., traction by ropes wound round drums or cylinders, worked by stationary or fixed steam engines, and the more recently introduced atmospheric system. Traction by ropes up steep planes had long been in use at the collieries in the North, where what are termed self-acting planes were established, upon which the descending loaded wagons attached to a rope, passing round a pulley-wheel, drew up by their superior gravity the empty wagons attached to the other end of the rope. The same principle was applied by Reynolds to transfer canal boats from one level to another, in the case of the Ketley Planes, on the Shropshire canals in 1788, also in the subterranean portion of the Bridgewater canal at Worsley, in 1797, and at other places. The system of rope-traction by stationary engines was adopted in the collieries of the North, the steep undulating nature of the country being well adapted for it. Thompson applied the reciprocating system with great success to the Seaham and Durham Junction, and other railways, the lines being a series of successive planes, extending over 8 or 10 miles, without interruption, having fixed engines with ropes actuated by them, so that the traffic was transferred from one plane to another, taking advantage of gravity in the descents. The rope and stationary-engine system was applied to work the steep planes on locomotive railways, which were considered at the time too steep for the locomotives to travel upon; but recently locomotives have been so much improved, and rendered so much more powerful, that they can ascend planes at considerable velocities and with tolerable loads, where formerly it was considered impracticable. Examples of these may be mentioned;—the inclined planes of Edge-hill and Rainhill on the Manchester and Liverpool railway, the Lickey plane on the Gloucester and Birmingham, the Euston-square incline plane on the Birmingham railway, and other places. The most remarkable and successful application of the rope system is the Blackwall railway, by Stephenson and Bidder, in 1840. The line commences at Fenchurch-street, and terminates at the East India Docks, Blackwall, being about 3½ miles long; it is carried upon brick arches above the streets, and at each end, or terminus, there are powerful fixed steam-engines, turning large drums or cylinders, round which the ropes for drawing the carriages are wound at the rate of 25 miles an hour. Each pair of engines at the London terminus, built by Maudslay, is 224 horse power, whilst each pair at the Blackwall end, built by Barnes, is only 140 horse power, the line descending all the way to Blackwall. The plan of accommodating the intermediate traffic is very simple and ingenious; it is effected by attaching the carriages to the rope, by a clutch worked by a lever; this is readily detached by a man on the carriage, whilst the rope is in motion, and answers perfectly. The planes between Fenchurch-street and the Minories are worked by the momentum of the carriages one way, and by gravity the other. This system has its advantages and disadvantages, and is more particularly applicable when the load is regular and constant, so that the full power of the engine may be employed to advantage. The wear and tear of the ropes is very expensive, but has latterly been much diminished, by the substitution of wire ropes for those of hemp.

Atmospheric Railways.

The atmospheric system has been the subject of much discussion here and elsewhere. It was first proposed in 1824, by Vallance, of Brighton, where a working model was constructed of sufficient dimensions for the carriages to be introduced at one end of a tunnel, and the air being exhausted by a steam-engine at the other, they were propelled forward, by the pressure of the atmosphere. It was even proposed to adopt the system for the speedy transmission of letters; the system, however, was necessarily so imperfect, that except for the ingenuity of the idea, it was of no practical utility. It was afterwards improved by Medhurst, in 1827, and was brought forward by Pinkus, in a more complete form, in 1834, by making the carriages travel outside the tube; and in 1839, it was further improved and patented by Clegg; since that period it has been brought into operation by Clegg and Samuda, who tried an experiment upon a working scale, in 1840, for about a mile in length, at Wormwood Scrubbs. This experiment showed that a load of 6 tons could be propelled at a velocity of 30 miles an hour, with an atmospheric tube only 9 inches diameter, and induced the leading proprietors of the Dublin and Kingstown railway, to adopt it, for extending that line to Dalkey, a distance of about 1¾ mile, where the country was difficult, and not well adapted for locomotives. That extension was opened in the latter end of 1843, and has continued working ever since. The line is single; the rails, although rather lighter, are laid upon the ordinary plan, and in the centre between them there is a tube about 15 inches in diameter, having a slit or opening at the top, which is closed by an elastic valve; a piston, fitted to the foremost carriage of the train, is inserted into the tube, which is connected at the upper end with an air-pump, worked by a steam engine, which exhausts the air from the tube, and the piston attached to the foremost carriage is then urged along the tube by the pressure of the atmosphere, and draws the train with a velocity in proportion to the perfection of the vacuum in the tube: as fast as the piston advances, the valve in the slit of the tube is opened, and is closed again after the piston has passed, and is rendered tight and impervious to air by a composition of fatty matter placed in the groove into which the edge of the valve falls. The planes of this line are extremely steep, being in places 1 in 50, and the curves are very sharp. The highest vacuum obtained has been 26 inches, with a speed of 35 miles an hour. The train returns from Dalkey by gravity alone. For a first experiment, it has been tolerably successful. The system is being tried upon a larger scale upon the Croydon and the South Devon railways; a portion of the former has been opened, and a speed of 60 miles an hour has been obtained, with a vacuum in the tube of 27 inches; and a train, consisting of 10 carriages, weighing 50 tons, has been propelled 5 miles in 8½ minutes, or at the rate of 35 miles an hour, the barometer indicating a vacuum of 25 to 28 inches. The engines are 3 miles apart, and a power of 300 horses is employed for the whole distance. The tube is 15 inches in diameter, and the air-pump 6 feet 3 inches diameter; the steepest plane is 1 in 50. The South Devon line has not yet been tried.

Considering the recent introduction of this system, and the new contrivances required in all its details, much has been done; with further experience, it is not improbable but that much more will be effected. Pilbrow, in 1844, patented a modification of the system, which is ingenious, but has not yet been sufficiently tested by experience to prove its merit. Hallette proposed to improve the valve on the top of the atmospheric pipe, by means of two small inflated elastic tubes, fixed in grooves on each side of the opening on the top of the pipe, through which the rod attached to the piston should slide between the tubes, and which should close the orifice as the piston moved. This ingenious idea requires the test of experience.

Steam Navigation.

The extraordinary improvement in the mode of communication, which has been effected by steam power and railways on land, had been preceded by equally surprising and important effects produced by the application of steam to sea and river navigation. The vast increase of personal intercourse between people of different nations separated by the ocean, which has resulted from this great discovery, and which is still augmenting, has operated more than any other invention on record (not even excepting printing, which has been greatly extended by steam) towards realising what was once considered Utopian—the bringing of the various nations of the world together, and uniting mankind into one great family, working harmoniously together for their common good. The steam engine, in its various and numerous applications, may justly be styled the grand improver and civiliser of the age. It is a gigantic yet docile labourer, equally well adapted for extracting fuel and other minerals from the bowels of the earth, as for performing all kinds of toilsome, complicated, or delicate operations, whether for forging the ponderous anchor and cable to preserve the gigantic vessel of war from shipwreck, or for weaving the most delicate web for a lady's garment. Its power can be increased to almost any extent, and it can be made to perform, with a degree of celerity, economy, and skill, every operation which formerly could be executed by the human hand alone, and an almost infinite variety of others, which without it could never have been attempted. It may also be employed as a means of conveying merchandise and travellers from one place to another, whether for business or pleasure, with a degree of certainty, expedition, convenience, and economy attainable by no other agent. The increase of commerce, national industry, and wealth, as well as greater personal intercourse between nations, serves to dissipate prejudices, and to create reciprocal good feelings towards each other, and thus to promote peace; but if, unhappily, war should ensue, then by the increased facility afforded for attack and defence, steam would equally serve to shorten its duration by rendering the results more decisive, and making mankind less willing to embark in it.

The origin of the application of steam for propelling vessels is claimed by several individuals of different nations; but it is generally admitted that to Great Britain is due the merit of having introduced and established the successful practice of the present age. The application of wheels to propel boats dates as far back as the Romans; in 1682, Prince Rupert's barge was propelled in a similar manner, and tug vessels, with wheels worked by horses, for towing vessels against wind and tide, were proposed. Papin proposed, in 1690, to propel boats by racks and pinions with pistons working in steam cylinders; Blasco de Garay, a Spaniard, is said to have made an experiment on propelling a vessel in the presence of the Emperor Charles V., at Barcelona, in 1543. The experiment is reported to have succeeded, and received the approbation of the emperor, who paid all the expenses. The invention, if it existed, died with the inventor, and nothing further was heard of it, until after the introduction of steam navigation, when the statement was made in order to claim for Spain the merit of this great invention. Had this claim been brought forward earlier, and published to the world, it might perhaps have been allowed; but appearing at this time, it could have no influence, and must clearly be regarded as in no way interfering with the title of Great Britain to the discovery. Jonathan Hulls, in 1737, published a small pamphlet, wherein he gives a plate representing a boat with a wheel attached to the stern, driven by a steam engine to propel the boat, and tugging behind her a vessel of war. This is clearly the first representation on record of a steam boat. He took out a patent for the invention; but experienced so much opposition from prejudice, that he does not appear to have prosecuted it afterwards. Hulls proposed to apply Newcomen's engine for propelling the wheel, but as it was very difficult to produce rotatory motion with that kind of engine, that may have been one reason why it was abandoned. Savery proposed, in 1698, to apply manual power to the capstan of a ship, by the intervention of a wheel and pinion for turning paddle-wheels attached to the sides of the vessel; and, at a later period, Captain Burton proposed a similar plan. All idea, however, of bringing the invention to bear appears to have been laid aside until 1765, when the mechanical and scientific world had again turned their attention towards the improvement of the steam engine, and Dr. Robison, of Edinburgh, proposed to Watt to apply steam for propelling vessels on land and by sea. Watt, however, at that time had not made sufficient progress with his invention, to enable him to take up and work out the idea with sufficient prospect of success, as it is evident that he could not have considered Newcomen's engine at all calculated for the purpose; Watt, therefore, confined his views to perfecting his engine, foreseeing, no doubt, that when once that end was accomplished, other important results would follow.

The subject of steam boats still lay dormant for a time. In 1782, the Marquis de Jouffroi is said to have made a steam boat, 140 feet long and 15 feet wide, which was tried on the Seine at Lyons, but it was not successful. About the year 1787, Watt had so far perfected his steam-engine, and rendered it capable of producing rotatory motion, as to enable it to turn mills: he had thus overcome one of the principal difficulties, and prepared the way for the introduction of the modern system of steam navigation; but although numerous attempts were made with imperfect engines for propelling vessels, even after Watt had obtained patents for his improved engines, yet it was not until after the expiration of his patent for the rotatory engine, in 1800, that it was applied to steam vessels.

About the year 1788, Fitch and Ramsey, of America, and Serratti, of Italy, appear to have tried some experiments, and thus they lay claim to the invention, but upon this point there is no accurate information. In the same year, Miller, of Dalswinton, constructed a double boat, 60 feet long, with two paddle-wheels in the centre, to be moved by manual labour, in order to race with another boat propelled by oars in the usual manner; it was tried upon the sea near Leith, when Miller beat his competitor, and the effect of this experiment convinced him, that power only was wanting to bring the invention to perfection. Taylor proposed to apply the steam engine for this purpose, and he then applied to Symington, a practical engineer of the day (who had previously proposed some improvements in Newcomen's engine, and had made a model showing how it might be applied for the purpose of propelling carriages), in order to assist him in applying the steam engine for working paddle-wheels. A steam engine with two cylinders, 4 inches in diameter, each of about one-horse power, was accordingly made by Symington and Taylor, and was applied to drive the paddle-wheels in the centre of the double boat, employed for pleasure on Dalswinton Lake, in the middle of October 1788, when it attained a velocity of about 3 miles an hour. The success of this experiment was complete as far as it went, and established beyond doubt the merits of the discovery; it therefore induced the ingenious and persevering projectors to prosecute it further by making another vessel of the same dimensions as the former one, to be worked by an engine on a larger scale. The engine was made at Carron, and was of a peculiar construction, in order to avoid infringement on Watt's patent; it had two atmospheric cylinders of 18 inches diameter, the pistons of which were connected with a lever acting alternately and by means of chains; pulley-wheels and ratchets turned two paddle-wheels, one being placed before the other, in the space between the two parts of the double boat. This machinery, it will be observed, was similar to Hulls's plan; improved, however, by having two cylinders. The boats and engines were completed, and the experiment was tried on the Forth and Clyde canal, on the 26th December, 1789, and was still more successful than the first, having attained a velocity of 4 or 5 miles an hour. An account of this experiment was published in the Edinburgh newspapers of the day. The signal success of this second steam boat rendered further experiments unnecessary, and it now only remained to bring it into practical operation. Messrs. Miller, Symington, and Taylor had proved to the world the merits of the discovery, and not wishing to incur further expense or trouble in combating the prejudices and opposition of mankind, which invariably obstruct the introduction and prosecution of every great invention, did not prosecute the subject further, but left it to others to work out and develop the powers of their extraordinary invention, which was destined, at no distant period, to produce such a wonderful revolution in the social world. The engines and machinery were accordingly taken out, and deposited at the Carron Works, and the boat, which was only a pleasure-boat, and fit for no other purpose, was transferred back to the lake of Dalswinton, and again applied to its original purpose. Mr. Miller returned to his agricultural pursuits; Taylor to his profession of a tutor; and Symington to his profession of a practical engineer.

In 1792, Ramsay made some experiments for propelling a vessel by forcing water out of the stern by a steam engine: this does not appear to have answered.

In 1795, Earl Stanhope, well known for his mechanical genius, tried an experiment for propelling a vessel, by means of a propeller in the form of a duck's foot; and about the same time Smith fitted a boat with an atmospheric engine on the Sankey Canal; none of these experiments, amidst several others which were tried, appear to have been very successful; the great difficulty seems to have been in producing the rotatory motion by the steam engine employed for the purpose, and it is singular that none of them tried Watt's engine, which had then become generally known, and Boulton and Watt themselves were too busy in making their engines for the numerous mills and waterworks then becoming daily more general, to turn their attention to fresh speculations, the issue of which was at that time doubtful, and which did not promise to be so lucrative.

In 1801, Lord Dundas, who took great interest in mechanical pursuits, employed Symington to construct a steam boat; this was propelled by an engine on Watt's plan, having one cylinder placed horizontally, and the piston, with a stroke of 4 feet in length, was jointed at the extremity, and attached to a connecting rod, with a crank at one end, turning a paddle-wheel, placed in a well-hole at the stern of the vessel, which had two rudders, one on each side of the cavity in which the paddle-wheel was placed. This was the first practical working steam vessel with an engine on Watt's system, and was called the 'Charlotte Dundas;' it was employed for towing vessels on the Forth and Clyde canal, and answered its purpose completely, but the proprietors of the canal objected to its being continued, in consequence of the agitation of the water produced by the paddle-wheels, which they alleged would injure the banks of the canal.

In 1802, Fulton, who had been some time in England, hearing of Symington's attempts, went to Scotland, visited him on board his boat, and requested to see it tried. Symington accordingly got up the steam, made several trips up and down the canal, and fully explained to Fulton every part of the boat, steam engine, and apparatus. Fulton made notes of everything, observing at the same time, that the objection of injuring the banks of the canals and small rivers might apply in England, but that in America, where they were upon a much larger scale, this inconvenience could not be felt, and he thought the application of steam boats in that country would be of immense public and private advantage, and stated his intention of introducing them there. After this visit to Symington, Fulton proceeded to France, where he constructed his first steam boat, and tried it on the Seine, at Paris, in 1803, and proceeded to America soon afterwards. It is rather singular that Napoleon, who was then First Consul, and who usually was alive to all great improvements, and carried them through with a degree of energy and talent which overcame all opposition, should not have appreciated the merits of the steam boat, and should have allowed such a fine opportunity of benefiting France to have slipped through his hands; but perhaps the same may be said of England, as being still more extraordinary, for the advantages of the steam engine and machinery had then become universally acknowledged. Fulton, however, impressed with the importance of the invention, and being thoroughly convinced of its ultimate success, pursued it with unremitting perseverance and energy, and in 1805 he applied to Messrs. Boulton and Watt to make a steam engine for a boat which he was about to construct in America: this boat was accordingly built in 1807. Watt's steam engine reached America in 1806. The vessel was named 'The Clermont,' from his friend Livingstone's residence; the wheels and machinery were on Symington's plan, propelled by Watt's engine; the boat was tried on the Hudson river, and only attained a speed of 5 miles per hour. This was the first steam boat used in America, and Fulton and Livingstone then took out patents for introducing steam boats in various places in America, and built several others upon a larger scale, for carrying goods and passengers, employing Messrs. Boulton and Watt to make the steam engines, which were sent from England, each succeeding engine being larger than its predecessor. Although it was generally known that the steam boats had succeeded perfectly in America, and that their employment was daily increasing, yet little or no attention was paid to the subject in England. The idea of employing steam boats on the ocean had never been conceived, and the objections raised to the agitation of the water by the paddle-wheels on the Forth and Clyde canal were considered so strong, that doubts were generally entertained as to the success of the system anywhere but in large rivers, such as those of America. In 1812, however. Henry Bell, of Glasgow, who was well acquainted with, and had deeply considered all that had been done by Symington, determined to try once more whether the invention could not be applied on the Clyde; he accordingly caused a small boat of 25 tons burthen to be built at Port Glasgow, by John Wood, who has since become so well known as a ship-builder; it was 40 feet long, with 10 feet beam, and in it was placed a steam engine of 4 h.p., on what was termed the bell-crank principle, introduced by Watt; the boiler was placed on one side of the vessel and the engine on the other, with four paddle-wheels worked by the intervention of spur gear; the wheels consisted of detached arms, with paddles or floats at the end, which, however did not answer, and the complete wheel, according to Symington's plan, was subsequently adopted. This steam boat, which was called the 'Comet,' began to ply for goods and passengers on the Clyde, between Glasgow and Helensburgh (Bell's native place), in January, 1812, and attained the speed of 5 miles an hour. The 'Comet' succeeded so well, that Bell determined to build another vessel of larger dimensions and power. Numerous other parties, seeing the success which had attended Bell's exertions, determined to follow his example, and several other boats were built during the succeeding years of 1813 and 1814; they were however, still very imperfect, until Cook, of Glasgow, in 1814, constructed the fourth vessel, the 'Glasgow,' with an engine of 16 h.p. The machinery of this vessel was so much more perfect and powerful than any which had been previously constructed, that it served as a model for many others; and from this period steam boats for river navigation were completely established.

Many of the engines employed for the above-mentioned vessels were upon the bell-crank principle; which, from their simplicity and portability, standing upon an independent frame, with the condenser forming part of it, were well adapted for steam boats, and were consequently generally used. The bell-crank levers, receiving the motion direct from the piston, communicated it by means of a connecting rod and crank to the main shaft, turning the paddle-wheels on each side of the vessel; the engine was placed on one side of the vessel and the boiler on the other. The boilers generally used were upon the principle proposed by Allen in 1730, and by Smeaton in 1765, having an internal furnace and flue, surrounded by the water. This form of boiler was first brought into use by Trevithick in 1803, for high-pressure engines, and for low-pressure engines, also, in one of the earliest steam-dredging boats. employed at Portsmouth dockyard, under Bentham; but the exterior shell of this boiler was of wood, as proposed by Brindley in 1758; in steam vessels the external shell of the boiler was made of wrought iron. All the steam vessels above mentioned were worked by one engine only. In 1814, Boulton and Watt first applied two engines, connected together, for working a small boat on the Clyde.

In 1815, a small vessel, with a side-lever engine of 14 h.p., by Cook of Glasgow, made a voyage from Glasgow to Dublin, and round the Land's End to London; it then ran between London and Margate with passengers with considerable success, and this led to others being established in various places; the Scotch boat serving as a model.

In 1816, Maudslay made a pair of combined engines, each 14 h.p., applying the power to the paddle-wheel shaft by the crank, instead of by cog-wheels, according to the previous mode.

In the same year, the late Mr. Baird constructed a steam boat at St. Petersburgh, with a boiler set in brickwork; this boat worked for some time on the Neva.

In 1817, Boulton and Watt purchased a small steam boat called the 'Caledonia,' which had been built in the Clyde, with very defective engines. James Watt, jun., having constructed a new pair of combined engines on the side-lever principle, of 14 h.p. each, made a great number of experiments with the 'Caledonia,' and went with it to the Scheldt and other places; the arrangement of the engines, as improved by Watt, served as a model for several other vessels.

In 1818, David Napier caused the 'Rob Roy,' of 90 tons burthen, to be built by Denny at Dumbarton, with an engine of 30 h.p., with which he successfully established a regular communication between Greenock and Belfast: this may be said to be the first time that a regular communication by steam boats, between two distant sea-ports, was established, and it set the example to every other place. Boulton and Watt, after the success of the 'Caledonia,' made a great number of marine engines of increased power, and with various new improvements, such as introducing wrought iron instead of cast iron for several of the moving parts; and in 1821, a great step was made, by establishing steam boats between London and Leith. Two of these vessels, the 'James Watt' and the 'Soho,' with engines of 120 h.p., by Boulton and Watt, were the largest which had been made, and answered very well.

In 1819, the 'Rob Roy' left the Belfast station, and was transferred to the English Channel, to run between Dover and Calais. About this time Napier built the 'Talbot' of 150 tons, with two engines of 30 h.p. each, which ran regularly between Dublin and Holyhead. In this year also, the late Mr. Rennie, who had for some time previous watched the progress of this great invention with considerable interest, foreseeing that it would ultimately supersede all others, proposed to the Admiralty to use steam vessels for towing vessels of war into and out of harbour against wind and tide; being perfectly satisfied that if once it was introduced into the navy, it could not be long before steam vessels of war would follow; great doubts, however, as to its success were entertained and expressed by many of the official subordinates. Lord Melville and Sir George Cockburn, however, overruled all objections, and, as a first experiment, they consented to allow the 'Hastings,' a 74 line-of-battle ship, to be towed from Woolwich by the 'Eclipse,' a Margate steam boat of 60 h.p. The 'Eclipse,' however, proved too weak, and after towing the 'Hastings' a few miles, it returned, and the 'Hastings' went to Chatham with her sails alone; the experiment was thus not quite so successful as could have been desired; nevertheless Rennie still determined to persevere. Oliver Lang, the master-shipwright of Woolwich Dockyard, entered fully into Rennie's views, and warmly assisted by every means in his power the introduction of steam vessels into the navy, contrary to the opinions of many of his superiors. At length the Admiralty, at their recommendation, ordered the 'Comet' to be built according to the draft and plan, and under the superintendence of Mr. Lang; she was 115 feet long and 21 feet wide, drawing 9 feet of water, and a pair of engines of 40 h.p. each, were ordered for her from Messrs. Boulton and Watt: this was the first steam vessel in the navy, and it is still in use. By degrees several others were built.

In 1820 a steam tug was built by Manby, for Messrs. Smith, for the purpose of towing their barges upon the Humber; and in the same year, Maudslay and Field applied the expansive action of steam in the cylinder, which was a great improvement; also escape valves for the water, which might boil over into the cylinders. In that year also, steam packets were introduced on the post-office station between Holyhead and Howth; and the 'Britannia,' with oscillating engines, and several other steam packets, were built by Manby for the Dover and Calais station.

In 1825, the General Steam Navigation Company was established by William Jolliffe, who built two of the largest vessels which had yet been tried, called the 'George the Fourth' and the 'Duke of York;' they were between 500 and 600 tons burthen, and had engines of 130 h.p., furnished by Messrs. Jessop of the Butterley Iron Works: these two vessels were intended to establish a regular communication between London and Cadiz and London and St. Petersburg; they accordingly started in September 1827, and answered extremely well, notwithstanding the heavy storms which they encountered in the Bay of Biscay and in the Baltic. The General Steam Navigation Company, considering the ideas of Jolliffe too extended, parted with the two vessels (which were afterwards purchased by the Government), and limited their views to the British Channel and the German Ocean. About this period, the 'Enterprise,' of 500 tons burthen, which was built by Gordon, and had a pair of combined engines of 120 h.p. constructed by Maudslay and Field, made the voyage from London to Calcutta, by the Cape of Good Hope. The advantage and superiority of steam vessels, in every respect, for both river and sea navigation, having been now thoroughly established, their employment became universal; and the size, power, and number of the vessels increased daily in every part of the empire.

From this period nothing remarkable appears to have occurred, until the construction of the 'United Kingdom,' which was by far the largest in size and the most powerful that had been made. She was 160 feet long, 26½ feet beam, and 200 h.p.; the vessel was built by Steele, of Greenock, and the engines by David Napier. As deep-sea navigation by steam advanced, it became an object of considerable importance to save fuel, and to obviate the inconvenience of the incrustation of the boilers by the deposit of salt, and other sediments occasioned by the use of sea water; David Napier therefore introduced the system of surface condensation, the condenser being made of a series of small copper tubes, through which the steam, after being used, passed from the cylinder to the air-pumps, the pipes being surrounded by a constant supply of cold water, so that the steam was condensed and the water was returned directly back into the boiler, to be again converted into steam, without the admixture of salt water according to the usual plan, thus employing the same fresh water over again, whereby the above-mentioned inconvenience of incrustation of the boilers was in a great measure avoided. Hall afterwards tried the same system with certain modifications, and it was employed in several vessels; but like Watt, Cartwright, and others who had tried it, he found the condensation was not so complete, and the weight, and cost, and difficulty of keeping the apparatus in order, has hitherto prevented it from being generally used; for although it possesses advantages in many respects, still upon the whole they do not counterbalance the disadvantages, and the old system of condensation by jet, with the aid of the brine pumps, is more generally employed. The brine pumps and refrigerators were invented and patented by Maudslay and Field in 1825, and were used on board the 'Enterprise.' After the 'United Kingdom,' numerous vessels of similar and even greater size were constructed, to ply between London and Leith, Glasgow, and Liverpool, and elsewhere.

The next great step in advance was the crossing the Atlantic. This had long been in agitation, and was freely discussed by numerous enterprising minds, anxiously bent upon working out the fulfilment of such a desirable and important object; but the great practical difficulties involved in the execution were not so easily overcome.

To construct a vessel of sufficient size, with engines of adequate power to propel her through the storms of the Atlantic, and carrying with her sufficient fuel to keep the engines in motion, was considered by many (and among them were very competent authorities) to be extremely doubtful, but by the world in general the task was considered to be wholly impracticable. To Bristol is due the origin of this great undertaking, and a company of enterprising individuals, with Brunel, as their consulting engineer, was formed for that object; it was, however, with difficulty that they found engineers to carry it into effect, some of the first constructors of the day having declined to undertake it. Messrs. Maudslay and Field, however, who had already taken such a prominent part in the prosecution of steam navigation, saw their way, and boldly engaged to construct engines of the requisite power, well adapted for the purpose. Accordingly a vessel, called the 'Great Western,' was designed by Paterson, and built by him at Bristol; and the engines were completed and fitted on board in March, 1838. The vessel was 210 feet long, and 38 feet beam, drawing 15 feet when laden, being 1240 tons burthen, and capable of carrying 600 tons of coals, which it was calculated would last twelve days. The engines were upon the side lever principle, each of 210 h.p., with cylinders 73 inches diameter and 7 feet stroke, making 15 strokes per minutes; they were fitted in cast iron frames, with the latest improvements. The boilers were constructed with the flues over the fires; they were called double-story boilers, and have been since much used; they had brine pumps, and were worked under a pressure of 5 lb. per square inch; the total weight of the engines and boilers, including the water and the paddle-wheels, was about 420 tons The vessel was completed with her engines, and made her first trial on the Thames in March 1838, realizing 12 miles per hour. On Sunday, 8th April, she started on her first voyage from Bristol, under the command of Captain Hosken, with seven passengers, and a cargo of 50 tons of goods, besides 500 tons of coals, and reached New York on Monday, 23rd April, a distance of 3000 miles, in thirteen days and ten hours. Her arrival created the greatest interest; the quays were crowded with spectators, anxiously waiting to give a hearty welcome to the enterprising and successful adventurers, who had thus so triumphantly solved the grand problem, and had brought the New World within a few days' sail of the Old. On her return she left New York on the 7th May and reached Bristol on the 23rd, with 70 passengers; performing the voyage in 15 days. The success of this voyage across the Atlantic having exceeded the most sanguine expectations of its promoters, and indeed of the whole world, there seemed no bounds to the extension of steam navigation; other companies were projected and numerous larger and more powerful vessels were designed, in equal confidence of success; then followed the 'British Queen,' by Napier, of 500 h p., the 'Liverpool,' of 500 h.p., and the 'President,' of 600 h.p., whose melancholy fate served for a time to damp the ardour of speculation. The practicability of steam communication across the Atlantic having thus been established, and its superiority over the old sailing system being clearly proved, time only was necessary to render it perfect. The line from Liverpool to Boston was then designed, and carried into effect by Cunard, for conveying the mails; it consisted of four fast vessels, the 'Acadia,' 'Caledonia,' 'Hibernia,' and 'Cambria,' of about 1000 tons and 450 h.p. each. This was followed by the gigantic project of the Royal Mail Company, for carrying the mails between England and the West Indies, consisting of twelve vessels, each of about 1200 to 1300 tons burthen, and 420 h.p. The engines of these vessels resembled very much those of the 'Great Western,' whose complete success induced their being taken as models for others. The great weight and space occupied by these engines, being upon the average about a ton for every horse-power, rendered it difficult for them to carry any great amount of cargo beyond the passengers, and thus the profits as a mercantile speculation were materially lessened; it became extremely desirable, therefore, to ascertain whether engines, equally efficient, could not be made of less weight, and to occupy considerably less space.

In order to effect this object, engines were invented, by which the power was applied directly from the piston to turn the paddle-wheel shaft, without the intervention of side levers; these were called direct-acting engines, and at first great objections were made to them in consequence, as was asserted, of the loss of power arising from the obliquity of the action of the piston-rod upon the crank on the paddle-wheel shaft. Messrs. Seawards were among the first to introduce this system into the 'Gorgon,' and notwithstanding the objections above stated, it has been improved by them and by other engineers, and has materially gained ground. The obliquity of action of this system, compared with that of the side lever system, can only be considered in the light of a little extra friction, which is fully, if not more than compensated for, by the reduction of weight and space. The modifications of the system by Miller, have been very successful, and combined with the forms of vessels adopted by him, have enabled great speed to be attained both by sea-going vessels, and his boats on the Rhine and other rivers. Even the objection of extra friction, however, if tenable, is obviated by the vibrating cylinders described in Trevithick and Vivian's patent in 1802; patented by Witty in 1813, and by Manby in 1821, by whom the first engines of the kind were constructed; subsequently improved by Maudslay and Field, and Spiller; and now extensively manufactured by Penn, Miller, and others; Maudslay and Field's double cylinder engines, so arranged that a long connecting rod is obtained by its being enabled to descend between the cylinders; the Trunk engine by Humphrey; and the modification of the concentric cylinders by Joseph Maudslay; as well as other varieties of this system by different makers. The substitution of wrought iron for cast in a large portion of the frame and condensers; the tubular instead of the common flue boiler, first proposed by Blakley in 1764, and afterwards improved in the locomotive boiler, and introduced into steam vessels by Maudslay, Spiller, Bramah, and others about the year 1829, as well as the use of steam of higher temperature and increased expansive action, have combined materially to increase the effect of the engines, and reduce the consumption of fuel; so that the space and weight occupied by them is now reduced to nearly one-half what it was originally, or in other words, engines of double the power now only occupy the same space and tonnage in the vessel; thus a material advantage has been gained in enabling vessels to carry a larger quantity of fuel, by which they can extend their voyage; and greater power is rendered disposable for propelling the vessel through the water. As economy of time becomes daily more important, every means which can effect it are brought into operation, and thus the power of the engines has been continually augmented, in order to produce greater speed and shorten the duration of the voyages. Referring to the navy, we find, that in 1822, 80 h.p. was the largest; in 1827, 160 h.p.; in 1828, 200 h.p.; in 1830, 220 h.p.; in 1838, 440 h.p.; and in 1845 we have the 'Retribution' and 'Terrible,' with nearly 1000 h.p. in each, and it is not improbable that, ere long, greater power will be employed.* Whilst the royal steam navy has been making such rapid progress, the mercantile steam navy has not only kept pace with it but has even led the way; for the enterprising, commercial spirit of this country is ever on the alert; every improvement is seized upon with avidity, and the greatest inducements are held out to make new discoveries, in fact nothing but constant progress can satisfy the restless spirit of improvement. In the infancy of the art, we were satisfied with 5 or 6 miles per hour, now, when we have attained above 17 miles per hour, we are confidently looking to a still greater result.

Whilst the improvements, above described, have been making in the engines and in the mode of applying them, various attempts have been made to obviate the inconvenience and loss of power occasioned by the concussion of the floats of the ordinary paddle-wheel entering the water, as well as the heavy drag or back action of the water when the floats leave it; numerous experiments and inventions have been tried for constructing a wheel, of such a form that the floats shall always enter the water in the most advantageous manner, and having effected the object, shall leave it again with the least resistance. To describe the numerous inventions of this kind would be foreign to my purpose, and would occupy too much of your time; it will suffice to mention that of Buchanan, by which the floats always enter and depart from the water perpendicularly; those of Cavé, Oldham, Morgan, Perkins, Seaward, and Barnes, which are modifications of it, differing chiefly in the angle at which the floats enter and leave the water, and the mechanism attached to the wheel by which the motion is communicated to the float-boards; the principle of this invention is extremely good, but in practice it has unfortunately been found, that the wheels of this construction, after a little use, are liable to get out of order; it is not therefore generally adopted, although, whilst they are in order, considerable advantage is doubtless gained. To obviate this inconvenience, as well as that of the common wheel, Field invented what is technically termed the Cycloidal Wheel; this consists in dividing each float-board into several parts or narrower boards, and arranging them so nearly in cycloidal curves that they shall all enter the water at the same place in immediate succession; as the acting force of each board is radiating, it propels whilst

* The total amount of steam power employed in the Royal Navy is about 35,000 h.p.

passing under the water in the ordinary way, and when it emerges, the water escapes simultaneously from each narrow board; this principle was not followed up by its inventor, and was afterwards patented by Galloway, since which it has been very generally adopted. The principle of reefing the paddle-wheels is also used, so that when the vessel is deeply immersed, the leverage of the paddles can be shortened, and when light, it can be lengthened, and can thus be always adjusted to the power of the engines.

As economy of fuel is an object of the greatest importance, so in long voyages it is advisable to employ the wind as a moving power, as much as possible, when favourable: it became therefore desirable to contrive a simple means of detaching the paddle-wheels from the engines, so as to allow them to turn round with the motion of the vessel through the water, and thus to prevent them from impeding her way; various contrivances of this kind have been invented but one of the most simple, and which is now much employed, was invented by Braithwaite and Milner; it consists of a friction clutch attached to the paddle-shaft, which, by means of keys and screws, can be tightened or slackened with facility, and thus the paddle-wheel is attached or released at pleasure. Numerous attempts have been made to introduce the rotative engine without pistons, but they have hitherto not been successful.

The great results rendered by steam navigation induced the mechanical world to turn their attention towards the extension and improvement of it; Boulton and Watt, Maudslay, Field, Robert and David Napier, Jessop, Glynn, Barnes, Miller, Ravenhill, Girdwood, Manby, Spiller, Scott, Sinclair, Caird, Todd, Fawcett, Bury, Forrester, Seaward, Penn, Fairbairn, Hall, Rennie, and numerous other able men devoted their minds to it, and have produced some splendid examples of engines and mechanism in that department. When we look back to Symington's original engine, in 1788, it appears to have been so changed as scarcely to be recognisable as the same, and from a speed of 5 to 6 miles an hour in smooth water, we now find that a speed of 8 and 9 miles an hour against a heavy gale and head wind in the Atlantic, and above 17 miles in still water, has been obtained, whilst improvements are in progress which lead us to anticipate at no very distant period far greater results; much of this, no doubt, is due to the perfection of the workmanship, as well as to the more correct proportions and adaptation of the various parts of the machinery, compared with what was formerly done, and which it was impossible to accomplish with the slender and inefficient means then at command; for this we are greatly indebted to the improved self-acting tools of Whitworth, Fox, Lewis, Sharpe, Roberts, Nasmyth, and others. The improvements in the form and construction of the vessels have also contributed much; and in the investigation of this difficult subject we are much indebted to John Wood, Oliver Lang, Fearnall, Fincham, Ditchburn, Symonds, Rule, Seppings, Scott, Russell, Edye, Patterson, White, Pasco, and others.

(To be continued.)

REGISTER OF NEW PATENTS.

PAPIER MACHE ORNAMENTS.

Charles Frederick Bielefield, of Wellington-street, Strand, papier maché manufacturer, for "*Improvements in the making moulds, or dies, used in the manufacture of papier maché and other matters, and in moulding or forming articles from certain plastic materials.*"—Granted July 14, 1846; Enrolled Jan. 14, 1847.

The invention relates, first, to improvements in making moulds or dies used in the manufacture of papier maché and other matters, and to improvements in moulding or forming articles from certain plastic materials. Secondly, to moulding or forming mouldings from certain plastic materials on wood.

The first part of the invention consists in the application and combination of certain matters hereafter mentioned, for making moulds or dies used in the manufacture of papier maché and other matters, by moulding or forming them therefrom. The materials are as follows:—tanogeletin, sulphur-balsam, gum-thus, and gutta-percha, with a suitable solvent of gutta-percha, preferring Venice turpentine. Gum-thus and gutta-percha are matters imported into this country, and are well known. Tanogeletin is prepared by mixing a solution containing tannin with a solution of glue or animal jelly, of about 36 parts of tannin and 64 of gelatine. Sulphur-balsam is a preparation of a solution of sulphur in fixed oils, mostly prepared with sulphur and linseed oil, and usually consists of two ounces of flour of sulphur and eight ounces of linseed oil, mixed, heated, and stirred, till the sulphur dissolves. In making the moulds or dies above mentioned, mix, dissolve, or combine tanogeletin in Venice turpentine; to this solution add cuttings of gutta-percha, and melt them by means of heat, preferring to use a pug-mill heated by an external steam bath for such purpose. These materials so combined may consist of various proportions of the ingredients, depending on the manner the combinations are to be used in making moulds: the following proportions are preferred,—nine parts by weight of tanogeletin dissolved in eighteen parts by weight of Venice turpentine, adding four to five parts of gutta-percha; this produces a plastic mixture which, whilst it remains warm, may readily be fashioned by placing it on the form from which it is desired to make a mould or die, or it may be pressed into a hollow figure to take an impression therefrom, or made into piece moulds; and when the combined matters have been allowed to remain till they have become cold, the combination of materials will have become hard, and may be used for various purposes, for dies or moulds, for making articles in papier maché and other materials. By adding a small quantity of glycerine, especially where little or no sulphur-balsam is employed, it will be retained longer from becoming hard. For very hard moulds or dies, capable of sustaining considerable pressure, mix with such combinations fine iron filings, using as much as possible so long as the combinations will retain a plastic state, and allow of being readily used, by being pressed into moulds, or into figures or models. White and red lead, and oxides of some metals, such, for instance, as oxides of iron in the state of powder, may be used for giving hardness to the compounds, taking care that they are not added to such an extent as to destroy the plastic materials of the combinations. Gum-thus and sulphur-balsam may be combined with gutta-percha without using the tanogeletin, by means of heat, and the effects of combining these two ingredients is, to produce a very plastic compound suitable for forming moulds or dies (by pressing them on or into suitable dies, surfaces, or models) for various purposes, and the same will be hardened and modified by using other ingredients, as before explained. And sulphur-balsam may also be combined with gutta-percha by heat, and will produce a plastic compound more or less fluid when hot, according to the quantity of sulphur-balsam used, and the same may be employed in taking impressions from models or surfaces (by pressing the same on or into suitable surfaces), and such impressions will be applicable as moulds for making articles from other plastic materials pressed therein. And such combination of sulphur-balsam and gutta-percha may be combined with the other materials above mentioned for hardening them.

When mixing the above mentioned materials, aided by heat, it will be necessary to heat or grind them by machinery, to make them blend intimately together. The first part of the invention also consists in employing the above mentioned combinations of materials as plastic preparations, to be moulded or formed in order to produce articles therefrom in any suitable moulds or dies for architectural and other ornaments and other uses; and owing to the peculiar properties of such plastic preparations they will be found highly useful, for they will take and retain very sharp impressions, which, when set and dry, will not be readily injured, and moisture will not have so prejudicial an effect on articles moulded from such compositions as on many other plastic preparations moulded into articles for like purposes; and such combinations, particularly where it is desired to give tenacity thereto, will be benefitted by having paper-makers' rag dust, or other fibrous material, ground or mixed therewith, and where pliability is desired to be given to the combinations above mentioned, glue may be mixed in quantities according to the degree of pliability desired to be obtained for the particular purpose to which the combination is to be applied.

The second part of the invention consists in forming mouldings for architectural purposes, by spreading gilders' preparation (glue or size and whitening) by means of gauges, on to wood, and then subjecting the same to the pressure of dies to emboss them. In making mouldings, it has been usual to prepare the wood mouldings to the contour desired, and to lay on a succession of coating of the gilders' preparation, and then by rubbing the surfaces thus prepared, the same are rendered smooth. In place of this process, the gilders' preparation is to be used somewhat thicker than heretofore, so that it will be suitable for making a substantive coating at once, and is then to be laid on to the wood moulding by means of a gauge. In performing this process, a sheet-metal gauge is fixed on a bed in such manner that a prepared wood moulding may pass under it, leaving a space between the gauge and the wood moulding, according as it is intended to have the preparation spread more or less thickly; and on one side of such gauge there is a hopper containing the plastic preparation usually employed by gilders, or printer's composition (glue and treacle) may be mixed therewith, to give elasticity or slight pliability to the surface. The wood mouldings pass under the hopper, which is heated by steam to keep the plastic material in a working state, the wood moulding being caused to slide on a long bed, by which it will become covered with the preparation. The wood mouldings being thus coated, are, when dry, to be subjected to the pressure of dies to emboss the surfaces thereof, and for this purpose the use of the roller dies is preferred.

In carrying out the first part of the invention, the plastic materials may be rolled out into sheets or strips, and then embossed and moulded into suitable forms for mouldings, or such plastic materials, or after having been first spread on wood mouldings in the manner described in respect to gilders' preparation, may be subjected to dies in like manner to be embossed.

LOCOMOTIVE ENGINES.

Elijah Galloway, of Buckingham-street, Strand, Middlesex, engineer, for "*Improvements in locomotive engines.*"—Granted April 18; Enrolled October 18, 1846. *With Engravings, Plate* IX.

In constructing locomotive engines for railways, it has heretofore been usual to give motion to two or more of the wheels which carry the engine and it has been proposed to apply a central rail to a railway and to employ rollers on either side, pressed towards each other by a hand lever, and motion was communicated to one of them from the axis of two of the carrying wheels. Now one of the objects of this invention is no longer to use the carrying wheels as driving wheels. Another object of this invention is to apply the power employed to both of two wheels placed on either side of a central rail, and to obtain the requisite holding or bite on the central rail by causing such two driving wheels to be pressed towards each other, and consequently against the rail, by means of springs and apparatus suitably arranged for causing the two driving wheels (on each side of the central rail) to press the rail more or less, according as more or less holding to the rail is required from time to time.

The driving wheels of the locomotive engine, shown in the engraving, Plate IX. are applied horizontally on each side of a centre or middle rail, and are pressed towards each other by means of springs, the pressure of which can be regulated by adjusting screws, or by any other convenient means, so that they may be pressed towards each other with any degree of force the springs will admit of. The pressure, therefore, of these wheels is exerted simultaneously on each side of the middle rail. By such an arrangement it will be evident that the bite or adhesion necessary to propel the train is independent of the weight of the engine, and as the adhesion can be increased or diminished exactly according to the amount of force with which the driving wheels are pressed against the rail, this system obviates the slipping of the driving or propelling wheels upon the rail, heretofore consequent on making the driving wheels also carrying wheels in a locomotive engine.

Fig. 1, is a side elevation, and fig. 2, a cross section of a locomotive engine and fig. 3, is a plan, with the boiler and such parts omitted as would interfere with the view of the same. *a, a,* are the driving wheels worked by cranked axes. Each wheel is worked by a pair of cylinders, the one above the other, the pistons of which operate on the axes in much the same way as the engines of the present locomotive. The slide valves may be at either side of the cylinders, and worked by eccentrics placed on the axes. To secure the necessary bite on each side of the middle rail, the lower bearings of the axes are at liberty to move for a limited distance horizontally, in mortices or slots for that purpose in the horizontal frame, *b, b*; these bearings are pressed towards each other by the springs, *c, c*. To effect the desired adjustment of the pressure of the springs, the rods are connected to the centre pieces, *e, e,* one of which has a right and the other a left-handed female screw through it, the threads of which fit the right and left-handed screws on the rod, *f, f*. On one end of *f, f,* there is a bevel wheel *g*, working into another bevel wheel *h*, the axis of which is carried up in front of the fire box, as seen dotted in fig. 3, and has a handle accessible to the engineer, so that the pressure of the springs on the driving axes, and consequently the bite of the driving wheels on the middle rail, can be adjusted at pleasure when the engine is in motion.

The claim is for the mode of giving motion to locomotive engines, whereby two actuated wheels, *a, a,* are used; and the causing of two wheels to be pressed towards each other and to a central rail.

THREE-CYLINDER LOCOMOTIVE ENGINES.

George Stephenson, of Tapton House, Chesterfield, in the county of Derby, engineer, and William Howe, of Newcastle-upon-Tyne, in the county of Northumberland, mechanic, for "*an improvement in locomotive steam-engines.*"—Granted February 11; Enrolled August 11, 1846.—(Reported in the *London Journal.*)* (*With Engravings, Plate* IX.)

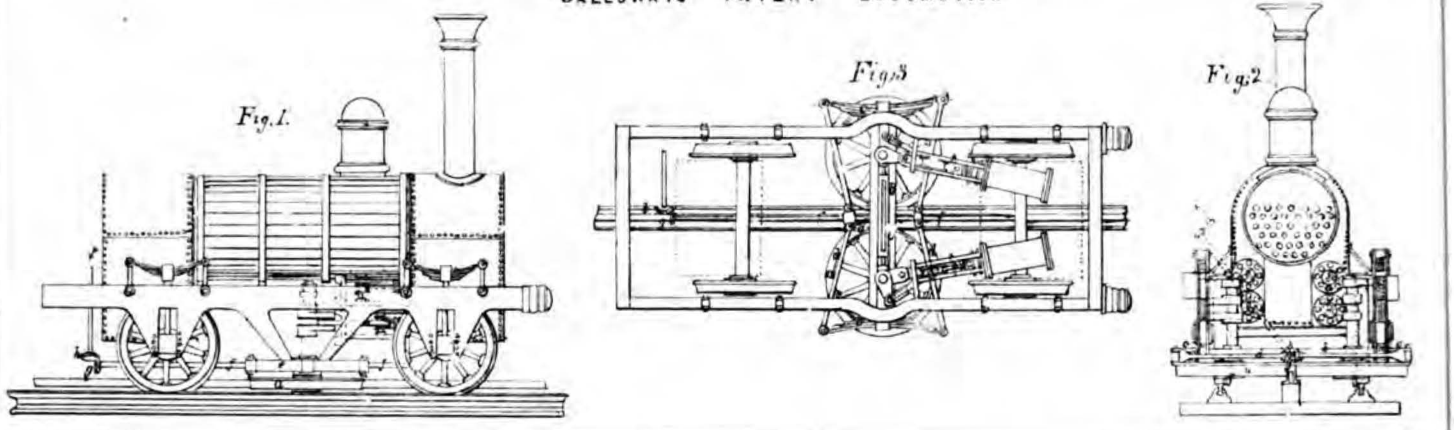
The ordinary kinds of locomotive engines are, as is well known, constructed with two horizontal, or nearly horizontal, steam-cylinders, disposed parallel to each other, either between or outside the wheels of the engine; the present improvement consists in substituting for one of the said steam-cylinders two smaller steam-cylinders, with suitable valves, &c.; the smaller cylinders being of such dimensions that the contents or capacity of the two together will be equal to the contents or capacity of the larger cylinder for which they are substituted. The two small cylinders are placed one at each side of the central line or middle of the breadth of the engine, and at equal distances from that central line; and the remaining large cylinder is situated in the said central line, instead of at one side thereof as usual. The crank-pins belonging to the smaller cylinders are arranged parallel to each other, and pointing in the same direction; and the crank-pin of the central cylinder is so placed, that the direction assumed by its radial line will be at right angles to the direction assumed by the radial lines of the other two crank-pins.

The object and effect of this improvement is to counteract or neutralise any tendency that the oblique action of the several connecting-rods on their crank-pins may have to produce a lateral vibration or rocking motion of the engine upon its supporting springs, when travelling very rapidly; because the oblique direction in which each connecting-rod acts, when the piston is near the middle of its course, causes the exertion of a force either to lift up or press down the guides which retain the joint at the end of the connecting-rod and of the piston rod in its intended rectilinear motion; and in the common locomotive engines, with two steam-cylinders, this force operates alternately at opposite sides of the central line of the engine, and consequently tends to produce the lateral vibration or rocking motion above mentioned. But this tendency to produce lateral vibration will be wholly counteracted or neutralised in locomotive engines constructed according to this improvement; because the central steam-cylinder, with its connecting-rod, is operative at the middle of the breadth of the engine, and therefore the lifting or depressing force resulting from the oblique action of that connecting-rod will act equally on both sides of the engine; and further, as the pistons of the two small cylinders act simultaneously, and in the same direction, the lifting or depressing forces which may result from the oblique action of their connecting-rods are equally operative at the same time, and in the same direction, at opposite sides of the said central line, and at equal distances therefrom, and will therefore have no tendency to produce lateral rocking.

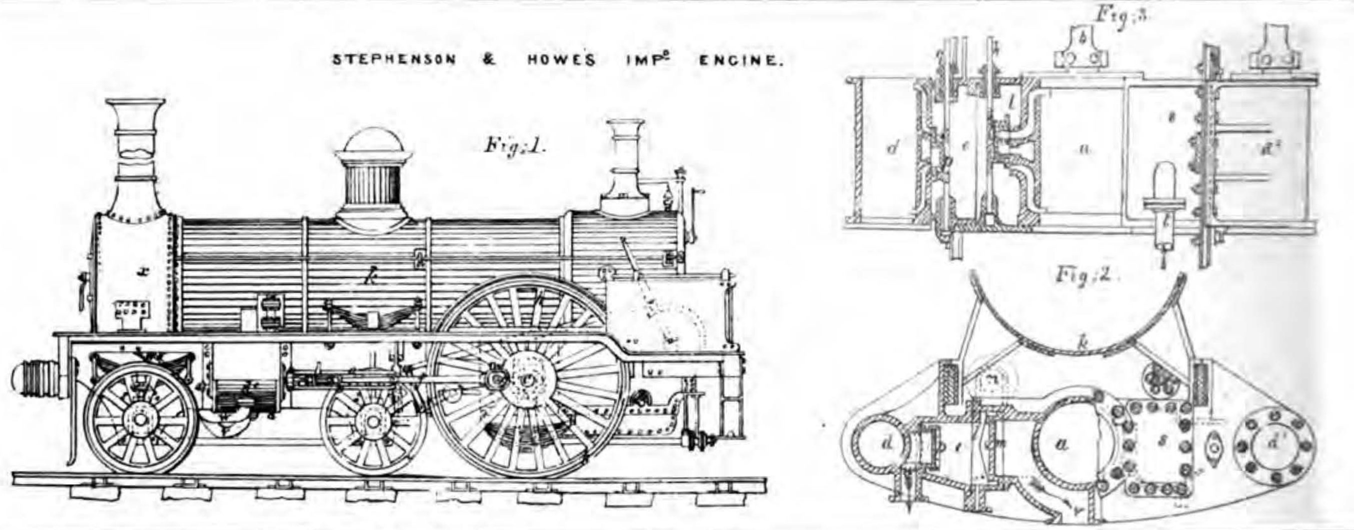
Plate IX., fig. 1, is an elevation of an improved locomotive engine; fig. 2, is an end view, partly in section, of the three steam cylinders, with their valves and accessaries, on an enlarged scale; and fig. 3, is a corresponding horizontal section and plan of the same parts. The ordinary parts of the locomotive engine being well known, any description thereof is unnecessary. *a*, is the central steam-cylinder, situated beneath the boiler. *b*, is the uppermost of the two guides for directing the motions of the joint by which the end of the central piston-rod is attached to the forked end of its connecting-rod, the other end of this rod is secured to a crank at the centre of the axis *c*, of the driving-wheels. d, d^1, are the two small steam-cylinders. *e, e,* are the guides for the joints of the piston-rods: each joint is connected by a rod *f*, with a crank-pin *g*, on the nave or boss of each driving-wheel. The requisite distribution of steam to the cylinders a, d, d^1, may be performed by means of sliding-valves, and working gear, in the usual manner, but so that the valves of the two cylinders d, d^1, will always be moved simultaneously in the same direction, which may be done by the working gear, without requiring any other eccentrics on the main shaft *c*, than is usual. In fig. 2, the valves are represented as sliding against vertical surfaces at the sides of their respective cylinders, in order that the valve-rods may point directly to the central line of the main shaft *c*; which arrangement of valves (as well as the arrangement of all the wheels *h, i, j,* beneath the cylindrical part *k*, of the boiler) forms part of certain improvements in locomotive engines, described in the specification of a patent obtained by Robert Stephenson, June 23, 1841; but although that arrangement of valves (and of the six wheels) is suitable for engines constructed according to the present improvement, the valves may be caused to slide against horizontal surfaces, and the wheels may be arranged beneath the engine in the usual manner. *l*, (figs. 2 and 3,) is the steam-chest or valve-box containing the slide-valve *m*, for the central cylinder *a*; and *n*, is the valve-rod, which passes through a stuffing-box in the end of the steam-chest. *o*, is the steam-chest containing the slide-valve *p*, for one of the small cylinders *d*; and *q*, is the valve-rod. The steam-chests *l*, and *o*, form one space for containing steam, which is conveyed from the boiler into it by the pipe *r*, and is alternately admitted into one or other of the cylinders *a*, and *d*, by their slide-valves. *s*, is the steam-chest of the cylinder d^1, which is supplied with steam from the boiler by the pipe *t*; and *u*, is the rod of the slide-valve belonging thereto. The waste steam is carried off from the cylinder *a*, by the eduction passage *v*, and from the cylinders d, d^1, by two passages *w*; these passages are continued by pipes, also marked *v*, and *w*, into the smoke-box *x*, where they are turned upwards, in order to discharge the whole of the waste steam up the chimney, as usual. The two steam-pipes *r*, and *t*, are branches of one common steam-pipe, to which they are united in the smoke-box; and the supply of steam

* An abridged account of this patent was given in the Journal for September last, without drawings.

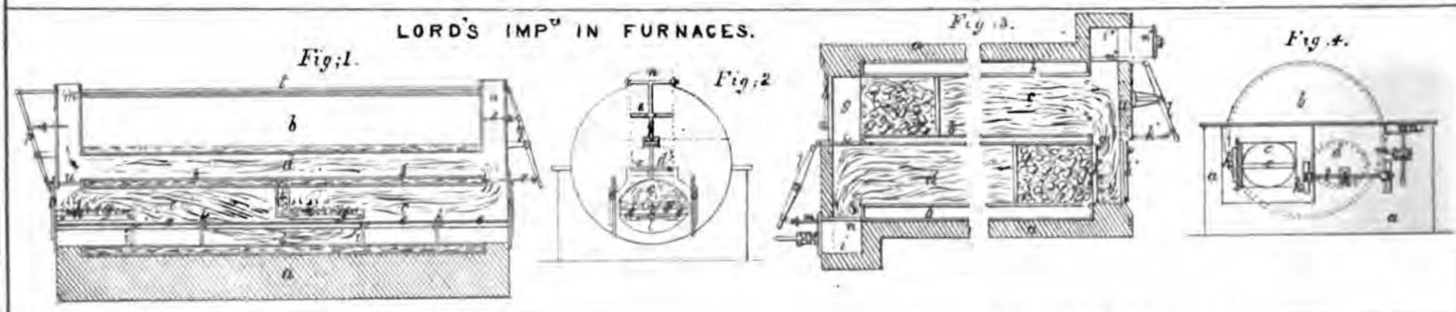
CALLOWAY'S PATENT LOCOMOTIVE



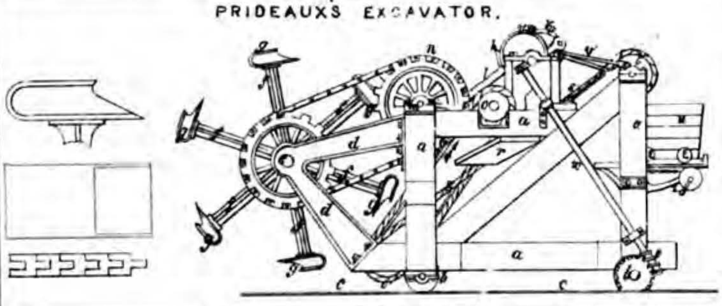
STEPHENSON & HOWES IMP^D ENGINE.



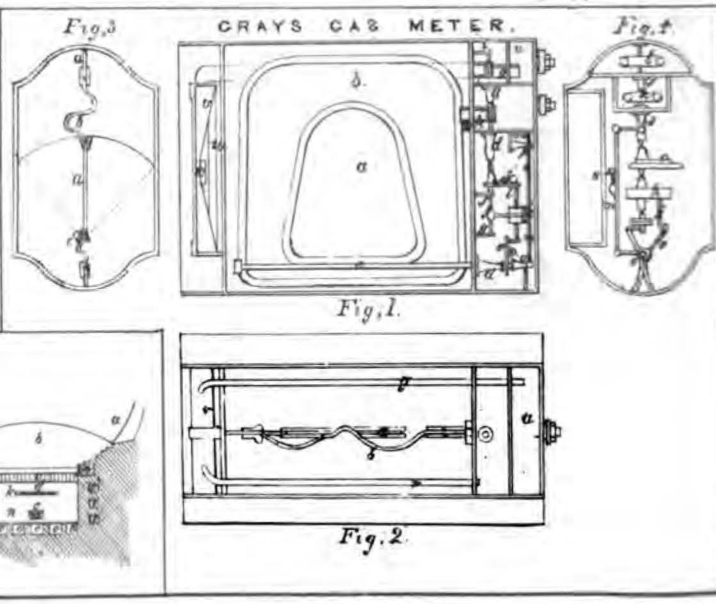
LORD'S IMP^TS IN FURNACES.



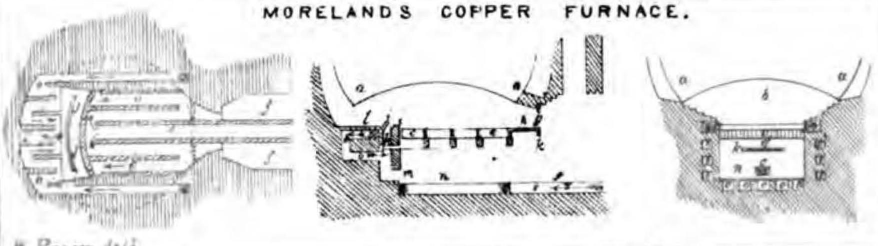
PRIDEAUX'S EXCAVATOR.



GRAYS GAS METER.



MORELAND'S COPPER FURNACE.



W. Pinney del.

through this pipe is regulated in the ordinary manner by a valve, the handle of which is seen at the end of the boiler within reach of the engine-man.

The working gear for moving the three slide-valves is of the ordinary kind, and is actuated by four eccentrics on the main axis *c*; one pair of eccentrics being used for working the slide-valve of the central cylinder, and the other pair for working the slide-valves of the two small cylinders.

The locomotive engine shown at fig. 1, is designed to run upon narrow gauge railways, and for that purpose the two small cylinders are fixed outside the framing; but when this construction of engine is required for broad gauge railways, the small cylinder may be placed within the framing; and in this case the connecting-rods of the two small cylinders, instead of being attached to crank pins on the driving wheels, are connected to cranks formed on the axis *k*, within the framing. In place of one central steam cylinder, two small cylinders may be substituted; so that there will be four small cylinders, the piston-rods of which are connected by rods with four cranks on the main axis; the cranks of one pair of cylinders being fixed at right angles to the cranks of the other pair. The present improvement is also applicable to locomotive engines mounted on four wheels, and to locomotive engines having four or six of their wheels connected by rods in the ordinary mode of coupling.

The patentees, in conclusion, state, that their invention consists in the improvement, hereinbefore described, of applying the steam cylinders, with their pistons, piston-rods, connecting-rods, and crank-pins, in a locomotive engine, so that there shall be two steam cylinders, connecting-rods, and crank-pins, disposed at equal distances on each side of the middle of the breadth of the engine (or of the rails whereon it is to travel); those two connecting-rods acting on the said crank-pins with like motion, in the same direction, one as the other, at the same time, to urge their crank-pins onward in their respective circular orbits. And also, that there shall be one large steam cylinder, with its piston, piston-rod, connecting-rod, and crank-pin, situated at the said middle of the breadth of the engine, or of the rails, in the manner of what has been hereinbefore termed a large central steam cylinder. Or otherwise, in place of such large central cylinder, two small steam cylinders, with their pistons, piston-rods, connecting-rods, and crank-pins, disposed at equal distances on each side of the said middle of the breadth, but as near thereto as conveniently can be. In order, by such application of the three or four connecting-rods, and corresponding crank-pins, as aforesaid, to counteract or neutralise all tendency that the oblique action of the several connecting-rods, on their respective crank-pins, may have to produce a lateral vibration or rocking motion of the locomotive engine, from side to side, on its supporting springs, when travelling with rapidity.

STEAM BOILER FURNACES.

Ambrose Lord, of Allerton, Chester, toll collector, for "*Improvements in furnaces and the flues of steam-boilers, for the purposes of consuming the smoke and economising the fuel.*"—Granted June 24; Enrolled December 24, 1846. (Reported in *Newton's London Journal.*) (*With Engravings, Plate* IX.)

This invention consists in the application, to one boiler, of two furnaces or sets of fire-bars, which are to be fed or supplied with coal alternately; and also in arranging or constructing the flues and regulating the dampers in such a manner, that the smoke, gas, and other unconsumed combustible matters evolved from the fire which has been last fed shall pass under and through the other fire when at a clear red heat, and be thus consumed. When the fire which was last fed has attained a red heat, so as to give out no smoke, the dampers are to be reversed, which will reverse the draught. The other furnace or fire-place may then be fed or supplied with fuel, and the smoke and gas from it will pass under and through the clear red fire, and so on alternately.

In order more clearly to explain his invention, the patentee has shown two modifications, one with moveable grates, and the other with stationary grates. In plate IX., fig. 1 is a vertical longitudinal section, and fig. 2, is an end view of a cylindrical boiler, with the improvements applied thereto. *a, a, a*, is the brick-work, supporting a boiler *b, b*, which has two oval flues *c, c*, and *d, d*, extending through it from end to end. The lower flue *c, c*, is provided with rails *e, e*, upon which the moveable grates *f*, and *g*, run, being provided with wheels *h, h*, for that purpose. It will be seen that the boiler *b*, is provided with a water-space *i, i*, about the centre, extending across the upper half of the flue *c, c*, and forming a bridge to direct the course of the smoke (or a bridge formed of brick-work may be used); and the flue *c, c*, is provided with cross-bars *k, k*, from which hang swing-doors *l, l*. When shut, these doors serve to direct the passage of the smoke and gases, and they may be opened for the purpose of removing the ashes. *m*, and *n*, are two upright flues, each leading to the chimney; and *o, o*, are the fire-doors, provided with air-valves, for the purpose of regulating the draught. When it is desired to heat the boiler, both of the moveable grates *f*, and *g*, are brought towards the fire-doors, and the fires are lighted. All the dampers are then opened, by placing the levers *p*, and *q*, (which work the dampers) in a perpendicular position; but as soon as one fire (say *g*,) has attained a clear red heat, it is pushed along the rails *e, e*, as far backwards as the bridge *i, i*, and the lever *q*, is pulled outwards, whereby the damper *r*, will be opened, and the damper *s*, closed; and by means of the connecting-rod *t*, and lever *p*, the damper *u*, will be opened and the damper *v*, closed. The apparatus will then be in the position shown in the drawing, and the smoke and other combustible gases proceeding from the grate *f*, being guided by the swing-doors *l, l*, and the bridge *i, i*, will pass under the furnace and through the clear red fire on the grate *g*, and thereby be consumed and converted into pure heat; thus effecting a great economy of the fuel. When the fire in the grate *f*, has burnt clear, and the furnace requires a fresh supply of fuel, the grate *g*, is drawn forward towards the fire-doors, and fed with fuel, and the grate *f*, is pushed backwards close to the bridge *i, i*; the dampers are then reversed, by means of either of the levers *p, q*, thus altering the direction of the current or draught through the flues, and causing the smoke, &c., evolved from the coal upon the grate *g*, to pass under the furnace and through the clear fire in the grate *f*, and so on alternately. If it is desired to reduce the heat of the furnace, this may be readily done by drawing both of the grates towards the fire-doors, and opening or withdrawing all the dampers.

Fig. 3, is a horizontal section, and fig. 4, an end view of a cylindrical boiler, showing the application of the invention with two stationary grates. *a, a*, is the brick-work, and *b, b*, the boiler, which has two flues *c, c*, and *d, d*, extending through the same from end to end, on a level with each other. These flues *c, c*, and *d, d*, contain the two stationary fire-grates *e*, and *f*, one at each end of the boiler. It will be seen also that at each end of the boiler there is a flue *g, g**, connecting the rods of the two flues *c*, and *d*; and that the fire-doors *h, h**, (which must be furnished with air-valves) are fixed in the flues *g, g**. These flues also communicate with the vents *i, i**, which lead to the chimney; and these vents *i, i**, are connected together by a flue (which is not seen in the drawing) passing under the boiler. Now, supposing the fire-grate *e*, to have just received a fresh supply of fuel, and the fuel upon the fire-grate *f*, to be burning at a clear red heat, then the damper *k**, in the flue *g**, must be opened by means of the lever *l**, which, at the same time, will close the damper *m**, communicating with vent *i**; and the damper *n**, in the vent *i**, leading to the chimney, must be closed. At the other end of the boiler, the damper *m*, must be opened, and the dampers *k* and *n*, closed. The smoke from the newly-fed fire *e*, will pass through the flue *c, c*, along the flue *g**, under and through the clear fire in the grate *f*, by which it will be consumed and converted into pure heat, which the draught of the chimney will cause to pass through the flue *d*, down the vent *i** under the boiler to the vent *i**, and thence to the chimney. When, fresh fuel is supplied to the fire *f*, the dampers must be reversed, and of course the draught; and, consequently, the passage of the smoke and heated air will be reversed also.

The patentee remarks, that although the flues, in which the fire-grates are placed, are described as being oval, and also shown in the drawing as such, yet he does not confine himself to that shape, although he would prefer its use, as allowing a greater width of fire-bars in the same circumference or area; nor does he claim the use of two fire-grates to one boiler; but he claims the application to one boiler of two separate or distinct fire-grates or furnaces (whether moveable or stationary), which are to be fed or supplied with fuel alternately, and which are to be connected together by flues, regulated by dampers in such a manner that the smoke and other products of combustion evolved from the furnace or fire-place which was last fed or supplied with fuel, shall be caused to pass under the other furnace or fire-place, and upwards through the fire of the same, for the purposes of consuming the smoke and economising the fuel.

EXCAVATING MACHINE.

Thomas Symes Prideaux, of Southampton, gentleman, for "*Improvements in machinery for excavating.*"—Granted July 15, 1846; Enrolled January 15, 1847. (*With Engravings, Plate* IX.)

The machine consists of a series of cutting instruments or buckets placed on the end of arms, made to rotate in such a way that after they have excavated the earth, the buckets will, as they descend, discharge the contents into a series of buckets on an endless band, and then discharge them on to a trough; and again the earth is transferred from the trough on another series of endless buckets to a moveable skid or wagon. The machine appears to be complex; but, if the principle was found to answer, might, we think, be simplified.

The following description, by reference to the engravings, will explain the machine. *a*, is a wooden frame supported on flange wheels *b*, that run on iron rails *c*; on the fore part of the frame is bolted another frame of iron *d*, for carrying a shaft *e*, upon, which the revolving arms *f*, are fixed side by side of each other, and on the ends of these arms are fixed the cutting instruments *g*. For working this machine, steam or other power is applied to a crank *h*, keyed on to a driving shaft *i*, upon which is a bevelled wheel for giving motion to a corresponding bevelled wheel *k*, and connecting rod *l*, thence by another corresponding bevelled wheel to a bevelled wheel keyed on the shaft *m*, which carries a chain wheel *n*, for tranferring the motion by an endless pin chain *o*, to another chain wheel *p*, keyed on to the shaft *e*, before explained; *q*, is an endless chain of buckets revolving round the rollers *o*, *o'*, to receive the earth from the cutting instruments when in the position *g'*, and carries it on to the trough *r*, from which the earth is again removed by another series of endless buckets *s*, that pass round the rollers *t*, and *o'*, and discharge it into the hopper *u*. These endless chains are set in motion by an eccentric *v*, keyed on the driving shaft *i*, from which motion is transferred by the connecting rod *v'*, to a crank or crank-pin on the wheel *t*, fixed on the shaft that turns with the roller over which the endless buckets *s*, revolve, and thence motion is given to the lower roller *o'*, that sets in motion the first endless bucket *q*. There is one other motion on the driving shaft *i*, which causes the connecting spindle *w*, to revolve, and with it the endless screw *x*, that takes into a pinion *y*, fixed on the axle of the flanged wheels for propelling the carriage as the work advances, and which may be regulated to any desired speed. The hopper or wagon *u*, is either tilted over by turning the handle *z*, or removed on to a platform for conveying it away.

FURNACES FOR COPPERS, &c.

Joseph Moreland, of Old-street, Middlesex, copper and still manufacturer, for "*Improvements in setting and fixing coppers, stills, and boilers, and in the construction of furnaces.*"—Granted June 29; Enrolled Dec. 29, 1846. (With Engraving, Plate IX.)

The improvements relate to the arranging the side and bottom air passages of the furnaces, and the application of hollow fire lumps. *a a*, shows a copper, still, or boiler. *b*, fire-place under same. *c*, furnace bars. *d*, bearing bars supporting same. *e*, ashpit. *f*, line of stokehole. *g*, furnace door and frame. *h*, apron plate or mouth plate. *i*, bridge of furnace. *j*, opening parallel with end of furnace bars at bridge, through which the heated air passes, and meets the vapour or gases arising from the burning fuel, and whereby a supply of oxygen in a rarified state being given it, or them, combustion takes place. *k*, valve or slide with handle to the same, and communicating with the front at door-frame for regulating the necessary amount of rarified air to be admitted in at the bridge of the furnace, which must be opened immediately after the fuel is thrown on the furnace, and to be closed when the combustion of the coal has taken place; holes or pins to be provided in the handle of the same, to prevent its being opened any wider than is absolutely necessary for the comb ustion of the fuel. *l*, flame bed or butt formed of fire-tiles or other incombustible materials, to cover the air-flue or oven, through which, by flame passing from the furnace, heat is communicated. *m*, door and frame, through which the dust and cinders may be removed, which will necessarily fall through the air opening, *j*. *n*, cast iron plates at bottom of ashpit, covering the air-flues, upon which the heat from the furnace and fire-place is reflected, and communicated through the same to air passing through flues underneath, and which plates are to be kept free from accumulating ashes. *o o o o*, air-flues for the atmospheric air first passing under and along the centre of ashpit, and dividing itself right and left under same, then passing on each side of, and in, the ashpit wall, and continuing on through the hollow fire lumps which line the furnace; after which, continuing on right and left under flame bed or butt, where it then meets and descends to the valve or slide at *k*, and passing through which, it then enters the furnace in a heated and rarified state at the opening at bridge of same, *i*. *p p*, hollow fire lumps for the lining of furnace, through which the air is continued from the flues of ashpit. *r*, entrance for the admission of the atmospheric air to flues, which is to be assisted and increased by the use of a fan or blower attached to same.

The darts or arrows show the direction which the atmospheric air takes in its progress to the opening at bridge of furnace at *i*. Also, the faint lines on ground plan show the construction of air-flues under the line of stokehole and ashpit. Also, the letters *f* to *b*, and *b* to *f*, shown in the cross section, mean respectively front to back, and back to front. And also, the dark dotted circle shown on the ground plan, is the bottom of copper, still, or boiler.

IRON AND BRASS MOULDS.

David Yoolow Stewart, of Montrose, Scotland, iron-founder, for "*Improvements in moulding iron and brass.*"—Granted July 14, 1846; Enrolled Jan. 14, 1846. (With Engraving, Plate IX.)

Fig. 1 is an elevation of the machinery and apparatus, and fig. 2 a vertical section of some of the parts; *a*, cylindrical mould box, preferred to be made in two parts and connected together, as shown by bolts passing through the straps *b*, and keyed up by wedges. At the lower end is a step to receive the lower end of the pattern *c*, which is preferred to be of metal. *d* a presser, to press the sand into the mould-box *a*, around the pattern *c*. The presser consists of a tube of thin sheet metal, with a projecting flange *d'*, or portion of a screw; the worm or flange not passing completely round, but it leaves an interval between the two ends. *f* is a projection, there being a similar one on the other side. These projections loosen the sand above *d'*. The tube *d* revolves round the pattern *c*, and keeps it upright; and as the presser *d* revolves, it rises by the inclined surface *d'*, that surface continually feeding in the sand, and pressing it down upon that immediately below it, thus causing the sand to be compactly pressed into a mould. On the upper end of the tube *d*, is fixed a cog-wheel *e*; and the upper end of the tube *d* revolves in an opening formed in the cross-head *g*, such cross-head being guided in its upward movement by the guide-bar *h*, and the revolving square-bar or axis *i*, which turns in bearings at *j j*. On the upper end of the axis *i*, is fixed a bevelled toothed wheel *k*, which receives motion from the axis *l*, by means of a bevelled toothed wheel fixed thereon; and such axis *l*, receives motion from a steam engine or other power, by a strap acting on a fixed drum *m*, as is well understood, or by other convenient means. *n* is a pinion which slides on the revolving-bar or axis *i*, but turns therewith.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

SOCIETY OF ARTS, LONDON.

On the evenings of the 3rd and 10th ult., this Society, for the first time, attempted to establish an Exhibition of British Manufactures: although it was not very extensive, it contained several interesting objects of art. The specimens of Carving by Machinery attracted attention. Those by Irving's patent were distinguished for clearness and precision of form; especially in mouldings, for which, indeed, this process seems best adapted. There were also some productions by means of heated moulds, which, though good, were eclipsed by those from Jordan's patent, which were very fine. A Bunch of Hops and Brace of Partridges were worthy to hang by the side of Grinling Gibbons's works. A portion of the Ghiberti Florentine Gates was also very successful. The machinery employed accomplishes precisely the task assigned to the sculptor's assistant. It clears away all the superfluities and prepares the object for the final touches of the artist,—no matter how high the relief, or how low and intricate the undercutting. Another feature connected with it, is that simultaneously several copies can be executed. The impetus which this machinery is calculated to give to internal decoration cannot be too highly estimated. It multiplies artistic power without limit; only stopping short of that perfection which makes the artist's last touch and approval necessary. This machinery is applicable alike to marble, alabaster, and wood.

The exhibition of Glass was not extensive. The specimens by Messrs Richardson, of Stourbridge, proved that we are already chemists enough to paint what colours we please on glass, as on china. This is quite a novelty. Some of the forms of the vases are very elegant—chiefly based on ancient examples.

The specimens of Metals were few and not very satisfactory. The Coalbrookdale Ironworks, though they have executed some pretty good castings, sent nothing to this Exhibition. Mr. Smith's specimen of chasing on sheet silver was interesting: it supersedes casting, and economises two-thirds of the precious metal. There was only one specimen of electro-gilding.

The show of Pottery and Porcelain illustrated that branch of English manufactures, and enabled any one so disposed to become acquainted with its rise and progress. The specimens were classed chronologically,—beginning with the butter-pots and many-handled "tygs," or drinking cups, of the time of Queen Elizabeth, and ending with the pottery of the present period, showing how the manufacture of English pottery has advanced step by step, until it has reached that perfection by which it commands a preference throughout the world. The manufacture at Delph is almost put down by it, and the best porcelain now to be met with at Dresden and Paris is of English manufacture, notwithstanding duties almost prohibitory. So far as successful *imitation* is concerned, English pottery has accomplished all that can be desired. It has superseded, owing to its superior make and cheapness, the originals which it imitated. The old native Delph plate is not to be compared with the modern English specimen. Wedgwood in many points surpassed the Etruscan vases; while the best specimens of Sevres vases and Dresden figures are equalled by us in general execution, and in many features of workmanship,—though inferior in some kinds of colour and in the "glazing." In respect of price, English manufacture has in all cases enormous advantages.

There were some noble specimens of Statuary Porcelain exhibited by Messrs. Copeland and Garrett, and in "Parian" by Messrs. Minton. From these specimens it appears that the works of the sculptor may be placed within the reach of unlimited numbers. The material or "body," in both cases, is very beautiful, and has only to be connected with good Art to produce a perfectly successful union. The workman, it is true, must have an adequate knowledge of the human form in order to be able to unite, with proper feeling, the separate parts in which the figure is necessarily cast. There were also some beautiful Porcelain Mosaics of Messrs. Minton.

Some examples of Block Printing for paper-hanging, exhibited by Mr. Horne, of Gracechurch-street, were good; one was a copy, on a large scale, of Murillo's "Beggar Boys," in the Dulwich Gallery.

We hope next year to see a large number of articles in cast iron, brass, and bronze, adapted for ornamenting the interior of edifices; likewise some specimens of carpets and paper-hangings. Some patterns which we have lately seen, manufactured in this country, are quite equal to the French.

ROYAL SCOTTISH SOCIETY OF ARTS.

Feb. 22.—George Wilson, M.D., F.R.S.E., V.P., in the Chair.

The following communications were made:—

Dr. Wilson experimented on the "*Noise of the Electric Spark in different Gases, as a means of illustrating the power of Elastic Fluids to conduct Sound.*"—The two aerial fluids experimented on by Dr. Wilson were common atmospheric air and hydrogen gas. When the electric spark was passed from one conductor in the interior of a glass globe, filled with hydrogen, the noise of the spark was exceedingly feeble, being nearly drowned by the noise of the spark taken outside from the prime conductor. On the contrary, when the globe was emptied of hydrogen and filled with common air, the noise of the spark in the interior of the vessel was louder than the exterior spark, having a metallic ringing sound.—He, therefore, suggested this as a simple method of illustrating the power of elastic fluids to conduct sound. Thanks voted and given from the chair.

By permission, Mr. Pownall exhibited Nott's "*Patent Electro-Magnetic Telegraph.*" The telegraph was shown in action, and was described by William Alexander, Esq., F.R.S.E., F.R.S.S.A. The Electro-Magnetic Telegraph invented by Messrs. Nott has a hand, similar in appearance to the hands of common clocks which tell the hour; this hand is longer on one side of the pivot or axle on which it moves than on the other side. The longer end points to a circle of four alphabets which surrounds the dial-plate, and the shorter end to a circle of figures which is at a short distance from the centre of the dial-plate. The hand (or hands) moves with what is termed a dead-beat escapement, the motive power being the electric fluid acting upon a toothed wheel with pallets and stops, by which the utmost regularity of movement is obtained. When the hand is to be put in motion, a key, something similar to a key of a pianoforte, is pressed, and the pressure removed when the hand points to the letter necessary to spell a word, or to a figure necessary to express a signal, as the case may require. Thus words are spelled with unerring accuracy, and signals pointed to without the possibility of mistake. No magnetic needles move on the dial-plate and by their deflections indicate the letters, or words, or signs, necessary, in the magnetic telegraph hitherto in use, to form a sentence. There is no alarum used, but a bell is used, the number of strokes struck on which indicates certain things to be communicated from one station or terminus to another. There is but one wire employed, and the cost of the apparatus, batteries, &c., is not much more than half the cost of the mode now in use. The great advantages of this invention are stated to be its simplicity, its accuracy, the ease with which it is worked and understood, and the almost impossibility of its sustaining injury, unless from great violence; there is no intricate mechanism, no springs or weights, and only one wheel. It was stated that it had been adopted between Northampton and Blisworth, where it answers admirably; and that it had been favourably reported upon by Mr. Faraday and Major Brandreth to the Admiralty; by Mr. Brande and by Professor Backhauffner;—that this latter gentleman has introduced it in a course of lectures, at the Polytechnic Institution. It was stated to be a most important improvement on the rapidity and accuracy of telegraphic correspondence, and a novelty in the application of the principle of electric communication.

March 8.—David Maclagan, M.D., F.R.S.E., President, in the chair.

Experiments were exhibited, showing the perfect safety of the patient from Explosion during the administration of the *Vapour of Sulphuric Ether;* and a description given of the forms of the Inhaler. By Mr. Archibald Young.

Mr. Young concluded his series of experiments on the inhalation of etherial vapour by showing that the etherised contents of the lungs would not explode; from which he conceived he had demonstrated the perfect safety of the patient from burning or explosion. A discussion followed, in which Dr. Wilson, Mr. Glover, Mr. Hunter, Dr. Douglas Maclagan, and Dr. Roberts, took part; in which, although it was admitted that there was little or no risk to the patient from internal explosion or burning, yet that, as a volume of vapour of ether, when mixed with 35 volumes of common air, formed an explosive mixture, persons using ether should not do so rashly, as, in certain circumstances, instances of which were given, explosion had taken place in the apartment; not, however, fatal ones, nor did they occur during the administration of ether by inhalation.—Mr. Young showed various simple forms of the inhaler, some with valves and some without them, and very portable, made of japanned tinplate, as suggested by Professor Simpson.

Description of an *Improved Kinnaird-Grate*, combining more perfect Radiation of Heat, with a provision for the admission of Air and returning it Warmed into the apartment. By Mr. James Gray.

This grate, whose heating power was stated to be much superior to the common form of the Kinnaird-Grate, is in appearance the very reverse of the common kind. In place of retreating backwards, it protrudes into the apartment as it were, by which means the fire is brought more forward with less risk of danger by the overheating of the back brick. It also radiates heat more perfectly into the apartment; and a provision is also made for cold air to pass up along the heated brickwork of the building, and along the top of the covering of the grate, which issues therefrom by pierced apertures pleasantly warmed into the room. Mr. Gray stated that this grate had given much satisfaction to those who had tried it. In appearance it is as elegant, if not more so, as the common Kinnaird-Grate, and not more expensive.—Referred to a committee.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

Jan. 25.—S. Angell, Esq., V.P., in the Chair.*

A communication from W. Bromet, Esq., respecting one of "*the Arches of Upton Church, in Buckinghamshire,*" was read; and a sketch by that gentleman exhibited, showing its principal feature, viz. a carved wooden archivolt, the mouldings of which are the dog-tooth alternating with small rounds,—the outer moulding adorned with a series of diagonally-set trifid leaves of a more antique character than Gothic ornaments commonly are.

"*A description of the Remains of the Ancient Norman Refectory in the Bishop's Palace at Hereford,*" by J. Clayton.—There are few existing examples of Norman architecture which present the timber-work in such excellent preservation as that at Hereford. This great Hall is one of the earliest examples of the class of buildings to which belong the Halls of Westminster and Winchester. It was originally divided into one centre and two side compartments, by two ranges of columns of four each, from which sprung the arches supporting the roof; and the peculiarity of this example consists in these pillars and arches being entirely constructed of timbers. The original dimensions of the Hall were 110 feet by 55 feet: and one half of the roof now serves to shelter the principal apartments of the present episcopal residence, erected upwards of a century ago. Above these apartments, which are of one story only, are seen the upper portions of the pillars, the arches, and the roof; the lower parts of the columns being concealed in the division walls of the modern rooms. The principal arches, viz. those over the centre compartment, were of 22 feet span; and each formed of two pieces only, cut in the arched form from the solid timber—which must necessarily have been of vast dimensions. This oak, although whitened by age, is perfectly sound. Drawing of the details were exhibited; as also one conveying the writer's idea of a restoration of the interior of the Hall—showing that the original building must have had an imposing appearance, not produced by a multiplicity of parts or richness of design, but from a massive grandeur, the peculiar characteristic of this early style of architecture. A few particulars were given of the city of Hereford prior to the erection of the refectory in question, which was probably soon after the Conquest.—The Hall at Oakham was then described by Mr. Clayton as a most beautiful specimen of the Norman buildings of this class. It does not possess the peculiarity of being composed entirely of timber, nor has it the magnitude of the examples at Hereford; but remains in an excellent state of preservation. It formed part of the ancient castle; and is now used as the county courts for the shire of Rutland.

"*Observations on the Ancient Roof of the Church at Adel, in the West Riding of York,*" by R. D. Chantrell, Esq.—Among the peculiarities, particularly alluded to was the corbel table, which had evidently been adzed out of the solid timber, having projecting pieces which fitted in between the ceiling joists, or rather beams. Mr. Chantrell was of opinion

* This evening's proceedings were accidentally omitted in last month's Journal.

that this roof was originally open, like the cradle roofs of the 13th century, many of which occur in the churches of Yorkshire. The south door was mentioned as exhibiting one of the finest specimens of Norman sculpture in the country. The capitals of the principal pillars of the chancel arches are in the best preservation. That on the north has a group of figures representing the Baptism, and the other the Crucifixion. It was mentioned that the same character and grouping occur above the door of the Baptistry of the Church of St. Basil at Bruges, known as "La Chapelle du Saint Sang," which edifice was certainly founded in 1082. The kite-shaped shield used in the time of William the First, and other peculiarities of style which occur in the sculptured figures of one of the southern capitals. are additional reasons for assigning the date of the 11th century to this building.

March 8.—S. Angell, V.P. in the Chair.

Mr. J. Scott Russell read the concluding portion of a paper "*On the Interior Forms of Buildings with respect to the Laws of Sound.*" After recapitulating his first and second principles, he went on to examine the *third* cause of bad qualities in the construction of a room. He showed that in a large square room, of the usual form, the reflexion of the same sound was carried to the speaker's ear by different paths, and in different periods of time; the result of which was the confusion of successive sounds and syllables with each other—and so a prolific cause of indistinct hearing. It required another principle to afford the remedy of these evils, and that was the fourth principle—which he believed was quite new. He might venture to call it the principle of the *non-reflexion* and lateral accumulation of the sound wave. It had originally been suggested to him by the observation of a similar phenomenon in the wave of the first order in water. This wave he considered to be the type of the *sound wave;* and on examination he had found experimental evidence of the same phenomenon in the latter wave. He had observed that at angles below 45° the sound wave was no longer completely reflected from the surface on which it impinged; and that when the obliquity of the wave to the surface was 60°, a phenomenon followed of total *non-reflexion*—and the wave continued merely to roll along the surface in a direction parallel to it. This fact furnished a ready means to remedy the evils so often produced by the reflexions and echo and interference of sound in public buildings.—Wherever it was possible to place flat or curved surfaces at such angles that the direction of the sound should be very oblique to the surface, it might be harmlessly disposed of, and prevented from injurious reflexion.—This was exactly what the stalls of a choir, the side chapels of a cathedral, and the partitions of boxes in an opera house, did so successfully for buildings of a large class. The same principle enabled him to explain the Whispering Gallery of St. Paul's (which is circular) and another equally celebrated, mentioned by Saunders, which is perfectly straight. The same principle also explained the conveyance of sound along the smooth surface of a lake and over the flat surface of a sandy desert:—as well as the extraordinary reverberation or accumulation of sound in some portions of a building. The *fifth* principle was that of the polarity of the human voice. Mr. Russell showed the rapid diminution of intensity of sound on both sides of the axis of the mouth;—and that instead of extending in a circular wave round the head of the speaker, as had been supposed, the line of hearing-distance was an elongated oval extending forwards from the mouth.

March 22.—Mr. C. Fowler in the Chair.

Mr. James Bell read his essay "*On the Adaptation and Modification of the Orders of the Greeks by the Romans and Moderns,*" for which a Medal of Merit had been awarded:—

The order, in Grecian architecture, constituted the chief feature, and contributed its character and proportions to the entire edifice. The column, on the introduction of the arch by the Romans, lost its importance, and together with that, its extreme delicacy of finish and proportion; in place of which, luxuriance and richness were substituted, so as to harmonise more thoroughly with the sentiments of the Roman people. This change gradually led to a complete debasement of the style; the arch, after the Constantine era, gaining in importance more and more until the Pointed style arose from the ruins of the Classic. On the revival, the Italians by the study of the antique, endeavoured to restore it to its primitive purity, and many of them were eminently successful in the attainment of their object, although the painter-architects introduced many flagrant abuses both in composition and detail. In the north of Europe, where the Pointed style had obtained a firmer footing, the change was produced by the grafting of Classic details on a Gothic outline, constituting the Elizabethan and Renaissance; and, at the same time, an increased intercourse with Italy led to the adoption of the new style in all its purity, for much of which we are indebted to Sir Christopher Wren, in whose school it was thoroughly naturalised. Since the middle of last century, the study of Grecian remains has led to the further purification of the Roman, together with a due appreciation of some of those delicacies of form and proportion which were previously either misunderstood or altogether overlooked, although the feeling of the age, so far as regards detail, tends rather to imitation than to modification. To the Germans, however, was due the merit of the most complete appreciation of the works of the Greeks,—a result which might have been anticipated from the analogy between the habits of thought and feeling, and even language, which may be traced between the two nations.

INSTITUTION OF CIVIL ENGINEERS.

Feb. 28.—Sir J. Rennie, President, in the Chair.

A supplement to the papers on "*the Helder or Great North Holland Canal,*" by Mr. G. B. W. Jackson, was read. It contained a description of the harbour and works at Nieuwediep, which might be considered as legitimately connected with the Helder canal, inasmuch as they were constructed with a view of affording shelter to vessels of war and merchantmen navigating the North Sea. The banks or shoals situated at the mouth of the Marsdiep channel act in a peculiar manner; they narrow the entrance, resist the undue influx of the tides, thus preventing injury to the coast of the Zuyderzee; they oppose difficulties to the entrance of hostile fleets, as the navigable channels run within range of the protecting forts; and they assist in maintaining the velocity of the currents which keep the channels at their usual depth. On the coast of Holland the ebb-tide continues to pass off along the Noorder-gat a full hour and a half after the tide has commenced flowing up along the Schulpen-gat; this can only be accounted for by supposing that the tide runs up from the south-west, and enters the Schulpen-gat, whilst the ebb still continues, in consequence of the draft of the tide northward along the coast. The Schulpen-gat and Landsdiep may therefore be termed the flood-channels; whilst the Noorder-gat may be considered the ebb-channel. Upon these spots, whose preservation was of such consequence to the country, the Dutch have lavished their best care, and exercised their ingenuity.

The shore-works consisted chiefly of groynes, composed of timber piles and fascines, with stone covering. The average length was two hundred yards, with slopes of about one in eight or ten. In consequence of the report of the commission appointed in 1780, the engineers, Brunnings and Goudrai, were instructed to proceed with the formation of a warping bank of fascines, 7360 feet long, with double planking guard to accumulate the sand, in order to fill up the interstices of the fascines, and thus preserve them from decay. A breakwater also, 1850 feet in length, 72 feet wide, at 3 feet below high water, with slopes of one to one. This was also formed of fascine beds, weighted with 2000 lb. of stone, and 4000 lb. of tiles upon every superficial area of 144 square feet. The upper surface was covered with matting, and made convex, the centre being one foot and the sides three feet below the level of high water. Hurdling was then used, and the whole was covered with blocks of stone weighing from 1500 lb. to 1800 lb. each. An additional length of 2080 feet was subsequently built, the warping bank being completed, and by means of these works the ebb-stream was increased to such an extent as at once to deepen the channel eighteen inches, although the bed was of clay. In 1782, dredging was resorted to, and, with the action of the stream, a depth of nineteen feet was arrived at. The whole length of the proposed harbour was then dredged to a depth of seventeen feet under high water level. Another warping bank of 3675 feet in length was then constructed, with numerous groynes to arrest the sand and preserve the coast. A quay-wall and jetty were then added; the piles composing the latter were covered with sheet lead between high water level and one foot below the ground, in order to preserve them from the ravages of the *Teredo Navalis*, which, however, it is the popular opinion, may be also prevented by driving the piles through fascines. A portion, sixty feet in length, of the breakwater was torn away by a storm: this slip was filled up with large stones, but they were ineffectual, and fascines were ultimately had recourse to for repairing the breach. The depth of the channel was thus increased to nearly thirty-five feet, so that frigates could pass with safety. In 1789, one hundred and fifty-one vessels were lying there at anchor, fourteen of which were men-of-war, and four were East Indiamen. The basin is 1292 feet long, and 646 feet wide, with large storehouses, dock buildings, fortifications, &c., of the most solid description, and thoroughly complete for a naval arsenal. The details of every part of the works were given. A special vote of thanks was passed to Mr. Jackson for the paper.

Remarks.—An interesting discussion ensued, in which the highest compliments were paid to the author for the paper he had presented, and the manner in which it was illustrated. A description was given of Dymchurch wall which defends Romney Marsh, an extent of 24,000 acres, and also of several other sea-defences at the mouth of the Thames, and elsewhere, in which fascines were extensively used. The Nene embankments were also described. Specimens were shown of the *Arundo Arenarea*, a coarse grass, whose roots extend sometimes to a length of upwards of thirty feet, and which is eminently useful in securing the sand of the coast from being blown or washed away.

Among several cases of the failure of protecting-walls, one was particularly described of a nearly vertical sea-wall, whose foundations were sunk down full five feet below the shingle of the coast: the wall was built with great care, and with first-rate materials—it was, however, exposed to the action of a heavy sea in North Wales. During a severe storm, the waves were thrown up in a mass full forty feet above the wall, and falling from that height with the force due to such a distance and mass, very speedily destroyed the whole wall. In quite as exposed a situation, a slope, which enabled the waves to expend their strength, and broke them up into foam, did not suffer at all. Numerous deductions were drawn from these and many other instances, all unfavourable to the theory of vertical sea-walls, which it has recently become fashionable to recommend as a theoretically even more correct form, in opposition to the well tried plan of eminent civil engineers, who have almost universally adopted slopes for resisting the action of the sea.

March 2.—This evening the discussion upon Mr. Jackson's paper was renewed, and was extended to such a length as to preclude the reading of any paper.

The comparative advantages and disadvantages of vertical and sloping sea-walls were discussed, and instances were given of the effect of seas upon the former when walls of a certain batter or curved face surmounted by an overhanging coping of such extent as to deflect the curling wave outwards, and throw it back upon itself rather than allow it to fall bodily inwards, as in the case of the Penmaenmawr wall mentioned at the last meeting. The manner in which the waves were driven up long slopes, acquiring force as they travelled along, was contrasted with this. On the other hand, the action of the various kinds of waves was shown upon sections of the beach at Madras, where the surf was so notoriously bad, and where it appeared that by the clawing off of the waves the beach was washed away into natural steps, of a level and then a small slope of 45°. A breakwater had been formed off that beach by throwing in loose masses of rock forming their own slope; this, when carried up to within ten feet of the water-level, stood well.

In Knootka Sound the same effect of the drawback of the waves was noticed. Sections of the Mole of Venice were shown. That mole, which is nearly 16 miles in extent, had a section of a sloped foreshore with a nearly vertical wall, then a slope at another angle, and above high-water mark another nearly vertical wall. When the seas rolled in upon the mole they partially curled over against the first wall, and were projected with augmented force against the upper one. The consequence was, that the mole was partially destroyed, and in the repairs, which had been executing for some time, it had been reduced to one uniform sloped face, at an angle of about 15°. The destruction of the nearly vertical walls of Portpatrick was also noticed. Those walls, although constructed of the finest Anglesea limestone, well dressed, dove tailed, and tied down vertically and horizontally by iron chain-bonds, were completely overthrown; and, until the thickness of the wall was increased to 80 feet of solid material, it could not be made to stand. The situation was extremely exposed, and the sea frequently sprung 50 feet above the top of the light-house, which was itself 60 feet above the level of high water of spring tides. The causes of the peculiar action of the draw-back of the waves, as exemplified by the removed shingle from the beach when the wind was on shore, and its accumulation when the wind blew off the shore, were also discussed; and it appeared to be the received opinion that, in these cases, the upper part of the waves being acted upon by the wind, a pecular rolling motion in a counter direction was imparted to the lower wave, which acted upon the shingle in the manner alluded to. This action appeared, however, only to extend to a depth of about nine feet, which it seemed to be agreed was the ultimate depth of detrimental action of all waves. The forts of Boulogne were given as further examples of the reflection of waves from nearly vertical walls; but it was shown that the darting over of the waves there was caused by their falling within the re-entrant angles of the fortification.

The effect of advanced groynes in protecting sea-walls was exemplified by the concrete walls at Brighton and Dover, which were extended merely for retaining walls; and such was the effect of the groynes, that since they had been put down the shingle had accumulated to such an extent that the sea did not approach injuriously to within 100 feet of the base. Our limits will not permit a greater detail of this interesting discussion, which will, however, appear entire in the proceedings of the Institution.

March 9.—The paper read was "*On the practical forms of engineering works exposed to the action of the waves of the sea, and on the advantages and disadvantages of certain forms of construction for breakwaters and sea walls.*" By Mr. John Scott Russell.

Although agreeing as a general proposition, with the truth of the observation, that it was impossible to lay down any one undeviating rule for a form of sea wall which should suit all cases,—the author had, from long and careful experiment, and examination of various localities, endeavoured to classify certain forms of artificial constructions, and to adapt them to certain cases, having reference in each case to the action of the waves to which they were to be exposed. His fi st process was to examine the action and character of the several kinds of waves, deducing as a given axiom, that,—First, the common form of waves is cycloidal. Second, the motion of the waves in a disturbed state is circular, and in a vertical plane. Third, the water near the top of a wave moves the same way as the wave itself. Fourth, the water in the hollow between the waves is receding. Fifth, the power of a wave is exactly in proportion to the height of its crest above the hollow between the waves. Sixth, the greatest power a wave can exert is at the moment of the crest breaking over into the hollow. Seventh, waves in the British seas have rarely been seen of a greater height than 27 feet above the hollow, and 32 feet may be taken as their greatest unbroken height; those of the Atlantic being stated to range higher. Eighth, waves have never been seen of the full depth of the water forming them, hence it is deduced that the greatest force waves can be exposed to may be determined by the depth of the water they are placed in. Ninth, there two or more classes of waves,—wind-waves, short, high, and superficial; and storm-waves, which are long, low, and deep. Tenth, the depth of agitation caused by a wave is in the ratio of its height and length conjointly. Reasoning upon these data, the paper then proceeds to examine two classes of hydraulic works. First, those which are designed to act upon the waves; and, second, those whose structures are exposed to the sea without any design of controlling it, but only to guide it under particular circumstances.

Of the first class are sea walls, piers, and other sea defences intended to restrain the action of the waves; for the forms of which a number of designs were given, ranging between the flat slope, with a foreshore, and the vertical wall. Of all these the preference was given to a wall having a concave or cycloidal curved face, to carry the wave up without breaking; overhanging coping curved on the underside to return the wave upon itself, and a recessed parapet on the outside to prevent the wave from being thrown inside. For breakwaters, whose object it was to resist the waves and produce still water within side, the best mode, under all circumstances of locality, variety of materials, and cost appeared to be the depositing of the large and small materials, and allowing them to find their natural slope under the action of the waves.

Of the second class, are works designed to direct the scour at low water, but which are quite covered at high water; the foundations of lighthouses, &c.—the object being to oppose the least possible resistance to the waves, and to suffer the least from them. Groynes, embankments, and other works intended to be under high water, also coming under this class; the best form is the parabola with the foot curved outwards on each side—the apex being raised or lowered, and the base proportioned to its application. This form being extended upward approximates to that of the Eddystone, Bell-rock, and Skerry-vore lighthouses, which have withstood the action of heavy seas so successfully.

The vertical wall was condemned for many satisfactory reasons; the cost of workmanship, the expensive character of the materials, the liability to destruction, if a breach be made, and the unsatisfactory action in consequence of the waves making a clear breach over them in heavy weather.

In the discussion that ensued, many interesting illustrations were given of the truth of these positions, derived from the works of Whitehaven, those on the South Devon Coast, and those at Hartlepool, in which latter case the strong red marl, dry punned, mingled with small stone, and faced with pitching, had been satisfactorily employed at a very small cost for the construction of piers.

March 16.—The paper read was "*A description of the method adopted in Preparing the Foundation, and in Building the Bridge over the Poldervaart, on the line of the Amsterdam and Rotterdam Railway.*" By the Chevalier Conrad, M. Inst. C.E., compiled by Mr. C. Manby (secretary), from documents furnished by Mynheer Wenckebach.

This bridge derived its importance from the peculiarly treacherous nature of the ground upon which it was constructed, for, although in Holland bad foundations are the rule rather than the exception, the difficulties were in this case so peculiarly great, as to demand particular notice. The Poldervaart, is a canal encompassing and conveying away the waters from the Polders, or spots of drained land in the commune of Kethel. The railway, traversing it at a considerable angle, rendered a skew bridge, of three openings, necessary—the centre one 13 feet space for the navigation, and the two side arches 21 feet space each, for the drainage water. The proceedings were commenced in the usual manner, with the intention of having separate foundations for each pier; this was by shooting in large quantities of sand, to form dams, within which, when pumped dry, the foundations would have been excavated. After a length of about 70 feet of sand, a dam 10 feet deep had been filled in, without exhibiting any signs of sinking; a heavy thunder-storm occurred, during which the whole mass of sand dam was suddenly engulphed to a depth of 29 feet; whilst there arose simultaneously, at a short distance down the canal, to above the water level, a mass of bog-earth, of an area of 4489 square feet—this mass increased at subsequent periods of the proceedings to the area of 9628 square feet. It was evident, that an extensive subterraneous shifting of the bog-earth had occurred, and there was reason to fear for the safety of the adjacent dykes and other works. Piling and fascine works were tried without success—piles of 70 feet in length, when driven and tied together by waling pieces, swerved bodily from their position, and became useless; fascines equally failed in producing stability. The engineer, therefore, determined, after directing the canal water into a side cut, to surround the site of the intended foundation with mounds of sand, allowing for their subsidence into the gulph below, and then squeezing up the bog-earth around and within the spot. This was at length completed, and the foundation pit was enabled to be pumped dry. It then became necessary to remove all the bog-earth from within the space for the foundation, which was accomplished by digging out spaces of a yard square, and filling them in with sand as they proceeded, until, by commencing at the exterior, and working inwards to the centre, all the bog-earth was removed, and a bed of sand had been formed in its place. The piles for the ordinary foundation, used in Holland, were then driven through the made ground, and the structure was completed with perfect success—the sand dams, and the masses of upraised bog-earth outside, being subsequently dredged up in the ordinary manner, to restore the canal to its original bed. In this description, the circumstance most deserving attention, appeared to be the sudden rising of the bog-earth during a thunder-storm. This is, however, of frequent occurrence in Holland; and it would appear as if the adhesion of the masses of bog-earth to the bottom was so slight, that the vibration communicated to the water by the thunder, sufficed to destroy the equilibrium, and the bog-turf, which, from its slight specific gravity, will float even when wet, instantly rose to the surface. When, therefore, as in this case, a heavy mass of sand was placed in the vicinity of such bog-earth, the bottom was unable to resist the pressure, and the least vibration caused it to break through the crust, being engulphed amidst the lighter material, which it forced up in the direction of the least resistance. The paper treated at some length on all the precautions necessary in this and similar constructions in Holland, where such bad foundations are of very constant occurrence. In the discussion which ensued descriptions were given of the simpler methods employed in similar situations in England, where bridges of greater weight and space were constructed upon foundations of nearly as treacherous natures—for instance, on one of the branches of the Norfolk Railway, for a bridge of which the swinging portion weighed 100 tons, a series of 16 piles, driven 50 feet deep into the silt in 12 feet water, supported a cast-iron kirb, upon which a cast-iron close-jointed cylinder was lowered and secured—within this, the centre foundation was built and had stood perfectly. Other instances of raft, or floating foundations, common in Lincolnshire, were adduced, showing the simple means by which such local difficulties were overcome in England.

NOTES ON FOREIGN WORKS.

The Russian Pompeii.—The emperor of Russia has ordered that the efossions, which have been made for several years past, near the town of Zarewim, in the county of Zaratow, should be continued, on a large scale. This town had been the capital of Tartar Chans of the golden tribe, during their 200 years domination in Russia. Some ruins of houses have been already discovered, in which divers utensils and 4000 Tartar coins have been found.

Great Adorning of the Banks of the Rhine.—Several of the old castles, casting their shadows on the waters of the Rhine, are about to be reconstructed, which will spread an uncommon lustre over these fertile and beautiful lands. Thus, Prince Frederick of the Netherlands has purchased Castle Fürstenberg, between Niederheimbach and Baberach, and will have it completely restored. The castle in its present state dates from the eleventh century, but a Roman post-tower previously existed on this far-sighted elevation. Prince Albrecht, of Prussia, has purchased Castle Schönberg, near Oberwesel; and the Prince of Prussia, Rheinfels, near St. Goar; all of which are to be rebuilt in an antique and most splendid style. [We wish something similar were done with some of our English and Scotch castles.]

Moving mountain in Italy.—From the embouchure of the Tronto up to Fermo (near Grottamare), extends a range of hills, of tertiary formation, up to the shores of the Adriatic, and is mostly covered by olive and orange groves. Some time ago, one of these hills moved to the extent of 125 paces, and passed into the sea to the extent of 25 paces. There were no other phenomena observable, save the uprooting of some trees; but a clayey substance flowed from the banks of the sea, and even, at times, from the crevices of the soil; and it appeared that an inward upheaving force, acting transversely upward, had caused this phenomenon. Count Nervoni, who observed it most accurately, thinks that it has been caused, like the earthslips on the Rhine, by some more or less distant earthquake.

Cutting of the Isthmus of Suez.—As Austria is determined on the prosecution of the Trieste overland route, the above project has been added as an accessory stimulus. Austrian engineers have visited the locality and reported thereon. The canal is to be navigable for three-masters. 150,000 francs have been already subscribed for the study and survey thereof, and English and French engineers consulted. No shares to be made accessible to the gambling of stock jobbers.

Reorganisation of the Sculpture Galleries of the Louvre.—The King of the French has ordered that the late demise of Messrs. Clarac and Dubois should be made instrumental in re-organising the direction of the above Galleries. The collection is to be divided into the departments of classic and oriental antiques, for each of which a separate director has been appointed;—for the former, Count Laborde, the well-known traveller in Arabia; and M. Longperrier, hitherto of the Royal Library, for the department of oriental antiquities. This new *sweep* bids fair for further improvement, and it is to be hoped that those treasures, hitherto stored in the vaults and cellars of the Louvre, like the great Egyptian antiquities, the Magnesian marbles, &c., will once more see the light.

Reach of the Human Voice.—On account of the speeches of Xerxes, and others, addressed to whole armies, the question has been mooted of late, amongst antiquarians, how far the human voice can reach. It has been pretty correctly ascertained, that a man may make himself heard by 20,000 persons—a very tidy number, in many respects. And thus, taking into consideration the enclosure of walls, the acoustic construction of domes, vaults, &c.—St. Paul's, and even St. Peter's, might be filled out by a human voice—of course, a strong one, in every respect.

St. Petersburgh.—March.—Since Peter the Great's time, the character of everything structural or material the Russian Government has attempted—has been one of greatness and splendour. Thus, the huge St. Petersburgh and Moscow railway will be open for traffic in about 18 months; and at the great festival which the city of Moscow is about to celebrate in September next—viz., the seventh centenary of its foundation,—parts of the line will be available to the public.—Amongst the huge buildings, public and private, lately erected at St. Petersburgh, we may mention the new addition to the palace of the general staff (horse guards), a structure of gigantic proportions;—the palace for the officers of the ministers of justice and the Imperial domains;—the complete rebuilding of the marble palace, and the *Eremitage* adjoining the Imperial winter palace.* The new stone Neva bridge is nearly ready;—and to conclude, the gigantic church of St. Isaac (entirely of granite) is now being internally adorned, in a splendid style, which will employ the artists of St. Petersburgh of every kind for a considerable time.

Cologne Cathedral.—The latest accounts state that this structure has risen nobly during the last year. Both the north and south porch have considerably advanced; the nave begins to be covered with galleries,—and the works of the stonemasons are praised as some of the richest and finest imaginable. The number of workmen employed is 500. The restoration of this national building has excited so much interest, that an especial journal—the *Domblatt* (the cathedral gazette)—is discussing its progress. In this we find several strictures on some late proceedings of the committee, which we shall mention, for the sake of proving the correctness of the old: "Iliacis peccatur in muris." The *Domblatt* says that 16,000 dollars are to be diverted from more legitimate purposes for paving the Cathedral even now,—although, surely, this will be injured by the progress of the works, &c. Above 20,000 dollars are to be employed for roofing the whole extent of the Cathedral in a temporary manner. This, certainly, is a large sum for the prurient desire of seeing at once the whole expanse of this astounding building. The painting and gilding of the choir also (the space where divine worship is hitherto performed), is objected to.

At a Meeting of the Archæologists of the Grand Duchy of Baden, an interesting essay was read by M. Zell, ministerial councillor, on two Roman inscriptions lately found. The first was a fragment of the inscription over the public guild-house of the trade of carpenters (*lignarii*) in the Roman colony, which existed under Caracalla, 1700 years ago.

What is Style?—by Goethe;—

> Style—in art, and otherwise—
> Is, where there is no stroke
> Of either pen, or brush, or tool—
> Too much.... nor too little neither.
> Wilt thou know how difficult this be....
> Try!

* Speak then of the dwellings of British Kings!

NOTES OF THE MONTH.

French Institution of Civil Engineers.—We are happy to hear that a similar institution to the London Institution of Civil Engineers is about to be formed in Paris, under the auspices of the French Government. M. Dumon, Minister of Public Works, has devoted his attention to its formation. We most heartily wish it success.

Shakspeare Cliff.—A large slip of this interesting locality took place on Monday, March 1, when a surface of chalk 254 feet in height, and 353 feet in length (about 48,000 tons), was precipitated to the bottom. Another fall of about 10,000 cubic feet have since occurred.

St. Peter's, at Rome.—The two statues of mediæval design, meant for Peter and Paul, standing on each side of the ascending steps before the portico, but which are two blocks of shapeless travertine, are to be removed. They might have harmonised with the Byzantine taste of the old basilica to which they belonged, but were a palpable eyesore in juxtaposition with the sculpture prevalent throughout the works of Leo X. and his successors. Their limbs are stiff, their attitude awkward and clumsy, their antiquity undeniably venerable. Like many other of our time-honoured respectabilities, they have received notice to quit, and will be immediately replaced by two marble statues of somewhat different taste, from the chisels of Fabris and Tadolini, the one director of the Belle Arti, the other a scholar of Canova. These modern productions are on a colossal scale; each figure is nearly twenty feet in vertical height, though a single block from Carrara. Each cost 12,000 dollars, and both are now ready to be transported from the workshop.

New Oxford Street.—By order of the Commissioners of Metropolitan Improvements, the thoroughfare from the east end of Oxford-street and Tottenham-court-road into Holborn has been thrown open to the public. The buildings, with some few exceptions, are completed, and many of them opened for business. The roadway is macadamised, and about 70 feet in width, with a foot pavement on each side 12 feet in breadth.

Elphinstone College, India.—Mr. Orlebar, professor of astronomy, and Mr. Pole, professor of engineering, have both resigned. Indisposition is, in each case, is assigned as the reason of retirement. The charge of the Observatory has devolved on the draftsman of the Indian navy.

Rise in the Soil of Egypt.—During the course of the cadastral operations lately ordered by Mehemet Ali, it was shown that the soil of Egypt is rising each year very perceptibly, in consequence of the continued deposit left by the Nile. This elevation is calculated at 30 feet during the last century for provinces adjoining the river.

Lord Dundonald's War Plan.—We understand, says the *Hampshire Telegraph*, that the secret official trial to ascertain the effect of a continuous evolution of intense gas in projecting shells or shot from a tube, resulted, on an average, in throwing twenty-five six-pounder shot to the distance of 7,000 yards. From this data, it is clear that balls of greater diameter would far exceed the range of common artillery. Another important advantage is said to accrue—namely, that the continuous rush during their emission would prove much less injurious to vessels projecting such missiles than the shock or recoil of single discharges. We learn that Lord Dundonald's ingredients produce an elastic emission, like that which would be evolved by kindling the end of a hawser or cable formed of hard twisted gun-cotton.

Some remarks on the Air and Water of Towns, by Dr. R. A. Smith, read at the *Chemical Society*, January 4.—Having given some attention to the inquiry into the health of towns, the author was anxious to find what the real evil in the polluted atmosphere of towns consisted of; and in furtherance of this object commenced a series of examinations on the water used in the town of Manchester for ordinary purposes. Rain-water, collected in cisterns, was first examined; and on heating the solid matter obtained by evaporation, it burnt, giving the odour of fat, and a strong smell of nitrogenised organic matter. Rain collected in a clean porcelain dish, and treated in the same way, gave indications of a similar kind, but in a smaller degree. The moisture condensed from the breath contained organic matter in large quantities; and when collected from the windows of crowded rooms, it smelt strongly of human sweat during the evaporation; and when the solid residue was heated, it gave the odour of burning flesh. Water from a great number of wells situated in Manchester was submitted to examination, and in all similar results were obtained. Dr. Smith finds also that the water of rivers and canals becomes contaminated in this way as soon as it reaches a town. The proportion of nitrates is also in many cases remarkable, arising from the rapid oxidation of these nitrogenised ingredients. The author concludes by stating that he is pursuing this investigation at various seasons, so as to make a more complete examination of the subject; and the whole of the analytical results will then be given.

THE GREAT BRITAIN STEAM-SHIP.

The following reports were read at a meeting of proprietors of the Great Britain, held lately at *Bristol*.

"18, Duke-street, Westminster, Feb. 27, 1847.

"Gentlemen,—I beg to inclose Captain Claxton's account of the proceedings at Dundrum Bay, during the time that he has been engaged in forming the breakwater or protection to the ship, in the manner recommended by me. Notwithstanding the great difficulties he has had to contend with from almost incessant bad weather, with the wind blowing dead on shore nearly the whole of the month of January, and consequently preventing the tides from ebbing sufficiently out to allow of the work being properly proceeded with; and notwithstanding the occurrence of more than one storm at the most critical period of the work, he has, as I fully relied upon his doing, succeeded in so far protecting the ship that she has been comparatively unaffected by violent seas which, there is no doubt whatever, would otherwise have seriously damaged her. We may now calculate with tolerable certainty upon preserving her without further injury until the finer, or at least more settled, weather sets in. In the work which Captain Claxton undertook, and has so successfully completed, he has been compelled to vary very materially the mode of proceeding first laid down; he has, in fact, been obliged to adapt his plans to his means of execution, and almost from day to day to devise modes of proceeding with only the experience of the past day to guide him. Numerous unforeseen difficulties have occurred, upon which he kept me daily informed; and simple as my plan might have appeared to others, it required much skill, contrivance, and unwearying perseverance to carry out, and many alterations and improvements as it progressed. I had relied confidently on success when my friend Captain Claxton undertook the work, and the result has fully confirmed my expectations. It is now necessary to turn our attention to the best mode of removing the ship. I hope in about a fortnight from the present time to be able to give you some opinion upon this point, but it is one requiring much consideration, and until I had the opportunity of conferring with Captain Claxton on the subject, and also had before me all the measurements and data which he has collected, it was useless to attempt it.

"I am, gentlemen, your obedient servant,

"I. K. BRUNEL."

"Great Britain, 20th February, 1847.

"Dear Brunel,—The change in the wind yesterday, and the appearance to-day of more moderate weather, leads me to feel that I may with some comfort meet your wishes, by quitting this in a day or two, for a consultation. I can venture upon this step with some confidence now, in consequence of the very satisfactory result of the late heavy gales and seas upon the breakwater, after its completion on the 7th instant. I will endeavour to meet your wishes, and embody, as concisely as I can, the substance of my various communications in one report of my proceedings since my arrival on the 22nd December, when I found Captain Hoskan using his utmost exertions to carry out your intentions, and I had the benefit of his assistance in trying to complete the foundation until Christmas-day, after which the tides for some days did not quit the work, and the time of the crew and labourers was entirely occupied in lashing the fagots together, in hoisting them on board whenever the water left the ship's bows sufficiently, in collecting chains and weights, and preparing the holding-down rods. On the 29th I succeeded in baying back the rivulet, as you beheld it, but which, in the very wet weather, proved to be a rapid and full-bodied stream, and which was greatly annoying us by choosing the ship's bed for its course; on that day the tide ebbed sufficiently to enable me to go on with the work, which it continued to do until the 2nd of January, when it blew a stiff gale from S.E. all night, all the next day, and with more or less force for several days after, until the sea ran so high that the surf never left the work at even dead low water and spring tides.

"About twenty bundles of fagots broke away, but, as was afterwards the case, they were picked up after the tide receded, and secured in place. On the 5th I found, on getting on the work, it had not only very much settled, or diminished in size from the pressure of the weights and the nature of the sand, but that the sheer force of the breakers had driven the whole body some feet forward. On the 6th, still finding it moving, I communicated with you respecting spars, and gave orders for preparing holding-down tackles, and such spars as belonged to the ship, over forty feet in length, to be got ready. On the 7th, it being still impossible to go on the work for any profitable purpose, the crew were employed as usual in packing together the larger bundles of fagots, and in preparing tackles, spars, &c. On the 8th, four birch spars, 42 feet long, were pointed through the foundation, with binding chains to their heels, at an angle of about 75 degs., and hove tight down with tackles to the cabin scuttles. It blew strong all night—and on the 9th, finding they had stood well, and that the weather was such as to bar us from fagoting, I settled for the delivery of 25 beech trees, of 45 feet in length, and 14 inches in diameter at the heel, with all despatch. The 10th, 11th, 12th, and 13th, the weather, wind, and tide, were still unpropitious; but on the 14th, we got some of the beech trees in place, in time to test them through a strong gale which blew that night, and all the 15th—when the tide having receded sufficiently, we laid about sixty bundles of fagots, and got a few more spars in place. On the 16th found the larger lot secured between the spars, and weighted with full four tons of iron chains, and other things, besides a quantity of large stones, had turned right over, leaving all the weights in a lump together, which I mention to give you an idea of the force of the rollers—they were as before collected and put back, and the air pump cover put upon them in addition to the other weights. On the 17th, 18th, and 19th, a little progress was made with the fagoting, but in consequence of the violence of the sea, and the want of stones, although every effort had been made to quarry and cart, we dared not put a large quantity—found what we did put sunk, shrunk, or settled each time at least three feet—this occurred four different times on leaving off as high as the screw shaft. Placing the spars still went on, but they did not conquer the inclination of the whole mass to move forward, which by admeasurement I found it had full nine feet; to check this, three tackles, with a spanner to each, with four arms for as many of the spars, were attached and hove tight to the three warps fast to the anchors out astern or on the port quarter, all the spars being attached to each other with chains. On the 20th we had a good tide, many fagots were laid, and several lighter spars were lashed laterally to the uprights, and six more beech trees were ordered. 21st, both tides happening in the dark, and the weather being extremely severe, nothing was done beyond lashing at daylight lateral spars as low as the coming-in tide permitted. On that night a heavy gale commenced from S.S.E., which only occasionally moderating, continued until the 28th, not allowing us the whole time to fagot, although, by great exertions, we were enabled to get the rest of the spars ordered in place. For a few minutes on that day we were enabled to examine the work—not a fagot had broken away, although they were a good deal jambed together—not a spar had moved from its berth, and the forward inclination was found to have stopped, although the test was the severest the breakwater had been, up to that period, put to. On the 28th the wind shifted to the westward, and afterwards to the northward; the water became perfectly smooth, and the tides excellent for our object. Every exertion was made to get on with the fagoting and placing fifteen more beech trees, which had been ordered and delivered, when it appeared so uncertain as to when we should be able to get on with the fagots. On the 7th, the whole of the fagots ordered, 4,600 bundles, were in place.

"The weather remained fine, and the water smooth, until the 13th of February, when it again changed, a heavy gale springing suddenly up from the south, which lasted until midnight. High water happening at 10 a.m., as was to be expected after such a sea, about 100 bundles of the fagots, which were only secured with chains and ropes to the screw and spars, or not loaded, similarly to those on the foundation, broke away, but the mass remained firm, although found to have settled or shrunk, or to have been beat down several feet, and jambed close against the ship. The effect, however, of the fagots and their spars was almost altogether to do away with the stroke from the sea, and the men were enabled to live on board with comfort. On the 14th it again came on to blow with the flood-tide from the S.W., and continued to do so with great violence until the springs took off, the highest of which, in the very height of a gale, was within eight inches of the memorable one which so altered the ship's position in November. The poles, lateral spars, and the fagots all held on well; and, although chafed and a good deal beat about and settled down, the latter had well done their work. I set the crew upon replacing and resecuring the few fagots which had broke away, and loading them with the best bower cable, which was unshakled from the anchor, laid out, and got on board for the purpose—preparatory to the trials which may be looked for before the March equinoxes shall have passed; and, judging by those it has already withstood, there can scarcely be a doubt of the breakwater weathering gales of even longer duration and of a still more violent character, if it should be the ship's fate to experience such while in her present unhappy position.

"Your whole plan would have been easily carried out if the weather between the 28th of January and 13th of February, could have been substituted for that of a whole month after the 30th December; 10,000 bundles of fagots might have been secured according to your plan, with much greater ease than we were enabled to build and secure 500 bundles after the completion of the foundation, on January 7, which itself contained about 1,200 bundles, and which kept so well together, that no one felt a doubt as to the effect of the remainder, if the tides and the weather had permitted us to go on. It was extremely fortunate that you approved so early in January of the plan of using spars to assist in keeping the fagots in place, as it was not until the 28th of that month that we fairly got to work upon that portion which may be said to be about a yard above the foundation, which really contains the great mass—about 8,000 bundles; and as we were by success encouraged to extend the system of spars, at a time a fagot could not be laid, and thus not only save time and money, but form an outer protection, which was of the utmost service afterwards, and before the fagots were high up. The sea now first strikes through this barrier of beech trees and lateral poles, the former, in some places, three deep, the entire number 70 with the ship's spars, the whole fixed in the foundation of fagots, chained together at the heel, and hove tight down from their heads with tackles—about 150 spars are lashed laterally and diagonally outside of these from the sand to the ship's gunwale—the fagots, with the exception of the foundation, are all built within these, resting against the ship's side, filling the hollow of the port quarter, and as the sea is forced, with whatever violence, through the openings of this net-work of spars, which commences at the starboard quarter and extends to abreast of the mainmast on the port, or exposed side, it is received by the mass of fagots, and not only is its whole force lost as it were, but, although the spray is thrown up to the height of the funnel over the aftermast, there is no shock whatever to the ship.

"Yours truly,

"C. CLAXTON."

MISCELLANEA.

Suspension Bridge, Lambeth.—Sir Samuel Brown, the constructor of Hammersmith Bridge, Brighton Pier, &c., has offered at his own expense to construct and maintain a suspension bridge across the Thames from Westminster to Lambeth, if he can obtain the authority of Parliament and permission to establish a toll. An inquiry into the merits of the proposal has been intrusted to Captain Vetch, of the engineers,—who has entered upon the investigation, with the assistance of Captain Washington, one of the Tidal Harbour Commissioners. The estimated cost, including structure, approaches, and the purchase of property, is 90,000*l.*; but this estimate has been made on granite—and the material is now intended to be either iron or stone. The width of water at high tide where the bridge is intended to be built is 858 feet—at low water, 828. It is intended to have two piers, each of which will intercept 45 feet of water. The erection of the bridge to be finished in two years from its commencement.

Jets of Water.—Some experiments were lately made at Liverpool by the Harrington Waterworks Company, in presence of the Government Commissioners of Inquiry relative to the supply of water to the town, and is thus described by the 'Liverpool Mail':—"Short lengths of hose, with pipes of 7-8ths of an inch in the nozzle, were attached to a stand-pipe from the main; and from one up to four of these branches were played for upwards of an hour,—the addition of one, two, or three, to the first appearing to make little or no difference in the respective power of any of them. The quantity of water which they projected was very great and continuous. It completely lashed the east end of the church, and not only went clear over the blockings above the cornice, and on to the roof in heavy volume, but at times ascended to the top of the flag-staff, a height, we should think, little, if at all, short of 80 feet. The plan, which combines hydraulic pressure with engine power, is decidedly much more effective than hand-worked engines; and, if adopted, will afford great and rapid protection to property in cases of fire—and that, too, with a large saving of expense."

Woolwich, March 10.—Sixteen 24-pounder gun carriages, with traversing platforms and equipments complete, have been shipped from the Royal Arsenal on board one of the Ordnance sloops for Pembroke, to be erected on the batteries for the defence of that seaport. Captain Turner's company of Royal Artillery, 6th battalion, will leave Woolwich next week for the same place, to take charge of the guns, and to mount them for use. In future, a company will be regularly maintained at Pembroke, so as to place the batteries in a state of complete defence.

The New Military Prison, erecting in the Royal Artillery Barracks, near the Riding School, is nearly completed; the main body of the building has been covered in. The prison, however, will not be appropriated for the reception of prisoners till about May next, as time must be allowed for seasoning the cells. In consequence of the great demand for labour to complete the coast defences, 110 gunners were entered lately in the Royal Arsenal as labourers.

The Coast Defences.—Northern District.—The following is the return of the number of guns mounted on the northern coast of England, from Hull to the coast of Scotland, excluding the guns ordered for the defence of the Humber. Hull citadel, seven 18-pounder guns on common carriages.—Tynemouth Castle and Clifford's Fort, five 12-pounder guns, and six 9-pounder guns on common carriages, and one 8-inch mortar; total 12 guns.—Perch Rock Battery, sixteen 32-pounder guns on traversing platforms, and two 18-pounder guns on common carriages; total 18 guns.—Scarborough Castle, six 18-pounder guns, and four 12-pounder carronades, on common carriages; total 10 guns.—Carlisle Castle, two 6-pounder guns, and one 12-pounder carronade on common carriages; total 3. Grand total for the district, 50 guns.

Lowestoft Harbour and Railway.—The timber works of the north pier, 1,300 feet in length, with the pier head, are completed, and the south pier, 1,250 feet long, is progressing rapidly. By the end of June, the harbour, it is confidently expected, will be available for ships to take refuge in drawing 15 feet water at an average tide. The work commenced last May, and there is now 2,600 feet of pier-work finished. The railway works are nearly completed, and the line will be open for goods traffic on the 1st instant. In the harbour there is upwards of 21 feet average depth of water at the lowest period of the tide, a depth which extends 100 yards within the entrance.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM FEBRUARY 20, TO MARCH 25, 1847.

Six Months allowed for Enrolment, unless otherwise expressed.

Joseph Clinton Robertson, of Fleet-street, in the City of London, civil engineer, for "certain Improvements in distillation and brewing, and certain applications of the materials used in, or suitable therefore, to other manufacturing purposes." (A communication.)—Sealed February 20.

Edward Brown, of Adam's Court, in the City of London, gentleman, for "certain carbonic compounds, formed of earth, vegetable, animal, and mineral rubbish, fecal substances, the waste of manufactories, and certain acids and alkalies, which compounds are applicable as manures."—February 20.

William Pidding, of Bernard-street, in the county of Middlesex, gentleman, for "an Improved process, or improved processes, for preparing certain vegetable extracts, and also for preserving the aroma of certain vegetable substances from the atmosphere."—February 24.

Charles Heard Wild, of Mortimer-street, Cavendish-square, civil engineer, for "Improvements in constructing parts of railways."—February 24.

Charles Fox, of London Works, Birmingham, for "a method or methods of welding, or uniting pieces of metal together, and of pressing or forming pieces of metal into forms or shapes."—February 24.

William Bayliss, of Bilston, in the county of Stafford, chain-maker, for "a machine for flattening and turning iron links for flat wood slub chains."—February 24.

George Russell Dartnell, staff-surgeon of the first class in her Majesty's army, now stationed at Chatham, in the county of Kent, for "an Improved truss for inquinal hernia."—February 24. Two months.

Alphonse le Mire de Normandy, of Bethnal-green, Middlesex, analytical chemist, for "Improvements in the manufacture of zinc."—February 24.

Frederick Walton, of Wolverhampton, japanner, and tin-plate worker, for "an Improved mode of coating or covering, or of coating, covering, and ornamenting the surfaces of articles which are, or may be, made of wrought iron, or of other metal or metals, which improved mode may be used in substitution of japanning, tinning, or other modes now in use of coating, covering, or of coating, covering, and ornamenting such articles."—February 24.

Juan Nepomuceno Adorno, of Mexico, in the Republic of Mexico, gentleman, for "Improvements in manufacturing cigars and other similar articles."—February 24.

John Lowe, of Manchester, engineer, and James Simpson, of the same place, joiner, for "certain Improvements applicable to carriages to be used upon railways, part of which improvements may also be used upon other roads."—February 24.

William Todd, of Holcombe Brook, near Bury, in the county of Lancaster, for "certain Improvements in the method of sizing and dressing yarns, and in the machinery or apparatus for performing the same."—February 24.

Frederick Ransome, of Ipswich, engineer, for "Improvements in working coke and other kilns, or ovens."—February 24.

Robert Snowden, of No. 7, City Road, Middlesex, tea-dealer, for "Improvements in treating or dressing coffee, to render it more wholesome for use."—February 25.

William Eccles and Henry Brierly, of Walton le Dale, in the county of Lancaster, for "Improved machinery to be used in spinning."—March 2.

John Wood, machine maker of Leeds, in the county of York, for "certain Improvements in machinery for spinning fibrous substances."—March 2.

Andrew Crosse, of Broomfield, in the county of Somerset, for "Improvements in treating fermentable and other liquids, so as to cause impurities or matters to be extracted or precipitated."—March 2.

Samuel Hunton Townsend Bishop, of Hackney-terrace, in the county of Middlesex, for "Improvements in the construction of the upper part of chimneys."—March 2.

James Napier, operative chemist, of Shacklewell Lane, Middlesex, for "Improvements in smelting copper and other ores."—March 2.

Charles Stewart Duncan, gentleman, of Lombard-street, for "Improvements in certain vehicles."—March 3.

George Tossick, engine-builder, Thomas Hackworth, engine-builder, and Thomas Elliott, superintendent of locomotives, all of Stockton-on-Tees, for "certain Improvements in locomotive and other boilers."—March 3.

Richard Roberts, engineer, of Manchester, for "Improvements in machinery for punching and for perforating metals."—March 5.

Richard Roberts, engineer, of Manchester, for "Improvements in machinery to perform the processes called beeshing, mangling, and the like."—March 5.

Amedée Francois Rémond, of Great Charles-street, Birmingham, for "certain Improvements in steam engines."—March 9.

Mathew Sproule, engineer, of Liverpool, for "certain Improvements in steam engines."—March 10.

James Stevens, engineer, of Darlington Works, Southwark-bridge-road, for certain "Improvements in apparatus for conveying signals or communications between distant places, parts of which are also applicable to lamps and burners."—March 10.

Kasimir Vogel, manufacturer, of Saint Paul's Church Yard, London, for "a new manufacture of weavers' harness, and for machinery for the production of the same."—March 10.

John Isaac Hawkins, civil engineer, of Liverpool-street, Kings'-cross, for "certain Improvements in holding together or filing letters, music sheets, newspapers, and other documents."—March 10.

Edward Johnson Coale Atterbury, merchant, of Leeds, in the county of York, for "certain Improvements in gearing machinery." (A communication.)—March 10.

James Murdock, of Staple Inn, Middlesex, for "an Improved mode of preparing and employing certain colours and materials for painting." (A communication.)—March 10.

Louis Nicolas de Meckenheim, machinist, of Birmingham, for a "certain Improvement or certain improvements in machines to be used in the manufacture of nails, screw-blanks, rivets, bolts, and pins."—March 10.

William Newton, civil engineer, of Chancery Lane, Middlesex, for "certain Improvements in engines to be worked by gas vapour or steam, either separately or in combination." (A communication).—March 10.

Henry Fletcher, manufacturer, of Over Darwen, in the county of Lancaster, for "Improvements in apparatus for ascertaining the distance which locomotive engines and carriages have travelled upon railways."—March 10.

Thomas Waterhouse, of Edgely, in the borough of Stockport, in the county of Chester, for "certain mechanical improvements applicable to railway engines and tenders, and to railway carriages of various kinds."—March 10; two months.

Sampson Lloyd, engineer, Old Park Iron Works, Wednesbury, in the county of Stafford, for "Improvements in the manufacture of tyres or hoops, or wheels or other articles to be made of iron or steel."—March 15.

Charles Fox, engineer, of Trafalgar Square, Westminster, for "Improvements in the construction of presses."—March 15.

Jean Joseph Hazard Petit, chemist, of King's Road, Chelsea, for "Improvements in the manufacture of oils, and in apparatus for disinfecting and purifying oils, and other inflammable or spiritous matters, and improvements in lamps and gas burners."—March 16.

Joseph Henry Tuck, gentleman, of Paris, in the kingdom of France, for "Improvements in apparatus for ventilating buildings, carriages, chimneys, and other places where a change of air is required."—March 16.

William Newton, civil engineer, of Chancery-lane, for "Improvements in engines to be worked by gas, vapour, or steam, either separately or in combination." (A communication.)—March 16.

Charles Tennant Dunlop, manufacturer, of Glasgow, for "Improvements in the manufacture of alkali and chlori, and in the application of the products resulting therefrom."—March 16.

Robert Scotthorn, engineer, of Somer's Town, in the county of Middlesex, for "Improvements in engines, for obtaining and applying motive power."—March 16.

James Wills Wayte, of Leeds, in the county of York, printer, for "certain Improvements in self-feeding furnaces, adapted both for land and marine purposes, for the better prevention of smoke arising from fires used in such furnaces."—March 18.

Peter Britus Coxon, of Lenton, Nottingham, machinist, for "A new method of embossing, raising, and forming ornamental figures and designs on certain intertwined textile fabrics."—March 19.

John Leslie, of Conduit-street, Hanover-square, one of the tailors to her Majesty's household, for "Improvements in the combustion of gas for the purposes of light."—March 22.

Charles Fox, of Trafalgar-square, Charing-cross, engineer, for "Improvements in the permanent way of railways, and in carriages to be employed on railways." (A communication.)—March 23.

Henry Kempton, of South-street, Pentonville, Middlesex, gentleman, for "Improvements in copying presses."—March 23.

Henry Smith, of the firm of H. Smith and Co., of Stamford, agricultural implement makers, for "certain Improvements in machinery for cutting and separating vegetable substances; also improvements in the construction of machines for dibbling, and sowing seed, and distributing vegetable substances and manure over land, part of which improvements is applicable to wheel carriages in general."—March 23.

William Bullock Tibbits, of Braunston, Southampton, gentleman, for "certain Improvements in obtaining and applying motive power."—March 23.

Henry Heycock, of Manchester, merchant, for "certain Improvements in rotary engines to be worked by steam, or other power, which said improvements are also applicable to raising or forcing fluids."—March 23.

Morris Lyons, of Birmingham, chemist, and William Millward, of the same place, silver operator, for "certain Improved alloys of metals, and improvements in the deposition of metals."—March 23.

George Fergusson Wilson, of Belmont, Vauxhall, Surrey, gentleman, for "Improvements in the production of light, and in the manufacture or preparation of materials applicable thereto."—March 23.

Henry Hatcher, of the Strand, civil engineer, for "Improvements in electric telegraphs, and in apparatus connected therewith, and also in electric clocks and time-keepers."—March 23.

Francois Stanilas Meldon de Sussex, of Millwall, Middlesex, manufacturing chemist, for "Improvements in smelting copper and other ores."—March 23.

William Bruce, of 4, Essex-court, Temple, and of Flimstow, near Pembroke, barrister-at-law, for "Improvements in constructing piers, breakwaters, and other submarine works of stone."—March 25.

ON THE MEASURES OF FORCE AND LAWS OF MOTION.

If a body be disturbed from a state of rest, or if the rate of a moving body be accelerated or retarded, the cause of the motion in the first instance, and of the acceleration or retardation in the second instance, is called *Force*. When a material particle, acted on by only two forces in opposite directions, is kept at rest, the two forces are said to be in equilibrium and statically equal. The material particle, last considered, is said to be kept at rest by the pressures of the two forces. The notion of pressure seems to arise from the peculiar sensation experienced in the muscles of the human frame, when the limbs are supporting a heavy weight or thrusting against an opposed obstacle.

By pressure, as manifested in the sense of touch, we are acquainted with the forms of all objects within our reach and grasp. If we had no other means of communicating with the outer world than by contact, our knowledge of it would be extremely limited; we could have no conception of colour, and but very little of distance; the extent of a hundred miles would be as difficult to imagine as a million with the aid of vision. These deficiencies in the sense of touch are compensated by the sense of sight—that is, by the consciousness of the presence and relations in space to each other of external objects,—as evidenced by vibrations in ether, which are communicated through the optic nerve to the brain. Hearing is excited by vibrations transmitted through the air or any other elastic matter, and which, in many instances, are so intense, as to be sensibly felt. Windows are frequently broken by the report of artillery,—and thunder, when close, shakes the walls of the stoutest buildings. We observe, then, that all our experience of the phenomena of the universe is derived from force.

Force acquaints us with the existence of matter;—nay, more, we might, with perfect propriety, consider matter as composed of geometrical points, the loci of radiating forces. In by far the greater number, however, of investigations which require the aid of mechanical science, it is sufficient to consider the properties of matter, without any reference to its ultimate constitution. Thus, having previously by experiment determined how far elasticicity, rigidity, flexibility, &c., influence the circumstances of statical or dynamical phenomena, we are enabled to solve problems involving these considerations, without any further enquiry into the nature of internal or molecular forces.

Before, however, we can apply mathematical reasoning to determine or predict what happens when any number of forces act upon a body, it is necessary that some of the effects of force should be susceptible of numerical comparison. In order to render our meaning clearer, let us, by way of analogy, consider the method usually adopted to measure heat. Heat is evidenced by many effects; among others, by the sensation of warmth,—by the impetus which it gives, when developed within certain limits, to the growth of plants,—and by its interference with the laws of chemical affinity. Yet none of these effects are sufficiently definite for the purposes of measurement. We cannot be certain that the same source of heat will always, under the same circumstances, excite the same sensations;—nay, we cannot be certain at any two times that the sensations of hot or cold we experience are the same. Still less can we avail ourselves of the effects of heat on vegetable life. While, as to the changes occasioned by a high temperature in the chemical constitution of bodies, they are involved with so many accompanying phenomena—so complex and discontinuous—that they could scarcely be compelled to furnish a scale of measurement.

There is another effect, however, of heat, which we have not yet noticed, and that is—its power of expanding the volume of bodies. This effect is rendered the more valuable by the fact, that whatever phenomena of heat are due, at any one time, to a particular temperature—that is, to a particular amount of expansion of the liquid of the thermometer—are likewise due to the same temperature at any other time. Here we have a class of effects which are always the same for the same causes, and are susceptible of arithmetical comparison—the two qualities necessary for a measure. Consequently, temperature is universally adopted as the measure of heat; and in thermotics, all the symbols and numerals have reference, not to heat, but temperature.

To return now to the effects of ordinary forces: among these, weight—or the statical effect of the force of gravity—suggests itself as an appropriate measure, not only of the gravity of different bodies, but of the pressures occasioned by any kind of forces whatsoever. By comparing the weight of bodies with the force of a spring-balance, it is found that the weight of the same body, at the same place on the earth's surface, is always the same—and independent of the position of the body in space.

Again, if we take a prismatic body, homogeneous throughout—say a cylinder of lead—and divide it into two equal parts, we shall find the weights of the two halves equal. Also, if we divide the cylinder into any number of equal parts, we shall find the weights of all these equal parts equal each to each, and the sums of their weights equal to the weight of the undivided cylinder. Let the weight of the cylinder be represented by the number w; then the weight of an nth part would be represented by $\frac{w}{n}$, and the weight of p (equal parts) by $\frac{pw}{n}$: but, as we have shown the weight of a body is not altered by dividing it into parts—consequently, the weight of a portion of lead, of which the volume is equal to the volume of the p parts, would be represented by $\frac{pw}{n}$; and its volume would be $\frac{p}{n} \times$ volume of the undivided cylinder. Hence we infer, that the weights of homogeneous substances vary as their volumes. If now we take the weight of a specified volume of a given homogeneous substance as the unit of measurement,—a force which would make equilibrium with a weight r times the specified weight is denoted by the number r: and all formulæ in statics concerning the relations of forces in equilibrio, represent each force by the number of times the unit of force must be multiplied in order to make equilibrium with it.

When we have to consider the motion of bodies, it is more convenient to employ another measure of force, the nature of which we now proceed to explain. We must first, however, define velocity. The velocity of a moving body, at any time t, is the space which the body would pass through in an unit of time, supposing the rate of the body uniform and the same as at the time t. As for example,—if 1 foot be taken as the unit of space, and 1 second for the unit of time, a body moving uniformly at the rate of 3 feet a second is said to have a velocity expressed by the number 3.

Now, it is found by experiment—First, "that if a body be at rest, it will continue at rest until acted on by some force; and if it be in motion, and acted on by no extraneous forces, it will continue in motion with an uniform velocity, and in a straight line."* Secondly, if when a body is in motion, it be acted upon by an invariable force, in the direction of its motion, the quantity by which the velocity of the body will be increased or diminished (according as the force is accelerating or retarding,) will always be the same in the same time; and is quite independent of the initial velocity which the body possessed before it was subject to the influence of the force.

This latter fact at once furnishes us with a convenient dynamical measure of force, known by the name of the measure of accelerating force. Professor Whewell well observes that the measure of the accelerativity of force would be a much better term for it. This measure of accelerating force, which, for the sake of brevity, is frequently simply designated "accelerating force," is the velocity generated in a moving body, during an unit of time, by an invariable impressed force. If the force vary with the time, the measure adopted for any time t, is the velocity which would be generated in an unit of time by the force if invariable, and the same as at the given time t: thus

* The paragraph between inverted commas enunciates the first law of motion.

gravity accelerates the velocity of a body falling in vacuo by $32\frac{1}{6}$ feet a second; taking feet and seconds as units of space and time, the accelerating force of gravity is represented by $32\frac{1}{6}$.

Our next object must be to endeavour to discover some law connecting the statical and dynamical measures of motion. We are conscious, from every day experience, that the velocity we can communicate to a large and heavy obstacle by thrusting against it with all our strength, is much less than the velocity we could communicate in the same time to a smaller and less ponderous obstacle. We know that the same pressure will not always communicate the same velocity to different bodies in the same time. Let us now define all bodies to have the same masses in which the same pressure would create the same velocities in the same time. This definition of the word mass will save much unnecessary explanation in the following experiment.

Suppose n equal balls made of the same material, quite smooth, and capable, by some mechanical contrivance, of being fastened to each other at pleasure, and thus forming one or any number of solid bodies.

Let $n-1$ of the balls be fastened together and placed on a smooth horizontal table, let the remaining ball be tied to one end of a thin inextensible string, and the other end of the string attached to the $\overline{n-1}$ balls. If now the single ball be allowed to hang down beyond the table and descend, dragging the other balls after it *on* the table, and the velocity at a time t from the commencement of the motion be measured, and if the experiment be again tried with 2, 3, &c., balls hanging down, and $n-2$, $n-3$ balls, &c. on the table, the velocities at the end of the same time t will be found to be proportional to the numbers 1, 2, 3, &c.; but the pressures communicating motion were the weights of the one, two, three, equal balls, &c., and the mass moved is invariable—namely, the mass of all the balls; consequently, we learn that when the mass is constant, the velocity acquired at the end of any time is proportional to the pressure causing it—the pressure not varying with the time. Moreover, we infer that the velocity *generated* in a given time, and therefore in the unit of time, is proportional to the pressure when the mass is constant.

Next suppose that the n balls are all united, and as one mass, compelled to move by the gravity of n, other equal balls; in this case, we shall find that the velocity generated in an unit of time is the same, whatever be the value of n; consequently, when the velocity generated in an unit of time is constant, the pressure varies with the mass; and we have already shown that when the mass is constant the velocity generated in an unit of time varies as the pressure;—therefore, when both the mass and velocity vary, the pressure varies as the product of the mass and velocity generated in an unit of time. It is not necessary in these experiments that the balls should be made of the same materials, provided they be of such a magnitude that any one of them, when attached in succession to each of the rest by the inextensible string above alluded to, should generate in them all the same velocities at the same time. Since the dynamical measure of the force of gravity is the same for all bodies, it follows that the weight of bodies varies as their masses. It is sometimes assumed that the masses of bodies varies as their weights, which of course leads to the same results.

If m denote the mass of a body, g the accelerating force of gravity, the unit of mass is so chosen that $m g$ shall $= w$, where w is the weight of the body. The property of matter by which it apparently resists a force tending to move it, in proportion to its mass, has sometimes been called the vis inertiæ,—an useless term, since it expresses nothing more than is expressed by the word mass. If v be the velocity generated in a body in an unit of time, v is the measure of the accelerating force acting upon the body: $m \times v$ is called the measure of the moving force, or more frequently the moving force, where the word force is transferred from the cause to the measure of the effect.

Consequently, when pressure, which does not vary with the time, acts directly on a body, the moving force is proportional to the pressure. In obtaining the above relation between the statical and dynamical measures of force, which is known by the name of the third law of motion, we assumed that the same pressure would generate the same velocity in any material system, provided its mass were constant, and its parts so connected that they must all have the same velocity. We assumed, in fact, that the pressure of the hanging balls produced the same velocity in the whole number of balls as it would have done on a single ball of the same material and equal in bulk to all of them.

This, perhaps, ought previously to have been demonstrated by experiment; although, in proving the third law of motion by means of Attwood's machine, most writers take the same principle for granted—as we think, most unwarrantably. Newton stated the third law of motion thus—action and reaction are equal and opposite: on this Professor Whewell observes, "since, in virtue of the equality of the action and reaction bewteen two bodies, the momentum gained and lost are always equal, the momentum gained and lost are sometimes called action and reaction, and the third law of motion is then expressed by saying that in the communication of motion reaction is equal and opposite to action."

By momentum is signified the product of mass by velocity. If we are to understand by action and reaction only the momentum lost by one body in transferring motion, and gained by the body to which motion is transferred, we do not think that there is any connection between the proposition of Newton and the third law of motion, as it is stated by modern philosophers. But in fact by the equality of action and reaction, is meant that force, whether measured by the pressure exerted or momentum lost in the body communicating motion, is productive of momentum in the body to which the motion is communicated, equal to the momentum lost, and proportional to the pressure exerted.

The principle of the equality of action and reaction is of the greatest importance: taking the statement in its most extended meaning, it enunciates not merely that in the communication of motion, the momentum gained and lost are equal, but that the internal forces connecting the different parts of a material system—provided the connection and relation of those parts continue the same—are likewise equal and opposite. We have now briefly described the various measures of force and the first and third laws of motion; the second law of motion is generally given in the following words: when a force acts upon a body in motion, the change of motion in magnitude and direction is the same as if the force acted on the body at rest. As an example of this,—if a body in vacuo were projected horizontally, it would arrive at the surface of the earth in the same time as though it had been simply allowed to fall from a state of rest. All the laws of motion are suggested by ordinary experiments; which indeed only prove them approximately, owing to the utter impossibility of excluding all forces but those the effects of which we are examining: nevertheless, in proportion as we remove disturbing causes, so do we find the results of our inquiries tend to coincide with the limiting statement of these fundamental laws. A far more accurate test, however, is furnished by astronomical observations:—the orbits of the heavenly bodies, calculated on the supposition of the truth of the laws of motion, are found to coincide with their observed orbits so nearly, that any difference may fairly be ascribed to errors of observation.

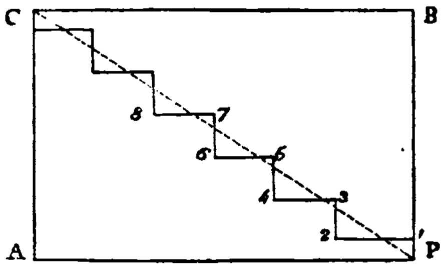
The only planet that could not be made to keep to its tables, was Uranus; the differences of its observed and predicted places were always, however, extremely small;—yet, from such data as these, Mr. Adams, previously, in England, and afterwards M. Leverrier, in France, computed the orbit of the new planet, long before its existence was announced by the telescope of the observer. In conclusion, we beg to state that we have not endeavoured to give any new definitions, or to vary the statements and terms usually employed to express the relations of force, motion, and matter; our aim has been to explain, to persons not accustomed to the terse style of mathematical works, the fundamental principles of mechanical science.

A NEW THEORY OF THE EARTH, THAT FULLY ACCOUNTS FOR MANY ASTRONOMICAL, GEOGRAPHICAL AND GEOLOGICAL PHENOMENA, HITHERTO UNACCOUNTED FOR.

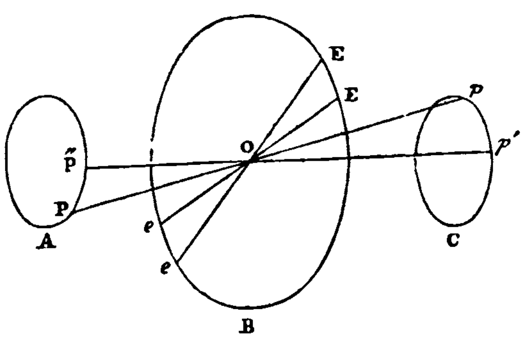
By Oliver Byrne.

(Continued from page 101.)

The following illustration will show, in a very simple manner, how different effects may appear to be produced by investigating causes separately, that act jointly.



Let a material point P, be acted upon by two uniform forces at the same time, in the directions P A, P B, and let the lines P A, P B, represent the magnitudes of these forces. It is well known, by what is technically called the parallelogram of forces, that it will not obey either of these forces, but the combined effect of both, and describe the diagonal P C. Now the point P, would arrive at C, in precisely the same time, if the causes of action be investigated separately, even if at every alternate instant the forces alternately act; yet the path described by P, would be very different from the true one, which the joint actions of the two forces cause it to describe. The zigzag path P, 1, 2, 3, &c., will be at best but an approximate to the true one P C. This illustration of combined action, viewed jointly and separately, simple as it is, compared with the joint actions of the sun, moon, and the other bodies in the solar system, on the excess before mentioned, shows how astronomers, by continually correcting a false hypothesis, have distorted the true motion, which we shall continue to explain. In stating that the earth's axis changes its position, we do not consider the mass moveable with it;—no; the change of the axis, which is to be understood by what is termed its *right motion*, changes the position of the equator, and, therefore, the latitudes of all places. It may be necessary to remark here, that the *right motion of the earth's axis* is very slow; so much so, that scarcely any perceptible difference in the latitudes can be observed in 100 years,—chiefly on account of this motion not being recognised in a proper manner, which has tended to baffle the theory of corrections, now so dissatisfactory. For the purpose of exemplification, we shall show how this motion of the earth's axis would cause the phenomena of a precession of the equinoxes. This may be shown by simply allowing the poles to change their position in two opposite circles. It may be necessary also to remark that this supposition is made merely for the purpose of illustration, for the right motion of the earth's axis is not in a circle, but in a looped spiral curve of double curvature, the nature and properties of which are given in the proposer's new work on the Theory of the Heavens and Earth, before alluded to. However, when this supposed plain motion is understood, *the right motion of the earth's*



axis (which at once effects these apparent motions, recognised by the terms precession, nutation, and the decrease of the obliquity of the ecliptic,) can readily be conceived. If a right line P p, be supposed to revolve about its middle point O, in such a manner as to describe a circle A P P″; the other point p, will describe an equal circle, whose plane will be parallel to that of the former circle. The lines P p, P″ p', &c., will have the same inclination to the plane passing through O, parallel to the planes of these circles. Now, if a plane be supposed to pass through O, perpendicular to P p, and intersect the plane E B e, in E e, when the point P, moves to P″, the plane perpendicular to P″ p', passing through O, will intersect the plane E′ E B, in E′ e'; so that if P p, P″ p', &c., be considered consecutive positions of the earth's axis, the plane of the ecliptic to be E B e, and the variable plane passing through O, perpendicular to P p, P″ p', &c., the plane of the equator, then the consecutive points E E, &c. show the precession of the points where the planes of the equator and ecliptic intersect, and how their positions are changed with the motion of the poles P p. A motion similar to this, but of a more compound nature, causes what is technically termed the precession of the eqinoxes. Now, the spiral motion, or rather change of the earth's axis, above alluded to, which is chiefly caused by the influence of the sun and moon on the excess of the earth above its greatest inscribed sphere, is what we have designated *the right motion*, or *change of the earth's axis*. The nature of this motion can be readily conceived from the apparent phenomena of precession, nutation, &c. Hence, this exposition shows that the earth has but three motions; namely, one round the sun, one on its axis, and a change of that axis; the nature of this last motion or change is something similar to that which is observed in a globular body spinning on an horizontal plane. However, the change of the axis in this globular body is only calculated to give an idea of the uniform change of the axis of the earth, caused, as we have before observed, by the constant and commanding influence of the sun and moon. As the poles shift their positions on the surface, so does the equator and the protuberance there; and, in fact, every particle of which this globe, if we may so term it, is composed, endeavours to accommodate itself to this motion, so that the earth's true form is that which may not be improperly termed an exvoluted spheroid, continually, but slowly, changing its relative position. To guard against any misconception, it may be necessary to state, that the change of the protuberance at the equator, or rather the change of the excess of the earth above its greatest inscribed sphere, is not a sliding of that excess over the inscribed sphere, but the establishing of another and another excess in different positions, in consequence of the change of the position of the earth's axis, which is continually beiug changed by the influence of the sun and moon on the excess existing at any time. Every particle, internal and external, natural and artificial, is influenced by this motion. The sturdy edifices of man soon moulder down, or their foundations are depressed or elevated: the true cause is never assigned. When no local cause can be trumped up, all is left upon what is commonly termed the ravages of old time, which lets nothing alone.

The changeable protuberance or excess is said to be about 34 miles more in diameter at the equator than the diameter through the poles;—this slow and constant change of the excess of the earth above its greatest inscribed sphere, has done more in baffling the observations of man, and all his inquiries respecting the nature and figure of the earth, than any other circumstance which might be named. If the earth were composed of one uniform substance, ready to accommodate itself to the behaviour of this change of protuberance, the true motion of the earth's axis would have been discovered long ago. The heterogeneous substances of which this planet is composed, and which are more and more changed with respect to colour, pliability, and form, with their varied positions by the influence of heat and cold in the great laboratory of nature, must in a greater or less degree, in every instance, point out the existence of this unerring law. The change of this protuberance, or rather the change of all the particles with respect to the imaginary line about which this planet makes its daily revolutions, although very slow and gradual, effects a change in the whole heterogeneous mass, every instant, more or less, according to the pliability of the several parts; those parts which do not instantly change, from the rigidness of their nature, ultimately feel its sway: so that the earth would become, from what we have termed the right motion of its axis, a figure whose nature and proportions could be readily determined, were it composed of one yielding and uniform substance; but on account of its heterogeneousness, and the rigidity of some of its component parts compared with others, this figure, which we shall here designate an exvoluted spheroid, becomes in parts more or less slightly indented or elevated, according as these parts and those surrounding them are more or less sensitive of the constant disturbing cause. Not only a change in the inanimate kingdoms is effected by the right motion of the earth's axis, but also a constant change in the animate: it is not asserting too much to say, that the gradual decline of nations is mainly to be attributed to the same cause; for this change, by its powerful influence, leaves places more or less suitable for the habitation of man and other animals. In the words of the justly celebrated Dr. Charles Hutton, "amid all the revolutions of the globe, the economy of nature has been uniform, and her laws are the only things that have resisted the general movement. The rivers and the rocks, the seas and the continents, have been changed in all their parts, but the laws which direct those changes, and the rules to which they are subject, have remained invariably the same." The following facts and statements may tend to illustrate this theory. The gradual change of the fixed stars, especially that which is termed the north pole star, (Ursa Minor) with respect to the apparent north and south, shows that the axis of the earth is continually changing its position; this fact is not disputed, but the parallels of latitude on the surface of the earth are supposed to remain fixed, which is by this theory controverted. In the "Boundehesch," a work containing the cosmogony of the Parses, and supposed to have been written by Zoroaster, it is said that Ormusd formed the light between the heavens and the earth; that he made the sun, moon, and stars, and divided the latter (probably those near the ecliptic,) into twelve constellations. Each star in the zodiac is said to be seconded by 6,480,000 smaller stars, and all these are represented as soldiers, ready to make war on the enemies of nature. Ormusd, it is added, has also placed in the four quarters of heaven, four sentinels to watch over the stars; of these Taschter guards the east; Sateris, the west; Venand, the south; and Haftorang, the north. There is said to be, also, a great star Meschgah, in the midst of heaven, for the purpose of giving further protection to the south when the enemy comes in great numbers. Now it is impossible to form an opinion what can be meant by this enemy so mysteriously announced; but the designation of the stars seems to correspond with the *Host of Heaven*, which is used in the scriptures, and with the attendants or guards of the Supreme Deity, which is the denomination applied by the Egyptians to some of the constellations and planets; and it has been attempted by modern astronomers to prove that four of the principal fixed stars were really situated in, or near, the four cardinal points of the horizon about the year 2200 B.C., which is the period assigned to the first Chaldean observations. D'Alembert remarks that the longitude of Aldebaran, at that epoch, was 11° 20′, and its latitude 5° 30′ south; and as Antares differs from Aldebaran in longitude by six signs, and has 4° 30′ south latitude, it follows that these stars were then very nearly in the points of the vernal and autumnal equinoxes; consequently, one of them would be seen to rise near the east about the time that the other was setting a little to the north of the west. Now, it has been alleged that Taschter signifies the genius presiding over rain, and we know that the heliacal rising of Aldebaran was considered by the ancients as an indication of approaching storms; hence it is, with some propriety, inferred that this star and Antares were two of those alluded to in the Persian story. The other two stars are less certain, *the right motion of the earth's axis not being recognised;* D'Alembert supposes they might be Fomalhunt and Regulus, which were then nearly in the plane of the solstitial colure, and the former would be visible in the south at an altitude of about twelve degrees above the horizon of Babylon, while Antares and Aldebaran were respectively rising and setting: but Regulus must have been 34° below the northern point of the horizon, supposing the axis not to change; consequently, according to this theory, Regulus would be visible at the same hour in that latitude. If, therefore, continues D'Alembert, it was meant that the four stars were at once seen in the situations just mentioned, we must look for some other star having the same longitude as Regulus, but having at least 34° of north latitude;—the *r in Ursa Major is so situated, and it is possible that this might be the star in question. M. Bailly observes, "that the notion of the four stars quartering the heavens seems to have extended to China, for in the History of the Astronomy of the Celestial Empire, it is said that there are four spirits which preside over the four seasons, meaning probably the quadrants of the Zodiac, and it is likely enough that this kind of observations would be made by any people among whom astronomy was in its infancy."

This general apparent change of all the fixed stars, in pointing out the motion or change alluded to, is much baffled from the dissatisfactory theory of corrections, from the rise and fall of all places in accordance with the change of the excess before alluded to, and from the very slow motion of this excess: another thing calculated to lead the observer astray, is the fixed opinion that the latitudes of places are never altered. It would appear that all astronomers and philosophers of every description had made up their minds to change everything before they would allow the latitudes to change, although such a change is shown to exist, whether the subject under consideration be astronomical, geological, or geographical.

The latitudes of ordinary places may differ from time to time, in a greater or lesser degree, from the inaccuracy of instruments, observations, or measurements; but it ought to excite a suspicion to find the latitudes of observatories changing, where oversights have no possible chance to enter into such a simple problem as the determination of the latitude. Now, it is a noted fact, that every astronomer in Europe counts his observatory to be in a different latitude from that of any of his predecessors, if such have had a predecessor; even astronomers called Royal, in enlightened England and France, differ respecting the latitudes of their respective observatories given by their several predecessors, but their differences are sure to be saddled upon any cause except the true one—the actual change of the place with reference to the poles. These facts are so well known, that it would be useless to give a list of the latitudes in which the several observatories have been said to stand.

It would likewise be useless to state the different latitudes which have been given to the same remarkable places on coasts and elsewhere; these were changed without the slightest compunction, as time could not be spared for them to undergo the like cookery which the latitudes of observatories have undergone.

Not only the change of the latitudes of objects and places show this change in the earth's axis; but among many other observed facts, we may here mention the foundation of all our old churches, which were laid out due east and west, and due north and south, have shifted to comply with the right motion of the earth's axis, and that too in direct proportion to the dates of their standing. One of the most remarkable instances of this kind that has fallen under our notice is that presented by the position of the city of Philadelphia, in the United States of America. The surveyors under the direction of William Penn, the founder, laid out Market-street and Broad-street, crossing each other at right angles, due east and west, and due north and south; but now they point in different directions, accommodating themselves to the universal law which is here for the first time shown to exist.

If we are to admit that the particular positions of the temples at Denderah and Esneh, in Egypt, were really given by design, we shall hardly be able to avoid concurring with Dr. Stukely in that part of his hypothesis concerning the Druidical monuments at Stonehenge and Abury, in Wiltshire, which relates to the direction of their longitudinal axis. The former of these is well known to consist of a great number of prismatic stones, placed on end in the peripheries of four ellipses, whose major and minor axes are respectively in the same right lines; the entrance is supposed to have been at one extremity of the major axis, and opposite to it, within the area, is a stone which seems to have been used as an altar. The doctor's opinion is that the founders of the monument intended to place it in a direction tending from nearly the south-west to the north-east, and to place the entrance opposite the latter point of the horizon, in order that it might receive the first rays of the rising sun on the day of the summer solstice; it being, he observes, the custom of the ancients to celebrate their great festivals at that season. The principal part of the work at Abury consists of one great range of stones, enclosing a circular area, within which are two double circular ranges, respectively concentric with each other, but neither of them having its centre coincident with that of the former and containing circle. A line joining the centres of the two double circles is also supposed by Dr. Stukely to have been intended to coincide with that joining the north-east and south-west points of the horizon; but he observes that in the temple at Stonehenge, the axis deviates 8 or 9 degrees southward from the north-east points; and in that at Abury, the line of the centre lies about 10 degrees northward from the same point. Now these different deviations, which are by Dr. Stukely supposed to have resulted from the employment of a mariner's compass to determine the directions of the axis of the temples; the needle being subject to a variation which is different in different ages, and the priests of the country being supposed to have considered, erroneously, that it coincided in direction with the *true* meridian of the place.

We conceive it unnecessary to offer any argument to disprove the latter opinion, that these monuments were *oriented* by means of a mariner's compass, it being highly improbable that such an instrument would be used for that purpose, when the heavens present so many phenomena by which the end might be gained with much more ease and accuracy. Among other objects which can be submitted to actual measurement, may be mentioned sun-dials of long standing, especially horizontal ones, as they partake of this motion in a two-fold manner—that is, with respect to the elevation of the gnomon and the gradual change of the horizontal plane. Many instances of this kind are on record;—sun-dials excavated from the ruins of Pompeii and Herculaneum do not now tell the hour in the latitudes in which they have been found; if any person would take the trouble to compare the time which such dials now show, with that time which they ought to show, they will find that the earth's axis must change in the manner which we have described. It may be supposed, because the bearings of natural objects, such as the tops of mountains, do not change in exact accordance with the motion of the earth's axis, like the foundations of churches and other structures of man, that such a law has not an equal influence over them: the fact is, that the rigidness of the materials of which they are composed not only prevents them immediately yielding to this motion, but also leaves them elevated or depressed, either gradually or suddenly, above or below the rest of the surrounding matter. This theory is borne out by many phenomena, but it is our intention first to test it by those which are capable of being submitted to actual measurement.

It is borne out by actual measurements which were instituted in different places, in order to determine the figure and magnitude of the earth. For this purpose, the lengths of small arcs were measured in different places on the surface of the earth, with the greatest care; but, for want of a true theory of the earth, their measurements, for the purposes for which they were instituted, were almost useless, and led to very dissatisfactory conclusions. Although these measurements disappointed the measurers, in pointing out the form which they supposed the earth to be before they commenced their operations, yet their results are of the greatest use in supporting what is here promulgated. We cannot avoid remarking here, that the plans upon which all our great measures of the earth proceeded were very injudicious—that is, first supposing the figure to be one form while they were carrying on their operations, and when finished affirming it to be another: besides, they give way as much as possible in all their measurements and calculations to their preconceived opinions, despite of all the natural exponents which pointed to the contrary. The values of the degrees of latitude found at different places on the earth's surface differ from each other more than might be expected, considering the great attention that has been paid to ascertain and make allowance for every known cause of error. In France, the lengths of the degrees were found to go on diminishing from north to south, but not in a regular progression. In England, on the contrary, they were found to diminish from south to north: so that if the figure of the earth were to be deduced from the degrees in the former of these countries alone, it would appear to be oblate; if from the degrees in the latter, it would appear prolate. As might be expected, the lengths of degrees measured in the northern hemisphere of the earth deviate, within certain small limits, from the values they should have on the surface of any conjectured figure, except the one which we have described. The degrees measured in corresponding latitudes in the opposite hemispheres also disagree;—this fact, as a matter of course, must necessarily follow. The proportions between the equatorial and polar diameters of the earth are, necessarily, stated to be various; the comparison of the arc measured in France with that in Peru (in which last, it should be remarked, the observations of Bouguer were made use of,) gives, for that proportion, 334 to 333; D'Alembert, taking a mean of the observations of Bouguer and La Candamine, afterwards found it to be as 309 : 308. The length of a degree in India, compared with that in England, showed the ratio to be as 329 : 328.

The ratios $\begin{cases} 318 : 317 \\ 314 : 313 \\ 289 : 288, \end{cases}$ and many others, have been given at different times from the same sort of measurements. The difference in these ratios instead of showing that they are all wrong, shows the exact contrary,—that they are all very nearly correct: which increases the number of observed facts that support the phisico-dynamical demonstration.*

That the earth is slightly indented or exdented in different places, appears at once from the different magnitudes which actual measurements point out: if it were otherwise, no matter whether it was supposed to be spheroidal, ellipsoidal, or any other solid, formed under a uniform law, except the form which we have here designated "an indented and exdented evoluted spheroid," the difference could not have been so great;—so that, although the right motion of the earth's axis, or rather the slow but constant change of the position of the excess of this planet above its greatest inscribed sphere, exercise its influence on all the particles of which it is composed, yet some of them for a time remain unaltered, from their rigidness,—but, ultimately, all must give way, or be covered by the ocean, which is always ready to obey this general law of nature.

The late trigonometrical surveys show, either that the latitude of places have changed, or that they were greatly misplaced by former surveyors. Now, it is more likely that the places have changed their positions with respect to the true north and south points, than that errors of such magnitude could be committed; one of the principal objects of trigonometrical surveying being to determine the geographical positions of principal or noted places, whether on coasts or inland, in islands or on continents, in order to give accuracy to maps, and for the purpose of accommodating navigators with the true latitudes and longitudes of principal promontories, lighthouses, havens, and ports. It is well known that these have, till lately, been requirements even in this country: the positions of some important points, as the Lizard, not being known within seven minutes of a degree; and the last survey found the best country maps in many cases to exhibit differences of more than three miles in distances of not more than twenty or thirty miles. The late surveyors may attribute all this to blunders made by their predecessors; but this is not at all likely, as the rudest instruments or the most careless observations could not so far mislead: in one hundred years from the present time, the same apparent blunders will be again detected. There is nothing which might be named that baffles the observer more, in determining the longitude either on land or at sea, than the erroneous opinion that the latitudes of places remain always unchanged. The whole face of nature points out this universal change;—geologists not having recognised it is astonishing: their conflicting and contradictory theories respecting the formation and structure of the earth, by this theory are set at rest for ever.

The chemical influence of heat and cold, combined with the gradual change of all matter, at once accounts for the several observed phenomena attributed to so many causes. By the right motion of the earth's axis, or rather the change of the excess so often alluded to, we have, among others, the following natural consequences:—Rivers appear to bury themselves in the earth, or rather, the places rise through which they flow. Mountains, which do not immediately give way to this change of surface, from the rigidness of the substance of which they are composed, ultimately, often without the slightest warning, decrease in altitude many feet. As this protuberance shifts its position, it only disturbs the particles, but in a very slight degree changes their respective distances;—for instance, it is not to be imagined that the particles of one valley co-mingle with those of another. In the ocean, islands appear and disappear from the same cause. Continents, as well as islands, are increased in some parts and diminished in others, and that in such a regular manner that the influence of this general law is at once recognised. The structures of man, as well as those of nature, are often instantly elevated or depressed. Countries, which were once fruitful and thickly inhabited, have become barren; and, on the contrary, those which were barren, become fruitful. This motion not only changes the beds of rivers, but those of oceans and seas, so as not to show the same levels in places only a few miles distant—that is, with respect to what is erroneously called the mean level of the sea. Mr. Whewell has fallen into errors in his account of the theory of the tides, from his not having observed this general law of nature. In fact, the true cause of the motion of the waters on the surface of the earth, is mainly to be attributed to this motion. The sea-worn pebble obtrudes through the caverns of the deep and appears on the surface of the earth many miles from the sea, mixed with marine substances and remains of shell-fish. Fossil remains are found many feet from the surface, and in different climates from those to which they belonged,—often imbedded in substances which are evidently deposits, assuming different appearances from pressure, position, and being submitted in the great laboratory of nature to the different changes of temperature, and other local causes. It is not difficult to conceive how transformation can take place, for in the laboratory of the chemist the most durable substance is easily made to pass from a dense to an aeriform state, and the contrary;—water on the surface of the earth affords us daily a familiar instance of this, in its three separate states of rock, fluid, and vapour. The varying spinning motion of the earth on its axis, which is continually changing the excess so often mentioned, has this effect on the particles that compose the ocean; they are daily and hourly obliged to accommodate themsevles to the behaviour of this motion, and also to the constant change of the less pliable substances over which they are compelled to move: therefore, to imagine that the ocean can have a mean or uniform level, as Mr. Whewell and many others do, is absurd. But this is satisfactorily shown by a comparison of the observations made on the tides in different ports and places. Slow as the right motion of the earth's axis appears to the shortsightedness of

* In consequence of an Editorial note, annexed to the first part of this article, it is necessary for me to state that the mathematical demonstration of this problem is given in my work on the Calculus, which is being printed, and will shortly be published. In due time my analysis shall be published, together with a concluding article on the "Strength of Materials," a subject fully discussed in my forthcoming work, just mentioned.

O. B.

man, yet, were it to cease, the earth would be shortly deluged. Not only the particles of the ocean, but of the air, are subject to its influence,—the magnet acknowledges it, and every particle composing and surrounding this heterogeneous mass. If geographers, geologists, and astronomers look at the constant changes which take place on the surface of the earth, and in the appearance of the heavenly bodies, in accordance with this general law of nature, they cannot for a moment question its existence.

ON THE MEASUREMENT OF WATER DELIVERED THROUGH LARGE (OR WIDE) ORIFICES.

By M. Morin.

(Communicated to the Académie des Sciences, Paris.)

In experiments on hydraulic motive powers, the most delicate portion, and that most subject to error, is the measurement of the quantity of water expended. Local circumstances, forms, or shapes, the arrangement of flood-gates, exert on that quantity great influence, which, as yet, has been too little studied, and the inexact appreciation of which has frequently led the most conscientious observers into serious errors, to which may be attributed, very frequently, the manifest exaggeration of certain results announced with the most perfect sincerity.

In order to avoid such errors, and to establish with some certainty, or at least with a sufficient approximation to it, the ratio of useful effect produced by the motive powers submitted to experiment, to the absolute amount of water expended, I endeavoured to determine upon a mode of measurement beyond the reach of controversy, which was somewhat difficult.

For this purpose, I first reflected whether I could measure, with sufficient exactness, the quantity of water supplied by an overshot-wheel sluice fixed at the head of a channel or race, in which the motive powers to be subjected to experiment were to be placed.

This sluice is equal in width to the head-race, constructed of masonry; it is inclined from above downwards at an angle of above 65 degrees to the horizon; its upper edge has an acute angle up-stream, and is rounded off down-stream; it is 3 inches thick. Two racks, each of 2 inches wide, reduce the clear width to 6 ft. 7 in.

In order to estimate the volume or quantity of water that passed over this sluice, the tail-race, which was constructed of masonry, with a rectangular section, was closed below by a vertical dam of plank, in which were made three openings; to these were fitted sluices of about 0·300 m. (1 foot) square, of thin sheet iron, of about 0·005 m. ($\frac{2}{10}$ in.) in thickness, sliding in front of the orifices, which were formed with sharp edges. These iron sluices were, by means of screws, worked by hand; rods with marks showing the level, were placed in front of the overshot-wheel sluice and the iron sluices, in order to show and to verify the invariableness of the levels.

From this short description, it may be readily conceived that by making simultaneous observations at the overshot-wheel sluice, and at the regulating orifice, the supply, or quantity delivered by the two kinds of orifices, might be calculated, by means of the very precise results of the experiments of Messrs. Poncelet and Lesbros, and which were evidently applicable, with all desirable exactness, to the case in question.

But these experiments, undertaken on canals of great dimensions, which had vast basins, subject to the effects of the winds, and whose level it was difficult to regulate perfectly by means of an ordinary mill sluice, could not possess a degree of exactness comparable to that of experiments made under more favourable circumstances. In order to examine into the whole together, and to disengage the results from accidental influences, we have re-produced them by a graphic construction, taking the values of the *charge* (or head of water) H, on top of the sluice, as abscissa, and those of the co-efficient of the supply or delivery as ordinates.

In examining the table of the results, and, above all, the curve which represents them, it is seen that the values of the co-efficient of the supply or delivery increase rapidly with those of the *charge* H, on the ground-sill of the orifice, from H = 0·03 m. (12 inches), and 0·04 m. (15½ inches), up to H = 0·10 m. (4 inches), a term beyond which they still continue to increase, but more and more slowly.

If, to compare these results obtained with a sluice of 6 ft. 7 in. in width, equal to that of the head-race, and placed in the before-mentioned circumstances, with those which relate to a sluice of 0·20 m. (nearly 8 inches) wide, to complete contraction, we determine, by means of the figure, the values corresponding with the *charges* observed; in this last case, the following table may be formed, which is limited to the *charges* with which we have operated:

Width of Orifices.	Values of the co-efficient *m*, of the formula $Q = m\,L\,H\,\sqrt{2gH}$, For the values of H equal to					
	0·04 m.	0·06 m.	0·08 m.	0·10 m.	0·15 m.	0·20 m.
0·200 m.	0·407	0·401	0·397	0·395	0·393	0·390
2·017	0·264	0·355	0·418	0·448	0·469	0·482

It is seen that for small *charges*, this sluice of 0·08 m. (3 inches) thick, produces a notable diminution in the supply or delivery, although the contraction may be nearly annulled on the vertical sides of the orifice. This effect is analogous to that observed by Messrs. Poncelet and Lesbros on small overfalls passing through a shute. We know, in fact, that, in the cases in which the contraction is nearly null on the sides, these observers found the following values of *m*:

Charges on the upper side of the overfall.	0·04 m.	0·06 m.	0·10 m.	0·15 m.	0·21 m.
Values of *m*.	0·246	0·271	0·308	„	0·324

These values, which, for small *charges*, made a very near approach to those we have obtained, show that the diminution of the supply or delivery depends, in both cases, on the same cause—on the resistance of the side or wall of the sluice, or of the shute. We notice, in fact, that in small *charges*, the fluid vein wets and follows the surface of the sluice; but in proportion to the increase of the *charge*, this influence of the sides or walls diminishes, and soon, indeed, the fluid vein detaches itself completely from the upper edge, which is sharp up-stream, and the resistance of the surface of the sluice ceases to be felt, whilst at the same time the suppression of the lateral contraction continues to exert an increasing influence on the augmentation of the supply or quantity delivered; whence it results that the co-efficient of the supply or delivery increases.

Such is the natural and simple explanation that may be given of the smallness of the values of the co-efficient of the supply or delivery for the small *charges*, and of their magnitude for the large *charges* observed in our experiments.

Notwithstanding the care taken in the execution of these experiments, the local causes and circumstances mentioned did not permit us to approximate nearer than $\frac{1}{15}$th or $\frac{1}{20}$th; but the sketch shows, nevertheless, by taking them as a whole, the gradual and continual progress of the increase of the co-efficient of the supply or delivery, and, until new and more precise researches are made, I think we may, in applications to analogous cases, adopt with sufficient accuracy for practice, the values deduced from the sketch, for the co-efficient of the supply or delivery, viz.:—

Charges on the Sill of the Overfall,—in metres.

0·04, 0·05, 0·06, 0·07, 0·08, 0·09, 0·10, 0·12, 0·14, 0·16, 0·18, 0·20,

Values of the Co-efficient m.,—in metres.

0·264, 0·318, 0·335, 0·390, 0·418, 0·437, 0·448, 0·460, 0·467, 0·472, 0·477, 0·482.

These values, which, for *charges* exceeding 0·10 m. (4 inches), are much greater than those which have been, up to this time, adopted for similar cases, show that sluices, arranged like that made use of by us, which is the case with many horizontal wheels, deliver more water than is generally admitted to be the case; and that, in experiments on hydraulic motive powers, we are liable, for want of a good method of measurement, to estimate the supply or delivery of water at one-sixth or one-seventh below the real amount, and, on the other hand, very much to overvalue the useful effect.

Experiments on an Orifice with the Charge on the Summit.

Although the *ensemble* of the results obtained with the overshot water-wheel sluice, enables us to determine with sufficient exactness, at least for practice, the amount of water actually supplied or delivered in the experiments proposed, on hydraulic motive powers, I have thought it best to make use, for this purpose, of an orifice with the *charge* on the summit, so that the height, and, consequently, the area of the orifice remaining the same, the *charge* on the centre, being alone exposed to slight errors of measurement, enters into the calculation of the supply or delivery, but as under a radical of the second degree, and the influence of these errors diminishes when the *charge* increases.

For this purpose, I caused to be made on the same race or canal, an orifice of 1·496 m. (4 ft. 11 in.) in width, the vertical sides of which were 0·16 m. (6·3 inches), and 0·165 m. (6·5 inches) from the sides of walls of the canal, and as the movements or risings of the sluice were very slight, when compared with these distances, the contraction might be considered as nearly complete on these sides, as well as on the upper and lower sides.

The determination of the actual supply or delivery by this orifice, was made, as has been before explained, by means of a small iron sluice, whose greatest opening was 0·300 m. (12 inches).

The examination of the results obtained, and above all, their graphic representation, show that the greatest deviations did not amount to more, and were almost always less, than $\frac{1}{40}$th of the ordinates of the curve which represents them. And as, for experiments on hydraulic motive powers, such an approximation is quite sufficient, we have been able, in the ulterior calculations of the supply or delivery of water, to adopt the values of the co-efficient of the supply or delivery deduced from this very curve.

We wish it to be observed that, in our experiments, the *charges* on the summit of the orifices having been comprised between 0·050 m. (2 inches) and 0·180 (7 inches) at farthest, and that this dimension, agreeably to the experiments of Messrs. Poncelet and Lesbros, producing an influence, at most, of only $\frac{1}{100}$, the variation of the co-efficients has scarcely depended on any thing except the height of the orifices.

We have therefore been enabled, in accordance with this remark, to seek to compare the values of the co-efficient of the supply or delivery which we have found, with those which have been determined for equal heights of orifices of 0·20 m. (8 inches) in width, by Messrs. Poncelet and Lesbros, and we have thus formed the following table:—

Nature of the Orifices.	Values of the co-efficient of the theoretical supply or delivery for height of orifices of		
	0·20 m.	0 ·1 0.	0·05 m.
Orifice of 0·200 m. wide,	0·592 m.	0·611 m.	0·630 m.
„ 1·496 m. „	0·675 m.	0·679 m.	0·727 m.
Increase owing to the augmentation of width,	0·083 m.	0·068 m.	0·097 m.
Or,	·100 m.	·100 m.	·100 m.
	8·130	10·000	7·530

It is seen that the width of the orifice appears to have had a considerable influence on the supply or delivery, and that the increase resulting from it for this supply or delivery has varied, in the cases in question, from $\frac{1}{7\cdot5}$ to $\frac{1}{10}$.

These results prove how necessary it was to verify beforehand the exactness of the formula to be made use of for the measurement of the supply or delivery of water, since differences of this kind might result from it.

We will moreover observe that these results, giving amounts of supply or delivery much greater than might have been calculated agreeably to the rules generally admitted, the useful effects obtained from the motive powers studied in the experiments of which we have to give an account, will be diminished in the same proportion, and that, in this point of view, our results will be less favourable to them than if we had been content to follow the ordinary rules.

Evaporation of Water.—A paper was read at the Academy of Sciences, Paris, respecting the quantity of heat annually applied to the evaporation of the water on the surface of the globe, and of the dynamic force of the streams of continents. M. Daubrée asserts that the evaporation employs a quantity of heat about equal to one-third of what is received from the sun, or in other words, equal to the melting of a bed of ice of nearly 35 feet in thickness if spread over the globe. The motive force of the streams in Europe is, according to M. Daubrée, equal to between 373,508,974 and 364,678,620 horses working incessantly during the whole period of the year.

ON M. BRUCHHAUSEN'S NEW THEORY OF THE TELLURIC FLUCTUATIONS OF THE SEA.

By Professor MADLER, of Dorpat.

Our globe presents an abundance of evidence, that its present condition is one which did not exist in times anterior. It is the purport of the present time to establish these facts and their corollaries, historically and empirically, and to frame the way for their genitic elucidation; while the purport of the future will be to penetrate into their genesis, and to elucidate, in an incontestible manner, the first causes, —whereby the existing effects and results may be proved and demonstrated to perfect evidence. We do not intend, by saying so, to discredit all present endeavours to arrive at these first causes of our globe-nature;—every endeavour in this respect is meritorious.

This apology we have to premise to our review of M. de Bruchhausen's (of Luxembourgh) theory of sea-motion, first communicated to the congress of *scientiates* at Bremen, and subsequently developed in an especial work. Its general features are as follows:—

1. If masses of ice become fixed on the bottom of the sea, they cause a preponderance of that hemisphere whose pole they form,—and, in consequence of that preponderance, the centre of gravity of the globe must change its place.

2. Ice masses of this kind are fixed as well at the south as at the north pole, but are not immutable, but increase and decrease alternatively.

3. The fact, especially, that in a cycle of 21,000 years, the poles have their summer in the perihelium and aphelium (by which, also a difference in the duration of seasons is given)—causes a disparity in the proportion of evaporation and precipitation, and consequently, a greater increase of the polar ice-masses on that pole which possesses, then, the shorter summer; as well as a decrease of those masses on the opposite pole.

4. In consequence of the shifting of the centre of gravity, caused by the increase and decrease of these masses, the sea must move to that pole where the bottom-ice is increasing,—flood the land there, and lay dry those on the opposite pole. Thence, so little land exists now on the southern hemisphere, and such breadth of land porects towards the pole on the northern.

These condensed statements will suffice for testing their plausibility. M. de Bruchhausen himself, considers the third argument the weakest, as the observations of Herschel (whose correctness is not disputed by M. B.) have proved, that the sum of the temperature of summer, is not changed by the different position of the Apside line. Still, the distribution of heat over single seasons is, certainly, somewhat—albeit, not much—different; and could, possibly, be the cause of an imperceptible increase of the polar ice. We say possibly, because such a complicated phenomenon demands the most accurate physical inquiry,—which M. Bruchhausen has not made, but endeavours to prove his position by induction.

In this place already, the objection can be raised, that an alternate increase and decrease of ice-masses (at least, as their limits are concerned,) takes place every winter and summer,—as, naturally, the winter pole will have more ice than the summer pole. If this difference were of sufficient quantity to act in the way put down by the author,—then, during every summer, we should observe a flowing from the north hemisphere southward; in winter, one in an opposite direction. The elevation of the continents and islands of the temperate and frigid zones, would be different in summer and winter. As, however, such a periodical change of the level of the sea (every year) is, surely, not observed,—then, also, the still lesser difference of aphelic and perihelic summers, is also incapable of producing such astonishing difference of the level of the ocean, which the author estimates at 20,000 feet. This difficulty cannot be obviated, even if the effect of this action be extended to several thousand years.

The same result will be arrived at by a simple calculation. Let us assume the extent of the polar ice, at an equal distance from the pole, at merely 15°; and as Weddel has sailed up to 74°, and Ross even to 78°, south latitude, we might safely consider it even as more. Let us further consider the curve of its surface (independent of the curve of the globe) as being parabolic: let us take the density of the polar ice at 0·86; the density of the globe, according to Baily's latest experiments, at 5·69; and let us express the thickness of the bottom-ice at the pole by x;—then the shifting of the centre of gravity of the globe thereby produced will be:

$$= \tfrac{1}{3}\,\frac{0{\cdot}86}{5{\cdot}69}.\ \sin.^{2}15^{\circ}.\,x = \frac{1}{394}\,x.$$

Whence it results, that for shifting the centre of gravity of the globe only one foot, a mass of ice will be required, which has a thickness of

394 feet at the pole, and reaches (on all sides) up to 75°,—being fixed at the bottom of the sea.

As, however, the opposite pole does not loose its bottom-ice, which (according to M. Bruchhausen's theory) is merelv diminished—the assumed shifting of [illegible] x is obviously too great; and if the two masses of ice are in the ratio of 1 : 2, it is to be reduced one-half. At any rate, even supposing these masses to be of the utmost thickness, the shifting will turn out to be quite imperceptible, and inadequate to produce such phenomena as the author wishes to explain thereby.

After saying so much, we hardly wish to inquire whether there really be ice-masses of the kind at the poles, or whether they be subject to such great changes and variations. The new antarctic continent, discovered by recent travellers, which rises with its volcanic peaks to the height of 12,000 feet, does not seem to allow of the assumption of such mighty masses of ice—and the same seems to be the case in the north. But even abstracting from these lands, the theory of M. Bruchhausen will vainly endeavour to point at any possible shifting of the centre of the globe's gravity.

In regard to the phenomena which the author endeavours to explain, it is easy to perceive that they do not tally with his theory. He refers to some upheavings observed on some littoral parts of the northern hemisphere. But this is quite a local occurrence—for while the coast of Sweden is rising, no such thing takes place on the shores of Denmark, England, or even the Prussian or Russian territories of the Baltic. Against this upheaving in one part—depressions, at no great distance, are observable—as, for instance, the whole coast of Dalmatia is descending, and the once market-places of several cities, like that of Zara, are now flooded by the sea. In other parts—such where cities three thousand years old are to be met with—all has remained *in statu quo*. The triangle of Sicily has been the same since remotest antiquity, all the old ports of the Mediterranean are the same; although, since their first foundation, nearly one-third of that period has elapsed in which the poles change their position—as far as the Apside line is concerned. All this proves sufficiently that the elevation of Scandinavia and the depression of Dalmatia, as well as other phenomena of the same kind in other parts, are merely of local character; and it is not the level of the sea which has changed, or ever can change,—but the land which, from epoch to epoch, is shifted like the scenery of some huge theatre. If there were really any such cause or agency, as the author supposes, a simultaneous elevation of one hemisphere, conjointly with a depression on the other, would take place, whose extent would only depend on the Sinus of the latitude.

We think that this simple statement will convince M. Bruchhausen and other investigators, that his labours have taken a wrong direction—as will those of any one, who will attempt an explanation of geological phenomena by astronomical agencies, both being perfectly distinct—at least, only confluent on their extreme limits. Because, while astronomy has to deal with space and matter of immense and hugest extent, geology is the doctrine of a thin crust of one of the most puny points in the great system of the *Cosmos*.

J. L——Y.

Bridge over the Rhine at Bâsle.—M. Edouard Krafft, a young engineer, who has distinguished himself by the building of several cast-iron bridges, and especially by that of Aspach, near Muhlhausen, has made a proposal to the corporation of Bâsle to build a new bridge, instead of the present old one, whose clumsy and unsightly form disgusts every beholder. M. Krafft proposes to obviate the great difficulties which present themselves, by introducing improvements in the laying of the foundation, hitherto only resorted to in mines. The principal improvement proposed by M. Krafft consists in placing the piles in the bed of the river by means of immense bells of sheet iron, of the shape of the piles, into which a steam engine would constantly pump air. This would enable the workmen to execute, even at a depth of 10 mètres below the level of the river, all the operations of excavation, the ramming in of the piles; the laying of the beton, and the masonry. The bells, whose upper part would be higher than low-water mark, would be cut at that height, after they had been filled up with masonry, and would remain (serving as a case for the latter) in the water. This work would supersede the cofferdam system (?), and save 30,000 francs per pile, besides offering an hitherto unprecedented degree of safety. The corporation of Bâsle has purchased M. Krafft's plan, which bids fair for its ultimate execution.

SANITARY REGULATIONS OF THE METROPOLIS.

If anything more worthily distinguishes the present age—notwithstanding Coningsby's outcry about the age of tinsel and brass—notwithstanding the charge of Mammon worship and the imputations of selfishness—it is the spirit of practical improvement, exemplified not merely in undertakings which are reproductive to the community and profitable to the conductors, but in those daily and long-continued exertions of the Government and the educated classes, for the amelioration of the condition of all members of society, and in particular of the condition of those who, from want of intelligence and want of means, are least qualified to help themselves.

It is well to assume the attitude of *laudatores temporis acti*; to speak of the good old times; to banish virtue to the annals of antiquity; and, in denying modern merit, to lament modern depravity. That is an old vice; it is aptly characterised by the Sage of Judea and the Poet of Rome;—and it is one so tritely known among ourselves, that it must argue some confidence in the extent of public credulity, to try it on any large scale in our times. Have we all forgotten the classic scene in the "Spectator," where the shrewd observer takes down a book from the shelves of his library, and reads to the grumbler an awful description of the depravity of the times? "How true," says the grumbler, "how accurate—how minute!" And yet the page of the moralist did not refer to the time of Queen Anne, but to that of Henry the Eighth. In the time of Queen Victoria, a large school, with the Coming Man at their head, and Pugin for their Michael, cry out on the worthlessness of the present day, and sigh for the middle ages, the forms of which they would fain revive among us. To copy the merits of our forefathers, to catch their noble spirit, is well worthy of our ambition;—but to adopt their system bodily, and to eschew all the merits and improvements of the present day, would be as insane in practice as it is antic and fantastic in suggestion.

If, however, there be one party who would drag us back, body and soul, to the middle ages, there is another who, for self interest, would oppose every improvement in the present day: so that no suggestion can be made for any practical measure, without its being met by the most violent outcry and misrepresentation. Such is the fate which has beset Lord Morpeth's bill and the sanitary arrangements.

None can have a more superstitious horror than we have of Government interference—none have been more consistent in their opposition to any unjustifiable attempt at extension of power and control. On the Steam Vessels question, our humble exertions were sufficient to frustrate the objectionable designs of the Board of Trade. On the proposition of the Buildings Act, we co-operated in obtaining the removal of the obnoxious clauses; and we cannot charge ourselves on any one occasion with neglecting the interests of the public or of those professional readers who favour us with their confidence. We cannot, however, go so far as to object to all Government interference, or to deny that it can be properly exercised; for we have ourselves, on many previous occasions, in reference to this present question of the sewage and sanitary arrangements of towns, exercised what influence we possess in the exposure and correction of the very serious abuses which are still so greatly prevalent.

We might sympathise with those who objected to the Government obtaining the sole control over the sanitary arrangements of the metropolis; but knowing what we do of the sewage, drainage, paving, cemeteries, and supply of water in the metropolis, and having so often had occasion to write in terms of disapproval, we cannot consistently say that the present system requires no alteration,—for we must say that it requires a great deal, and that Lord Morpeth's bill in that respect errs only in not going far enough.

We defy any sensible man to look at the wretched and confused mode of administration, the number of conflicting local boards, the host of useless and inefficient functionaries, the opposition and antagonism shown in the details of arrangement, and the miserable and contemptible results,—we defy any man, we say, to consider these things, and not feel ashamed that in the greatest metropolis of the world, and among the most practical and business-like people, such a disgraceful state of affairs should exist,—whereby the public money is wasted, the public wants are neglected, and the public health is endangered.

On this point all opinions ought to agree—that the local boards should be abolished, and the administration simplified: common sense requires this, if economy and public justice did not imperatively claim the reformation of the present abuses.

This point conceded, an efficient working must follow, which is mainly prevented not by the want of capacity of the local officers employed, not by their want of professional skill, but by the want of power to carry out the most essential improvements and the best conceived designs.

If we look at the state of the sewage of the metropolis, we are sure all must agree that its present condition is bad, and that even the worst Government board could not be worse. The metropolis is split up among several irresponsible boards, exercising independent jurisdictions, and acting on the most discordant principles. While the upland is under the Finsbury and Holborn Commission of Sewers, the outfall is under the City of London Commissioners. The Tower Hamlets Commission take charge of the East of London, sending some of their drains into the Finsbury division. The western parts of London are delivered over to the Westminster Commission of Sewers, who have the Crown Commissioners for Regent-street and the Regent's-park interfering with them throughout. The southern suburbs belong to the jurisdiction of the Surrey and Kent Commission.

The result may be anticipated: as there is no central authority, there are repeated conflicts between the jarring functionaries,—for the divisions embracing districts of undulating surface, have not, in all cases, the command of their own outfall, or have not the command of the natural outfall. Hence, circuitous lines of sewer are adopted, to the great inconvenience of the public, and to the great loss of the rate-payers. The Regent-street and Regent's-park district, which is under the Woods and Forests, runs right up in a narrow strip through the Westminster division, from Scotland Yard to the Regent's-park, and has its own main sewer and its own separate outfall. The consequence is, that the Westminster Commissioners, instead of sending some of their northern drainage into the Regent-street main sewer, have recourse to a long detour, by a sewer of two miles in length, to join the King's Scholars' Pond Sewer, higher up the Thames.

Proceedings of this kind are fraught with mischief and injustice; for not only have the Westminster Commissioners to contend with a very slight inclination, and a very bad outfall, through the King's Scholars' Pond Sewer, but a great deal of money is wasted in the original outlay for the circuitous sewer, there is always a difficulty in keeping it in order, and there is necessarily a much heavier charge for its repair. The Regent-street sewer is one of great capacity; it is carried to a considerable depth, and is sufficient to drain all Westminster and Marylebone,—and yet a new and needless sewer has, under the present system, been made.

There is also, from the nature of the boundaries, some difficulty in securing the proper cleansing of the sewers by flushing; for the Westminster and the City of London divisions of sewers have not within their districts access to a sufficient supply and head of water. Under a combined system, reservoirs of water would be formed at Hampstead, Highgate, Hornsey, and on the northern range of hills, and would be applied to properly flushing and cleansing out the sewers and drains in the lower divisions of the City, Holborn, Westminster, and the Tower Hamlets. In the Holborn and Finsbury division, the flushing plan is well carried out; but there is no reason why, by proper arrangements, the same facilities should not be generally and economically applied.

It is also very well known, that until a very late period, from want of a proper control on the part of the public, and from want of exertion on the part of the functionaries, the greater part of the sewers in the metropolis were constructed on improper principles, and in a wasteful and insufficient manner. This was particularly the case in the Westminster Commission of Sewers, and we believe we may claim some part of the merit—as having been to a considerable extent effected by our exertions—that the new sewers are being carried out in a manner, much more economical, much more efficient, and much more satisfactory. The present surveyor has done a great deal to lessen the expense by laying down oval sewers, and by giving sewers of a small size to courts and alleys he has extended the accommodation without increasing the outlay. Indeed, almost as much has been done as perhaps can be done, by the formation of small oval drains and the introduction of pipes, to make the construction of sewers as cheap as it can be,—so that our objections are not made on that ground. It is with regard to the proper direction of the sewers, and their proper application, that the greatest deficiencies are felt; and these are so serious, and have lasted so long, that we can place no confidence in the present system for their efficient and final remedy.

We have already said so much on these points (particularly in our Journal for 1843, vol. VI., p. 43), that we are almost disinclined to say any more,—except that being obliged to go over the same matter four years afterwards, and to contend with the same opponents, we cannot escape the repetition. Those who will refer to Vol. VI., p. 43, will find that we have gone as minutely into the subject as we can, and particularly in reference to Mr. Donaldson's defence of the Westminster Commission of Sewers; which, however, furnished us with ample evidence as to the defects of the present system, or rather want of system, and the necessity for its entire reform.

We cannot recapitulate all that we then said, but we may usefully avail ourselves of some of the evidence which we then adduced. We showed, on the authority of Mr. Donaldson, that in consequence of the want of unity of action, very large sums had been expended in rebuilding the main sewers and deepening the outlets. Thus, the Essex-street sewer, between 1816 and 1836, was lowered throughout a length of 5800 feet, or upwards of a mile. The eastern branch of the Hartshorn-lane sewer, likewise in the Westminster Commission, between 1831 and 1839 was lowered throughout a length of 4200 feet; and another branch of the same sewer, between 1820 and 1837, throughout a length of 2400 feet. The whole of the King-street sewer was, before 1832, lowered on a length of 1200 feet, and the Wood-street sewer, the College-street sewer, and the Horseferry-road sewer, were also lowered. Thus, in one division—the Westminster division—the great extent of 21,450 feet (or 4 miles) of new main sewer has been constructed. Of this we should not of itself complain, if the whole system were not faulty, and if, instead of merely rectifying old errors, the new works did not, as we have already shown, involve further errors.

The works on King's Scholars' Pond Sewer are so heavy and so extraordinary, that Mr. Donaldson and others look upon them with a great degree of pride, as involving the application of much skill and ingenuity to overcome the difficulties with which the surveyors had to contend. Thus, the driving of the new sewer, for 550 feet in length, and at a considerable depth, was carried on from withinside the sewer, and an inverted arch was constructed, and the old obstructions removed; the works being carried on under buildings, and having been considered impracticable by John Rennie, Jessop, Chapman, and others. In some parts of its course, this sewer was driven under courts narrower than itself, and frequently below the foundations of contiguous buildings, without inflicting injury upon them.

It is scarcely credible, that works so expensive and so difficult should have been undertaken without any adequate necessity; and yet such is the fact, for, as we have already shown, the Regent-street sewer is amply sufficient for the drainage of the district; and, by the use of it, the enlargement, or rather reconstruction, of the King's Scholars' Pond Sewer might have been avoided, and the drainage carried to a shorter and more effective outfall.

The works in the City of London Commission have been, to a great extent, of the same character as in the Westminster Commission, having been directed to the formation of new outfalls, not for their own drainage, but for that of the upland districts. Under a proper system, the expense of the outfalls would fall on the whole district, and the outfalls would be properly adapted to the extent of duty which they have to perform.

The Westminster Commission, among others, long persisted in the use of flat sides to their sewers, though frequent failures occurred in their application, and they were expensive and cumbrous in construction, while there was adequate experience that the oval form of sewer adopted in the Regent-street and Holborn divisions was of greater solidity, was less expensive, and better calculated to secure a quick drainage. Naturally, the great object in sewage is to get rid of noxious waters as quick as possible; not to keep them penned up, festering among the dwellings of the people, but to discharge them with the utmost speed. This, the Westminster form of sewer was not calculated to effect; while the oval form was perfectly competent, as the investigations in our Journal, and the subsequent adoption of our views, have fully proved.

A comparison of two classes of sewers, in the Westminster and Holborn divisions of sewers, under the old plan, will show how wasteful was the expenditure under the former system.

In these calculations, the cost of materials and labour being taken as the same in each case, at 1s. per foot reduced, or £13 12s. per rod of brickwork, and 1s. per cubic yard for digging, strutting, and filling-in or removing the surplus ground; the top of the sewer being taken as six feet below the surface of the ground.

Westminster first-class sewer: 17 feet brickwork, 17s.; 3⅓ yards digging, 3s. 4d.;—total . . . . . 20s. 4d.

Holborn and Finsbury first-class sewer: 12 feet brickwork, 12s.; 3 yards digging, 3s.;—total . . . 15s. 0d.

This shows a difference of 5s. 4d., or more than 30 per cent.

Westminster second-class sewer: 15 feet brickwork, 15s.; 3 yards digging, 3s.;—total . . . . 18s. 0d.
Holborn and Finsbury second-class sewer: 9 feet brickwork, 9s.; 2½ yards digging, 2s. 4d.;—total . . 11s. 4d.

This shows a difference of 6s. 8d., or between 50 and 60 per cent.

A Holborn first-class sewer used to cost less than a Westminster first or second class—being, in fact, 20 per cent. cheaper than the Westminster second-class sewers. It is, therefore, scarcely conceivable that the monstrous waste of money involved in carrying out the Westminster mode of construction should have been so long persevered in.

The worst feature, however, in the present administration of the sewage is, that it is virtually inaccessible to that class of houses which most require drainage; and it is no exaggeration to say, that the dwellings of the lower classes in London are left without drainage. Very expensive and very well constructed main sewers and secondary sewers are laid down, but so far from being applied to drain the dwellings, it is as much as they do to drain the surface of the streets and roads. This arises from the commissioners of sewers carrying their labours no further than the streets, leaving the householders to make the communications with the sewers.

We were going to say that the commissioners left the householders to make the communications at their own expense with the main sewers, but that would scarcely represent the true state of the case, for the fact is, that the householders can only make a communication by exposing themselves to heavy pains and penalties. The regulations of the commissioners in most districts require as much expense to be incurred in carrying a drain up to a house, as in laying a sewer in a small street, and the result is that sewer drainage is a luxury unattainable by many of the middle classes, and the majority of the mechanics and of the poorer classes.

A most expensive main sewer may run within a few yards of a house, but the outlay required for running a drain into it is so large, is so disproportioned to the necessity of the house, and so exorbitant in reference to the means of the landlord and the extent of the rental, that the idea of incurring such an expense is given up as hopeless. The consequence is that numbers of houses have cesspools, and in the closely crowded houses in the small courts and alleys, it may be taken as the general rule that there are no water closets, that fetid waters are kept on the premises, that noxious miasma is as it were hoarded up, and all the appliances of fever are held in readiness to tell with fatal effect among a population, whose careless and improvident habits readily predispose them to the attacks of infectious disease. For such a state of affairs, so fatal to the poorer classes and so dangerous to the wealthier, the commissioners of sewers must be held accountable; and no remedy can be considered effectual until such a system is adopted, as will make it incumbent on the officers of sewers to provide adequate drainage for every house, rich or poor, and give medical men and officers of health the efficient means of removing evils which they may deplore, but cannot prevent.

We have already stated in the pages of the Journal that the charge of the Westminster Commission of Sewers acted as prohibitory on fourth-rate houses within their jurisdiction, the charge being 10s. per foot. This charge of 10s. per foot is made on the length of the frontage of the house for permission to be allowed to enter one of the commissioners' sewers, built at the expense of the public; and if it be a corner house, the commissioners will not allow it to be drained at all into the sewer, although there is a public one within 12 feet of the house, and will compel the party to build a new sewer along the front of the house, and be at the expense of an expensive connection with the old sewer. The whole expense of forming this sewer and a drain for one fourth-rate house would cost at the least 15*l.* to 20*l.*, being 10 per cent. on the cost of the house, which might be done for about 2*l.*, if the commissioners would allow the house to be drained into the existing sewer. This is not a supposed case, but one which has actually occurred within the Westminister district, so that parties considered it their duty to construct cesspools to avoid an excessive outlay. By requiring each house to have separate drains, at whatever distance the house may be from the sewer, the charge of a heavy drain is seriously aggravated, whereas in many cases one drain would be sufficient for two or even for three houses. In fact, what is the difference between allowing such a practice, and running an inferior sewer up a small court into which many short drains are allowed to be made?

We wish some member of the House of Commons would move for a return of the length of all the sewers which have been built, rebuilt, or repaired at the expense of the public by the commission, their cost, and the actual number of houses on each side of the sewer which drain into it, and the number which do not, distinguishing courts; if we are not very much mistaken, this return alone would upset the present commission, and would show that these commissions do their utmost to obstruct the drainage of the metropolis, and consequently to injure the health of the inhabitants. What we contend for is, that if the commissioners are obliged to construct a sewer for public purposes, that all the houses on each side should be allowed to enter it, for, generally speaking, where the commissioners do build a sewer, it is through an old district which has been paying sewer rates for many years: for instance, a sewer has been built in High-street, St. Giles's, by the commissioners, and although the houses on each side have been paying rates these 50 or 60 years past, they are not allowed to drain into it, without paying a fine of ten shillings per foot frontage.

If the management of the sewage in the metropolis present such a state of affairs, what can be said of the paving boards? It is bad enough to have half-a-dozen commissions of sewers, each of which embraces a large borough or many parishes; but the paving boards in many cases have not even the jurisdiction of a parish or a borough, but some parishes are split up among a score paving boards, each separate estate having its own paving and lighting boards, its own set of commissioners, and its own set of officers to take charge of the paving, lighting and cleansing of a narrow confined district. The nuisance prevails to such an extent, and the want of organization is so strongly felt, that it is most extraordinary that it should have been submitted to so long. If Lord Morpeth should let the commissions of sewers alone—though we do not see why he should—there ought at any rate to be a consolidation of the paving boards, either into a central board or borough boards. At present, the City of London is the only district having a consolidated board, which is also that of the commissioners of sewers, and nothing has occurred in the working of that board to show its inferiority to the labours of the score or more boards, who mismanage the affairs of districts not greater in superficies, nor of more importance in extent of traffic.

It is stated, that besides the City of London Commission and the Regent-street Commission, there are no less than 84 different boards having the management of the paving in the metropolis. In the parish of St. Pancras alone there are no less than 16 different boards. In Kensington there are ten boards, in Lambeth there are seven boards, in Newington Butts six, in Whitechapel six, in Bermondsey five, in St. George's, Southwark, four, in St. Andrew's, Holborn, four, and in Shoreditch, four.

Some boards have only the management of the highways, some only of the lighting.

Altogether there is such a confusion that the commissioners themselves in some cases scarcely know what they are about.

Of course, each of these boards has it own commissioner, its own clerk, its own surveyor, and its own rates, and it is easy to determine what must be the consequences,—that while the ratepayers are overcharged for such an establishment, the officers are inadequately remunerated. Instead of liberal salaries being given to parties of competent abilities, miserable stipends are allotted to those who now discharge the offices, while the public are not thereby benefited.

That it is requisite to have eighty-six clerks to boards and their subordinates, we cannot conceive that any one will take the trouble to affirm; while their reduction would leave a well-paid staff, and effect a large saving.

The surveyors and assistants attached to eighty-six boards would, no doubt, be reduced in number, though perhaps not to such an extent as the clerks, while the re-appointments would secure a large and efficient body of officials, with a graduated scale of liberal salaries; giving a stimulus to merit, and holding out an adequate reward for long services.

We are sure that the surveyors of the City of London, of the Woods and Forests, and of St. Marylebone, are not worse paid than the surveyors of such petty districts as Ely Place, the Saffron Hill Liberty, Tothill Fields, the Brewer's Estate, the Lucas Estate, or the Harrison Estate.

Under the present state of affairs, it frequently happens that the commissioners of sewers or of paving are restricted in their powers of useful action, or imagine themselves to be so, and as the cost of amending a local act for a small district is considerable, they are often virtually debarred from the official discharge of their duties. This is one of the many circumstances consequent on their small and limited jurisdictions. Some of the commissioners of sewers consider that they are not empowered to do anything else but to repair old sewers,—all concur that they have no effective powers to make drains to houses, or to take necessary measures for the preservation of the public health.

There is nothing in the management of these paving boards, which can be considered at all favourable to their pretensions of fulfilling their duties. They are virtually irresponsible in the discharge of individual duties, and individuals are powerless against them; while being appointed by popular, and often by party election, they will take no measures, which by increasing the rates, may secure a better state of affairs, but endanger their tenure of office.

It is scarcely possible to walk down a main street without seeing the various tastes of these gentlemen exhibited in the shape of specimens of granite, macadam, wood, or asphalte, in every variety of form, often so badly constructed as to endanger the lives and limbs of passengers and cattle, and always in such a filthy condition as to be a serious and objectionable nuisance. By the dirty state of the streets and roads, the houses are bespattered with mud, and shopkeepers are deterred from adopting light and expensive paintings and decorations. The dust created is blown into the houses to the deterioration of books, linen, and furniture, and in the case of tradesmen, to the very considerable injury of their stock. As to passengers, in summer their eyes, mouths, and nostrils are filled with dried horse-dung under the name of dust, and in winter their clothes are spoiled by the accumulations of mud; whereas, under a proper system, it has been practically shown, there is no reason why even the most crowded thoroughfares should not be kept clean, summer and winter.

Upon the waste of manure which takes place in the metropolis, we will not dilate. It suffices that it is disgraceful to a practical country like this, that such large resources should be lost to our agriculture.

We must say, that if an amalgamation of commissioners is to take place, we can see no reason why it should not include the metropolitan roads and the county bridges, which should certainly not be separated from the jurisdiction of a competent authority.

We are free to admit, as we have already said, that it may be a matter of question how far Government control should extend, but we do not think, on a fair and impartial investigation, there can be any doubt that a consolidation should take place under one body of the jurisdictions for draining, paving, lighting, and cleansing the metropolis.

Whether that should be under a Government board, or whether under an elective board, we are not prepared to determine, though each would have its advantages and disadvantages.

A Government board would be virtually irresponsible, and would involve the disposal of a considerable amount of patronage, over which at the present time no effectual control could be devised.

An elective board might want unity, might court popularity by avoiding the discharge of disagreeable duties, and might dispose of its patronage if not for political purposes, at any rate for jobbing purposes.

Some of the evils of an elective board might be readily cured by making the election, not annual, but for a period of four years, thereby securing a certain degree of permanence of character in the board, and at the same time leaving each member at a proper period to answer to his constituents for the discharge of his duties. At present, the commissioners of sewers are irresponsible, and no Government board could be so bad in that respect.

An amalgamated board might be formed from representatives of each great division of the metropolis, those from the City of London being named by the corporation, and those from the large divisions, as St. Pancras and St. Marylebone, being named by the vestries. There could be no more difficulty in electing members of such an administrative and representative body than in electing guardians for poor-law boards, and we know of no objection to the adoption of such a course.

Under such circumstances, the distribution of patronage would be less obnoxious, and would most probably be faithfully complied with.

If such an elective board were formed, there should be no controlling power on the part of the crown, for that would destroy the energy and responsibility of the board without transferring it elsewhere. We should, however, be disposed to allow to the Crown a complete power of inspection, which for all practical and useful purposes would be quite as effective as control, and would bring the proceedings of the board within the cognisance of parliament.

At all events, whatever may be our views as to the parties with whom power should be intrusted, we have no doubt it is for the interest of the public, and for the interest of architects, engineers, and surveyors, that the general principles of Lord Morpeth's bill should be adopted and carried out.

THE ROYAL ITALIAN OPERA, COVENT GARDEN.

One of the most important architectural events of the season has been the reconstruction of Covent Garden Theatre, as the Royal Italian Opera. This has been executed under the direction of Mr. Benedict Albano, hitherto better known as an engineer, in which profession he has already acquired much reputation among us. The transition from flax-mills, steam boats, and railways, to an Opera-house, is a sudden, perhaps a violent one, but Mr. Albano has shown that in the fine arts and the useful arts he has equal powers of design and execution.

Covent Garden was previously known as one of our largest theatres, but it did not afford the extent of accommodation required by the new lessees, and Mr. Albano therefore laid before them three plans, one by which it would have been transformed into the largest theatre in the world, surpassing San Carlo and La Scala, a second smaller than those theatres, and a third which, though it gave additional tiers of private boxes, left the theatre of its original size. It is the second plan which has been adopted, though we wish, for Mr. Albano's sake and our own, he had been allowed to eclipse our foreign rivals, and redeem us from Byron's old reproach of inferiority to theatres which will each accommodate nearly 4000 persons.

The old Covent Garden Theatre, it will be remembered, was constructed by Sir Robert Smirke, after the fire in 1808. He, also, wished to have a larger theatre, but was overruled by John Kemble, who was fearful that if the theatre were larger nobody would be seen or heard. Sir Robert's object was therefore to construct the smallest possible interior or auditory within as large an available exterior as possible. His interior stood against fire and harm during the long theatrical generation of nearly forty years, but has succumbed at length, before the hand of Mr. Albano, to an unhappy fate, that of the destruction of works, which is likely to attend Sir Robert Smirke, as it has Sir John Soane. Sir Robert modelled his building, according to his statement, on the Parthenon at Athens, and the exterior possessed considerable merit.

We must now proceed to give what sketch we can of the building, though we cannot go into any detail, in consequence of our engravings not being complete for the present number, which prevents us from making the necessary references to illustrate our description.

It must be observed that the great design has been to convey the idea of grandeur and imposing magnitude, and this has been most skilfully carried out; while all that constructive skill could do, and all that attention to comfort demanded, has been completely effected.

The plan having been settled, Mr. Albano proceeded to pull down the whole interior of the audience part and parts adjoining, and to re-arrange it. He has thus been able to get an enormous auditory, and a grand range of saloons with suitable approaches.

In the grand front, beyond what we have already noticed, the chief alteration is the carrying of a carriage-way beneath the portico, whereby visitors are saved the annoyance of getting out of their carriages in the wet, and the street approaches are widened.

On entering by the grand front, a magnificent hall and staircase attract attention. These are decorated with columns painted in imitation of Sienna marble, and lighted from lofty bronze candelabra.

At the head of the staircase is a range of saloons level with the grand tier, and 130 feet in length. Preceding these is the Shakspeare room, with a statue of the poet; the next is the ante-room communicating with the saloon or crush-room, forming three compartments by means of Ionic columns, and with a quantity of large mirrors on the walls. As the walls are papered with green, the gilding produces an exceedingly good effect, while comfort and luxury are consulted in the ottomans and couches.

On entering the theatre, it is seen that its dimensions are on a very large scale, as to height and breadth. The breadth between the boxes, 60 feet diameter, is particularly striking, and also the extreme height of the house. The pit has been sunk, and the tiers of boxes now rise six in number, forming a colossal amphitheatre of unaccustomed proportions.

The dimensions of the house are 80 feet from the curtain to the front of the boxes, and 60 feet in breadth between the boxes, and the width across the stage between the columns of the proscenium 46 feet.

The ceiling is one of the attractions. Its dimensions are 70 feet by 62 feet. From the centre depends the enormous chandelier, one of the largest in England, and which is almost the only source of light to the house. It consists of several rings of light, and twelve clusters of twenty to five-and-twenty jets, producing the most brilliant light, while the reflection and polarization of the drops and pendants increase the picturesque effect. The ceiling itself represents the sky, and is of peculiar form, partly elliptic and partly hyperbolic, so as to be in conformity with acoustic principles. It is also coved all round. We may note, too, that the proscenium forms a splayed arch, so as to throw the voice into the centre of the house. All that could be done to make the house a good hearing house has been effected.

The ceiling is in keeping with the decorations of the house, of which the leading colours are white and gold, here and there set off with a slight turquoise blue. The relieved ornaments are all in the cannabic composition, which admits of the gilding being highly burnished. The whole effect of the decorations is chaste and picturesque, while, by the boldness of the proportions, grandeur is preserved.

We may note that the ventilation has been the subject of the special care of the architect, and in which he seems to have attained much success.

The approaches to the house have all been re-arranged, separate entrances being provided to the royal boxes, to the boxes and stalls, to the pit, and to the gallery, with fire-proof staircases. The details in every part are also so arranged as to give the greatest comfort, and to enable a large audience conveniently to sit through a long performance, as well as to hear perfectly. This is really as great an advantage to the actor as to the hearer, as, without it, due attention cannot be paid to any representation, however skilful.

While we cannot withhold our testimony to the solidity of the construction, having inspected it in detail, we are bound also to notice the rapidity with which the alterations were completed, the old interior having been pulled down, and the new one erected from the foundations, within four months. This is a great feat, performed by Mr. Albano; and we must state that great credit is due to Mr. Holland, the builder, and Mr. Ponsonby, the decorator, for the rapid manner they have executed the work. The brilliancy of the gas also, it is to be observed, is due to the use of Mr. Low's patent for napthalizing t.

STATE AND PROSPECTS OF FRENCH RAILWAYS.*

One of the greatest advances that has yet taken place in the progress of European civilisation is slowly but surely approaching in the comprehensive system of railways in course of construction in France. The object of the following review is rather to glance rapidly at the present position of French railways than to dwell at any length on the reflections that naturally present themselves on entering into the consideration of such a subject.

Paris to Rouen.—The first line that comes under our notice is that from Paris to Rouen, opened for traffic on 1st May, 1843, being the first of the French railways, in chronological order, which was completed to the north of Paris. It is eighty-four English miles in length, and was constructed from the plans of Mr. Locke, the engineer of the South Western Railway. The present net returns are about 8 per cent. on the capital, and the receipts which were 8,832*l.* from passenger traffic, and 3,722*l.* from goods traffic in January, 1844, were respectively 10,038*l.*, and 14,693*l.* in the same month of the present year. The extension of this railway, 57 miles in length, from *Rouen to Havre*, is completed, and opened last month: it has occupied a long time in construction, from the numerous works of art necessitated by the uneven character of the country through which it runs: among others, six important viaducts, one of which—that at Barentin—fell down shortly after it was completed, about fourteen months ago, and has since been rebuilt. There is also a bridge over the Seine, at Rouen, about 1.200 feet long. This line will complete the railway communication between Paris and Havre, which is the port of the capital, as far as its maritime trade with countries out of Europe is concerned, and where it will communicate directly with extensive docks now building. The terminus of the Rouen railway, at Paris, in common with that of the short lines from Paris to St. Germains, and to Versailles, by the right bank of the Seine, opened in 1837 and 1839 respectively. In 1840 another railway was completed to Versailles by the left bank of the Seine. Neither has proved very profitable; but it has been proposed for the two companies to amalgamate, and from a joint station at Versailles, to extend their lines to Chartres, Rennes, and Britanny.

Paris to Orleans.—Going westward, the next line we meet is that from Paris to Orleans, completed at the same time as that from Paris to Rouen, in 1843. The length of this line, including a branch to Corbeil, is 93 miles; the share capital 1,600,000*l.*, and the net returns about 10 per cent. It not only unites Paris with the flourishing city of Orleans, but also is extended thence in several directions; 1st, by the Orleans, Tours, and Bordeaux Railway, 300 miles long, now in progress throughout, and already opened from Orleans to Tours, a distance of 69 miles; 2nd, by the Tours and Nantes Railway, a branch from this to the principal centre of commerce on the west coast of France, 120 miles in length, the works of which are in a very forward state for about 65 miles, from Tours to Angers; 3rd, by the central railway from Orleans to Vierzon, Bourges, and Châteauroux. From Orleans to Bourges by Vierzon, a distance of 70 miles is completed, and may be opened for traffic as soon as a bridge over the Loire at Orleans is finished. As the construction of such a bridge will require a considerable time, a temporary bridge is about to be thrown over to connect the two railways in the interim.

Paris to the Mediterranean.—The next grand trunk line leaving Paris is that to the Mediterranean, the first section of which, from Paris to Lyons, will be about 300 miles in length. It is in progress throughout, but will not be completed until 1849 at the earliest. About 45 miles from Dijon to Chalons, situated half-way between the two extremities of the line, are nearly completed, and might be opened in the course of the present year. From Lyons there are railways already open to St. Etienne, Andredieux, and Roanne, remarkable as being the first lines of any length completed in France. The total length is about 90 miles, and these afford communication between the valleys of the Rhone and Loire, and pass through the Loire coal fields. The great line to the Mediterranean is continued from Lyons through Avignon to Marseilles; that part from Lyons to Avignon, 195 miles in length, including a branch to Grenoble, is not yet begun, although in the hands of a company; from Avignon to Marseilles, 65 miles in length, is nearly finished, and will probably be opened in the present year. A railway, which will branch from this at Tarascon, and runs to Nimes, Montpellier, and Cette, a rising port on the Mediterranean, with a branch to the mineral district about Alais, is finished, as also a small line in the neighbourhood of Bordeaux. A junction railway from Bordeaux to Cette through Toulouse has been proposed, and a company has been formed to construct it.

Paris to Strasburg.—A company has also taken the railway from Paris to Strasburg, the length of which, including branches to Rheims and to Metz and the Prussian frontier, is nearly three hundred and sixty miles. The works are in rapid progress, and a tunnel under the Vosges, 2,800 yards in length, completed. The greater part of the line will be finished in 1848, and the rest in 1849, with the exception of the section from St. Dizier to Nancy, which cannot be completed before 1850. A line from Strasburg to Bâle, the total length of which, including the branch from Mulhouse to Thann, is 95 miles, was opened in the summer of 1841; it has not enjoyed much traffic, and cannot until extended from Strasburg to the more important towns on the lower part of the Rhine. In the district enclosed between the Paris and Lyons and Paris and Strasburg railways, one railway is in progress, viz., a branch from the former line to Troyes, and another is proposed from Dijon to Mulhouse, uniting the two. One from St. Dizier to Gray, the point where the Saône becomes navigable, has also been spoken of.

The Northern Line from Paris.—The next line we arrive at, pursuing our course round the French territory, is the Northern line from Paris through Amiens and Arras to Douay, where the railway is continued in two directions, one branch proceeding through Lille to the Belgian frontier, where it meets the Belgian state line from Ghent, and the other reaching the frontier *via* Valenciennes, whence it is continued by the Belgian government line to Brussels. The total length is 204 miles, and the railway was opened throughout on the 20th June last. Branches from Criel (on the main line) to St. Quentin, and from Lille to Dunkirk and Calais are in progress. This line is of great importance, as connecting Paris with Belgium, Holland, and the North of Europe, and of still greater from the fact that 90 miles of it, as far as Amiens, form part of the approaching railway communication between London and Paris. The rest of the railway from Amiens to Boulogne, 75 miles in length, is in a very advanced state, and will be completed in less than a year. 28 miles from Amiens to Abbeville have been finished for some months past, and are expected to be opened for traffic in the course of next month. When this is accomplished the journey between London and Paris will be comfortably made in 17 hours; and in 12 hours when the railway is open to Boulogne. To complete our survey of French railways, we have only now to notice the branches from Rouen and Havre Railway to Dieppe and Fecamp, for the construction of which a company has been organised.

The hasty enumeration we have made of the various French railways completed, in progress, or undertaken by companies who have already obtained their acts, appear sufficient to justify the assertion, that when finished, they will not only furnish ready communication between Paris and the various centres of population and industry throughout the French territory, but also with the adjacent countries; and likewise afford great facilities on several lines of transit which already enjoy considerable traffic, both in passengers and goods, and some of which are indeed the high roads of Europe: such as those from London to Switzerland, the Mediterranean, or Spain, through Paris, from the United States to Switzerland, *via* Havre (a route taken by a large amount of goods-traffic), &c.

Little remains to be said in addition to this almost tabular view of the French system of railways; but it would be incomplete without a few remarks on the railway legislation of France. All the French railways, with one or two exceptions, are only conceded to the companies who have undertaken their construction, for a term of years, so that the companies have to provide for the reimbursement of the capital at the expiration of the lease by means of a sinking-fund, varying according to the length to which it extends. The railways from Paris to Rouen and to Orleans were conceded directly to the companies for terms of 99 years; and that from Rouen to Havre for 97; their agreements with the government having been afterwards submitted to the Chambers for ratification. After 1842 the government began to work on its own account on several of the great lines of rail-

* This interesting document lately appeared in the "Daily News."

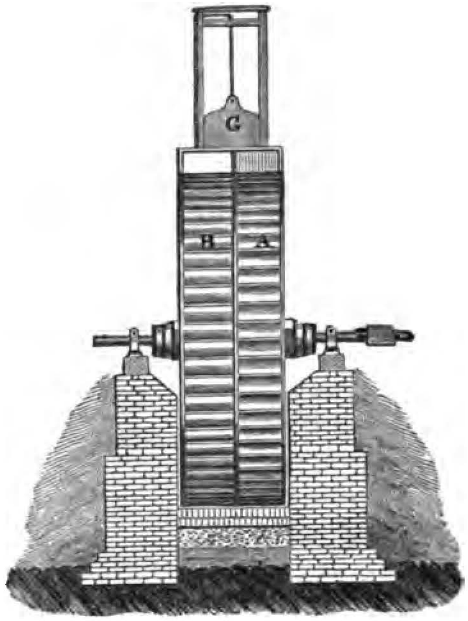
way, the exact directions to be taken by which were settled by the Chambers in that year; and since that period, the greater part of the new lines have been put up to auction, and conceded to the company offering the greatest reduction on a maximum term of concession fixed by the Chambers. For some, the government has been reimbursed by the companies for any outlay expended on the line conceded to them; for others, it continues to pay all the expenses of the earth work, leaving the company only to provide the rails and working stock—the length of lease of course varying, as one or other of these alternatives has been adopted. Among the lines in the latter position, are those from Orleans to Bordeaux, from Orleans to Vierzon, from Tours to Nantes, from Avignon to Marseilles, and from Paris to Strasburg; and in the former, are the Northern Railway, those from Boulogne to Amiens, from Paris to Lyons, and several other important undertakings. The length of the leases has varied much, according to the time at which the concession took place. The Boulogne and Amiens Railway, conceded in October 1844, before the excitement of 1845, was taken for 99 years, although of great value, as commanding the traffic between London and Paris; the Northern Railway, taken during the heat of that excitement, and the great advantages of which had been greatly exaggerated, has only a lease of 38 years; the Paris and Lyons, taken subsequently, has one of 41. The Lyons and Avignon is conceded for 45 years, the Bordeaux and Cette for 66. Among the lines, part of the outlay for which is borne by the government, that from Avignon to Marseilles has a lease of 33 years, during which it is calculated it will produce 10 per cent. per annum to the shareholders, while the less lucrative line from Orleans to Bourdeaux has only one of 28 years. The Paris and Strasburg Railway is conceded for 44 years, and that from Tours to Nantes for 34. By their acts, the various railway companies have a certain maximum tariff imposed upon them, under which they may make any alteration, but which they cannot exceed. These rates are 1·66d. per mile for a first-class passenger; 1·24d. for a second-class; and 0·91d. for a third-class passenger. For goods, the maximum rates allowed vary on each line, and are generally much higher than those actually charged on lines already at work. French railway legislation is confused, and, in many instances, faulty; while no one can now be blind to the evils of reckless competition, induced by the system of putting the leases of railways up to auction. On the other hand, the absence of parliamentary expenses, and the recognition of the principle that the first thing when a railway is to be made in any particular district is to get a decision from the Chambers respecting the exact route to be taken by it, so that no surveys need be undertaken by the company until this is determined upon, contrast favourably with the course of proceedure adopted in this country. On the whole, however, many of the strictures on the French system of railway legislation made by Mr. David Salomons in the lucid and interesting comparison between that system and the one pursued in this country, contained in his recent pamphlet, will be found to be correct. We have now entered into all the details it was our intention to touch at in the course of this brief investigation, but the whole subject will be probably rendered clear by a tabular view of the share capital of the various French railway companies, which we subjoin:—

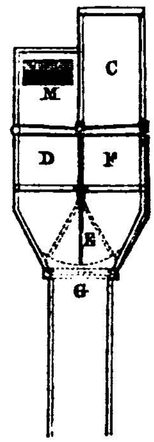
Name of line.	Paid-up capital.	Capital not called.	Total share capital.
Andrésieux and Roanne ..	..	..	..
Avignon and Marseilles ..	£ 800,000	..	£ 800,000
Bourdeaux and Cette ..	1,120,000	£4,480,000	5,600,000
———— Teste ..	200,000	..	200,000
Boulogne and Amiens ..	1,350,000	150,000	1,500,000
Central line	660,000	660,000	1,320,000
Dieppe and Fécamp ..	288,000	432,000	720,000
Grand, Combe ..	640,000	..	640,000
Lyons and Avignon ..	1,200.000	4,800,000	6,000,000
Monterean and Troyes ..	560,000	240,000	800,000
Montpellier and Cette ..	120,000	..	120,000
Mulhouse and Thann ..	104,000	..	104,000
Northern of France ..	3,200,000	4,800,000	8,000,000
Orleans and Bordeaux ..	780,000	1,820,000	2,600,000
Paris and Lyons ..	3,200,000	4,800,000	8,000,000
———— Orleans ..	1,600,000	..	1,600,000
———— Rouen ..	1,440,000	..	1,440,000
———— Sceaux ..	120,000	..	120,000
———— Strasburg ..	1,250,000	3,750,000	5,000,000
Tours and Nantes ..	400,000	1,200,000	1,600,000
St. Germain	360,000	..	360,000
Strasburg and Basle ..	1,176,000	504,000	1,680,000
Versailles (Right Bank) ..	440,000	..	440,000
———— (Left Bank) ..	400,000	..	400,000
Total ..	£21,408,000	£27,636,000	£49,044,000

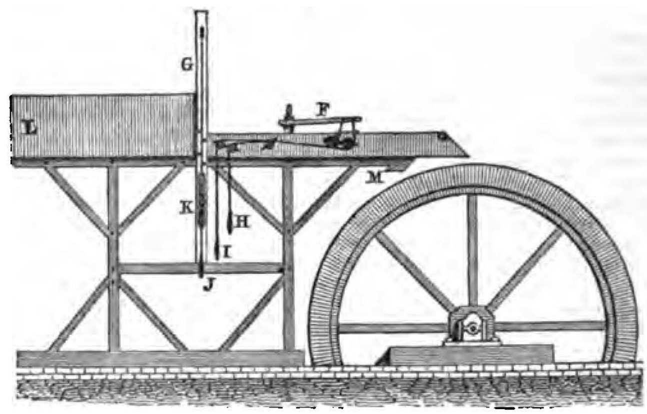
Or a little more than 49,000,000*l.* Besides which, the several companies have raised by loan about 2,400,000*l.*

RICHARDSON'S REVERSING WATER-WHEEL.

This wheel is designed for the purpose of raising slate from the Coombe Valley Quarry, and is proposed to do the work of a steam engine, without its attendant expenses—the chief object being to throw all its available power into direct action, without the intervention of gear-work. Its projector, Mr. Richardson, says, that to cause rotary machinery to reverse, it is usual to introduce bevelled gear—all gear-work creates friction—friction loss of power, waste of time, and money. To save time is the great desideratum in conducting the works of a public company; for if this important point is neglected, the profits expected to be derived can never be realised.







The following description will explain the method of its working:—A and B represent a front elevation of the wheel; the buckets on the side A, are placed in an inverse direction to those on the side B; C, is an over-shot launder, or water-course, flowing on to B; D, a backshot launder, conducting the water on to A, which acts in a reverse manner to that of B; E, a reversing gate, hung on a centre, and having a hollow quoin, similar to a common navigation lock-gate. F, a lever, attached to the axle of the gate, E, which, with its connecting pulleys, H and I, is made to turn the water alternately off and on to the overshot and backshot launders, C, and D; G, the stopgate. H, the overshot pulley; I, the backshot pulley. J, the stopgate pulley, having a graduating plate, K, attached for the purpose of regulating the feed. L, feed-head, or reservoir. M, the water way of backshot launder, D: when the wheel is set in motion, the lever F, is pulled over, and the gate G, raised; the water then flows on to the overshot section B. On the signal being given to stop, the gate G, is shut down; and the water in the launder C, is just sufficient to drive the wheel half a revolution, when it stops for want of its propelling power. On the signal being given to start in a reverse direction, the lever F, is pulled over; and on the gate G, being raised, the water flows on to the backshot section A, and thus alternately. Thus, nearly the whole of the gravitating force of the water is applied in a direct manner, and must save, independent of the cost of construction, and liability of breakage in gear-work, a great amount of power, which, where water is scarce, is a considerable advantage.—*Mining Journal.*

REGISTER OF NEW PATENTS.

GAS IMPROVEMENTS.

GEORGE LOWE, of Finsbury Circus, civil engineer, for "*Improvements in the manufacture of, and in burning gas, and in the manufacture of fuel.*" Granted October 8, 1846; Enrolled April 8, 1847.—(Reported in the *Patent Journal.*)

This invention relates firstly, to preparing peat in combination with resin, pitch, oil, fat, or other hydro-carbonaceous matter, and making gas therefrom; secondly, to a mode of arranging apparatus for purifying gas; thirdly, to improvements in making gas from coal and other matters rich in carbon, by introducing steam highly heated into the retorts used for that purpose; fourthly, to improvements in Argand gas-burners, whereby the gallery or apparatus for supporting the chimney is made to rise on a screw, so as to adjust the admission of the air to the flame; and fifthly, to certain means of manufacturing fuel from peat by causing dry blocks of peat to be saturated with pitch or other hydro-carbonaceous matter: the peat being prepared and dried, is piled in a square iron vessel, about eighteen inches deep, till within two or three inches of the top; a quantity of resin, tar, or other hydro-carbonaceous matter, highly heated, is run into the vessel till the peat is entirely covered; heat is also applied to the bottom of this vessel, in which the peat is kept for about an hour, in order to induce the hydro-carbonaceous matter to enter the peat; it is then run off, and the cakes of peat thus saturated are placed on shelves or racks, and allowed to drain the unabsorbed matter from the surface thereof. A method which the patentee considers preferable to the foregoing is, instead of placing the dry peat in an open vessel, he introduces it into a close vessel, similar to that used in the well-known method of treating wood in which he forms a vacuum by steam or otherwise, and then allows the heated matter to run in, and afterwards forcing it in with considerable pressure; the peat is permitted to remain in this state for about half an hour, when it may be withdrawn, the unabsorbed matter being drained from the surface as before. Where tar is used the patentee prefers mixing with it about from five to ten per cent. of quicklime in a state of powder.

The second part relates to an apparatus for purifying gas, and which consists of two chambers placed one above the other, filled with coke, through which the gas passes, in a similar manner to that which is known as the scrubber: the chambers containing the coke are divided by a space containing an apparatus for distributing a weak ammoniacal liquor on the coke contained in the lower chamber; this apparatus, which forms the novelty of the invention, consists of two or more arms, placed on an axis, on which it revolves horizontally, each arm being perforated with a number of holes on one side, at different distances from the centre or axis; the holes in one arm being on a different side to that of the other, any liquid being allowed to pass into it causes it to rotate, and thereby distribute the liquor over the coke. The principle of this will at once be recognised to be the same as Barker's mill, and will be readily understood. The upper chamber is furnished with a similar apparatus, which supplies it with water, or water slightly acidulated with muriatic or sulphuric acids, in a similar manner to the other; the weak ammoniacal water, or acidulated water, are contained in reservoirs above the chambers, the fall propelling this apparatus as before described. The coke in the upper and lower chambers is sustained on gratings, allowing the gas to pass freely through, which enters from the condenser by a pipe at the bottom, and passing through the chambers of coke, escapes from the upper chamber, partially freed from ammonia. This operation may either be conducted before or after the usual process of purifying gas, but he prefers that it should take place after that process.

The third improvement, for the method of introducing highly-heated steam to retorts during the production of gas or other matters, rich in carbon, is as follows:—Steam being generated in a suitable boiler, is allowed to flow freely into the retort, at a point furthest distant from that at which the gas escapes; the steam in its passage from the generator to the retort is passed through pipes, heated to a great degree, in a similar manner to that employed for obtaining the hot blast, used for smelting iron and other purposes; it is well known that this method of heating steam does not materially interfere with the pressure at which it may be generated, and which should not be greater than that at which the gas is produced, as it would cause too great a flow into the retort, neither should it be allowed to flow during the whole time of one charge, and, therefore, the pipes must be furnished with suitable stop-cocks, and each retort furnished with a gas-burner, so as to enable the workmen to judge when the jet of steam should be discontinued, which will be when the gas begins to lose colour, the regulation being easily acquired by a little experience.

The fourth improvement consists in constructing the gallery which carries the chimney, so that it shall be adjustable, in order to regulate from time to time the height of the point at which the air supplied for combustion shall be made to impinge on the exterior of the flame: the method shown in the drawings attached to the specification, is by cutting a screw on the inside ring of the gallery, and on the outside of the burners; it will, therefore be apparent that on turning the gallery round it will either raise or lower it, and at the same time the contracted part of which for deflecting the air will either be brought nearer to or farther from the jet of the burner, according to that which may be considered the best position, and will be regulated in some measure by the extent of flame required; when the air is deflected by a cone inside the chimney, it is attached to the gallery and moves up and down with it; other means besides the screw may be employed for raising and lowering the gallery, and thereby regulating the admission of air as before explained.

Fifth and lastly, this invention relates to the treating of dry peat and hydro-carbonaceous matter for fuel, in the same way as that described under the first head of this specification. Having described the nature of his invention, and that which he considers the best means of carrying the same into effect, he wishes it to be understood that he does not confine himself to the precise details herein described, so long as the principle of either part of his invention be retained; but what he claims is—first, the mode of treating blocks of dried peat for the manufacture of gas by placing them in an open vessel and immersing them in highly-heated resin, pitch, oil, fat, or other hydro-carbonaceous matter, and also the saturating blocks of dry peat, by placing them in closed vessels. Second, the application of revolving perforated pipes to distribute the purifying liquor in apparatus, such as before described. Third, the application of highly-heated steam introduced into retorts when making gas from coal or other matters. Fourth, adjusting the admission of air to the outer flame of Argand burners by means of a screw or otherwise. Fifth and lastly, the saturating blocks of dry peat, for the purposes of fuel, with resin, pitch, oil, fat, or other hydro-carbonaceous matter, by means of an open vessel and heat, and also by means of a closed vessel, as hereinbefore described.

GUN COTTON.

JOHN TAYLOR, of the Adelphi, gentleman, for "*Improvements in the manufacture of explosive compounds.*"—Granted October 8, 1846; Enrolled April 8, 1847. (A communication.)

This improvement relates to manufacturing an explosive substance, by the application of nitric acid or nitric and sulphuric acids to vegetable matters. The specification describes the converting of cotton into an explosive substance, as the patentee considers cotton the most available substance.

In preparing cotton, take nitric acid of sp. gr. from 1·45 to 1·50, and sulphuric acid of sp. gr. 1·85, and mix the acids in the proportions of three parts sulphuric acid, and one part nitric acid; they are then allowed to cool down to between 50° and 60° Fah. and then rough cotton, previously freed from all extraneous matters, is to be immersed in the mixed acids, in a suitable vessel of glazed earthenware, in as open a state as possible, occassionally stirring it with a glass rod; the excess of acid is to be drawn or poured off, and the cotton pressed with an earthen presser, lightly, so as to separate the principal part of the acid. The cotton is then covered and allowed to remain for one hour; it is then pressed, and thoroughly washed in running water, to divest it from all free acid until it does not in the least affect litmus-paper; afterwards it is to be partially dried by pressure, and to insure its freedom from free acid, it is to be washed in a dilute solution of carbonate of potass, made by dissolving one ounce of carbonate of potass in a gallon of water, and put under a press, and the excess of carbonate of potass solution pressed out, which at the same time renders the cotton nearly dry. It is then washed in a solution consisting of one ounce of pure nitrate of potass in a gallon of water, pressed and dried in a stove or room heated by steam or hot water to the temperature of from 150° to 170° Fah. The nitrate of potass seems to increase the explosive force of the cotton, but it is not absolutely necessary. In using cotton prepared as above, it must be borne in mind that to produce the same effect, much less must be used than of gunpowder, that is, in about the proportion of three parts of the prepared cotton to eight parts of Tower proof gunpowder.

Explosive cotton may be prepared by using nitric acid only, but the patentee prefers using the above mixture of nitric and sulphuric acids. In using cotton prepared as above for the purpose of propulsion, as it is of a fibrous nature, it may be rammed at once into the gun, or if made slightly moist and pressed into a mould, it will, when dry, retain its form, and thus may be made into cartridges.

The patentee does not confine himself to the specific gravity of the acids above mentioned, neither to the exact process herein described, but what he claims is, the converting vegetable matters into explosive substance by means of nitric acid.

FILTERING APPARATUS FOR STEAM ENGINES.

Nicholas Harvey, of the Hayle Foundry, Cornwall, engineer, for "*Improvements in filtering of water for steam engines and boilers.*"—Granted September 3, 1846; Enrolled March 3, 1847.

These improvements relate to the introduction of a filterer in connection with steam engines and boilers, for the purpose of preventing incrustation, by packing in a vessel *a*, compressed sponge *b*, or other filtering medium, between two perforated plates *c*, as shown in the annexed figures. The supply of water is forced through the sponge by the action of force pumps, and during the passage of the water, the mud or sediment is deposited in the vessel *f*, from which it is occasionally removed.

Fig. 1, is a vertical section of the apparatus, *a* is a cylindrical case, *b* the sponge or filtering medium compressed between two perforated plates *c*, the pressure on the top plate being regulated by the weights *d*; the sediment is deposited on the funnel-shaped diaphragm *e*, and then passes through the aperture in the bottom into the vessel *f*; at the top of the vessel is a funnel *g*, with a cock for the purpose of introducing water to cleanse the sponge or filtering medium; *h* is the feed pipe for supplying the filterer with water, and *i* the feed pipe to the boiler; *j* is a pipe for drawing off the sediment from the vessel *f*.

Fig. 2, shows the apparatus connected with the hot well, and is similar in principle to fig. 1.

Fig. 1.

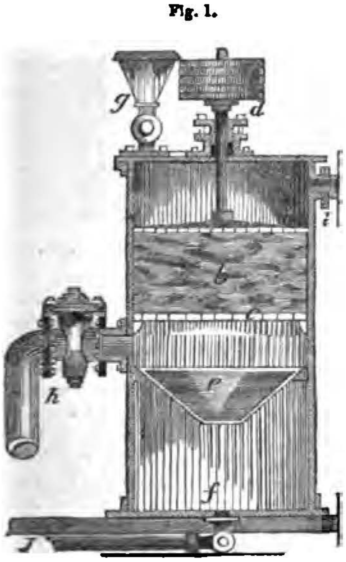
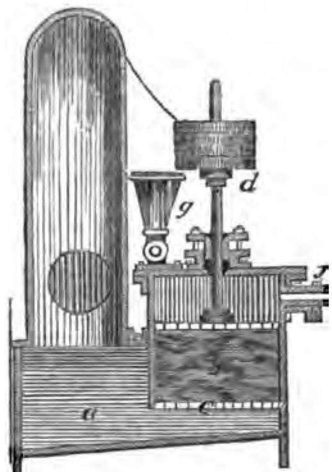


Fig. 2.



FLATTENING GLASS KILNS.

Henry Deacon, engineer, of Eccleston, Lancashire, for "*Improvements in the construction of flattening kilns.*"—Granted September 26, 1840; Enrolled March 26, 1847.

These improvements relate first to the introduction of a moveable bridge, or partition to close the aperture between the flattening kiln and the piling kiln, used in the manufacturing of glass, and in the application and arrangement of wheels and rails to the floors of the kilns, and to the flattening stone. The bridge is similar to those generally adopted by iron masters, engineers, and smiths, for furnace doors, by constructing a frame of wrought or cast iron, to cover the opening between the kilns; this is filled full of fire-bricks, and suspended from the end of a rod passing through the roof of the kiln, and attached to the end of a chain, which after passing over pulleys, has a counter-balance weight attached to it, in a position for the workmen to open or close the communication between the kilns.

The patentee states that this moveable bridge is very useful in bending glass for tiles, or for roofs of conservatories, &c. The mode of manufacture is as follows: having placed the mould on which the glass is to be bent on the flattening stone, the glass is inserted through the push hole, where, after it is properly heated, it becomes the shape of the mould; the communication between the kilns is opened by raising the bridge or partition, and the mould is pushed back into the piling kiln, where it is removed from the mould by suitable instruments used for that purpose, and may be piled there, either on its edge or on its side; the bridge is then closed, and the operation of preparing another article is commenced as before.

The second improvement relates to building in the floor of the spreading and piling kilns, and furnishing the spreading stone with suitable rails, to run thereon. The wheels employed for this purpose are of cast iron, about 17 inches diameter, by an inch broad in the rim; they are built in the floors of the kilns in two rows, each row about two thirds the breadth of the spreading stone from the other, and the wheels from centre to centre, at a distance in proportion to the length of the stone; the floor is built close up to the sides of the wheels, till nearly on a level with the periphery; any dust or broken glass falling down into a chamber below, from whence it may be drawn by suitable instruments. The rails on which the spreading stone is supported is straight along the lower edge, or that which comes in contact with the wheels; the upper edge has several raised clipping pieces which are reduced until the stone is fairly bedded thereon; and furnished with lugs at either end to embrace the stone and keep it in a proper position with the rails. One of the rails is furnished with a groove in the direction of its length rather wider than the periphery of the wheels, which guides the carriage as it traverses backwards and forwards on the circumference of the wheels, from the spreading or flatting kilns, to the annealing or piling kilns.

TUBULAR BRIDGES.

William Fairbairn, of Manchester, civil engineer, for "*Improvements in the construction of iron beams for the erection of bridges and other structures.*"—Granted October 8, 1846; Enrolled April 8, 1847.

Fig. 1.

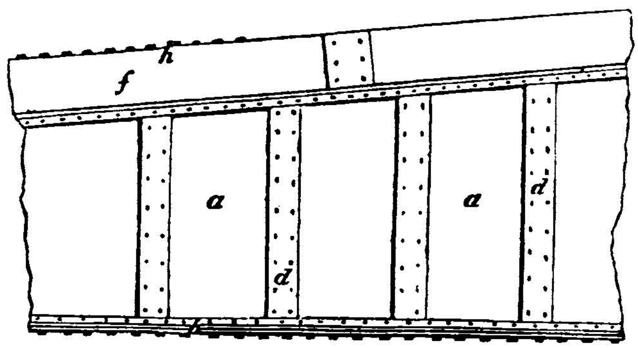
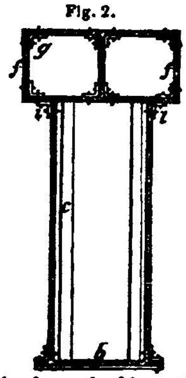


Fig. 2.



These improvements relate to the construction of iron beams or girders, for bridges and other structures, by the use of plates of metal united by rivets and angle iron. Fig. 1, is a side elevation of part of a hollow iron beam, or girder; and fig. 2, a transverse section,—*a*, side plates; *b*, bottom plates; *c*, *c*, interior vertical angle or T iron for connecting the plates, *a*, *a*, with the covering plates, or styles, *d*, and rivets. The side plates are to be put together with butt joints, and rivetted in a similar manner to boiler making. The top of this hollow beam is formed of two or more rectangular cells, composed of plates *f*, and angle iron *g*, fastened by rivets, and attached to the side plates *a*, by the angle iron *i*. The bottom of the hollow beam or girder is formed of iron plates *b*, fastened by means of covering plates over the cross joints, and rivets attached to the side plates by angle iron. The top of the hollow beam, or girder, may be constructed of cast or malleable iron, either cellular rectangular, as shown in fig. 2, or of an elliptical or any other suitable form, to prevent the top giving way, or puckering from compression; or other methods may be employed, such as thick metallic casting, or lighter iron plates, arranged so as to form hollow cells. The bottom of the hollow beam or girder may be also constructed of a series of plates, *b*, either of single or double thickness, rivetted together; the plates are united to each other by alternating or breaking joint, and by a peculiar mode of riveting, called by the inventor chain-riveting, as it forms an entire chain of plates throughout; and the structure so unites the covering plates over the joints as not to weaken or otherwise injure the plates by rows of transverse rivet holes, but to form a connecting link to each joint, by a series of longitudinal rivets or pins. The drawings attached to the specification show various forms of girders to render them applicable to factories, warehouses, dwelling-houses, &c.

IMPROVED WATER CLOSETS.

JOSEPH BUNNETT, of Deptford, Kent, engineer, for "*Improvements in water closets, part of which improvements is applicable to other useful purposes.*" Granted April 15; Enrolled Oct. 15, 1846.

Fig. 1

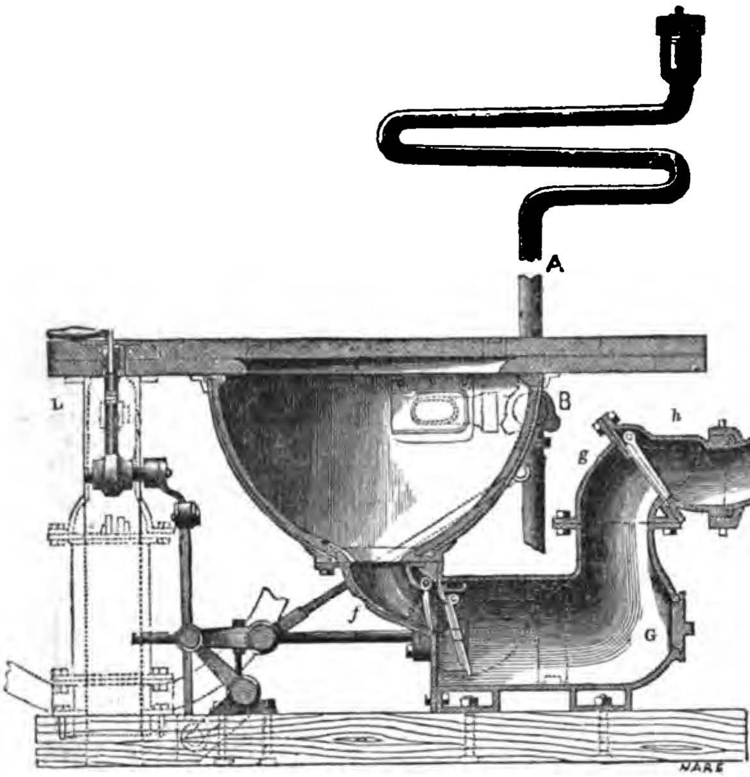


Fig. 2.

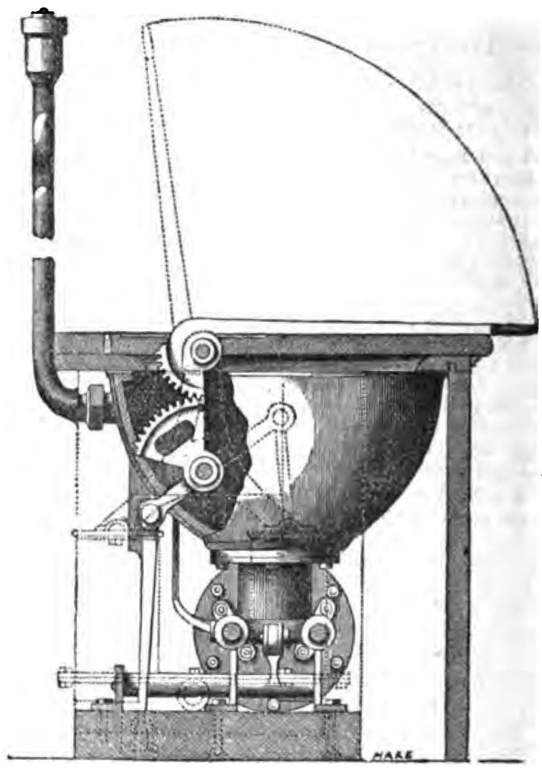
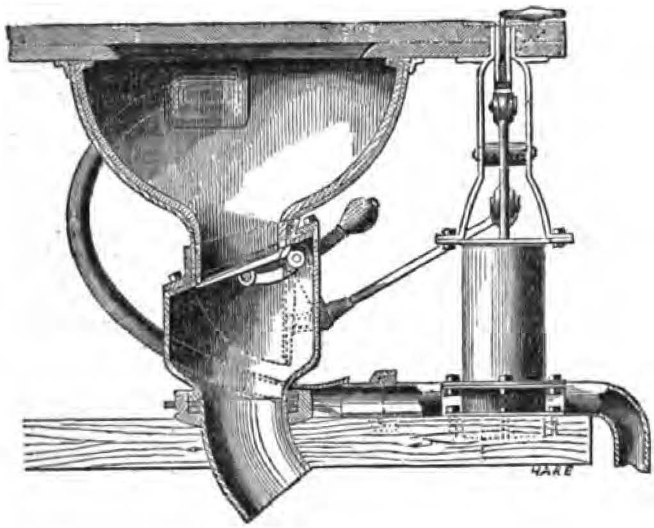


Fig. 3.



This invention relates to an improved form of water closet, for shipping, and which is also applicable for dwelling-houses, where the sewer or outlet may be *above* the water closet. Fig. 1 is a section, and fig. 2 a side view, of a water closet with the improvements. The basin is supported upon a flanged elbow piece *f*, and bolted to a horizontal pump or piston barrel G, terminating in a delivery piece *g*. Within the elbow piece *f*, there is a valve, opening towards the piston barrel, which valve is fitted and dropped into its place upon a seating, as shown in the drawing, previously to the basin being fixed. Within the piston barrel G, there is a piston, furnished with a valve, opening towards the delivery end of the barrel; this piston is worked by two horizontal piston-rods, passing through stuffing-boxes,—only one is seen in fig. 1, but the ends of both are shown in fig. 2. On the upper part of the delivery piece *g*, there is a valve, opening outwards towards the second delivery piece *h*, upon which an union screw is cut, for the attachment of a soil pipe, which may be taken to the most convenient point (either above or below the water-line), for delivering the matters ejected by the piston. L is the handle, working through a slot in the seat of the closet, by which the action of the closet is effected, through levers and connecting rods, working the horizontal piston-rods, and also for giving motion to a rod which opens and closes the cock B; this cock communicates with the water on the outside of the ship by a pipe on its under side, and with a reservoir or cistern pipe (A) above, and also with the basin of the closet. On raising the handle L, motion is given to the cranked levers, which causes the piston with the valve to traverse in the barrel G, as shown by the dotted lines (fig. 1), and expel whatever substances have passed through the valve. The motion of the levers will at the same time open a communication with the pipe A, the contents of which will rush down into the basin. On pressing down the lever, the piston will retrograde in the barrel G, and whatever substances have passed the valve *f*, will be forced through the valve in the piston, into the piston barrel, and be ejected by the next motion of the piston. The connection with the external water will, by the same movement, have been opened, and the pipe A will become filled, ready for rinsing the basin on the next movement of the pump. In order that the pipe A, may perform the office of an elevated reservoir or cistern, it should be from two to three feet higher than the top of the basin; it is fitted with a floating air-valve at its upper end, which is closed by the rising of the water when the pipe is filled, but opens and admits air when the pipe is discharging its contents into the basin. The pipe must be of such capacity as to hold the quantity of water required for the use of the basin. The patentee prefers a small pipe (say ¾ inch diameter), and leads it in a convoluted or zigzag form, as shown in the engraving, so as to maintain a head of water as long as possible, to give the necessary force to the jet passing through the fan. If the watercloset is to be fixed in a ship, so that its seat will at any time be less than two feet below the level of the external water, the water will not rise high enough in the pipe A, to acquire sufficient force by its gravity to cleanse the basin. In such cases the supply of water is to be drawn by means of a small force-pump or pumps worked by the lever, as shown in fig. 3; these pumps drive the water through a pipe carried up one foot or more higher than the level of the external water line, so as to guard against any undue influx of water through the pump valves.

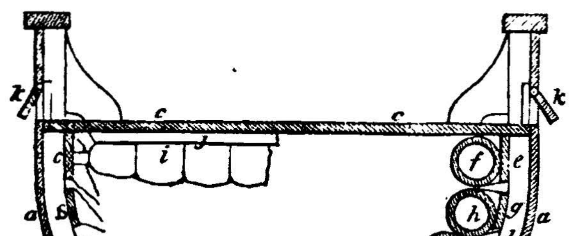
LIFE BUOYS AND BOATS.

ARTHUR HOWE HOLDSWORTH, Esq., of Brookhill, Dartmouth, Devonshire, for "*Improvements in buoys, and in giving buoyancy to boats.*"—Granted August 29, 1846; Enrolled February 29, 1847.

This invention relates to the employment of india-rubber for tubes, and vessels, prepared as described in the specifications of patents granted to C. Hancock and A. Parkes.

The life-buoys are tubular vessels of prepared india-rubber, filled with air, like those described for boats; each when thrown into the water will constitute a life-buoy, and cords may be attached to them, to admit of a person securing himself thereto. "Watching buoys" may be made of any form, but the patentee prefers a globular shape, or a cylinder with hemispherical ends; the buoys are enclosed in a net of strong cord, and the mouth secured to a ring, to which the mooring chain is to be fastened.

For the purpose of giving additional buoyancy to boats, tubular vessels of prepared india-rubber are filled with air, and attached by cords to the raisings under the thwarts, from the head to the stern, or placed across the boat, beneath the thwarts, and secured thereto by cords. Apertures five by three inches are made in the sides of the boat (the bottom being level with the thwarts), and each furnished with a valve, opening outwards, so that water may be discharged but cannot enter through them. When applying this invention to the quarter boat of a large ship, four apertures in the sides are made with valves; to each side of the boat are attached six tubes, six feet long and six inches in diameter, four being secured to the raisings below, and two to the raisings above the thwarts: each tube is capable of supporting from 74 to 80 lb. when immersed in the water. The reason for placing the tubes at the side, rather than across the boat is, that she may be more readily restored to an even keel, if, in being lowered from the ship, or from any other cause, she should be thrown on her side and suddenly filled with water; when this happens, the buoyancy of the tubes causes the boat to rise and the water to flow from it through the apertures, until the gunwale becomes elevated to a height above the surface of the sea, corresponding to the difference in height between the apertures and the gunwale—the crew can then easily throw out the remainder of the water. Boats intended to be used solely as life-boats, have six or eight apertures in their sides, and in addition to the ordinary raisings under the thwarts, one or two more are fixed below them, and to these additional tubes are secured.



The annexed figure is a transverse section of a boat, constructed according to this invention. *a, a*, are the side and bottom planks; *b, b*, the ribs; *c, c*, the thwarts; *d, d*, the internal bottom boards; *e, e*, the raisings or rails under the thwarts; *f*, one of the tubular vessels attached thereto; *g, g*, the additional rails; and *h, h*, the corresponding tubular vessels. *i*, is a tube connected to the under side of the thwart by cords, for which purpose the rails *j*, are applied; *k, k*, are the valves or doors for closing the apertures in the sides of the boat; they turn on a hinge at the upper part, and are furnished with weights to cause them to close readily, and be kept closed, when required, by means of cords.

BRICK MACHINE.

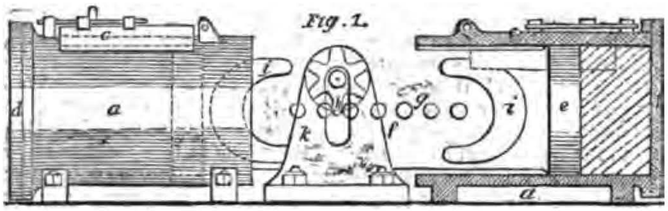
FREDERICK RANSOME, of Ispwich, engineer, and JOHN CRABB BLAIR WARREN, of Little Horksley, Essex, clerk, for "*Improvements in the manufacture of bricks, tiles, pipes, and other articles composed of plastic materials, and in the preparation of plastic materials to be used for such purposes.*"—Granted July 6, 1846; Enrolled January 6, 1847.

The first part of the invention consists in mixing in the pug-mill, with the clay or plastic materials, of which bricks, tiles, and similar articles are usually composed, vegetable, bituminous, or other substances that are susceptible of being destroyed by fire, or burnt out of the bricks, &c., when burning.

As the sole object of adding these destructible ingredients is to render the article porous, the addition of one-tenth part by weight, more or less, of the destructible to the indestructible or plastic ingredients will be found to effect this object.

Tiles, bricks, and pipes made in this manner will be found to be exceedingly porous, and, when employed for draining, will allow the water from adjacent earth to percolate or filter freely through them into the hollow space within, but at the same time effectually prevent any sand or extraneous matters from entering the drain.

The second part of the invention consists of an improved apparatus for forming bricks, tiles, pipes, and other articles, of clay or plastic material.



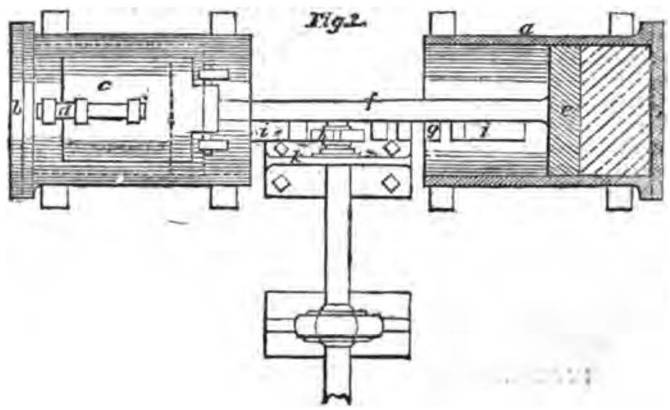


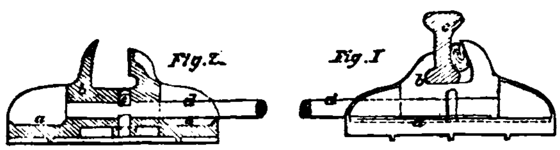
Fig. 1, is a side elevation of the machine, partly in section, to show the interior construction; and fig. 2, is a plan, also partly in section. In this arrangement two horizontal fixed cylinders are employed, furnished with dies at their outer ends, and doors on the upper part for the admission of clay, which is forced out through the dies by the action of pistons working within the cylinders, in the manner commonly practised. The peculiarity consists in the mode of working the pistons. *a, a*, are the horizontal cylinders, secured to a bed-plate; *b, b*, are suitably-formed dies, bolted to the outer ends of the cylinders; *c, c*, are doors hinged to the cylinders with a bolt *d*, for securing them; *e, e*, pistons, attached together by a plate *f, f*. Upon one face of this plate are pins *g, g*, into which a pinion *h*, takes alternately on the upper and under side thereof. *i, i*, are semi-circular guides attached to the plate *f, f*, and intended to keep the pinion, when it has arrived at either end of the series of pins, still in gear therewith, in order that the traverse of the pistons may be continuous. The pinion *h*, is mounted in a slotted bearing *k*, and its axle may be provided with a winch-handle, for communicating a rotating motion to the pinion. The cylinders *a*, are filled alternately with clay by the door *c*. When the cylinder is filled, the door is closed, and the rotation of the pinion *h*, will then bring forward the piston, and cause the clay to find an exit through the die *b*. While this is being effected, the other cylinder is ready to be charged with clay, which in its turn will be forced out by the return motion of the pistons. It will now be understood that the continuous rotation of the pinion *h*, in one and the same direction, will force the pistons alternately forward in their respective cylinders, and cause them to press the clay contained therein through the dies attached to the ends of the cylinders. In some cases, instead of filling the cylinders by hand, as is the plan generally adopted, the patentees propose to attach a hopper to each cylinder, whereby the clay may be fed in by the rotation of "sweepers" or arms, set radially from the central shaft, and at an inclination from the perpendicular. When these hoppers are used, it will be necessary to stop the supply of clay as the pistons advance to press it through the dies: this may be done by a sliding-plate, or a valve, opening inwards, being made to close the bottom of the hopper; or the pistons may be provided with a shield to shut out the further supply of clay as they advance. In either case it will be requisite to stop the rotation of the sweepers or arms of the pug-mill.

INCRUSTATION OF BOILERS.

MAXIMILIAN FRANCOIS JOSEPH DELFOSSE, of Regent-street, Middlesex, for "*Improvements in preventing and removing incrustation in steam-boilers.*"—Granted August 25, 1846; Enrolled February 25, 1847.

This invention consists in adding to the water used in steam-boilers a mixture which acts on the precipitable matters in the water to prevent them forming any incrustations on the interior of the boiler, and which will also remove any incrustations that may have been previously formed. This mixture the patentee has named the "antipetrifying mixture;" it is composed of dry tannic or gallic extract, hydrate of soda, or soda deprived of its carbonic acid, muriate of soda, and subcarbonate of potash. The proportions will vary according to the impurity of the water, and to the boiler being stationary or locomotive. If the boiler be stationary, and fed with fresh water, the amount of antipetrifying mixture for 336 hours consumption per horse-power may be made by mixing together 12 oz. of muriate of soda, 2¼ oz. of hydrate of soda, 2 drachms of dry tannic or gallic extract, and ½ oz. of subcarbonate of potash. For locomotive boilers, travelling on an average about 140 miles each day, the quantity of the mixture per horse-power is increased one-fifth. If the water be brackish, or a mixture of salt water and fresh (such as the water of tidal rivers), the muriate of soda is omitted, and instead 6 oz. are used for 2¼ oz. of hydrate of soda, and five drachms instead of two of the dry tannic or gallic extract; the mixture is also prepared in this manner when sea-water is used in the boiler. The patentee prefers introducing the mixture into stationary boilers in quantities sufficient for two, three, or more days; but locomotive and marine boilers are to be supplied daily with a portion of the mixture, corresponding with the amount of duty to be performed.

IMPROVED RAILWAY CHAIR AND SLEEPER.



M. M. Bessas-Lamégie and Henry, of France, propose to combine the ordinary railway chair and the sleeper, by forming them of cast-iron in one casting, as shown in the annexed figure; *a* is a cast-iron plate, and *b b* the chairs, which are kept at the proper gauge by an inch round wrought-iron bar *d* passing through the chair, and secured thereto by vertical pins *e*; the underside of the plates are grooved or ribbed to prevent them slipping.

HISTORY OF ENGINEERING.

BY SIR J. RENNIE, PRESIDENT OF THE INSTITUTION OF CIVIL ENGINEERS.

(*Concluded from page* 119.)

IRON VESSELS.

The very important improvement in the introduction of iron for the construction of vessels, enables us to combine lightness and elegance of form with strength and durability. For this valuable addition to marine architecture we are indebted to Aaron Manby. In 1820-21 he constructed at Horseley, near Birmingham, a wrought-iron boat, called the 'Aaron Manby,' 120 feet long and 18 feet beam, and when laden drawing 3 feet 6 inches water; it was propelled by Oldham's feathering paddle-wheels, worked by a single engine of 80 h.p.; and was built for the purpose of plying on the river Seine. The boat was completed in 1821-22, and was navigated across the Channel by the present Sir Charles Napier, who was deeply interested in the undertaking; it was not only the first iron vessel that ever made a sea voyage, but also the first that conveyed a cargo from London to Paris direct, without transhipment. She continued plying between Paris and Havre for several years, until superseded by other more powerful and improved boats: the hull is yet in existence, and is still used with new engines on board, as are three others, which were built about the same time. In 1832 Maudslay and Field built four iron vessels for the East India Company, for the navigation of the Ganges, and fitted them with oscillating engines, of the united power of 60 horses; they were 120 feet long, 24 feet beam, and drew 2 feet water; they were so successful that six more were ordered shortly afterwards. The use of iron, however, did not make much progress until recently, on account of the prejudices and obstacles which generally, if not invariably, impede the progress of all great inventions. At present, iron is much employed for vessels, and promises in many cases to supersede timber. Objections against its general employment have been urged, on account of the bottoms of the vessels being liable to become foul on long voyages, and for the purposes of war, the splinters of the iron when struck by shot are said from recent experiments to be more detrimental than from wood. The art of building iron vessels is, however, in its infancy, and it is very probable that further experience and investigation will, in a great measure, obviate the evils. The strength, lightness, and other qualities that have been mentioned, give it great advantages for the construction of fast-sailing passage-vessels, and the water-tight bulkheads constructed with it, give great additional security in case of accidents; these water-tight bulkheads are now almost universally adopted; but the precise date and origin of their introduction is not very clear. Captain Evans, of Holyhead, proposed them for timber vessels in the year 1826, and soon after that time they were used in an iron vessel constructed by Grantham for C. W. Williams. Examples of their importance have frequently occurred, demonstrating the necessity of their introduction into all vessels, whether for river or sea navigation.

SCREW PROPELLING.

Great as has been the result of steam navigation under the paddle-wheel system, still as perfection is approaching, it cannot be denied, that it has several disadvantages when applied to sea navigation during stormy weather, which it is most desirable to obviate. Paddle-wheels act to the greatest advantage in smooth water and upon an even keel. The unequal immersion of the paddle-wheels during the rolling of the vessel, in a heavy sea, prevents that uniformity in the action of the engines, which is necessary to insure their greatest effect, and although this may be lessened, to a certain degree, by the use of mechanical or feathering wheels, as I have already stated, the complexity of their construction is objectionable. The resistance, offered by the paddle-boxes to the wind, in addition to their top weight, has a sensible influence in diminishing the speed and effect of the engines, and in ships of war, the great space occupied by the wheels on the broadsides of the vessels, materially interferes with the efficiency of the batteries; moreover, the wheel, as the principal propelling agent, being constantly exposed to shot, is under very considerable risk of having its efficiency impaired. The idea, therefore, of substituting for it some other propelling agent, had long been a favourite object of investigation amongst engineers. The origin of this, like every other great invention, is very difficult to be ascertained with accuracy, as the same idea not unfrequently occurs at the same time to different individuals, totally unconnected with each other. The first idea of stern-propelling was very probably suggested by the movement of fishes, whose chief propelling power exists in the tail, as also from the common and ancient practice of sculling a boat from the stern. A rude idea of stern-propelling is attributed to Duguet in 1727, but it was so totally different from the system now employed, that it can scarcely be called the same invention. His system consisted of two boats, connected together by two cross beams with a screw, inserted between the boats; this double boat was moored to a post in the river, and the current, acting upon the screw, turned it round, the motion thus generated, was communicated over pulleys, to which were attached the vessels to be drawn along; this plan may be likened to the effect of a water-wheel, or any other fixed first mover; still there is an idea of the screw, which, if pursued, might have been converted into screw-propelling. In 1768 Painton proposed the pteraphore to be applied to the bow and stern and sides of a vessel horizontally, but does not describe how it was to be moved. Lyttleton also proposed a screw-propeller in 1794. The first practical experiment, however, appears to have been made by Shorter in 1802, with a propeller like the sails of a windmill, applied to the stern of a vessel in the Thames. He afterwards tried several propellers, particularly in the 'Superb' line-of-battle ship in Gibraltar Bay, worked by a screw by the intervention of the capstans, by which the vessel was moved through the water at the rate of about 2 miles an hour.

Shorter does not describe the kind of propeller used in this experiment, although Napier, who afterwards proposed a similar plan without knowing what had been done, when he accidentally found Shorter, had from him an account of his experiments, and saw a large collection of propellers applicable to the bow, stern, sides, and every part of the vessel: Napier acknowledged and admitted that Shorter had conceived almost every possible kind of arrangement, and that his models and plans comprised most of the systems since made public by different parties; Shorter also exhibited several experiments with different propellers, and attributed the best results to a propeller with a single blade projecting from the axis. In 1824 a work was published under the direction of the French government, describing the several modes of propelling in use in America, on the principle of the screw; one plan was to have a hollow in the bottom of the vessel nearly as long as the vessel itself, with a screw revolving in it to produce motioo forwards or backwards; another form of this system was to have a double screw between two boats. In 1825 a company was formed for applying Brown's gas vacuum engine to navigating boats on canals, and a premium was offered for the best invention for propelling boats without paddle-wheels. In 1827 the ingenious and indefatigable Tredgold, in his work on the steam engine, described and investigated the theory of screw propelling; about the same time, or perhaps rather before, Brown, the inventor of the gas vacuum engine, proposed to apply a propeller, consisting of two blades placed at an angle of about 90° to each other and 45° to to the axis; this was intended to be placed in the front of the bow of the vessel, and attached to a shaft working through a stuffing-box, which could be raised or lowered at pleasure. He obtained the premium of the Canal Towing Company for this, and they determined to pursue the subject further; in furtherance of this object, they built a vessel at Rochester with a gas vacuum engine of 12 h.p., which was applied to working Brown's propeller by means of bevil gear; the result of this experiment does not exactly appear, although it was considered sufficiently satisfactory for Brown to continue his investigations: he accordingly built another boat with similar engine and machinery, and made several experiments with it on the Thames, near London, when he is said to have attained the velocity of seven miles an hour with it.

Subsequently, Cameron, Woodcroft, Lowe, Ericson, and others pursued the subject and took out patents for various modifications; nothing, however, was materially effected until 1836, when T. P. Smith obtained a patent for the application of a screw to propel vessels, by placing it in that part of the stern of the vessel called the "dead wood." He accordingly builta small vessel, and made numerous experiments with her on the Thames; this little vessel was 34 feet long, 6 feet 6 inches beam, and drew 4 feet water; in it he placed a small high-pressure engine, with a cylinder 6 inches in diameter, and 15 inches stroke, which was applied to working a screw 2 feet diameter, having a pitch of 2 feet 5 inches. With this vessel he obtained a speed of from 7 to 8 miles an hour; he then tried her on the sea between Ramsgate and London, and she answered very well in driving against the wind in a heavy sea. Upon the success of this experiment a Company, called the Ship-Propelling Company, was formed, Smith being their adviser, and under his directions a vessel, called the 'Archimedes,' of 232 tons burthen, was built in London by Whimshurst; she was 125 feet long and 21 feet 10 inches beam, having a draught of water of between 9 and 10 feet; she was propelled by a pair of engines of the united force of 80 h.p. The engines and machinery, which were made by Messrs. Rennie, instead of being placed transversely in the vessel as was usual in paddle-wheel steam boats, were placed longitudinally; these engines were upon the direct-acting principle, and their power was applied to work the shaft upon which the propeller was placed, by means of two spur-wheels with teeth of hornbeam wood, and two pinions with iron teeth working into each other, the motion of the propeller shaft being 5·33 to 1; or, in other words, when the engine made 25 strokes, the propeller made 133·3 revolutions. The propeller, which was in the dead wood, was united to the shaft, by means of a water-tight stuffing-box passing through the stern of the vessel. The propeller at first consisted of a single-threaded screw; but this not answering so well, another screw was employed, with two threads opposite to each other, 5 feet 9 inches diameter, and 8 feet pitch. The 'Archimedes' obtained a velocity of 9 miles per hour through the water, and proved herself an admirable sea-boat, going head to wind in a heavy sea, and she established beyond all doubt the success of the invention, and its superiority over paddle-wheels in many cases; still, however, much remained to be done before prejudice could be overcome, and before the system could be brought to such perfection as to compete in velocity successfully with paddle-wheels, which had so long and so completely engrossed the public attention as scarcely to leave an opening for any other system; latterly, however, screw propelling has made considerable progress. In 1842, the 'Bee' was constructed by Maudslay and Field for the Government; she was worked by a steam-engine of 10 h.p., adapted for driving either the screw or the paddle-wheel in the same vessel, and thus to try the comparative merits of the two systems. From the trials and experiments made with the 'Bee,' it appeared, that upon the whole the paddle-wheels had an advantage as to speed under all circumstances. In 1840, the 'Dwarf,' of 210 tons burthen, which was the first screw vessel ever commissioned in the British navy, was constructed by Messrs. Rennie; the engines, of 120 h.p., upon the direct action principle, were attached to two spur-wheels, with two pinions for working the screw upon the propeller shaft, on the same plan as the 'Archimedes.' The 'Dwarf' proved herself an excellent sea boat, and attained a speed of 12½ miles per hour through still water. The 'Rattler' was the second screw propelling vessel introduced into the navy. She was 176 feet long, and 32 feet 8 inches beam; drawing 11 feet 3 inches water, carrying 20 guns, and was about 888 tons burthen. The engines, of 200 h.p., were by Messrs. Maudslay and Field; and her screw, which was 10 feet diameter, and 11 feet pitch, was driven by cog-wheels; the screw made 103 revolutions per minute, being in the proportion of 4 to 1 of the speed of the engines; her velocity through still water was 9½ miles per hour, and she proved a good sea boat. All these have been surpassed in speed by the Royal yacht, the 'Fairy,' built for her Majesty, by Ditchburn, with engines by Penn; she is 260 tons burthen, with two oscillating engines of the united force of 125 h.p., driving one spur-wheel and one pinion; the screw consists of two blades, and makes 250 turns per minute, being in the proportion of 5 to 1 of the moving power. The speed of the 'Fairy' is 15¾ miles per hour through the water. The merits of the screw system have now been so completely tested, that the Government have determined to introduce it more generally into the navy, particularly for guard ships; these vessels are to be of two classes, line-of-battle ships and frigates; the former having combined engines of 550 h.p., the latter 350 h.p.; the cylinders of the engines will, in some cases, be applied horizontally, and the pistons will act directly upon the propeller shafts, by cranks, without the intervention of wheels; the propeller shaft will make from 50 to 60 revolutions per minute, and the speed of the vessels will be from 5 to 7 miles an hour; this velocity will be sufficient to enable them to command their own position; and with heavy guns and the free uninterrupted use of their batteries, they will be fully equal to cope with any vessels of their class. The 'Amphion' frigate is also being fitted with a screw propeller, to move with a greater velocity than the guard-ships. She is 1290 tons, was originally built for sailing, and carries 36 guns; she is propelled by a screw of two blades, 15 feet diameter, and 21 feet pitch, driven by a pair of engines of 300 h.p., making from 45 to 50 revolutions per minute; her speed on trial was 7 knots an honr, and promised more; the whole was designed and executed by Messrs. Miller and Ravenhill. To Miller the constructive portion of marine engineering owes much; the forms of framing, the graceful proportions, and scientific combination of strength with lightness; the arrangement of the several working parts of the engines, so as to diminish the weight, and increase their compactness, without impairing their efficiency, have produced the natural consequences, not only in the fast river boats on the Thames and the Rhine, and other rivers where peculiarities of construction were specially demanded, but also in the sea-going vessels, for the mercantile as well as for the Royal Navy and the Post-office service of both France and England.

Much discussion has already taken place, and is still going on, as to the best form and dimensions of propellers; nothing, however, but careful and well-conducted experiments can determine this important point. In these investigations Rennie has taken a leading part; Smith, Lloyd, Sunderland, Barlow, Guppy, Brunel, Airy, Maudslay, Field, Miller, Barnes, Penn, and others have also done a great deal. Up to the present time the double-bladed propeller has produced as good a result as any other form. In the first application of steam power to screw, or stern propelling, cog-wheels were usually employed to drive the propeller; then straps, or bands, working upon wooden or iron cylinders; and in the 'Great Britain,' endless chains were employed; in this case, however, the chain had claws, resembling teeth, attached to it, which fitted into corresponding recesses or cavities, on the drum, and to a certain degree, prevented the stretching or slipping to which chains of the ordinary description are liable; adhesion wheels were also tried by Messrs. Rennie, but were not found so good as cog-wheels. Latterly the system has been much simplified, by applying the piston of the engine to act directly upon the propeller shaft, and a successful result appears probable. Whilst upon this subject, the 'Great Britain,' the largest vessel constructed in modern times, must not be omitted. She is 322 feet long, 50 feet 6 inches beam, draws 16 feet of water, and is 3444 tons burthen. She is propelled by the screw, with a pair of engines of the united force of 1000 h.p.; there are four cylinders, inclining at an angle of 60°, and parallel with the keel; the pistons act by means of cranks upon a large wheel, which turns the drum with the chain and propeller shaft; the diameter of the screw is 15 feet 9 inches. She left Bristol on her first trial on the 8th January 1845; and on the 23rd of the same month, for London and Liverpool,—for New York on the 26th July, 1845, and reached that city on the 10th August; left New York on the 30th August, and reached Liverpool on the 15th September. This vessel and her machinery may be considered as a great experiment, from which useful results may be expected. She has already made two voyages across the Atlantic; and, notwithstanding the prognostications of many as to her failure, according to the report of her able and experienced commander, Captain Hosken, has answered well as a sea boat. Since then her engines and machinery have undergone certain modifications, and some trifling alterations have also been made in the vessel, which experience has proved to be necessary, and which from the novelty of the construction, and the great scale upon which the experiment was tried, might have been expected, and for which every allowance should be made. These alterations have improved her materially; and it is greatly to be desired that so much labour and expenditure should be attended with complete success. This gigantic structure, which has had the advantage of Brunel's assistance, is certainly bold, original, and in the right direction; for nothing but proportionable mass, power, and correctness of form, are calculated to contend with the heavy swell and gales of the Atlantic. It is by these and other well conducted experiments, that we may look forward with confidence, at no very distant period, to the voyage between America and Europe, much as it has already been shortened, being still further reduced. The same may be said of the voyage between India and Europe, the importance of which cannot be too highly estimated.

The advantage of steam, as an auxiliary to sailing vessels in long voyages, the steam power being only applied in calms, or when the wind is unfavourable, is beginning to be generally felt; and numerous vessels are now being fitted out upon this principle. For this purpose the screw propeller, with the means of taking it out of the water and replacing it when required without stopping the vessel, appears peculiarly well adapted; for whilst it enables the vessel to retain all her sailing qualities, as well as her capability for stowing cargo, it still gives her the advantage of steam power when necessary. The steam power, as it is not intended to be the chief agent, should be compressed into the smallest practicable space, still so as at the same time to give the greatest power: in order to effect this, tubular boilers of the most improved construction and power of evaporation; direct acting engines, in which wrought iron is substituted for cast iron whenever it is practicable, using sufficient steam of a greater density, together with ample stowage for fuel to last for the average probable time that steam power may be required, must be used. By the judicious combination of steam with sailing, the time of long voyages may be materially reduced, and at the same time considerable saving may be effected in the transport of merchandise.

The Electrical Telegraph.

Connected with, and forming a most important adjunct to, the locomotive system of communication, may be mentioned that extraordinary and useful invention, the Electrical Telegraph.

The invention consists in directing a current of electricity through a wire or a series of wires connecting together the intended points of communication. The galvanic or electric current may be produced, either by a battery or by employing the natural electric currents of the earth. The telegraph is worked by handles, which act by means of galvanism upon needles attached to the wires at the other end of the telegraphic line, through which the galvanic current is conveyed, and deflects them to points on a dial-plate, having symbols (according to Cook and Wheatstone's system) or letters or numbers to represent the intelligence to be communicated. By this means intelligence is conveyed from one point to another along the line of wires, almost as soon as conceived, and thus, independent of the advantage as a means of conveying intelligence from one point to another unconnected with the railway, it is of great importance in the working of the railway itself, by preventing accidents; or in the event of an accident unfortunately occurring, enabling assistance to be despatched without loss of time to remedy the evil and clear the obstruction. Several persons claim the merit of this invaluable invention; it is difficult to decide with accuracy upon the claims of priority; like most other inventions, however, it has been perfected by degrees, and each party is entitled to his due share of credit. About the year 1819, Mr. Ronalds, of Hammersmith, is stated to have applied electricity for the purpose of effecting telegraphic communication, and succeeded so far as to complete a current through eight miles of wire. He also employed electricity as a means of communicating motion to a series of wheels. This apparatus, however, was too imperfect to be of much use, but it is evident, that the idea once propounded and partially carried into effect, to a certain extent, establishes Mr. Ronald's claim to the merit of the discovery. In 1830, M. Ampère pointed out the means of deflecting magnetic needles by a current of voltaic electricity, for the purposes of telegraphic communication, and the principles of this discovery have, it is said, been applied to many of the modern electrical telegraphs. The first plan employed was so very complicated, and so liable to get out of order, that it was soon abandoned; but Wheatstone and Cook so completely improved upon it as almost to make it a new invention. Their system consisted of a dial-plate with symbols, to which the deflected needles pointed, when moved by electric agency. At first it was considered that it was necessary that the wires for conducting the current of electricity should be kept entirely isolated in iron pipes; subsequently, however, this was found to be unnecessary. They are now stretched between a series of posts placed at given intervals apart, beside the railway, and a dial apparatus is placed at most of the principal stations, as well as at the termini. The first telegraphic line upon Wheatstone's plan was established, in the year 1839, upon the Great Western Railway, between London and Slough, a distance of 18 miles, and since that time it has been so much improved that it is now generally adopted. It is already complete on the South Western Line between London and Portsmouth, and is being laid down on the North Western and on numerous other lines.

A company, called the Electrical Telegraph Company, has been formed for carrying out the plans proposed by Wheatstone, to whom great credit is due for the perseverance and ability with which he has worked out his system. Bain also claims a right to the invention, and, in addition to the means of electrical telegraphic communication, has invented a mode of printing by it at the same time, thus affording the means of secrecy, and preventing mistakes; for the apparatus being kept locked in a room or box, no one can have access to it but the person to whom the communication is made. Other modifications of the system have been introduced, but hitherto without being extensively employed.

Another valuable application of electricity to engineering operations consists in blasting rock and other materials above and under water. The first effective application of this principle to blasting, may be said to be due to General Pasley, who employed it for blowing up the wreck of the 'Royal George,' sunk at Spithead, in the year 1782, and which, by its own bulk as well as the alluvial deposit accumulated round it, formed a serious obstruction in that important roadstead. Pasley, at the request of the Admiralty, undertook to remove it, and commenced his operations on the 29th August, 1839, by sending down divers, in order to ascertain the exact state and position of the wreck; having done this, he proceeded to place powerful charges of gunpowder in water-tight tin cases in those parts of the vessel where they would have most effect, and they were exploded by an electrical current conveyed through them, by means of wires attached to them, and connected with a voltaic battery placed in a boat floating near: the explosions were instantaneous and almost unfailing, and a great effect was produced: in this manner he succeeded perfectly in removing the wreck in about two summers. The same system was afterwards pursued, in removing the wreck of a vessel in the Thames, and is now generally adopted in similar circumstances. It was applied by Cubitt, at Round Down Cliff, for the purpose of removing a large mass of the cliff on the line of the South Eastern Railway, between Dover and Folkestone: the portion operated upon was several hundred feet long, and between 200 and 300 feet high; the charge of powder consisted of 18,000 lb., disposed in several cells in the line of the intended explosion, and properly tamped with sand: the explosion took place on the 28th January, 1843, and was perfectly successful, removing about 250,000 cubic yards of chalk rock; its success was of great importance to the railway operations, inasmuch as it materially expedited them, and considerably reduced the cost of this difficult portion of the line. This method of blasting upon a great scale is now generally adopted, and enlarges the sphere of operation in this department of civil engineering, as well as in the removal of rocks under water; for which it was used by Rennie many years since. A very successful application of gunpowder, for facilitating engineering operations, has recently occurred in the removal of a number of marl rock shoals in the bed of the River Severn, executed by Edwards, for Grissell and Peto, under W. Cubitt. Martin Roberts also lays claims to the invention; he exhibited his experiments at the Craig Leith Quarries, in March, 1839.

Thompson has proposed to effect the blasting, or rather the ignition of the powder, by means of common electricity, produced by an apparatus enclosed in an air-tight box, so as to prevent the admission of moisture; this apparatus is said to be more simple and less expensive than the galvanic battery.

Clocks.

Connected with the correct working of the railway system, nothing is more important than accurate time-keepers; for upon these depend the regular starting and arrival of the trains, so that one train may not interfere with the other, and collisions be prevented.

The introduction of clocks into Great Britain took place about the year 1288, and, in 1326, Wallingford is said to have constructed a clock regulated by a balance, which was put in motion by weights, but whose action was extremely irregular. The great improvement of the pendulum does not appear to have taken place until about the middle of the 17th century, and the name of the person who first employed it for this purpose is not accurately ascertained. About 1641 Richard Harris is said to have constructed a pendulum clock for St. Paul's church, Covent-garden; however, as Huygens, in 1658, was the first who explained accurately the motion of the pendulum, the chief merit of its application to clocks may be attributed to him. The application of the spiral spring to the balance is due to Hooke in 1658; and the introduction of the compensating mercurial pendulum by Graham, in 1715, was the next great step in improvement; by means of this valuable invention, the unequal expansion and contraction of the pendulum from change of temperature, which rendered impracticable the accurate measurement of time, was obviated. Graham also suggested the idea of employing different metals, having different properties of expansion, so that the one should neutralise the other; his idea was afterwards carried out by Harrison, in the construction of the gridiron pendulum. For the going fusee, the compensation curb, and other improvements, he received a Parliamentary reward.

The scapement, which communicates the sustaining force to the pendulum or balance, demands the greatest skill and accuracy, and various forms have been attempted; amongst others may be mentioned the original scapement-wheel, with its teeth at right angles to the plane of the wheel; the anchor scapement, invented by Clement in 1680; which was improved by Graham, so as to render it more isochronous; the duplex scapement, which does not require such extreme accuracy in the teeth, whilst at the same time it performs equally well: the detached scapement, by means of which the teeth of the scape-wheel always rest on a detent, except when it is unlocked to impel the pallets, is employed in chronometers where great accuracy is required; these, and many other improvements, too numerous to mention, are worthy of notice.

The art of clock or watchmaking, termed horology, may be said to be principally composed of four parts. 1. The moving power, which is generally a weight for clocks or fixed time-keepers, and a spring for watches or moveable time-keepers; in the former case, the line suspending the weight should be equal throughout its calibre, and the cylinder on which it is coiled should be true; in the latter case, the form of the spring should be such that its force may act as equable as possible. 2. The scapement, which communicates the sustaining force to the pendulum or balance: the construction of this demands great skill; there are various kinds, the common crown wheel, the anchor, the duplex, the detached, &c. 3. The means of communicating the power to the minute, seconds, and hour hands, which is effected by a series of wheels nicely proportioned and adjusted to each other, having many of the axes or centres working upon diamonds or rubies, to reduce the friction and diminish the application of oil, which is objectionable on account of its being acted upon by the temperature. 4. The regulator, which is effected by a pendulum in clocks and by a balance in watches. The striking (being merely a secondary part), is easily effected, when the other great points have been determined. The perfection of the art consists in the proper proportions, adjustment, and adaptation of the various parts to each other, and the combination of the several improvements above described; this has now been so completely attained that time can be marked so as not to vary the fraction of a second in a day: for these important and valuable improvements in this useful and indeed indispensable art, in England, we are indebted to Wallingford, Huygens, Harrison, Graham, Hooke, Cumming, Mudge, Ellicott, Sutherland, Earnshaw, Arnold, Vulliamy, Dent, Frodsham, Parkinson, French, Kater, and others.

Mineralogy and Geology.

Mineralogy, geology, and mining may be said to form an important branch in the profession of a civil engineer. Without some knowledge of these, the engineer will, in many cases, find himself unable to carry on his operations with that degree of certainty and economy, which is necessary to ensure success, and independently of their value in this respect, there are few departments of knowledge which have contributed more to the advancement, comfort, and civilization of mankind; whilst on the other hand, no class has contributed more to the advancement of them than the civil engineer, so that each department is essentially allied to and dependent upon the other. Geology enables the engineer to obtain a proper knowledge of the various strata through which he has to carry his operations; if for a cutting or embankment of a railway, it is essential to know the slopes at which the earth or rock will stand, the value and applicability of the materials excavated for his bridges, culverts, and viaducts, and their capacity for water, &c., in order to form a correct estimate for working through them, whether for his cuttings or his tunnels. If for a canal, the same will apply, with the addition of the knowledge of the sources from whence his supply of water can be obtained: this latter will also apply to waterworks, in which the knowledge of the various qualities of water applicable to the economy of mankind is so essential. In the construction and maintenance of harbours, it is most important to have a thorough knowledge of the geological strata, and of the nature of the coasts where the harbour is to be situated, in order to render it easily accessible to vessels, whether for commerce or refuge, for its construction in the most economical manner, or for its maintenance, in order that the alluvial matter held in mechanical suspension by the adjacent waters shall not fill it up when made. In the management and improvement of rivers for drainage and navigation, in order that they may carry off the superfluous waters from the low lands and marshes, and at the same time maintain the channels in the most efficient state for navigation. In the formation of embankments against the ocean, in order that nature herself may be rendered subservient, as far as is practicable, in affording the requisite protection; in these as in the operations of smelting the minerals of the precious or the more useful metals, geology and mineralogy are of essential service to the engineer and deserve his peculiar attention.

Mining.

Mining appears to have been known and practised in Great Britain from the earliest periods of our history, for the Carthagenians are said to have conveyed tin to Tyre, from Cornwall; but in those early days the operations must have been rude, and merely confined to the surface. This invaluable art made little progress until the knowledge of chemistry, and the invention of machinery, enabled mankind to extract from the bowels of the earth Nature's rich treasures, to investigate their different properties, and to apply them to the purposes of life; the steam engine, which enabled the miner to extract the water and enlarge the field of his operations has been of invaluable service when the ore was raised from the mine, as also aiding in its reduction and the extraction of the metal in its most refined state. Some of the Cornish mines have been extended to a depth of more than 220 fathoms below the surface. As regards coal-mines, they also have been worked to an extraordinary extent, as in the case of the Cumberland coal-fields, which have been wrought above a mile beneath the sea. The total quantity brought to the surface and consumed annually amounts to between 30,000,000 and 40,000,000 of tons. Without the steam engine these operations would be entirely paralysed, and must cease. The total annual value of the British mineral produce is said to amount to about 26,000,000*l*. In this valuable department we are much indebted to the establishment of the Museum of Economic Geology, which will be the means of extending the knowledge and use of minerals, as well as the best mode of obtaining them. Neither must we forget the valuable services of Sir H. De la Beche, Murchison, Sedgewick, Greenough, Buckland, Horner, Lyell, John Taylor, Griffiths, Buddle, Sopwith, Philips, Wood, Atkinson, Bald, and others, who have contributed so largely to the advancement of this important branch of science.

Ventilation.

Connected with mining may be mentioned the important subject of ventilation, the value of which is now so universally appreciated, not only for mines but for public and dwelling houses. The art consists in conveying volumes of fresh air through apartments, so that the air shall be always as nearly as practicable in the proper state for respiration; but in effecting this, it is desirable that the temperature shall not be reduced too low, otherwise inconvenience may be produced in other respects; whilst ventilation, therefore, is of great importance, the artificial warming of apartments is of equal consequence, and to combine both effectually is the great desideratum. Heat is the great medium for producing circulation, as in the example of collieries and mines, and on extraordinary occasions mechanical power may be applied. The common fire-place is the most wasteful of fuel, but possesses many advantages; and, although the stove may produce a more equable temperature, a proper combination of both seems best adapted to unite the advantage of a thorough circulation of air with the required degree of temperature; warm water and steam conveyed through pipes have been employed in many cases; those systems are however the best whereby a large body of air is raised to about 100° by passing between cases filled with hot water, and is enabled to flow freely into the apartments, expelling at the same time a corresponding bulk of vitiated air; thus rendering ventilation an integral portion of the system of warming; by such a plan, warm water may also be supplied to any part of the building for domestic purposes. When stoves are used, they should be upon the principle of slow combustion, and be so contrived as to avoid producing any disagreeable odour; for this reason porcelain is much employed, and it is essential to have a thorough circulation of pure air where stoves are employed. Upon this important subject, much information has been elicited by the late Parliamentary Reports, and by the labours of Sylvester, Tredgold, Arnott, Reid, Hood, Price, C. Manby, Perkins, Haden, Stephenson, and others.

Engineering Architecture.

The pursuits of the engineer are intimately connected with architecture, not merely as regards construction, but in taste also; and, although it is not necessary that he should be so thoroughly conversant with all the details of ornament, as to be able to practise as an architect, still he should be so far acquainted with them as to be able to carry out the leading principles with effect, whenever it becomes absolutely necessary in the course of his practice. The works of the engineer, associated as they are for the most part with the great operations of nature, should be designed and constructed so as to harmonise with them. They must strike by their general mass and proportion rather than by trifling details or minutiæ of ornament, which as a matter of taste, would be misplaced and unnecessary, and wasteful as regards expenditure; consistently, therefore, with their first grand object of fitness for their purpose, they should be simple, and in the few instances where ornament may be necessary, it should harmonise with the structure and be sparingly used.

In architectural masonry, the ancients have left us admirable models which cannot be too much studied, and may be generally followed with great effect and advantage; but the adaptation of timber and iron to modern architecture requires a different treatment. The massive proportions and dimensions which suited well the character of stone are no longer necessary, and would be misplaced when applied to the more solid and tenacious properties of iron; here equal strength is obtained with much smaller dimensions, which, at first sight, from their lightness and apparent weakness (until the eye becomes accustomed to them), produce a feeling of insecurity which can only be overcome by time; but this feeling soon vanishes, and the great convenience, economy, and security introduced by the employment of wrought and cast iron, has caused it to be generally adopted whenever practicable. In order, however, to ensure success, great care must be taken in the selection of proper materials for its different applications, and much depends upon the mode in which it is manufactured; the right understanding of this and of the different processes of converting the ore into the several states of cast and malleable iron and steel, all of which possess very different properties, and require different proportions and dimensions in their application, demands no ordinary skill and experience.

The application of heated air for the purpose of reducing iron from the ore (commonly called the "hot blast" system, invented by Neilson, in 1826), has produced a considerable revolution in the character of the metal, as well as in the economy of manufacturing it, and the comparative merits of hot and cold blast iron is still a subject of controversy, which requires to be duly considered in its application to construction. Cast iron, from the rigidity and brittleness of its texture, is not so well adapted to resist concussion, or any sudden strain, as wrought or malleable iron, and when employed, it is necessary to make greater allowance to meet it; hence the employment of malleable iron has become more general, and has, in many cases, superseded the use of the former, as while it contributes equal strength with less weight, it gives warning previous to fracture, and enables a remedy to be applied, which cast iron does not. For these reasons it is now almost universally employed for all purposes where it is required to resist tension and sudden irregular strains, and to combine strength and lightness; whilst cast iron is only used to resist compression, and to counteract by its mass and rigidity any tendency to movement or alteration of form. By thus carefully studying the different properties of both materials, we soon acquire a knowledge of the best mode of adapting them to their different purposes, and giving to them those architectural forms best suited to their respective qualities and the objects for which they are employed. One of the great advantages of wood consists in the first economy and the facility of converting it to the several purposes where it can be employed, and hence, until the properties of iron and the mode of working it became better understood, wood alone was used in conjunction with stone and brick, both for engineering and architectural purposes; and, notwithstanding it has been altogether superseded for many purposes by iron, nevertheless it still possesses advantages in the construction of bridges, roofs, and other works where the first outlay of iron or stone would be too great. Enough, I trust, has been said, to show the intimate connexion of the professions of the civil engineer and architect, and, without the one usurping the province of the other, it is much to be desired that a harmonious understanding should be cultivated between them, as it must tend to their mutual advantage, and nothing can contribute to this desirable object more than the meetings of this Institution, to which it is gratifying to find so many architects have attached themselves.

Agriculture.

Neither must we forget the comparatively recent adaptation of engineering knowledge to the advancement of agriculture, and the various implements connected with it, for ploughing, drilling, threshing, &c. Since the improvement in the working of iron, the machines for conducting these various operations are constructed with a degree of portability, economy, and efficiency which render them of the greatest importance to the farmer, and enable him to cultivate the soil, as well as to convert its various products to domestic purposes, in a much more economical and expeditious manner than formerly, and to derive a greater profit from his exertions. In the construction of agricultural implements, Messrs. Ransome, May, Cottam, Stratton, and others, have greatly distinguished themselves.

In modern agriculture, under-draining forms an important and valuable principle; stagnant water generally has been proved to be injurious to agriculture, and it is, I believe, now universally admitted that without thorough drainage it is impossible to cultivate the soil effectually; for this purpose small drains formed by tiles laid from 1 foot to 4 feet below the surface, are generally adopted; the tiles are made by machinery invented by the Marquis of Tweedale, Ainslie, and others, at a trifling cost; the surface water is thus conveyed from the land into the adjacent main drains and thence to the rivers. Water is the grand natural fertilising agent, and any amount of care in its proper distribution is well bestowed: it is, therefore, worthy of consideration, whether in hilly countries and districts subject to alternations of dry and wet seasons, it would not be advisable to establish large reservoirs for water, to be used during dry seasons for irrigation, in the manner adopted by the ancients; by this means, districts might be cultivated with advantage, which now are comparatively sterile.

Surveying.

Land and Maritime Surveying form an essential department in the profession of a civil engineer; without a correct knowledge of the former, it is impossible for him to lay out and determine in the best manner the proper lines of communication in a district, whether by canal, railway, or common road; and without a knowledge of the latter, it is equally difficult for him to decide upon the best situation for a port, and the most advisable means of improving and maintaining it. In these valuable departments much progress has been made. The great Trigonometrical Survey of the British Islands, which is now very nearly completed, is the greatest work of this kind ever undertaken in this country, and serves as a model for minor works of this nature. It was commenced by General Roy in the year 1783, under the direction of the Ordnance Department of the government, and has been subsequently carried on, with equal ability, by General Mudge and Colonel Colby, of the Royal Engineers, under whose direction it now is. This great work, so far as it has proceeded, has already proved of essential service to the civil engineer, inasmuch as all the towns and villages, the chains of hills, valleys, and rivers, being laid down trigonometrically, his labours, as well as the expenses of his employers, are materially diminished, in tracing out the best lines for railways or other internal communications; instead of having to survey the whole district of his operations trigonometrically, he has only to take the leading points, and to fill in the detail of fields, buildings, &c., to a larger scale; and even before incurring this labour he can, with one of the Ordnance maps in his hand, determine in a great measure the general direction and course of his line; notwithstanding this, it is essential for him to have a thorough knowledge of the use of instruments, the theodolite, sextant, and transit, the most accurate mode of measuring bases, and to see that those employed under him are competent to their task, and employ the necessary means to ensure accuracy in their surveys. Connected with surveying, we must not omit the important department of levelling, for simple as it is, nothing requires greater accuracy,—in fact, upon this being properly done the success of the whole scheme or undertaking in hand may be said mainly to depend; too much attention, therefore, cannot be paid to it; the instruments employed should be of the best construction, simple and substantial, easily adjusted, and kept in good order; the levels should be referred to one datum and proved in various ways, and recorded in a plain intelligible manner, so that they may at all times be easily referred to.

Maritime Surveying requires an intimate knowledge of the general laws which govern the tides, the set of the currents, the prevalence and direction of the winds, the soundings, anchorage ground, &c.; these should be regularly observed for a given period, in order to ascertain every possible variation, and regularly registered and referred to the same datum. For this purpose, self-acting tide-gauges, with a clock apparatus attached to them, for marking the time of high and low water, if placed in proper situations, are extremely valuable: that at Sheerness dockyard, by Mitchell, and the improved one at Ramsgate harbour, are here worthy of remark.

Mineral or Underground Surveying differs from the above in its being necessary to ascertain the dip or angle at which the several strata lay, their general direction and thickness, their quality and value, and the best mode of working them. For laying down the underground survey, the magnet and circumferenter are much employed.

In the investigation of the laws which govern the tides we are much indebted to the valuable scientific researches of our honorary members Lubbock, Whewell, Airy, and others. Connected with the various branches of surveying, the construction of philosophical instruments is entitled to an important station; as without accurate instruments it is impossible to make correct surveys, and for the construction of these we are much indebted to the labours of Ramsden, Troughton, Dollond, Carey, Simms, Watkins, Jones, Elliott, and others.

Drawing.

Drawing and modelling, although minor, form valuable, and, in fact, indispensable departments in civil engineering; for unless the various projects proposed to be carried into effect, are in the first instance correctly delineated upon paper, it is impossible to convey a just idea of them, or to form a correct estimate of the cost. Drawing may be classed under three heads:—mechanical or geometrical drawing, is that whereby the plans and sections are simply represented as they would appear on a plane surface; perspective drawing consists in representing the objects as they appear when seen from a given distance and height; this kind of drawing, although very useful, and indeed indispensable, to the architect, in order to represent the true effects of light and shade of his different compositions, as they would appear when carried into effect, and upon a true perception of which, the success of his building will mainly depend, is not of that importance to the engineer, whose works are of a different kind, and much more extensive, so that to represent them perspectively would in many cases be impracticable; but inasmuch as in detached portions of his works, such as important bridges, viaducts, machinery, &c., perspective drawing may be employed with great advantage, it ought to be studied. Landscape and topographical drawing is also useful, in order to convey to unscientific persons an idea of a particular locality, in the manner they are accustomed to view it, where works are proposed to be executed, and thus to remove fancied objections which otherwise might be overcome with difficulty; and this is still more successful with the application of colours when applied as seen in nature. These different kinds of drawing should be carefully studied and practised with accuracy, as they will be found essentially to forward the views of the engineer, and give satisfaction to his employers.

Although drawing, however, is most valuable, modelling in many cases is essential; for in the former case the objects are merely represented upon paper, assisted by light and shade and perspective, which, to persons in some measure acquainted with the subject, conveys a tolerably correct idea of what is proposed to be done, but a model represents it (although upon a reduced scale) exactly as it is intended to be, with the different planes, dimensions, and surfaces; hence, nothing, except the work itself, gives such a perfect idea or representation as a model; it also enables the engineer to detect many imperfections which otherwise would escape his notice; whenever, therefore, models can be conveniently adopted or employed, it is advisable to do so; and it is gratifying to know that the art of modelling has made considerable progress, so that now they can be obtained at a moderate cost in wood, card-board, plaster, and clay, and will thus be more generally employed. In this department Salter, Deighton, Day, and others, have attained deserved celebrity. Working models of machines are extremely useful to give an idea of the action of a machine, but we should be cautious in drawing conclusions from the results, for it too frequently happens that a machine succeeds extremely well when tried in a model, but fails when put in practice; we should, therefore, merely consider the results of working models as guides to be worked out practically.

Meteorology.

The principles of this science, as far as they have yet been determined, claim our particular attention. Without a knowledge of the winds, and the quantity of rain falling in a particular district, we cannot determine with precision the proper form and dimensions of moles or piers to resist the action of the sea, or of drains to carry off water from extensive districts of marsh land, or of the extent to which it may be necessary to improve the channels of rivers; or in carrying lines of railway through a country, to design the works in such a manner that they may withstand the shocks of the elements; neither can we select the proper kind of stone or other materials for constructing buildings, unless we know the vicissitudes of climate to which they may be exposed, or the extent to which they may be acted upon by it.

In the investigation of the phenomena of this difficult science, we are much indebted to the late Professor Daniell, and to C. H. Smith, whose report upon the qualities of the different kinds of stone, as regards their tenacity, hardness, capability of resisting moisture, and durability, for the purpose of selecting the best material for the new Houses of Parliament, forms an important and useful example, for which the engineer and the architect are much indebted, and the same course should be followed, as far as is practicable, previous to commencing every great work, and indeed, for the want of it, we now find many magnificent buildings partially decayed, which otherwise, would have been in excellent preservation.

Patents.

The improvements in manufactures, machinery, and other branches of art, resulting from a great number of curious and valuable inventions, necessarily gave rise, on the part of the successful inventors, to a desire to secure for themselves and their posterity, as far as is practicable, the benefits of their labours. The Government, perceiving and duly appreciating the advantages which not only the inventors themselves, but the nation at large, derived from them, wisely resolved to give every possible encouragement, by securing to them the exclusive right and title to their inventions for a certain number of years, and to enable them to recover, by legal process, severe penalties against any person attempting to use their inventions, without the previous consent of the inventors themselves. Hence arose the Law of Patents, or a privilege of the Crown to grant letters patent, conveying to the persons mentioned therein, the sole right to use or dispose of any new invention or discovery for a limited period, which is generally about fourteen years. It is difficult to fix the date of the first assertion of this privilege of the Crown, but it was first defined by statute in the reign of James I. The law has at various times undergone certain alterations and modifications, so that it now forms a branch of itself, which, with its various complicated relations, demands a peculiar study. Ever since the reign of Anne, parties have been compelled to specify in detail the particulars and nature of their invention or discovery, previous to obtaining royal letters patent.

The great number of inventions, which have multiplied considerably of late years, has given rise to an important class of professional gentlemen, styled patent agents, who devote themselves exclusively to the study of inventions and the pecular laws relating to them, in order to secure to inventors their just rights and prevent them from being infringed upon by others. Amongst these gentlemen we may mention the names of Robertson, Newton, and others, to whom inventors are much indebted for the skill and attention with which their interests are guarded, as also to Godson, Holroyd, Hindmarsh, Rotch, Webster, Farey, Carpmael, and others, who have devoted themselves to the study of the Patent Laws, and have written ably upon them.

Theory and Practice.

In the preceding pages, my remarks have been almost exclusively confined to the notice of the various works which have been carried into effect by civil engineers since the time of Smeaton; and although practice, upon the whole, is most important, nevertheless, we should not omit the study of the theory or principles upon which that practice is, or ought to be, founded, and without the due study and comprehension of which, we may frequently be led into great errors in practice. Our junior members should, therefore, previous to commencing their professional career, be well versed in arithmetic, algebra, mathematics, mechanics, and the principles of natural philosophy in general, and the mode of applying them to practice. They should cultivate a patient and equable temper of mind, in order to enable them to investigate, with rigid impartiality, the principles so beautifully illustrated in nature, and upon which the great operations which may hereafter be intrusted to their charge as civil engineers depend; and once having found out, and thoroughly understood, these principles in all their various applications, they should never depart from them; always bearing in mind, that nature will submit to assistance and guidance for the benefit of mankind, but never to opposition with impunity; her laws are immutable, and we may be assured that, either for good or evil, the same causes will produce the same effects: if, therefore, we wish to command success, we must adhere to her laws, and when we once thoroughly understand them, we shall be amply rewarded for all our toil; difficulties will vanish, and success will invariably attend our efforts. Previous to commencing practice, our junior members should not neglect the workshop; on the contrary, it would contribute materially to their advancement to undergo an apprenticeship of some years in that department; for inasmuch as the success of many of the works in which they may hereafter be engaged, particularly the mechanical, depend in a great measure upon the correct application of the principles which can be only thoroughly learned in the workshop, that is the place in which they must be studied; moreover, it will imprint indelibly in their minds the principles which they acquire from books, and induce a degree of accuracy of thought and execution which cannot be acquired elsewhere; hence we find that some of our greatest engineers, both of the past and present age, have there acquired a considerable portion of their education, and owe a great degree of their celebrity to that invaluable nursery for engineers. Nothing, therefore, can be more erroneous than to suppose that theory and practice are incompatible with each other, for they are intimately connected with and dependent upon each other. Without a thorough understanding of the theory or principles upon which engineering is founded, it is impossible to carry them into practice without endless failures and wasteful expenditure of means; and without the experience derived from practice, the principles acquired from theory will be of little avail; both, therefore, must be carefully studied and combined in order to produce a good engineer. Finally, composition, or the art of putting ideas into simple, clear, and intelligible words, should be studied, in order to convey to the world just notions of the measures proposed; also an intimate knowledge of the value of materials and workmanship, in order that he may be enabled to make correct estimates, upon which the success of all commercial undertakings so materially depend.

Continental Engineers.

In making the foregoing remarks, I have endeavoured to confine myself strictly to what has been done by civil engineers in England during the past and present centuries; but in so doing, I should be extremely sorry to be considered as detracting from, or underrating in the least degree, the great merits of continental engineers, or the progress which has been made by them also during the same period, and we are proud to number many of them among the members of this Institution. To attempt to enter upon this equally interesting and instructive subject, would compel me to trespass much longer upon your patience, which I fear has been already tried too much; but I cannot omit remarking, that the greatest credit is due to our professional neighbours on the Continent, for the example which they set in the infancy of the science, when it was so little known in this country, and for the great progress which has subsequently been made, and the numerous inventions which have emanated from them. In Italy, we have only to mention the harbours of Genoa, Venice, Ancona, Civita Vecchia, Leghorn, and Naples; the canals and silk machinery of Lombardy; and the names of Leonardo da Vinci (said to be the inventor of the pound lock), Gugielmini, Frisi, Manfredi, Martinetti, Fazio, Miliani, and numerous others. In France, the mole and docks of Cherbourg, Toulon, Brest, Havre, Boulogne, Calais, and Dunkirk; the canals of Languedoc, Burgundy, and Picardy; the embankments of the Loire; the bridges of Neuilly, Bordeaux, the Dordogne; and the names of Belidor, Papin, Gauthey, Rondelet, Dupin, Perronet, Prony, De Cessart, Lambarde, Reibel, Sganzin, Frissard, Hallette, Navier, Jacquard, and others. In Switzerland, the Alpine roads of the Stelvio, Mont Cenis, St. Gothard, the Splugen, the Brenner, the Simplon, &c. In Holland, the magnificent embankments for defending the country from the sea; the great Texel, and numerous other canals. The system of drainage, although perhaps too complex and artificial, is also meritorious and worthy of remark. Throughout Germany, the system of managing the great rivers Danube, Rhine, Elbe, the bridges across them, the canals connecting them together, as well as the roads and mining operations. In Sweden, the docks of Carlscrona, and the Trohlhatta canal. In Russia, the docks at Cronstadt and Revel, the extensive inland navigation, roads, &c. In Spain, the moles of Malaga, Alicant, Tarragona, and Barcelona; the docks at Ferrol, Carthagena, and Cadiz, and the Arragon canal; and the railway system, which owes its origin to this country, is now making rapid progress everywhere on the Continent. Neither must we omit to mention the ingenuity and vigour of our transatlantic brethren, the United States, to whom the world is much indebted for their many splendid public works and useful mechanical inventions and discoveries.

Conclusion.

I have thus endeavoured to take a rapid survey of the different departments which constitute the profession of a civil engineer, since the commencement of the last century, or rather, from the time of Smeaton, down to the present day. Imperfect, however, as this survey has been, I fear it has trespassed too much upon your valuable time, although the interest and importance of the subject justly entitle it to an extended notice, and would amply repay the perusal, if it had been treated by an abler hand, at even a much greater length. Looking back to the humble goal from which we started, a little more than a century since, and then adverting to the exalted pinnacle upon which we now stand, what almost immeasurable space have we traversed—what triumphant progress have we made! In how great a degree have both public and private prosperity, and the civilisation of mankind, been promoted by it. Within a few years our profession was comparatively unknown, and the great and beneficial results which have sprung from it were never anticipated; now it is universally in the ascendant, and it may be so with reason, for without presuming to undervalue the merits and importance of other professions, that of the civil engineer may be said to embrace everything which can tend to the promotion of the comfort, the happiness, and the civilisation of the human race, and to be established upon principles of the very highest order.

Comparatively speaking, only a few years have elapsed since Great Britain, as regards engineering works, was in a very backward state: she had neither roads, canals, harbours, machinery, nor manufactures worthy of being compared with those of her neighbours on the Continent. Let the comparison be made now, and we find that if we do not surpass every other nation we are inferior to none. And to what may this extraordinary change be attributed, but to the progress of civil engineering? Notwithstanding, however, we have advanced thus far, much still remains to be done. Great as has been the result, we may be said scarcely to have passed the threshold of improvement. It is true we feel the influence of our position, but this can only be maintained by future advancement. To stand still is to retrogade; our career must be onward; and what has been done should only serve as a stimulus to greater exertions. We have still a very wide field before us; let us, therefore, by our exertions, cultivate it to the very utmost; let us never rest satisfied so long as anything remains to be done.

Much yet remains to be discovered in the formation, construction, and maintenance of harbours, in order to afford the greatest facility of ingress and egress under all circumstances, without at the same time diminishing the necessary protection and depth;—in the improvement of rivers, so as to enable them to drain and carry off the floods effectually from the adjacent marsh-lands and valleys, and at the same time to render them capable of navigation to their utmost extent; to point out the most effectual means of enabling them to discharge their fresh waters into the sea or estuaries, and to receive the tidal waters without causing them to deposit the alluvial matter held in suspension by their waters, in such a manner as to form injurious bars or shoals;—in determining the best form and construction of vessels, so as to render them capable of giving the least resistance in their passage through the water, and conveying the greatest burthen or cargo with the utmost safety and velocity;—in determining the best form, dimensions, and construction for locomotive engines for any gauge, so as to combine the utmost capability of producing steam, with the least quantity of fuel, and drawing the maximum load with the greatest velocity, combined with the greatest safety and economy;—in determining the proper width of gauge which shall satisfy all the required conditions of safety, economy, and speed; in determining the most expeditious, safe, and economical means of transferring goods, passengers, and carriages from one line to another, whenever a break of gauge becomes necessary;—in determining the best and most economical mode of constructing and laying down the permanent way, in such a manner as to enable the trains to travel with safety, at the greatest speed the engines are capable of producing, with the least wear and tear either to the permanent way or to the engine and carriages;—in determining the resistance of railway trains; in devising means for obviating the leakage by the valve in the atmospheric system; in discovering a substance for sealing the valve which shall preserve the desired consistency under all degrees of temperature; and in generally investigating that system of traction, in order to remedy any practical defects which may exist, and to ascertain when it may be applied with the greatest advantage;—in the improvement and adaptation of machinery to many new objects in the arts and manufactures, and in the application of chemistry and geology to our operations.

These, and a variety of other improvements, are to be desired, and are worthy of our particular attention and study. The steam engine itself, improved as it is, and wonderful as have been the results produced by it, is capable of further improvements. Its bulk and weight may be further diminished, both in the form and construction of the boiler as well as in the engine itself, and thus, in effect its power may be increased; or it may be reserved to us to discover the means of producing and rendering subservient to our purpose some other power which shall surpass steam, or, perhaps, to substitute for it that all-powerful agent electricity, which Jacobi has already attempted to apply to navigation. Obscure and difficult as the subject may appear now, it may still be realised. Our indefatigable and enlightened honorary member, Faraday, has pointed out the way, and is still proceeding in his distinguished career with remarkable success, and we must not lose the opportunity of profiting by it: in fact, by well-directed and combined exertions, it is impossible to foresee the results which may yet be arrived at.

This Institution, which but a few years ago was scarcely known, has now taken its station amongst the first scientific societies of the kingdom; and as its objects are second to none in importance, whether as regard their public or private utility, so must it continue to flourish and increase in importance if those objects be only legitimately and steadily prosecuted. In order to effect this we must not relax in our exertions, there must be no schism among ourselves; the Institution must be our rallying point; we must all work for the common good. We must contribute to its advancement, as well as that of our profession, by every means in our power—whether by papers, by verbal discussions, by contributions to the model-room or the library, or by the construction of works which shall serve as examples worthy of being followed—in fact, in every practicable manner, each according to our several opportunities.

Let the senior members, both by their precept and example, and their forbearance, courtesy, and assistance towards each other, with liberal and right minded zeal, for the honour of themselves and their profession, point out to the junior members the true road to eminence; and as they, by the common lot of mortality, must quit this transitory scene, let them be succeeded by others fully competent to fill their places, and to enlarge the boundaries of their profession.

On the other hand, let the junior members look up to their seniors as friends, and as sure guides to follow, and from whom we may with confidence seek for assistance in the hour of need; and, banishing all jealousies or other ignoble feelings, let them rally round and support their seniors under all circumstances. Let the chair of this Institution be an object of honourable ambition to the youngest graduate, as a goal to which he may look forward as one of the rewards, and that not the least, of his successful exertions in his professional career.

By thus pursuing steadily, with one vigorous and sure effort, this grand object—the elevation and advancement of the profession—we shall have the proud satisfaction of finding that our exertions will be crowned with success; that the Institution, as well as ourselves, will flourish; and, what is a far nobler achievement, we shall find that by removing, or, at least, diminishing, as far as may be practicable, all physical obstacles by sea and by land to the free communication of nations with each other, and by the invention of new machinery, or other means, to supply their mutual wants, we shall ultimately understand our true interests. Prejudices and national jealousies will vanish, and instead of exterminating each other by that greatest curse of mankind—war, we shall become bound to each other by the ties of peace, and united like one great family, striving together for the benefit of the human race.

A Great Bridge.—The new railroad bridge across the Susquehanna, at Harrisburg, is an immense structure. It is about 4,000 feet long, built upon the improved double-latticed plan. There are 23 spans, averaging 173 feet each; and two arched viaducts, one 53 feet, and the other 84 feet long. The entire cost of this immense structure is short of 100,000 dollars.—*American Paper.*

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

ROYAL SCOTTISH SOCIETY OF ARTS.

March 22.—DAVID MACLAGAN, M.D., F.R.S.E., President in the Chair.

The following communications were made:—

1. "*On the Principles employed in the Decoration of the Room for the Meetings of Proprietors in the Commercial Bank of Scotland, Edinburgh.*" By MR. D. R. HAY.

Mr. Hay showed that there is a demonstrable truth in ornamental design, which constitutes its beauty, independently of any fancy or whim in the individual to whose inspection a work of this kind is presented, and without any reference to what are called the styles of ornamental design; and that this truth was of a mathematical nature, and so far teachable, as to enable the decorator to produce perfect symmetry of form and harmony of colour in almost infinite variety, without copying or even imitating the works of others. Thus proving that we might have a style of decorative ornament belonging exclusively to our own country and our own period. He showed also that the beauty thus produced differed from picturesque beauty, in so far as the former is teachable, while the latter is exclusively the province of genius. In doing this, he referred to the immense quantity of counterfeit high art produced at the present day, and the bad effects of ingrafting this counterfeit upon ornamental design, instead of inculcating the first principles of symmetry of form and harmony of colour. He pointed out what he conceived to be the fallacious proceedings of the Government Schools of Design in these respects.

Mr. Hay next referred to the appropriateness of various kinds of ornamental design, and held up to ridicule the egregious blunder committed by the German decorator, Herr Sang, in the piazza of the Royal Exchange, London, who, instead of following up the architect's idea of massive strength, or referring to the use of the edifice, has bedecked it with a species of (*ornament!*) at once meaningless, flimsy, and fantastic. He then proceeded to show that the decorator ought, on all occasions, to endeavour to follow up the original idea of the architect, and impart the same feeling by his colouring, that the latter had imparted to the general construction and architectural decorations, which, although now generally finished in lath-and-plaster work, imitated, in their configuration, either the marble employed originally in the classical styles of architecture, or the wood employed in those of the middle ages. He then showed that the imitating of marbles and woods was closely allied to high art, and the prejudice against these species of imitative art arose from its being often employed in churches and other public buildings, which are generally painted at the lowest estimate, and consequently exhibit this branch of the decorative art as performed by the lowest grade of artists.

In respect to the principles adopted in the style of decoration employed by Mr. Hay on the ceiling and walls of the room appropriated to the meetings of the proprietors of the Commercial Bank of Scotland, he showed that it depended for its beauty simply upon a combination of geometric with chromatic harmony, being the practical application of a theory which had met the approval of Sir David Brewster, who had also suggested its application to the decorative arts. Mr. Hay, in referring to the great hall of the Society of Arts in London, where he had first introduced this new style of decorative painting, said, that its being in that case necessarily confined to the ceiling, did not put it fairly to the test; but that the walls as well as the ceiling of the proprietors' room in the Commercial Bank being decorated in this way, that apartment might be said to be the *first* in which this new style had been properly exhibited.

Mr. Hay exhibited two finished specimens of the work, with five explanatory drawings. The first specimen was that applied on the ceiling panels, and arose out of a diagram in which the equilateral triangle and circle were harmoniously combined. The second specimen was that of the pattern applied on the walls, which he showed arose from the combination of elliptic bands. Both these specimens represented mosaic or inlaid work, composed of *lapis lazuli*, gold, *giallo-antico*, and *rosso-antico*, while the five explanatory drawings showed the simplicity of their construction, and the nature of their harmony. Mr. Hay referred to a work upon ornamental design, which he published some years ago, for more ample details, and concluded his paper by referring to the ornamental decoration of the title-page and dedication of the *Art-Union Journal*, as examples of the low state of that art in the metropolis, and how much still remained to be done for it even there.

2. "*Drawings of a Patent Atmospheric Railway Valve.*" By PETER FAIRBAIRN, Esq.

This valve seemed to be admitted to be perhaps the most perfect of the kind yet invented. There is no hinge and no necessity for grease to fill up the chinks of the valve. The valve itself consists of strata, so to speak, of different substances:—1st, iron, strong but gently flexible, occupying the lower portion and filling neatly the longitudinal cavity of the exhausting tube; 2nd, vulcanized india-rubber, a little larger, so as to overlap the iron; 3rd, wood, to press down upon the india-rubber, but leaving the sides of the latter free; 4th, strong leather fitting the top of the flange of the tube, which is ground flat, to receive the sides of the leather, thus giving along with the india-rubber a double security to the vacuum; and 5th, a band of iron again, broader than the leather, and bending down at the edges so as to protect it. The inner and outer bands of iron are the portions of the valve on which the wheels act in opening and closing it. The whole valve is lifted out of its seat by the inner wheels during the passage of the piston, and is again replaced in it by one of the outer wheels. It was stated that the specification had been enrolled in October last.

3. "*Improvements in Railway Carriages.*" By Mr. James Wight.

Mr. Wight exhibited a full-sized drawing of his proposed carriage wheels, having the tire at an angle of 45 degrees to the rails, entirely obviating the rubbing and shearing friction of the present wheels, while the load is sustained by the second set of spokes converging at the upper journal of the axle, perpendicular to the rail. His proposed conical form requisite for the periphery of the driving wheels was also exhibited, adapting themselves to the curves over which they pass, and moving freely round without any slipping of the wheels, or twisting of the axles, resulting from their present form; and entirely dispensing with the clumsy artifice of watering the rails from the locomotive, designed to assist their sliding when compassing a curve,—a property the reverse of which is of the utmost importance to the utility of the locomotive. He also suggested an improvement in the mode of traction, by appending the drag hook at the head of a single buffer rod issuing from the centre of each carriage, in place of one from each side as at present, the end of each rod being made to comprehend two convex springs, which are placed under the centre of the carriage, so that either in the traction or propulsion they are compressed simultaneously, and the concussion is sustained at the centre of the carriages without the slightest tendency to throw them off the rails.

April 12.—George Tait, Esq., V.P., in the Chair.

The following communications were made:—

1. "*New Method of Ventilating Public Buildings*, Churches, Schools, Dwelling-houses, &c., by means of Hot-Water apparatus placed at the roof of the building, for extracting the exhaled air;"—successfully employed to ventilate various buildings. Designed and applied by Mr. Robert Ritchie.

Mr. Ritchie gave a short account of the methods which have been usually employed in ventilating buildings, and showed that, as the object was to induce a current from a difference in temperature, the plan he had in previous communications suggested (1843-4), of making use of the heat from hot water or steam, afforded a safe and efficient medium for extracting the exhaled air from apartments. He had since had several opportunities of carrying his views into effect in large buildings, and the result has been quite successful. He then described the method he had adopted at the Justiciary Court-house, Glasgow, and elsewhere. A powerful hot-water apparatus of patent tubes—raised to a high heat, and supplying themselves with water—is placed in a small chamber at the roof, and is heated by a furnace placed at the basement of the building. The apparatus acts as an artificial fire, and from the rarefaction of the air within the chamber the exhaled air from the apartment to be ventilated is drawn towards it, through the ventiducts formed over the ceiling, and rises or is expelled through an elevated chimney or shaft into the atmosphere—the heated current being protected from the action of the wind by means of turncaps or screens.

Mr. Ritchie showed the arrangements he had provided for the regulation or control over the velocity or movement of the air in the room. He pointed out, amongst other advantages of this mode of ventilation, that it was free from all risk of fire, as the furnace might be 50 or more feet from the heated chamber at the roof; that the air within this chamber admitted of simple means of increase; that there was no risk of the reflux of the exhaled vapours, and, even were it so, these could, by no possible means, be mixed with the products of the combustion of fuel: that the apparatus was simply managed, and the expense not greater than other plans in use. He likewise showed the necessity of combining, with every plan for extracting the exhaled air, an adequate supply of fresh air—that buildings, whether heated with or without open fires, should have the means afforded for obtaining a continued supply of moderately warmed air in winter, to replace that which is vitiated by respiration and gas, or which goes off by chimneys. He showed the plan he had adopted for warming the Court-house, Glasgow, and the Commercial Bank, Edinburgh, with simple hot-water apparatus, which afford supplies of fresh air, duly regulated in temperature and humidity. He concluded with pointing out that the principle of the ventilation described was equally applicable to domestic as to public buildings; that a great many rooms might be ventilated with the same hot-water apparatus placed at the roof, and heated at the basement; that the architect (W. Nixon, Esq.) for the New Police Buildings, Edinburgh, had adopted this plan for extracting the exhaled air from the cells and other rooms; that whole tenements (so important to salubrity) might thus be ventilated; for the capabilities of the patent screw joint apparatus was such, when combined with the ingenious systems of continuous circulations, that as much 6000 feet of pipe can be heated with one small fire.

2. "*Improved Chimney Cans or Fumi-Expulsors*," for the Cure of Smoke and Blow-downs in Chimneys. By Mr. James Stewart, jun.

The principle on which these chimney-cans are invented, is to prevent the inconvenience of smoke being sent back into apartments by high winds or by change of wind; and to have the construction of the chimney-cans such as to improve the draught, and to present no obstacle to the free egress of the smoke, nor to the cleaning of the vent; while, in ordinary circumstances, no undue accumulation of soot can possibly arise. The cans being stationary, are less liable to go out of order than the moveable ones in common use. Mr. Stewart stated that their operation had been quite successful, and that they had cured of smoke rooms which before had scarely been habitable. These cans can be made in galvanised iron from 28s. to 30s., or in clay for 10s. 6d. The valve is fixed on the chimney-top or can, to prevent back smoke or down-draught, and is operated upon by a wire or chain from the fire-place.

3. "*Self-acting Cart-Drag or Break*," which is worked by the Horse itself. By William Rutherford, land-steward to the right honourable Lord Douglas.

This break can be fitted up on any two-wheeled cart or coach, with shafts, at a very moderate expense, from the simplicity of its machinery. It consists only of the following parts:—Two wooden rubbers, applied in front to the rims of the wheels, are connected with each end of a cross-bar of malleable iron, 1½ inches deep and ⅝ of an inch thick, placed at right angles to the shafts, and horizontally, below the body of the cart in front of the wheels. This cross-bar is held in its place by keepers of iron attached to the outside of each shaft, leaving about 3½ inches of space for the cross-bar to move backwards and forwards, so that the rubber may be easily withdrawn from or applied to the wheels. To the cross-bar are attached two iron rods, ⅝ths of an inch in diameter, running each below a shaft, and parallel to each other. Two keepers retain each rod below its shaft, and allow it to move freely backwards and forwards. A hook is attached to each rod about two inches from their ends, so that when the horse is yoked by the shoulder and back-chains in the usual way, the back-chains are attached to the hooks. The horse has thus the power, when urged by the load behind, on a steep incline, to press back the rubbers upon the wheels, and retard their progress to any extent desirable. When the rubbers are not required to act, such as when the horse is pulling forward on a level, or going up an incline, the break is kept from touching the wheels by a spring fixed behind the cross-bar to which the rubbers are attached, and pressing that bar forward. Finally, two small keepers and hooks, at the ends of the rods, are used for the purpose of preventing their motion when backing the cart.

4. "*A new Regulating Index for the Pendulum.*" By Mr. James M'Ewan, watchmaker.

The bob of the pendulum is made in two halves, being hollowed in the centre, so as to admit a contrate wheel, carrying on its arbor an index-hand which points on a dial-plate in front of the bob to the words fast or slow; the nut at the bottom of the pendulum being turned, it acts on the wheel by a pinion, and thus any person who has occasion to regulate the beat of the pendulum can see by the index-hand how far he raises or lowers the bob. Of course, Mr. M'Ewan intends this merely for common domestic clocks, and not for fine time-keepers, whose rate would be affected by the mere motion of the index-hand round the dial-plate of the bob.

5. "*An Alveolar Hæmorrhage Compress*," for suppressing undue Bleeding, resulting from the Extraction of Teeth, constructed by Dr. Robert Reid, dentist, was exhibited.

6. Specimens were exhibited of Mrs. H. Marshall's "*Patent Intonaco Cement*," the inventor stating that although only half-an-inch thick upon the lath, its capabilities of resisting fire were very great, and indeed, might be subjected to a trial by fire for a considerable time, while the lath behind it, and in contact with it, would scarcely be singed.

A ist of Prizes to be offered for Session 1847-8 was submitted by the Council and approved of, and ordered to be printed and advertised as usual. (See Advertisement.)

SOCIETY OF ARTS, LONDON.

March 31—Wm. Pole, Esq., F.R.S., V.P., in the Chair.

M. Ricardo, Esq., gave an account of his "*Indicator for ascertaining the Speed of Railway Trains.*" The machine consists of a pair of governors, to which motion is given by means of a band working on a horizontal wheel, attached to one of the carriages; as the speed of the train increases, the governors fly open and pull round a hand, which points out, on a graduated dial, the number of miles per hour at which the train is travelling. The governors are prevented from flying open with a jerk by two pieces of vulcanized india-rubber, which lengthen gradually as the speed of the train increases.

The Secretary read a paper by Mr. T. R. Crampton, "*On the working of his large-wheel narrow gauge Locomotive Engine, the 'Namur,'*" for the design for which he last session received the Society's Gold Isis Medal.—The author having made some remarks on the statement put forth by him last year, as to the advantages possessed by an engine built on his principle over those on the old plan, proceeds to give the following account of the Namur:—

The Namur is a six-wheeled engine, with the whole of the working parts outside.

Diameter of the driving wheels	7 ft. 0 in.
do. supporting do.	3 ft. 9 in.
Distance between centre of the extreme wheels	13 ft. 0 in.
Diameter of cylinder	0 ft. 16 in.
Length of stroke	0 ft. 20 in.
Number of tubes	182
Length of ditto	11 ft. 0 in.
Diameter of tubes, outside	0 ft. 2 in.
Length of fire-box	4 ft. 3 in.
Breadth of ditto	3 ft. 5 in.
Area of fire-grate	14 ft. 6 in.
Surface in fire-box	62 ft. 0 in.
Surface of tubes, inside	927 ft. 0 in.
Total surface	989 ft. 0 in.

This engine is constructed for the Namur and Liege Railway, and has run on the London and North Western Railway, with every variety of train, a distance of 2300 miles. In the course of the experiments the following speeds have been reached:—With a train of trucks loaded with coke, and weighing 80 tons, exclusive of engine and tender, 51 miles per hour on a level;—with a train weighing 50 tons, 62 miles per hour was attained, between Tring and Wolverton. But the most severe test an engine can be put to is when it has no train behind it: an experiment of this kind was tried with the Namur,—Capt. Addington, inspector general of railways, and Capt. Simmonds, his assistant, being on the engine at the time, with which a speed of 75 miles an hour was attained on level ground, going round a curve between London and Harrow. The speed was taken by Captains Addington and Simmonds, and both were perfectly satisfied with its steadiness at that rate of speed. A second engine is building for the North Western Railway with 8 feet driving wheels.—The author concludes by offering, at an early date, to furnish an account of the expense of working the engine, and the consumption of coke, water, &c.

Mr. Harding observed that Mr. Crampton had done perfectly right by increasing the dimensions of the fire-grate, for while the heating surface of the ordinary engines has been quadrupled, the fire-grate has not been increased 30 per cent. He considered that the experiments, as far as they had gone, were quite satisfactory.

Mr. M'Connell considered that the engine had performed very well,—and that Mr. Crampton might congratulate himself on having lowered the centre of gravity, and increased the area of the fire-bars and the size of the driving wheel.

April 14.—Thomas Winkworth, Esq., in the Chair.

The secretary read a communication from Mr. W. C. Fuller, on his "*Vulcanized India-Rubber Buffers for Railway Carriages.*" The invention consists in substituting a series of rings of india-rubber, separated by iron plates, for the ordinary spiral spring. The buffer-rod passes through the centre of the rings, and is protected from being bound by the india-rubber when compressed, by means of a conical flange affixed to the iron plates. The advantages which this invention appears to possess over the ordinary springs are—great reduction in weight—less liability to get out of order—greater facility of increasing or decreasing the power of the spring—and its ready applicability to carriages already constructed, without increase of cost.

Mr. Ricardo wished to know what would be the compression of the buffer under ordinary circumstances—supposing the length of the india-rubber employed to be 3 feet?

Mr. Fuller stated, that the length of stroke required for the buffer is from 10 to 13 inches; that the ordinary strength of the present springs is from 3 to 3½ tons; that is, 3 tons reduces the circular spring to a flat, while the India-rubber is capable of resisting from 5 to 50 tons.

The next communication read was by Mr. Philip Palmer, "*On the Application of Crown Glass Metal to the Manufacture of various Domestic and other Articles.*"—The author commenced his paper by stating, that he did not intend, on the present occasion, to claim the attention of the Society to works of art in glass, but to such as are of recent manufacture, and have arisen out of the repeal of the duty on that material. Before the repeal of the duty, crown glass was only used for glazing windows and for prints, while the various articles for the table were made from flint glass. After describing the difference of manufacture employed in the crown and flint glass, he proceeded to enumerate some of the articles which are now being made of crown glass, and which were never before made of glass; among them were the following:—A glass dairy pan, for setting of cream; the advantage of using glass, instead of zinc, tin, or lead, is its producing a larger quantity of cream—equal, it is stated, to from 30 to 50 per cent. The next articles enumerated were propagating glasses, for horticultural purposes; these supersede the use of metal frames, bee and grape glasses, cucumber tubes and seed protectors, pantiles for roofing, and for domestic purposes, glass pipes, pickle jars, rolling-pins, pastry pans, jugs, &c.

The author having also shown the application of crown glass for coloured railway signal lamps, concluded by stating—"That the success which has attended the exertions of the flint glass manufacturers, and enabled them to produce their brilliant specimens, will (he fears) make these humbler samples appear dull and uninteresting, until their cheapness and applicability show in what their advantage consists."

April 21.—Dr. Roget, Secretary, V.P., in the Chair.

"*On the Manufacture of Shell Cameos.*" By Mr. Gray. Six specimens of shells with the cameos cut upon them were exhibited.

The author commenced by stating that the ancients formed cameos by engraving figures in low relief on different kinds of silicious stones, and generally selected for that purpose those which had layers of different colours, so that the figures, or different parts of the same figures, were of divers colours. Such cameos are now made in Southern Europe and in France, where this art has lately been attempted to be revived; but the hardness of the materials require so much labour to be employed in their fabrication, that they are too expensive to come into general use.

Numerous attempts have been made to substitute various materials, such as porcelain and glass, for the ancient cameos, but their great inferiority has caused them to be neglected. The best, and now most used, substitutes are shells, several kinds of which afford the necessary difference of colour, and are, at the same time, soft enough to be worked with ease and hard enough to resist wear. The shells now used are those of the flesh-eating Univalve, which are peculiar as being formed of three layers of calcareous matter, each layer being a perpendicular lamina, placed side by side. The cameo cutter selects those shells which have the three layers composed of different colours, as they afford him the means of relieving his work; but the kinds now employed, and which experience has taught him are the best for his purpose, are, the Bull's Mouth, the Black Helmet, the Horned Helmet, and the Queen Conch—the two first are the best shells. After detailing the peculiarities of these shells, Mr. Gray proceeded to give an account of the progress of the art, which was confined to Rome for upwards of 40 years, and to Italy within the last 20 years, when an Italian commenced it in Paris, and now about 300 persons are employed in this branch of trade in that city. The number of shells used annually, thirty years ago, was about 300, the whole of which were sent from England, the value of each shell in Rome being thirty shillings. To show the increase of this trade, the number of shells used in France last year was nearly as follows:—

Bull's Mouth,	80,000,	at average price each,	1s. 8d.	..	£6,400
Black Helmet,	8,000,	"	5 0	..	1,800
Horned Helmet,	500,	"	2 6	..	60
Queen Conch,	12,000,	"	1 2½	..	700
	100,500 shells	.. ..	..	..	£8,960

The average value of the large cameos made in Paris is about six francs each, giving a sterling value of £32,000, and the value of the small cameos is about £8,000, giving a total value of the cameos produced in Paris, for the last year, of £40,000; while, in England, not more than six persons are employed in this trade.

The thanks of the meeting were presented to Mr. Gray for his communication, and to Mr. John Turner for two specimens, which he presented to the Society for its museum.

The second communication was "*On a means of rendering Sculptured Sandstone impervious to the effects of our changeable climate and humid atmosphere.*" By D. R. Hay, Esq.,

The author, after stating the nature and structure of the various sandstones, the causes which operate upon them and separate the particles, and the plans usually resorted to for preserving masons' work from the injurious action of the air, said he had found that the ordinary process of saturating the sandstone with linseed oil was ineffectual, and having occasionally used bees-wax as an ingredient in paint, and knowing from experience that it is impervious to the blanching or oxydising influences of the common atmosphere, he considered that if applied to sandstone, it would render it very durable. "I believe (observes Mr. Hay,) that it has been used by the ancients in securing their fresco paintings, by rubbing it upon them, and facilitating its absorption by the application of hot iron, and a similar application has been recommended in modern times in respect to sculptured marble; but such a process must be very uncertain as to its efficiency, in as much as the absorption must be very partial and unequal. The plan I would recommend is applicable to statues, vases, and all sculptured architectural decorations—namely, a trough of suitable capacity must be built of brick, with a furnace under it, and the trough filled with sand; place among the sand, at one end of the trough, a vessel made of tin or copper, and of the requisite capacity, into which put spirits of turpentine or naphtha and bees-wax, in the proportion of two or three pounds of the latter to a gallon of the former, according as the stone to be saturated is more or less porous. Keep the furnace burning until the sand has become sufficiently hot to dissolve the wax amongst the oleaginous or bituminous spirits in the tin or copper vessel. Place the stone to be saturated in the unoccupied part of the trough until it becomes of a temperature equal to that which has dissolved the wax, and if the capacity of the vessel admits, let the sculptured stone be immediately removed from the sand and dropped into the adjoining vessel, when, in a few seconds, it will absorb a sufficient quantity of the wax, held in solution by the spirits, to prevent the humidity of the atmosphere ever acting upon it."

An interesting discussion took place after the reading of the paper, in which Mr. Ray, Mr. Tennant, Mr. C. H. Smith, Mr. Crace, and several other scientific gentlemen, took part.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

April 12.—The followingpaper on the important public question of "*Ventilation*," and how far it may be rendered compulsory by legislative enactments, was read by Mr. J. TOYNBEE.

The author commenced by stating, that the result of the extended investigations, so long conducted by the medical profession, into the nature and treatment of disease, demonstrated that the great duty of every man was to carry out preventive measures. English people seemed to be but little aware of the large amount of disease by which man at the present time is afflicted; and yet the details in Lord Morpeth's recent speech, the returns of the Registrar-General, and statistics from various sources, showed that among them disease was the rule, and health was the exception. Let it be continually repeated, and never be forgotten, that one-fourth of the children born in England die before they reach their fifth year; and out of 49,089 people who died in London in the year 1846, 22,275 were carried off before they reached the fifteenth year; and only 2,241 died of old age, which Boerhaave stated to be the only disease natural to man. In addition to this, it must be known that, as a general rule, when the body is examined after death, whether of a child or adult, one or more organs is found in a state of disease: a fact which induced a physician to state that he looked upon every adult he met in the streets of London as a walking museum of morbid anatomy. If the causes of the 49,089 deaths in 1846 be examined, it will be found that the enormous proportion of 14,368 was from diseases of the organs of respiration. Now it has been shown that the great source of these diseases was the respiration of impure air. To suggest measures for the removal of this great evil, and to prevent some of the most distressing diseases to which mankind is subject, was his object in responding to the request of the Society that he would deliver the present address.

Mr. Toynbee then proceeded to consider the subject in its various bearings. In proof of the necessity for ventilation, he stated that it was of great importance that air should be continually in motion; for, like water, when stagnant, it became offensive and injurious. This was accounted for by the fact, that the air always contained a large quantity of animal and vegetable matter in the form of the ova of infusoria and the seeds of the lower vegetable organisms. But the act of respiration was the great cause of the deterioration of the air. The air in the lungs was exposed to 170,000,000 of cells, having a surface equal to thirty times that of the body; so that during respiration the air was deprived of oxygen, and became loaded with deadly carbonic acid gas, and was rendered totally unfit for a second respiration, being in reality no longer atmospheric air, but a poisonous gas. A second cause of the deterioration of the air is the combustion of lamps, gaslights, candles, &c. A single candle is nearly as injurious to the air as a human being: two fourteen-hole argand burners consumed as much air as eleven men. A third source of atmospheric impurity is the vapour, loaded with animal matter, given off from the lungs and the skin: each of these parts pours out an ounce of fluid every hour; so that, in a church containing 500 people, twelve gallons of noxious fluid are given off in two hours. A fourth source of bad air in towns is the large quantity of decomposing animal and vegetable matter left to give off its effluvia; and the difficulty there is in the renewal of the air in towns by means of the winds, on account of the vicious mode of their construction and their large size. In reference to the impurity of the air of London, Dr. Mantell states that various classes of infusoria, which he was in the habit of keeping alive in his house at Clapham, all died in London; and it is well known that scarcely any plants will live in London.

It was then stated that certain diseases were distinctly traceable to the absence of ventilation—namely, fever, consumption, scrofula, deafness, and that most fertile origin of numerous diseases, the common "cold." It was shown that 120,000 people in England and Wales are always slowly dying from consumption; that there is double the amount of this disease among in-door than there is among out-door labourers; that it was more frequent among women than among men; that in 1839, out of 33 milliners who died in London, 28 died of consumption.

Mr. Toynbee then declared that, up to the present time, the subject of ventilation had been entirely neglected in the construction of rooms, houses, towns, and cities; that the greatest injury had been inflicted upon mankind by this neglect; and, as the population increased, and towns became larger, the evil must become greater, unless remedies were at once carried into effect. Under these circumstances, until society should be sufficiently informed voluntarily to secure its well-being, it was the bounden duty of a government, the enlightened guide of its people, to suggest measures, and see them carried out, to prevent the large amount of misery that the absence of ventilation was producing. The important question, then, was—How far could Government interfere with advantage in enforcing plans of ventilation by legislative enactments?

Mr. Toynbee then submitted the following propositions, for the adoption of Government, to the consideration of the Institute:—

1. That no living, sleeping, or work room shall contain less than 144 superficial feet, or shall be less than 8 feet high.
2. That such room shall have one window, at least, opening at the top.
3. Also an open fireplace.
4. That in every living, sleeping, or work room erected in future, some method shall be adopted of allowing the foul air to escape from the upper part of the room.

He then pointed out the practicability of carrying out this provision, either by the introduction of Arnott's valve into the chimney, thousands of which were at this time in operation, and which might also be adapted to existing chimneys, without fear of smoke, by the addition of a simple contrivance which he described; or a distinct channel might be made for the purpose.

5. That every such room erected in future shall have some means of continually admitting fresh air.
6. In every public building in which gas is used, to insist upon the use of plans to carry off the products of combustion, and not to allow them to escape in a room. Various plans having this object are in operation in hundreds of shops, and may be seen in many shops in Regent-street; by their use not only are the goods in the shop saved from injury, but the health of the people is improved. He was happy to hear that in Covent Garden Theatre not a particle of the products of combustion from the gas was allowed to enter the theatre.
7. That all churches, schools, theatres, workshops, workhouses, and other public buildings, shall adopt such methods of ventilation as are approved by the Medical Officer of Health.

Mr. Toynbee pointed out how these desirable objects were to be effected, and showed that every house and room must be so arranged that it can be supplied with fresh air, to replace the vitiated air which has been removed. Prof. Hosking had carried out these plans in every part of his house; and until they were general, the diseases dependent upon the want of ventilation must be a scourge to society. He observed that in all the stables now erecting, admirable plans of ventilation were adopted. Having given this subject deliberate consideration, he had arrived at the above conclusions; in which, among many others, he was supported by Dr. Sutherland of Liverpool, and Dr. Guy of London—two of his many fellow-labourers in the public-health cause, whose enlightened intelligence was only equalled by their benevolence.

In conclusion, he stated that the various Health of Towns' Associations were at work heart and soul, instructing the masses of the people as to the best means of promoting their physical welfare—a labour in which every enlightened man should join. And he felt that if government would lend all the aid in its power towards carrying out sanitary measures, not only would an enormous amount of misery be saved, but an extent of happiness would be gained of which we had at present only a faint idea.

INSTITUTION OF CIVIL ENGINEERS.

March 23.—Sir J. RENNIE, President, in the Chair.

A paper was read "*On the Ventilation of Mines.*" By Mr. J. RICHARDSON. It dwells at some length on the present methods of ventilation and the objections to them, illustrating the positions by quotations from the best authorities on the subject; all of which went to show, that in spite of all the care and attention that had been given to the question, all the skill of the engineer, and the introduction of the safety-lamp in 1816, the loss of life had been greater since that period than it was in a corresponding period previous to its introduction. This must not be charged entirely to the lamp; for although it might have rendered men bolder, and induced them to trust too much to it in venturing into those parts of the mines which formerly would have been abandoned, still it must be borne in mind, that as the coal was got at greater depths and distances from the shafts, the ventilation becomes more difficult; and, from the greater number of persons emyloyed in one mine, if an accident did occur, the loss of life was greater in proportion. The author then entered into calculations, showing that the dimensions of the "upcast shaft" should in all cases be increased, in proportion to the augmented volume of the air from the expansion of the higher temperature at which it leaves the mine after traversing all the passages; and if this were attended to, not only would the general ventilation be better, but in the event of an accident occurring by an explosion, or the derangement of some of the air-passages from falls of the roof, &c., an extra power could be applied, which would at any rate prevent a portion of the frightful loss of human life which now occurs. The conclusion drawn, however, was, that in almost all cases it was the culpable neglect of, and not the want of means of prevention, that caused the destruction of health, life, and property in the mining operations of the kingdom.

This opinion appeared to be participated in by all the speakers, in the discussion which ensued, and in which the interference of government by legislative enactments, with respect to methods of ventilation, was severely deprecated. It had become fashionable now, whenever a difficulty occurred, to recommend "legislative enactment" as an universal panacea; as if a committee of the house, or a body of commissioners, none of whom probably possessed any practical knowledge of the subject, could at once fall by inspiration upon the methods of prevention or cure which had so long eluded the careful investigation of scientific and practical men, whose time, talents, and fortunes, had been all devoted to the subject, from that great incentive to exertion—self-interest. When the example of foreign countries was quoted, it should be at the same time shown in how backward a state they were in engineering, in mining, in commerce, and, in fact, in everything with which the government interfered, as compared to the high state of perfection arrived at in this country, where there was nothing, fortunately, but competition to urge manufacturers and miners to bring their produce to market of the best quality and at the cheapest possible rate.

March 30, and *April* 13.—The discussion on the above paper was continued through both these meetings, to the exclusion of any other subjects. The methods of ventilation in use in the mining districts were fully described, and their peculiarities discussed. The causes of accident by explosions, and the consequent choke-damp, were inquired into; and the fitness of the attempted methods of prevention or cure was debated upon. The method of exhausting the air was contrasted with that of forcing it forward into levels by means of bellows and pipes. The system used in the north of placing a furnace at the bottom of the up-cast shaft was insisted upon as that best calculated for the extensive coal-mines of that district; while the method introduced by Mr. Gibbons in Staffordshire of exhausting the foul air, by air-heads cut in the top of the coal, connected with a channel in the side of the shaft, terminating in a chimney on the surface, was received as a decided improvement upon the ordinary system in use in that coal-basin, where the extraordinary thickness of 30 feet of the vein of coal renders a peculiar plan indispensable. Various methods of attempting to carry off the foul air from the 'goof,' whether by additional shafts or by bore-holes, were proposed, and shown by mining experience to be totally impracticable, and calculated to be rather prejudicial than useful. The interference of Government was strongly insisted upon, and as decidedly objected to by those miners whose long experience and good judgment entitled their opinions to deference and consideration. It was shown that the foreign mines which were under the constant superintendence of Government engineers, far from being exempt from accident, were not only more liable to the effects of deficient ventilation, but that the actual loss of human life was greater than in England; and that if our mines were subject to the same annoying trammels, the price of fuel must be unduly raised, without any corresponding advantage, or any immunity from danger. There could be no objection on the part of the coal-owners to the formation of an association for regularly inspecting and reporting upon the states of the various mines, and the communication between the various districts of the methods found to succeed best under the attendant peculiar circumstances; but reasons were given why such a power should not be placed in the hands of Government officers.

The subject of safety-lamps and their uses was also discussed: Dr. Reid Clanny's first invention of the lamp in 1813, which necessarily failed from its cumbrous form and general inapplicability for working purposes, and the recent form he had adopted, combining portions of the other lamps in use, so as to show a bright light and yet be free from danger: the extraordinary coincidence of inventive thought between Sir Humphrey Davy and Mr. George Stephenson, the one acting upon purely chemical theory, and the other upon mechanical knowledge and practice, and yet both simultaneously producing lamps which were almost identical, and which still remained very generally in use under the names of the "Davy" and the "Geordie."

April 20.—"*On the Defects in the Principle and Construction of Fire-proof Buildings.*" By Mr. Fairbairn, of Manchester. The paper commenced by insisting strongly on the danger of making use of cast iron beams of large span, without intermediate supports, unless the dimensions of the beams were very large, and pointing out the treacherous nature of a chrystalline metallic body, such as cast iron, when applied to support heavy weights in the construction of buildings. After some further remarks on the importance of a thorough knowledge of the laws which govern the use and application of cast iron as a material in building, under the various strains to which it may be subjected, the author proceeded to investigate the circumstances connected with the fall of Messrs. Gray's cotton mill at Manchester. This building was stated to be about 40 feet long, and 31 ft. 8 in. wide, and to consist of two storeys in height, containing the boilers below and the machinery above, over which, instead of a roof, was a water cistern, covering the whole extent of the building. The first floor was composed of large iron beams, of 31 ft. 8 in. span, without intermediate support; on these beams brick arches were turned, sustaining the whole weight of the upper part of the building. The author then demonstrated, that these large beams were totally inadequate to support the weight of the superincumbent mass, especially as the whole pressure was upon the centre of the beams, which were of a form ill calculated to bear the pressure; added to which, the wrought iron trussing was so badly applied, that the breaking strain was arrived at before the truss rods were brought into a state of tension. The consequence of this was, that one of the lower beams broke in the centre under a less weight than it had previously supported, both under preliminary trial, and when the cistern was fuller than at the time of the accident. The paper closed with some remarks on the delicate and invidious duty of reporting on such accidents as those in which the reputation of gentlemen of high professional acquirements may be involved; and the author expressed his reluctance in condemning the construction of the building in question.

In the discussion which ensued, it was argued that, if proper proportions of material had been observed, the accident ought not to have occurred. It appeared evident that the wrought iron truss rods had been so put on, that they allowed more than the breaking strain of the cast iron to be arrived at, before they came into operation. The instances of the trussed-beam bridges, extensively used by Mr. Stephenson, and other engineers, on railways, were quoted to show, that by a judicious employment of wrought iron trusses upon cast iron beams, large spans might be crossed with safety; and even, in some cases, where, from unseen defects in the metal, a beam had fractured, the brass rods had sufficed to support the structure, and enabled the traffic to be continued across the bridge until the repairs could be effected. In all cases a strength of not less than four to one should be employed, and for such uses as the iron beams of pumping engines, which were exposed to great vibration, and sudden shocks, from the sudden influx of steam below the piston, or the accidental breaking of a pump-rod, the proportions of seven or eight to one should be observed.

CHEMICAL SOCIETY.

March 15.—Lieut.-Col. P. Yorke in the Chair.

"*On the Decomposition of Water by Platinum and Black Oxide of Iron.*" By Dr. G. Wilson.—The interesting researches of Mr. Grove, on the decomposition of water by white-hot platinum, lately made public, have necessarily led to many conjectures concerning the cause of a phenomenon so extraordinary and unexpected. Certain remarkable peculiarities possessed by platinum, and in a less degree by others of the noble metals, have thrown some doubt on the powers of mere heat to effect the decomposition of a compound of such stability as water. The repetition of the experiments with other substances not open to the same objections is, however, a matter of great difficulty. While reflecting on the means of accomplishing this, the attention of the author was accidentally called to the evolution of small bubbles of gas from the fused globules of oxide of iron, produced by burning iron wire in oxygen gas, falling into water. In the hope that this might afford some clue to the phenomenon in question, arrangements were made for performing the experiment in such a manner that the gas evolved should be collected and preserved for examination. This was easily done by directing the fused globules of oxide, by means of an inclined plane of tin-plate, from the jar in which the wire was burned, under the edge of an inverted funnel entering a test-tube immersed in the water of the pneumatic trough. The quantities of gas disengaged by the globules were very unequal; some gave none at all. Generally, globules from the thickest wire produced most gas. The gas on examination, however, was discovered to be pure hydrogen, merely sullied by a trace of atmospheric air; and its origin was at once explained by an examination of the globules themselves, for very many of these latter were found to contain in their centre a kernel of fused metallic iron, which had escaped oxidation when the wire was burned in the gas, and which in a highly heated state coming in contact with water occasioned the decomposition of a portion of the latter in the usual manner. The black oxide of iron does not appear to have the power of further abstracting the oxygen from water. This experiment is, therefore, valueless in elucidating the fact of the decomposition of water by heated platinum. It is probable, too, that the temperature of the melted globules of oxide of iron is really much inferior to that of platinum in the state in which it is employed in Grove's experiment, namely, just at the point of fusion.

Dr. Wilson then argues, that the decomposition of water by a white heat may be referable to the mechanical disruption of the particles in direct contact with the heating body, and not to the decomposing power of heat alone; as the statement that water can be produced by the same processes that disunite its elements would be tantamount to affirming that unlike effects may flow from the same cause, without any alteration in the qualities or conditions of the water.

REVIEWS.

Encyclopædia of Civil Engineering,—Historical, Theoretical, and Practical. By Edward Cresy. Royal 8vo. London: Longman and Co. 1847.

[Second Notice.]

We paused last month in our notice of Mr. Cresy's book, at the interesting subject of engineering in England, of which we only gave one extract, that relating to New London Bridge.

Docks deservedly occupy a considerable space in Mr. Cresy's book, for they are works in which the English have peculiarly distinguished themselves. Indeed, the tidal phenomena of the English coasts have had as much to do with the extension of this class of work as any commercial demand, for whereas in the coasts of Holland and the United States, and in many parts of the world, the rise of tide is little or nothing, on the English coasts it is in all places considerable, and particularly favourable for all kinds of docking operations. In France docks and basins are chiefly for naval purposes, and in the Mediterranean there are no tides, so that England stands almost alone in a class of works which demand great scientific resources, and which are frequently on a scale of colossal grandeur.

Mr. Cresy in taking up this subject prefaces it by a description of the natural features of each river and harbour, which is essential to a proper appreciation of the engineering works. In the Thames, Mr. Cresy states that there are not only the commercial docks in the London district, but Government docks at Deptford, Greenwich and Woolwich, which, with the numerous small basins belonging to ship-builders and merchants, present an accumulation of works of this kind, not elsewhere to be met with, though the area of the Liverpool docks is much more considerable. Another very numerous class of works in the Thames are the landing piers, some on a considerable scale. Mr. Cresy notices the Gravesend piers, but not that at Southend.

In adverting to the east coasts of the island, the author describes some of those harbours which have given so much trouble to the engineer, on account of their shifting channels, and the silting up of their basins. Of Wells harbour he gives a very curious illustration.

It may very well be conceived how well a review of the harbours and ports of England is calculated to bring under the notice of the professional reader a number of works which, however well known in their respective localities, are not familiar to distant engineers, and the particular value of a work of this kind is, that in this way it enlarges the sphere of professional observation, and in so far of professional experience. This is particularly desirable in the present state of engineering, when an engineer from the south may be sent to execute hydraulic works in the north, or an engineer from the east be despatched to the west, and so forth. Were this experience more diffused, we should not see cases, as we have recently done, of steep stone walls being run up as sea walls, under the idea that with strength of material, good masonry, and plenty of concrete, the engineer had done all that was required of him, and that the sea would not tumble it down.

In the present day, railway engineering and surveying employ many members of the profession, whose chief experience is in connection with earthworks, so that when they come to be employed either generally in hydraulic engineering, or are required to execute works of that class in the construction of a railway, they are very apt to find the want of a more extended experience. Hydraulic engineering is so different in its character, and in its application—it varies so much in its forms, according to the localities in which it is practised, that it is well calculated to bewilder the uninitiated or the inattentive. If an engineer runs up a railway embankment, or a viaduct, all he has to care about is that it be made of sufficient material, and with sufficient workmanship, and he has no need to think about it again, for it will stand for ever. Not so if he puts a pier in the sea, or builds a quay wall; in such case, it will require something more than bricks and mortar to secure the efficiency of the work, for though he may lay down what he considers a very strong and sufficient work, it may be that the stronger and the more rigid his materials, the more certainty of its being swept out to sea. Hence the very serious complaints that we hear of the unsatisfactory nature of so many of our hydraulic works; for if in our railway works we are as it were spotless, and without blame, our harbours are perpetual sources of annoyance and complaint. We are therefore particularly glad to see a work like Mr. Cresy's, which carries out on a large scale, and in a comprehensive manner a design, which in the pages of the Journal we have only been able to do piecemeal, and in a very imperfect manner.

Mr. Cresy gives plans of most of the docks in the Thames, with sections of the entrance locks, and also describes the docks at Sheerness. The Hull Docks are given in great detail; Spurn Point affords the author an opportunity of describing the old lighthouse, built by John Smeaton. Hartlepool Docks are also described, and a plan is given.

Many of the Scotch harbours have of late years been improved at a great expense, and the present work contains plans of most of them. Among them we may notice Leith and Dundee. There is also an account and engravings of the Slip at Dundee. Gourdron Harbour, by Telford, is a specimen of a small fishing harbour among rocks. Aberdeen Harbour is accompanied by a plan and engravings, representing the masonry works. Peterhead is another specimen of a harbour constructed among the rocks, and which was partly executed by Smeaton. Frazerburgh and Burghhead are also represented in plans.

Findhorn, Avoch Harbour, Cullen, Fortrose, Mahomac, Kirkwall, Kyle, Rhea, Tabermory, East Tarbet, Small Isles Pier, Feoline, Corran, Androssan, are some of a multitude of works constructed on the Scotch coasts. Of all those named, plans and other engravings are given in the present book. Of the works in the Clyde we do not however notice such ample details.

Liverpool, of course, gives an opportunity for lengthened description, but in this case also we think Mr. Cresy's details might have been given fuller with much advantage. His subject is however so extensive, his space limited, and the amount of information he has given so great, that we cannot quarrel with him even about Liverpool.

Holyhead Harbour is described, and we may observe that this encyclopædia will be found a work of easy reference for plans of docks and harbours.

St. Ive's Harbour and Plymouth are the chief illustrations on the West coast, but the Breakwater and the Eddystone Lighthouse come in for an ample share of description. Many of the courses of the lighthouse are shown, so as to exhibit the manner in which the work was tied in by dovetailed and jointed masonry.

Dover and Ramsgate are the plans given on the South-east coast, with a copious account of the works. The Bay of Dublin, with Kingstown and Howth, serve for examples of Irish works. Jersey Harbour and St. Aubin's close the list of harbours.

Among the lighthouses, of which numerous examples are given, we notice the omission of cast iron lighthouses and screw-pile lighthouses, which are recent additions to the resources of this department of engineering.

As exemplifications of ancient art, Mr. Cresy gives some of the old gates and castles dispersed throughout the country, and thence he proceeds to bridges.

We are not quite disposed to concur in his dictum that no bridges of any consequence in this country were erected previous to the Roman invasion, for we think he has given evidence to the contrary in the case of Old London Bridge. Anciently, bridges were erected of timber in preference to stone, because timber was the material at hand, the cheapest and the most available, as it is used for the same reasons at the present day in many parts of America and Europe. Mr. Cresy gives a history of bridges in England, of which we shall avail ourselves of some extracts.

"*Bridges.*—We have no evidence of any bridges of consequence being erected previous to the Norman conquest, and the names of our principal towns on the banks of rivers, having the word ford attached to them, seems to confirm the opinion that none existed. Following the course of the Watling Street, or great Roman road over the Medway, we meet with Aylesford; over the Darent, Dartford; the Cray, Crayford; the Ravensbourne, Deepford; and so with most other rivers in England. The capital in all probability would first have a bridge in preference to a ferry, which is noticed over the Thames. We have an account of a timber bridge constructed by Etheldred in 1002, which lasted many years, and also of another built in 1165.

The first stone bridge was begun in 1176, by the celebrated Peter of Colechurch, who continued the work during the reigns of Henry II., Richard I., until the second year of the reign of King John, when he died, and was buried in the crypt of the chapel erected over the centre pier.

It appears to have been the custom with the society called the Brothers of the Bridge, when any member died during the superintendence of any important work, to have his remains entombed within the structure; and as all great bridges were provided with a chapel and crypt, every means was afforded for the performance of the annual rites that were usually instituted. The great bridge at Avignon, when built by S. Benezet, or Johannes Benedictus, the first brother and founder of the order, had such a chapel, where he was buried in 1238.

This stone bridge was 926 feet in length, 15 feet in width, and 60 feet in height above the level of the water. It contained a drawbridge, and nineteen broad pointed arches, with massive piers, varying in solidity from 25 to 34 feet, raised upon strong elm piles, covered with thick planks, bolted together.

Timber bridges of very simple construction were long made use of over the wide rivers in England, but no skill was exhibited in the framing, nor any further mechanical principle than that of strength; trees merely squared, were laid side by side, at right angles with the stream, supported on a single row of perpendicular piles, or several rows parallel to each other, capped and cross braced, and sometimes planked over to the height that the water rose, the space between being filled in with stones. The roadway was cross-planked, covered with chalk and gravel, and frequently required repair, in consequence of the air not being admitted to the upper side of the planking.

It would be an endless task to enumerate all the bridges erected in England by the freemasons of the middle ages; many were built, as has been observed in the same manner as the vaults of the chapter houses and cathedral churches; after the piers were carried above the level of the stream, ribs of stone spanned the opening from one pier to the other, and supported a rubble construction laid above them, an arrangement combining both economy and convenience. In subsequent instances we see one or more rings of voussoirs spanning a river, upon which slabs of stone are laid, and the bridge completed; but it must be borne in mind that such ribs only serve the purpose of centres, and cannot have the strength of our modern bridges, where a wedge-like form is given to every portion of the stone.

After the reign of Henry VIII. bridge-building underwent a considerable change; timber constructions again became very common, and some of the principal rivers were crossed by them. In the year 1636, Inigo Jones erected a bridge at Llanwast in Denbighshire, after the method practised in Italy, which was the model for some of the succeeding structures.

It was formed of three segmental arches, the middle spanning 58 feet, with a versed sine of 17, and the breadth of the soffite of the arch 14 feet. The depth of the voussoirs, measured on the face, was 18 inches, the piers were 10 feet in thickness. The pointed arch was no longer used, and the defences of towers and gateways were unnecessary: the passage was made more convenient, and the roadway approached a horizontal line, in consequence of the substitution of vehicles for the pack-horse for the transit of merchandise.

At the commencement of the eighteenth century we find evidences of an attempt to improve the bridges throughout England, but there is no account of any principles by which the engineer could be directed, nor are there any names upon record to whom such constructions were particularly entrusted; what had been done in Italy does not seem to have found many imitators here, and though Newton had discovered the principles upon which mechanical science was based, it was long before the equilibrium of the arch occupied the consideration of practical men. Dr. Hooke had, however, drawn attention to the figure which a heavy chain or rope assumes when suspended at the two ends, and shown the properties of the *catenaria*; but it was not then applied to the construction of bridges."

The exemplifications of the larger bridges of modern times will be found very useful, as they include details of every important work. In most cases the construction of the coffer-dams, centering and auxiliary works is fully shown. Copious extracts are also given from the specifications, particularly valuable in illustration of the workmanship. The railway bridges give so many examples that a very good instance is shown of the enlarged field of practice in the present day. This affords Mr. Cresy the opportunity of describing skew bridges.

Cast iron bridges form a section of themselves, and are followed by suspension bridges, both of which are amply illustrated.

The Ancient World, or Picturesque Sketches of Creation. By D. T. Ansted, M.A., F.R.S., F.G.S., Professor of Geology in King's College. London: Van Voorst, 1847; 8vo. pp. 408; woodcuts.

Some years ago, the readers of French literature were entertained by an abridged version in that language of a work bearing the truly oriental rhyming title, "Takhlis ulabriz fi talkhisi Bariz"—*The purification of gold in the description of Paris.* The author was a young student, the Sheikh Refaa, sent to France by the Pasha of Egypt to complete his education. The original work was published at the Arabic press of Boulaq, in Egypt.

The Sheikh Refaa, though a Mussulman, resided in Paris, for the purpose of learning the philosophy of the Christians. Impressed with the wonders of European civilisation and the magnificence of the city in which his education was completed, he became anxious to overcome the prejudices entertained by his countrymen against the arts, sciences, and institutions of the Franks. The chief difficulty which he experienced was in reconciling the Newtonian system of astronomy with that of the Koran. He remarks that the former is altogether irreconcileable with the account given in the books accounted sacred by the Christian as well as the Koran; and that the orthodox of both creeds will have to exercise great caution in reading the modern scientific treatises; for they are written with such logical precision and mathematical accuracy, that nothing but the strongest faith is proof against their conclusions.

Here was the testimony of a sensible man, whose reason drew him one way and his prejudices another. This state of incertitude was not, however, peculiar to him. A great continental mathematician thought it necessary to preface his investigations with an apology for the discrepancies which did violence to his faith, and made an excuse which meant, as far as any meaning can be attached to it, that he did not see any way of escaping the conclusions of modern science; but if he *must* assent to them, it was against his will. The thunders of the Popes (who, until the present, have always preferred dogmas to proofs) have frequently produced recantations, expressed in a similar spirit.

A numerous and zealous sect existed in our own country not many years since, who denounced the doctrines of Newton as blasphemous, and attributed to the credence they had obtained the temporal calamities of the country. Many half-taught enthusiasts have attempted refutations of the *Principia*,—and with perfect success, if it be a sufficient criterion of success that no one has replied to them. Even within the last twelvemonths, the Quixotic attempt to enter the lists with Newton, Lagrange, and Llaplace, has been renewed by a Mr. Isaac Frost: whose chivalry we should have deemed somewhat too late for the times, had we not read the reviews of his essay. These convinced us of that which otherwise we should have deemed impossible—that Mr. Frost might yet find disciples. It is difficult to decide whether he or his reviewers display the most ludicrous ignorance of the subject with which they imagine themselves acquainted. Why should Mr. Frost despair?—Johanna Southcote was eminently successful in her day, and even now has followers.

Geology is in the same predicament as astronomy—it is unanswerable, but heterodox. It is true, that various disputants have appeared, and among them those of whose education better results might have been anticipated. For example, the Dean of York published long letters in the *Times*, in which he demolished geology to his own perfect satisfaction. Had he kept to the question of heterodoxy, he would have been inexpugnable—*cuique in suâ arte credendum est.* But when he descended from the mountain to the plain,—when he attempted to discuss mechanical principles, he admitted the rights of human reasoning and put himself upon a level with his opponents. This was the fatal error of his tactics. He illustrated the motion of planets by the whirling of a pail of water—it was but too evident that he had tried the experiment, and been made giddy by it. He treated of the congelation of igneous vapours—and in language which plainly indicated that he had incautiously exposed himself to their fumes. The good doctor's zeal was worthy of a better cause. An excellent theological library was turned into a bad laboratory, and the Schoolmen and the Fathers were displaced by crucibles and the three mechanical powers.

The philosophers of this school seem to forget that the simple denial of the theories of modern geology is not sufficient; if they reject these, they must substitute others. A vast number of natural appearances have been recorded—the skeletons, exuviæ, and vestiges of by-gone races of animals,—the traces of violent disturbances of the materials of the earth,—and those ancient records to which the Pyramids are ephemeral gossip, are written in so large and legible characters that it seems impossible to dispute their meaning. If, then, the interpretation given by geologists be rejected, have they not a right to demand that a better be supplied? You dispute—say they—our explanation of the facts; the facts themselves cannot be disputed;—how then do *you* explain them?

To this question no reply has been even attempted. But lest the student of geology should feel himself in the same anomolous position as the Sheikh Refaa with regard to astronomy, let him be assured that neither science need, in reality, offend his scruples. The subject has been so hotly debated that, at the risk of appearing to discuss topics not strictly within our province, we will endeavour to show how the discrepancies in question may be reconciled without resorting to scepticism. The view which we take may be best explained by an illustration. Suppose that an eminent writer on the laws of commerce and navigation were in the course of his writings to make incidentally a mistake respecting the construction of steamers or sailing vessels;—would that mistake invalidate the whole of his treatise? A wise reader would discriminate between the two kinds of knowledge, and allow that his author might be thoroughly versed in political and financial economy, and yet be ignorant of engineering and ship-building. In the same manner, when David speaks of the "round world" being made "so fast that it cannot be moved," are his aspirations of thanksgiving the less worthy of reverence because he erred in thinking the world a flat circle instead of a spheroid, and was ignorant that the spot where he indited was moving with a velocity which the swiftest arrow never attained?

What would be thought of the wisdom of a judge who opposed trial by jury because the Jews had no such institution,—who adopted the severe penal code of the forty years' sojourners in the wilderness,—and passed sentence of death where subsequent experience has proved a milder punishment to be more efficacious? Could an English mariner adopt the rules of seamanship practised when Paul navigated the Archipelago;—or a farmer adhere to the Levitical rules for fallow lands;—or an architect imitate the construction of the temple of Solomon? Must modern physicians adopt Hezekiah's plaister of figs, or astronomers prefer his sun-dial to their own chronometers? Must we disbelieve in the existence of America, and suppose Gades the extremity of the world, because the geographical knowledge of the inspired writers was imperfect? Must England imitate "the freest nation on earth," (the United States) and sanction slavery because it is recognized in the Pentateuch? Such, indeed, is our absurd position, if we suppose that their commission extended to purely secular objects; if, in other words (for the whole of the recent confusion on the subject may be referred to this) the same respect be demanded for their *incidental* remarks as for their primary doctrines.

Can anything be more unreasonable than this? Men of every creed admit that when the Queen appoints Royal Commissioners for a particular investigation, their authority does not extend beyond the objects of their commission: and yet those who carry out the analogy in matters of higher import, are reviled for impiety, blasphemy, and scepticism!

One more observation on the question as it affects geology, and we dismiss the subject. The Mosaic account of the creation, like that of Hesiod, was in all probability nothing more than a record of the belief generally prevailing among the contemporaries of the writer. At all events, there is not one word in the accounts which assumes to them a higher character. But however this may be, one thing is certain—that the Mosaic account would be inconsistent with itself if interpreted literally. The sun was not created till the third "day;" therefore, during the previous days, there were no means of marking the period of twenty-four hours—the interval between sunrise and sunrise, or sunset and sunset. We are, therefore, forced to a conclusion which no sophistry can elude,—that here, as elsewhere in Hebrew, the day is an indefinite period or epoch. Lastly, be it remembered, that if the Biblical student reject the conclusions of geology, he must do that for which in many cases he is not prepared—extend his scruples to astronomy also: both sciences are equally at variance with the Mosaic cosmogony.

Of Professor Ansted's *Ancient World* the established reputation of the author renders a critical examination unnecessary. The principal object of this work is to present to the uninitiated reader a series of pictures or descriptive representations of the appearance of the earth at different periods of its transition, from the chaotic condition, to that in which it became duly prepared for the habitation of man. With this object in view, Professor Ansted has generally confined himself to the statement of the results of observation, and has frequently deemed it unnecessary to detail the steps leading to those results. In a work intended, not to *prove* the science of geology, but simply to lay before those who are about entering upon its study, a general description (an outline chart, as it were) of the route they are to take, the minuteness of logical induction would be tedious and unnecessary.

The great merit of the work is its fidelity and vividness of description. The wonderful story of creation is not told as an old story; but the reader is put in the position of an actual observer of the phenomena, and is transported to the very scene and time of their occurrence. This method of *realising* the results of science is beneficial to the student, by the strong impression it makes upon his memory; it is profitable, also, to the more advanced in knowledge. The advantage of clearly tracing out the results and actual applications of science can only be duly estimated by those who have experienced the benefit of this kind of study. The remark applies to both the inductive and exact sciences. The philosopher who contents himself with understanding a particular "law," and the method of proving it, is content with knowing half a subject. He must develope the consequences of the law under all the variations of circumstances to which it can be applied—in other words, he must translate it into familiar, untechnical language—before he can be said to have apprehended the whole of its meaning.

Although the work before us displays geology in a new light—not as a description of the fossils of a museum, but as the natural history of animated beings,—although the dust of ages is wiped away from these records of the pre-adamite world, we are not to suppose that the author has given license to his imagination at the expense of scientific accuracy. He exhibits the ancient inhabitants of the earth as living creatures, exhibits their form and size, their habits and manner of living, their relations to coeval animals, their means of securing their prey, and of resisting or eluding hostile attacks,—but nothing is represented or described without authority. These Sketches of Creation are not fanciful sketches. On the contrary, they are drawn with scrupulous adherence to known facts, and in many cases, are even left somewhat obscure, because more precise representations of the subjects could not be given without the hazard, at least, of inaccuracy.

The opponents of geology are uniformly ignorant of its facts; but those whose prejudices are not too strong, nor intellects too weak, to allow them to learn truth, may acquire the rudiments of the science pleasantly enough from the present treatise. It is sufficiently precise and methodical for a lecture room, and yet far more entertaining than nine-tenths of the new novels. The author has practised an innocent artifice—a pious fraud—upon his readers. While they seek mere amusement, they are being instructed. Correctives of error and wholesome truths are administered as pleasantly, and swallowed as unsuspectingly, as the dosed cakes given to fractious children, who resist medicine in its more palpable form—the unconscious victims fancy they are indulged, while in reality they are being physicked.

It would have perhaps added somewhat to the interest of Professor Ansted's work to the general reader, if the accounts of fossils had been less detailed, and the information respecting the changes which have taken place in the strata composing the earth's crust more ample. When, however, we consider the knowledge which has been wonderfully, but securely, attained from the fragmentary remains of ancient animals, we can scarcely feel surprise that one of the most zealous students of palæontology should desire to confine attention to its results. A striking instance does this new and wonderful study present of the value of accumulated knowledge. By co-operation and unanimity of purpose, by the willingness of each labourer to pursue the task where his predecessor left off, the steep rugged road of knowledge has been made so smooth, and carried so far, that the labours of individuals are almost insignificant compared with the whole work accomplished.

It is no ordinary contemplation to see creatures that perished ages before history—*our* history—began, reanimated by this Promethean flame of science which exhibits them moving freely on the face of the earth that has so long hidden their remains. "Can these dry bones live?" For uncounted cycles of time, their sepulture has been undisturbed. Earthquake, flood, tempest, and volcano's fire have passed over, yet not effaced, them. The rough hands of the miner and the delver reveal these sacred hieroglyphics, and the patient researches of men of science expound them. The one exhibit the world as the repository of the skeletons of nations: the other penetrate the mysteries of the great charnel-house, and unfold one page more of that blazing scroll which records the benificence and power manifested in the works of creation. The dry bones are dry no more: reclothed with flesh, renewed with life and strength, they add yet another testimony to the potency of that voice which is "mighty in operation," and the Vision of the Valley is fulfilled and interpreted anew.

Engineering Field-Notes of Parish and Railway Surveying and Levelling. By H. J. Castle. London: Simpkin and Co., 1847.

This work, which we recently noticed, has already attained a second edition, and which has been improved by adopting some of the suggestions we gave in our review—one of them, adding sketches to the field-book.

The Baronial and Ecclesiastical Antiquities of Scotland Illustrated. By A. W. Billings and W. Burn. Part I. Quarterly. Edinburgh: Blackwood and Sons.

If we may judge of the example before us, this work promises to be one of great interest to the architect and the antiquarian. The present part is illustrated by four well executed engravings of Glasgow Cathedral, which we see are from the drawings of Mr. Billings, a gentleman well known to the Profession for his zeal in promoting works on Gothic architecture.

MR. WARNER'S INVENTION.—THE BALLOON "LONG RANGE."

Extracts from the Journal of the Proceedings of the Committee (Captain Chads, R.N., and Lt.-Col. Chalmer, R.A.) *appointed to inquire into* Capt. Warner's *Inventions, by the Board of Ordnance.*

13th August, 1846.—Capt. Chads and Lt.-Col Chalmer repaired to the official residence of the first lord of the Treasury, where they met Lord J. Russell, the Marquis of Anglesey, Viscount Ingestre, and Capt. Warner, to settle preliminary instructions.

"Much conversation took place on the subject of the course of experiments necessary to test the practicability of the 'Long Range.' Capt. Warner stated that he found it impossible to come to a proper understanding without he was permitted to disclose a part of his secret, which he proposed to do, and which was assented to by the committee, under the sanction and caution contained in paragraph 8* of the master-general's instructions.

"Capt. Warner then produced five drawings, showing that his mode of operation is by means of an air-balloon.

"The committee submitted to Capt. Warner the following experiment, requesting from him an estimate of the cost of carrying it out, viz., that he should construct a balloon capable of carrying 45 projectiles; that he should deposit 15 of these at 4 miles; 15 at 4½ miles; and the remaining 15 at 5 miles." [At a subsequent meeting, held 10th Sept., it was agreed "that the number of projectiles should be 30, instead of 45, and that each projectile should weigh at least 10lb., and that 10 should be substituted for 15 at the distances agreed upon; and it was further agreed upon that Capt. Warner should be in communication with Lt.-Col. Chalmer, with the view of selecting a spot suitable for the experiment, and that he will endeavour to be ready in all respects by the first week in October."]

* "The committee will very fully explain to Capt. Warner that it is not desired that he should reveal his secret, or any part thereof; but if in the course of proceedings he should be desirous of doing so, that it must be in writing, and he must clearly understand that this will not establish any claim on the government for remuneration."

15th August.—Capt. Warner delivered in his estimate for the expenses of the trial proposed to be made to test his "Long Range," amounting to £1300. On the 12th Sept. this amount was advanced by the Treasury and paid into Capt. Warner's bankers.

28th Sept. to 9th Nov., the Journal shows was occupied by Capt. Warner in seeking a suitable situation for the experiments.

"9th Nov.—Lt.-col. Chalmer proceeded to Stafford, having previously received notice from Capt. Warner that a suitable situation for the experiment would be found on Carnock Chase.

"10th Nov.—Lord Ingestre met Lt.-col. Chalmer at Silkmore, near Stafford, took him in his gig to Haywood-park, and was kind enough to lend him a horse for the purpose of surveying the Chase; they rode over this for some hours; Capt. Warner had previously seen the ground, and approved of it, and had selected a place at Haywood-park suitable in all respects for his operations; and as there was a clear uninterrupted space of many miles, Lt.-col. Chalmer consented to the situation for trying the experiment, and, on his return to London, reported accordingly to the Marquis of Anglesey, to whom the Chase belonged, who most readily gave his consent, directing at the same time that every assistance should be given by his keepers; and Capt. Warner was informed to this effect, and requested to proceed with his preparations for the experiment with as much haste as possible, on account of the advanced season of the year.

"20th Nov.—Letter from Lord Ingestre, stating that everything was progressing as fast as possible, and expressing hopes that all would be ready for Monday (23rd), and requesting Capt. Chads and Lt.-col. Chalmer to sleep at Birmingham on Sunday night (22nd), where they should find a letter detailing the movements for the next day.

"22nd Nov.—Capt. Chads and Lt.-col. Chalmer left London by the mail train at 8h. 45m. for Birmingham, where they found a letter from Lord Ingestre, stating that the experiment would not take place the following day.

"23 Nov.—Lt.-col. Chalmer and Capt. Chads took a chaise from Stafford to Haywood-park; the day was very wet, foggy, and unfavourable, so that little was to be seen; they went on to Ingestre, having received the honour of an invitation from Earl Talbot.

"24th Nov.—Lord Ingestre drove Capt. Chads and Lt.-col. Chalmer over to Haywood-park-farm, where Capt. Warner was located, in a wood near which he was preparing his machinery for the experiment. Lord Ingestre went out to seek Capt. Warner, who came to the farm-house by another route. Lord Anglesey rode up to the farm about one o'clock, expecting to find us all there, but Lord Ingestre was not present.

"Captain Warner was asked when he could act? he replied that he must have a northerly wind to give him the necessary range; that he would act from the place on which his machinery now was, as it was not necessary that he should see the spot he was to act against. It was mentioned to Capt. Warner, that we ought to see that all was fair, and that no one went up in the balloon. He objected to our seeing his operations, and, as to any persons going up in the balloon, he stated 'that would be impossible,' as, when the last flight of missiles took place, the balloon would be burnt; that he should drop many more balls than specified as the balloon went along the range, some of them having small flags that they might be the more readily found and seen. One of the balls he showed us, made of copper filled with lead, about the size of a 12 lb. shot.

"The Fair Oak, a large old tree, about three miles distant from the station at Haywood-park, in a S.S.W. direction, was fixed upon as the mark for the flight of shot, and there Capt. Chads was to be stationed, and Lt.-col. Chalmer was to be near the machine. It was pointed out to Capt Warner that he should place the same confidence in us as in those who were assisting him; further, we did not wish to pry into his secret.

"Lord Anglesey met Lord Ingestre after the meeting, and told him what had passed.

"25th Nov.—The following arrangement was agreed upon between Lord Ingestre and Capt. Warner, on one part, and Capt. Chads and Lt.-col Chalmer on the other:—

"1. Capt. Warner to send over to Lord Anglesey as early as possible on the morning of the day on which he means to operate.—2. The time of operation to be as near noon as convenient.—3. A pilot to be sent up half-an-hour precisely, and another five minutes before the operation commences.—4. Capt. Chads will place himself as near the Fair Oak as he judges convenient.—5. Lt.-col. Chalmer will be at the starting point.—6. Lord Anglesey will place himself where he thinks proper.

"Capt. Chad and Lt.-col. Chalmer left Ingestre Hall for Beau Desert, having received the honour of an invitation from the Marquis of Anglesey.

"27th Nov.—Capt. Chads and Lt.-col. Chalmer addressed a letter to Capt. Warner, representing to him the inconvenience the detention occasioned them, and pressing that he should remove to a site from whence he would have greater chance of operating; or that he would inflate the balloon at its present station, and remove it so to a position proper for its ascent, so as to command the necessary direction of range. Mr. Warner replied, that if the wind stood as it then was, he would be able to operate in the course of the next day, and that he would send over to Beau Desert early in the morning to let us know whether he would be able or not.

"28th Nov.—The morning appearing fine, with the wind at north, gave us reasonable hopes that the long-expected experiment would now take place. Lt.-col. Chalmer left Beau Desert at half-past ten o'clock, A.M., for Haywood-park; when within a mile of that position he fell in with a messenger bearing a letter from Lord Ingestre to the Marquis of Anglesey, dated Haywood-park, Nov. 28th, 11 A.M., requesting that Capt. Chads and Lt.-col. Chalmer might be at the four cross roads on the Chase at two o'clock, 'everything being ready.'

"Lt.-col. Chalmer went on to Haywood-park, where he met Capt. Warner, and shortly afterwards Lord Ingestre, who both stated that the experiment would take place at three o'clock.

"Capt. Warner stated to Lt.-col. Chalmer that he had despatched a pilot balloon at 11 o'clock A.M., and that its course was as desired, and that he considered that the whole distance of five miles and the three deliveries of shot would be accomplished within 10 minutes.

"Lord Ingestre stated to Lt.-col. Chalmer that he was deputed by Capt. Warner to convey to him that it was objected to by Capt. Warner's friends (or committee) that he (Lt.-col. Chalmer) should be stationed at or near the balloon, as had been arranged.

"Capt. Warner took Lt.-col. Chalmer into another room, and there showed him the frame, and the method of suspending the shells, and expressed his regret that he could not exhibit more of his plan, or show him the balloon. As Lt.-col. Chalmer could not be permitted to take up the position assigned to him, he preferred returning to the open Chase, and joining Lord Anglesey there, to taking up a position at the gate of Haywood-park, as proposed to him by Capt. Warner.

"Lt.-col. Chalmer left Haywood-park at half-past-two o'clock; Lord Ingestre left about a quarter of an hour afterwards, passed Lt.-col. Chalmer on the road, and conveyed to Lord Anglesey and Capt. Chads the intelligence that the experiment could not begin till half-past three o'clock. and that a pilot balloon would be despatched ten minutes before the large one as a signal.

"Lord Ingestre and Capt. Chads took up their station at the Fair Oak, Lord Anglesey and Lt.-col. Chalmer at the cross roads to the eastward of the Fair Oak, and about a quarter of a mile nearer Haywood-park. Half-past three o'clock had arrived, and all parties waited in anxious expectation, directing their attention towards Haywood-park. At a quarter-past four o'clock, Lord Anglesey left the ground. The sun had set, it was growing dusk, and we gave up hopes of the experiment taking place, when at 20 minutes after four o'clock, Lt.-col. Chalmer perceived the balloon at some height coming from Haywood-park, and, as he thought, directly towards him. He called out loudly, which soon brought Lord Anglesey back to his old position. The balloon continued to approach, its elevation increasing considerably, and it continued visible to Lord Anglesey and Col. Chalmer for more than twenty minutes, taking a more easterly direction (many points wide of the Fair Oak), till it disappeared, from its great elevation. Neither Lord Anglesey or Lt.-col. Chalmer could distinguish anything to fall from the balloon, and they had doubts whether it was the pilot or the large balloon they had seen.

"Lord Ingestre and Capt. Chads had given up all hopes of seeing the balloon that evening, when their attention was called to it by the shouting of Lt.-col. Chalmer; it was at a considerable height, drawing on towards south-east, and rising quickly, till lost sight of by them. When moving on to join Lord Anglesey, they heard a sudden rushing noise to the eastward of them, but nothing was perceptible; and Lord Ingestre and Capt. Chads had also their doubts as to whether the balloon seen was the one containing the shot or only the pilot one.

"Capt. Chads and Lord Ingestre rode to Haywood-park, and there ascertained that it was the balloon with the shot that had been seen; and it being now late, and too dark to make search for the projectiles (or shot), the party left the Chase and returned home.

"29th Nov.—Capt. Chads and Lt.-col. Chalmer left Beau Desert at nine o'clock for Haywood-park, to meet Lord Ingestre and Capt. Warner, for the purpose of ascertaining where the shot had fallen the preceding evening; on their way thither they examined the ground to the eastward of the cross roads, without finding anything. Near the farm-house they met Lord Anglesey's keeper, who had been present at, and assisting Capt. Warner in his experiments; he told them that the balloon had been found last evening half a mile short of the village of Rugeley, which is about three miles distant from Haywood-park, and 1½ to 2 miles to the eastward of the Fair Oak (the object marked out).

"Lord Ingestre and Capt. Warner joined at Haywood-park-farm, and the whole party rode in the direction Capt. Warner pointed out as the most probable line for finding the shot, and after three hours' search, without success, it was abandoned. During a part of this time, Lt.-col. Chalmer separated from the party, and rode over the ground a second time, to the eastward of the position he had occupied during the experiment, but found no shot.

"At about four o'clock, Lord Ingestre proposed to drive Capt. Chads and Lt.-col. Chalmer in his chaise, through Rugeley, on their way back to Beau Desert, and having ascertained that the balloon had been conveyed to the Bell tavern, they stopped there to obtain information.

"On going into the town, they were met by a person whom Lord Ingestre appeared to know, and who informed him that the balloon had fallen about half a mile short of Rugeley the preceding evening (near the four cottages); that some labourers had got hold of it, and had given it up to a gentleman for a guinea: that he (the person who addressed Lord Ingestre) had claimed it as his own, on which disputes arose about it; and some alarm had spread over the village, as some powder, and nine of the shot, were found attached to the balloon, and there was also a suspicion that some one had gone up with the balloon, and had been killed. The police were sent for to take charge of the balloon, &c., and directed by a magistrate to retain it.

"Lord Ingestre told the police that he was a magistrate, and that there was nothing improper intended, and to give the balloon up to the person claiming it, and that he (Lord I.) would be responsible for their so doing; to which they assented. This person then went with Lord Ingestre and Capt. Chads to a stable; showed them the balloon, and explained the circumstances of its ascent, and was quite conversant upon the subject. On Lt.-col. Chalmer's entering the stable, he recognised this person to be one of the Messrs. Green (the aeronauts), and who stated that the balloon was his property, and named the 'Albion.' Mr. Green was passing under the name of Brown, in order to keep all proceedings as to a balloon being in the neighbourhood a secret.

"Lord Ingestre said that further search should be made by the keepers for the shot, but that then we could do nothing more. We left Rugeley for Beau Desert, and on arriving there we all had an audience of the Marquis of Anglesey, reporting what we had seen and heard, Lord Ingestre acknowledging that he considered the experiment a failure, in which Capt. Chads and Lt.-col. Chalmer fully coincided.

"Capt. Chads and Lt.-col. Chalmer took leave of Lord Anglesey, and returned to Birmingham that night, on their way for London, considering they had now only to make the official report of the experiment.

"Lord Anglesey directed his keeper, Mr. Cockayne, to make diligent search for any of the shot that had been dropped from the balloon in its course from Haywood-park to Rugeley. Reports were received from Mr. Cockayne, dated 8th, 9th, 10th, 11th, and 12th December, 1846, and 10th January, 1847, showing the number that had been recovered, the direction in which they were found, and their penetration into the ground; he also sent up two diagrams, exhibiting (from the positions the shots were found in) the tortuous course of the balloon, which twice crossed the turnpike road from Haywood to Rugeley.

"Mr. Cockayne reports that 18 shot had been recovered: five within 100 yards of where the balloon fell; eight at about three miles from Haywood-park; and five one mile from whence the balloon started (Haywood-park). The penetration was from one to four feet, in hard gravelly soil.

(signed) "H. D. CHADS, Captain, R.N.
"J. A. CHALMER, Lieutenant-Colonel, R.A."

[We propose next month to give an analysis of Sir Howard Douglas's account of the proceedings of himself and the other commissioners appointed to consider Captain Warner's claims.]

MILITARY AND NAVAL ENGINEERING.

LIEUTENANT ROBERTS'S MORTAR.

Some experiments were recently made at Portsmouth, to test an improved mortar, suggested by Lieut. Julius Roberts, of the Royal Marine Artillery. The mortar tried on board the Curfew, a 10-gun brig, was a 13-inch, weighing 5 tons. It was suspended between two cheeks or brackets by a wrought iron spindle or bar of 9 inches in diameter, being attached to this bar by two wrought iron shafts of 5 inches diameter to the trunnions, and a short shackle chain under the muzzle, by which the elevation is altered or maintained to 45 degrees. The brackets above-mentioned stand firmly bolted to a circular oak platform 13 inches thick, having a square hole cut through it, which platform is placed to revolve over a circular hatch or hole on the deck with sufficient bearings for support, and a combing round it, in which two opposite key bolts are allowed to work to prevent the platform rising. The square hole in the platform being immediately over the circular one in the deck, the mortar, by a single 6-inch rope, passed for the purpose, when hanked over the bar and hooked to a chock and ring placed into the muzzle, is lowered, muzzle downwards, at a moment's notice, into the hold, and so secured there, by which the enormous weight of five tons is instantly removed from off the upper deck; the same rope as easily returning it to its mounted position, the muzzle chain being unshackled, or shackled when raised in position for use. By the very simple means of its suspension, the shock, on firing, by the mortar recoiling to it, is greatly reduced, and a consequent reduction of strength and weight of deck, supports, and fittings is likewise effected.

The plan of fitting her supports is admirably arranged for lightness and strength, there being eight upright "struts," or pillars, where the Scourge and other mortar vessels require from 18 to 22, besides additional beams between every one, and fore and aft beams of enormous strength (from 15 to 18 inches square) connecting the whole; saving thereby, in the fittings of Lieut. Roberts's mortar, about 20 tons of this material alone, supposing the mortar in both cases to be the same height from the keel. The jumping up of the mortar, as usually fitted, on firing, is almost as destructive to the vessel as its downward shock, and this was strikingly exemplified in the trials of the mortar fitted to the Scourge steam-sloop, where the bolt securing the mortar to the deck beams was forced upwards with its key-bolt through an iron plate into the beams, the nut requiring screwing up every time, and the muzzle requiring to be lashed down also every time to prevent the mortar jumping backwards. By the principle of Lieutenant Roberts's plans, these evils are entirely removed, the mortar lying harmlessly and only seeking to return to its inert position on the recoil. The platform traverses on an iron bull-ring, and works most easily with two single tackles. It occupies no more room on deck than the present mortar beds; by being suspended as above described, it can be fired to the greatest nicety, the direction of the object fired at being simply taken by two small iron pickets in line with the axis, instead of that awkward and very uncertain method, when a vessel is in motion, by a plumb-line. The mortar just tried is fitted on a vessel in no way calculated to stand any concussion, should any have taken place. These many and very important advantages over the old mortar vessels are bodied in so simple a construction, as to render Lieutenant Roberts's mortar available for any class of vessels.

ARMAMENT FOR WAR STEAMERS.

The Lords Commissioners of the Admiralty, after considerable experience of the power of the various steam frigates and other steamers in the Royal navy, as regards their capabilities of bearing heavy armaments, have resolved to fix the following as the armament of each particular steamer. Vessels of similar, or nearly similar, tonnage and horse-power, are to be arranged in classes:—

Steamers Propelled by Paddles.

STEAM SHIPS.—Terrible, 1,850 tons, 800-horse power; main deck: four 56-pounders of 97 cwt., 11 feet in length; four 8-inch guns of 65 cwt., 9 feet; the 56-pounders on pivot slides, and carriages; the 8-inch guns on common carriages—upper deck: four 56-pounders of 97 cwt., 11 feet, on pivot slides, and carriages; four 10-inch guns, 85 cwt., 9 feet 4 inches, on common carriages: total guns, 16. Penelope, 1,616 tons, 650-horse power; main deck: eight 8-inch guns of 65 cwt., 9 feet, on slides and carriages; two 68-pounder carronades of 36 cwt., 5 feet 4 inches, on Hardy's compressor carriages—upper deck: two 68-pounders of 95 cwt., 10 feet, on pivot slides and carriages; four 8-inch guns of 65 cwt., 9 feet, on slides and carriages: total, 16. Retribution, 1,641 tons, 800-horse power; main deck, none (but it is arranged that all steam ships which do not carry an armament on the main deck shall, if possible, carry four 32-pounders of 56 cwt., for head and stern firing)—upper deck: two 68-pounders of 95 cwt., 10 feet, on slides and carriages to pivot; four 10-inch guns, 85 cwt., 9 feet 4 inches, on slides and carriages: total, 6.

STEAM FRIGATES.—Class 1. Avenger, 1,444 tons, 650-horse power; and Birkenhead, of 1,400 tons, 500-horse power. Upper deck: two 68-pounders of 95 cwt., 10 feet, on slides and carriages to pivot; four 10-inch guns, 85 cwt., 9 feet 4 inches, on slides and carriages; total, 6. At present the Avenger carries, by way of experiment, two 32-pounders of 65 cwt., instead of two of the 10-inch guns.—Class 2 (A). Odin, 1,326 tons, 500-horse power. Main deck: 32-pounders, 56 cwt., 9 feet 6 inches, on common carriages. Upper deck: two 68-pounders, 95 cwt., 10 feet, on pivot slides and carriages; four 10-inch guns, 85 cwt., 9 feet 4 inches, on slides and carriages; total, 12. The steamers also belonging to this class are the Sidon and the Leopard.—Class 2 (B). Gladiator, 1,210 tons, 430-horse power; Sampson (450-h.p.); Centaur (540-h.p.); Dragon (560-h.p.); Firebrand (400-h.p.); Vulture (400-h.p.); and Cyclops (320-h.p.). Upper deck: two 68-pounders, 95 cwt., 10 feet, on pivot slides and carriages; four 10 inch guns, of 85 cwt., 9 feet 4 inches, on slides and carriages; total, 6.

STEAM SLOOPS.—1st class. Gorgon, 1,111 tons, 320-horse power; Bull-dog (500), Fury (515), Inflexible (378), Devastation (400), Sphynx (500), Cormorant (300), Thunderbolt, since wrecked in Algoa Bay (300), Virago (300), Eclair (287), Driver (280), Geyser (280), Growler (280), Styx (280), Vixen (280), Spiteful (280), Stromboli (280), and Vesuvius (280). Upper decks: one 68-pounder of 90 or 95 cwt., 10 feet, and one 10 inch, 85 cwt., 9 feet 4 inches, on pivot slides and carriages. Four 32-pounders of 42 cwt., 8 feet, on Hardy's slides and carriages. Total for all vessels of this class, 6.—2nd class: Medea, 835 tons, 350-horse power, Salamander (220), Hydra (200), Hecate (240), Hecla (240), Hermes (220), and Trident (350). Upper deck: two 10 inch guns, 65 cwt., 9 feet 4 inches, on pivot slides and carriages. Four 32-pounders, 25 cwt., 6 feet, on Hardy's compressor carriages. Total, 6.—3rd class: Ardent, 810 tons, 200-horse power, Alecto (200), Polyphemus (200), Prometheus (200). Upper deck: one 32-pounder, 45 cwt., 8 feet 6 inches, on pivot slides and carriages. Total, 3. A special exception is made in this class of the Janus, 763 tons, 220-horse power, which carries only two 10 inch guns of 85 cwt., 9 feet 4 inches, on pivot slides and carriages.

BOMB STEAMERS.—Scourge, 1,124 tons, 420-horse power; upper deck, one 68-pounder, 95 cwt., 10 feet, on slide, and carriage to pivot; one 13-inch mortar: total, 2.

STEAM GUN-VESSELS.—Class 1. Firefly, 550 tons, 220-horse power. Blazer (120), Tartarus (136), and Flamer (120). Upper deck, one 32-pounder, 42 cwt., 8 feet, on slide and carriage to pivot. Two 32-pounder carronades, 17 cwt., on Hardy's carriages.—Class 1 (A). Grappler 559 tons, 220-horse power. Pluto (100), Columbia (100), Oberon (260), Triton (260), Antelope (260), Acheron (170), and Volcano (140). Two 32-pounders, 56 cwt., 9 feet 6 inches, on slides and carriages to pivot; two 32-pounders, 25 cwt., 6 feet, on compressor slides and carriages; total, 4. Class 2 (A). Spitfire (432) tons, 140-horse power. Porcupine (132), Lucifer (180), Avon (170), Gleaner (130), Shearwater (160), Kite (170), Lighting (100), Meteor (100), and Comet (80). One 18-pounder of 20 cwt., 7 feet, on slides and carriages to pivot; two 18-pounder carronades, 10 cwt., 7 feet, on Hardy's compressor carriages; total, 3.—Class 2 (B). Torch 345 tons, 154-horse power, Locust (100), Harpy (200), Jackal (150), Lizard (150), Bloodhound (150), and Myrmidon (150). One 18-pounder gun of 22 cwt., 7 feet, on pivot slides and carriages, and two 18-pounder carronades, 10 cwt., 7 feet, on Hardy's carriages.

Steam Packets.—Wildfire, 186 tons; Fearless, Dasher, Monkey, and Dwarf. Two 6-pounder brass guns of 6 cwt.

Tugs.—Echo, 295 tons, 140-horse power, African and Confidence. Two 32-pounders of 56 cwt., 9 feet 6 inches, on pivot slides and carriages.

Troop-ships.—Rhadamanthus, 812 tons, 220-horse power, Dee (220), and Alban (120). Four 32-pounders of 42 or 56 cwt., 8 feet, on common carriages.

Steamers Propelled by Screws.

Steam Frigates.—Class 1. Simoon, 1,053 tons, 780-horse power. Main deck: twelve 32-pounders, 56 cwt., 9 feet 6 inches, on slides and carriages. Upper deck: two 68-pounders, 95 cwt., 10 feet, on pivot slides, and carriages; four 10-inch guns, 85 cwt., 9 feet 4 inches, on slides and carriages. Total, 18. Vulcan, 1,747 tons, 700-horse power. Main deck: eight 32-pounders, 56 cwt., 9 feet 6 inches, on slides and carriages. Upper deck: two 68-pounders, 95 cwt., 10 feet, on pivot slides, and carriages; four 8-inch guns, 65 cwt., 9 feet, on slides and carriages. Total, 14. Termagant, 1,556 tons, 620-horse power; Dauntless, 520; Euphrates and Vigilant, 520. Main deck: eighteen 32-pounders, 56 cwt., 9 feet 6 inches, on common carriages. Upper deck: two 68-pounders, 95 cwt., 10 feet, on pivot slides, and carriages; four 10-inch guns, 85 cwt., 9 feet 4 inches, on slides and carriages. Total 24.—Class 2.—Megara, 1,391 tons, 556-horse power, and Pegasus (510). Main deck: four 32-pounders, 56 cwt., 9 feet 6 inches, on slides and carriages. Upper deck: two 68-pounders, 95 cwt., 10 feet, on pivot slides, and carriages; four 8-inch guns, 65 cwt., 9 feet, on slides and carriages. Total, 10.

Steam Sloops.—Class 1.—Conflict, 902 tons, 400-horse power, Desperate, Niger, Enchantress, Falcon, Basilisk, and Florentia. Upper deck: one 68-pounder, 95 cwt., 10 feet; one 10-inch gun, 85 cwt., 9 feet 4 inches, both on pivot slides and carriages; six 8-inch guns, 65 cwt., 9 feet, on slides and carriages; total, 8.—Class 2.—Encounter, 895 tons, 360-horse power, and Harrier. Upper deck: one 68-pounder, 95 cwt., 10 feet; and one 10-inch gun, 85 cwt., 9 feet 4 inches, both on pivot, slides, and carriages; four 8-inch guns, 65 cwt., 9 feet, on slides and carriages; total, 6. Class 3.—Rattler, 888 tons, 200-horse power; and Phœnix, 260; one 8-inch gun, 65 cwt., 9 feet; one 32-pounder, 56 cwt., 9 feet 6 inches; four 32-pounders, 25 cwt., 6 feet, on pivot slides, and carriages, or otherwise if necessary; total, 6.

Steam Gun-boats.—1st Class.—Rifleman, 483 tons, 202-horse power, Sharpshooter, Archer, Parthian, Sepoy, and Cossack; one 68-pounder, 95 cwt., 10 feet; and one 10-inch gun, 85 cwt., 9 feet 4 inches, on pivot slides, and carriages; two 32-pounders of 25 cwt., 6 feet, on Hardy's carriages. Total, 4.—2nd Class.—Teazer, 301 tons, 100-horse power. Minx, Boxer, and Biter; one 8-inch gun, 65 cwt., 9 feet, on pivot slides, and carriages; one brass 6-pounder. Total, 2.

Steam Guard-ships with Auxiliary Power.—Edinburgh, 1,772 tons, 450-horse power. Ajax, Blenheim, and La Hogue. Lower deck: Twenty-six 42-pounders, 66 cwt., 9 feet 6 inches, on common carriages. Quarter deck: Two 56-pounders, 87 cwt., 10 feet, on pivot slides, and carriages; four 10-inch guns, 85 cwt., 9 feet 4 inches, on slides and carriages. Forecastle: Two 56-pounders, 87 cwt., 10 feet, on pivot slides, and carriage. Total, 56 guns.—Eurotas (fr.), 1,168 tons, 350-horse power. Horatio, Seahorse, and Forth. Main deck: Twenty 42-pounders, 66 cwt., 9 feet 6 inches, on common carriages. Quarter-deck: One 56-pounder, 87 cwt., 10 feet, on pivot slides, and carriages: two 8-inch guns, 65 cwt., 9 feet (or two 10-inch guns of 85 cwt., 9 feet 4 inches), on slides and carriages. Forecastle: One 56-pounder, 87 cwt., 10 feet, on pivot slide and carriage. Total, 24.

Steam Frigates with Auxiliary Power.—Arrogant, 300-horse power. Main deck: Twenty-two 32-pounders, 56 cwt., 9 ft. 6 in.; and six 8-inch guns, 65 cwt., 9 ft, on common carriages. Quarter-deck: one 68-pounder, 90 or 95 cwt., 10 feet, on pivot slide and carriage; sixteen 32-pounders, 32 cwt., 6 feet 6 inches, on Hardy's carriages. Forecastle: One 68-pounder, 90 or 95 cwt., 10 feet, on pivot slide and carriage. Total, 46.—Amphion, 300-horse power. Main deck: Fourteen 32-pounders, 56 cwt., 9 feet 6 inches, and six 8-inch guns, 65 cwt., 9 feet, on common carriages. Quarter-deck: One 68-pounder, 90 or 95 cwt., 10 feet, on pivot slide and carriage; eight 32-pounders, 25 cwt., 6 feet, on compression carriages. Forecastle: One 68-pounder, 90 cwt., 10 feet, on pivot slide and carriage. Total, 30.

This return does not include the numerous packets that ply as mail steamers on the various stations round the coast and in our colonial possessions.

Niagara Wire Bridge.—It is stated in the *Rochester Democrat*, that the Niagara Suspension Bridge Company will shortly proceed to the erection of a wire bridge across the Niagara river—the Queen's assent having been obtained. The whole of the stock, 200,000 dollars, has been taken—one half in Canada, and the remainder in New York.

NOTES ON FOREIGN WORKS.

Munich Art-Union.—Audiatur et altera pars.—The Munich Union is on the decrease, evidenced by the reports both of 1845 and 1846. Surely an association which possesses an annual income of nearly 40,000 florins (a large sum of money at Munich!),—might, all other advantages combined, have done more. The public taste, to mention one incident, does not seem to go apace with higher art-tendencies, for amongst 127 pictures open to prizeholders, only *three* historical ones were chosen;—here also the mere hunting after portraits and *genre* painting. Compared with this decline of the Munich art-union, even that of the Düsseldorf art-friends does not bear a comparison—which latter have had painted an altar-piece for the Cathedral of Cologne, adorned the guildhall of Elberfeld with frescoes, and provided similar embellishments for the Emperors'-hall of Aix-la-Chapelle. Even the Art-Union publication (*Vereinsblatt*), which might easily have been elevated to an organ of real art-value, very seldom rises beyond the sphere of ephemeral art, and labours under a mere hunting after external appearances and picturesque effects. This year's exhibition, also, does not afford any very cheerful prospects, although the king has sent to the exhibition some Dutch paintings of his own private gallery. In the department of sculpture, L. Schaller has exhibited a St. Bernard in bronze; and the model of a Penelope, by Brugger, may be also mentioned.

The Valley of Chamouix has been the scene of an awful event. By an avalanche which fell from the Aiguilles-Rouges, and filled the bed of the Arve, the small village of Des Prats on the banks of the rivulet, was completely buried in *débris* of rock and snow, with some considerable loss of life. Another avalanche which came down lately from the crags of the Eisenstein, in Tyrol, buried several persons who were on the return home.

Road over the Alps.—The Sardinian government has given orders to repair and open the gigantic road, which leads from the south of France (Briançon) to Italy. This road over the Mont Genèvre was constructed by Napoleon, in a most solid and costly manner, but has since been neglected and got out of repair and use. It will be of great importance when Turin and Pignerol are connected by a railway.

Public Works in Senegal.—Captain Grammont, R.N. of France, the governor of the above settlement, in opening the legislative assembly, adverted, at some length, to the public works to be executed in the colony. Amongst these, a regulation of the harbour of St. Louis, embankments of the river, and draining of its banks are conspicuous. His excellency very properly observed, that by such improvements the native (Negro) workman will be formed, and the process of material civilisation of Africa advanced.

Legislation of Rivers and Watercourses.—The French Congres Agricole, presided by Prince De Cazes, have discussed the above subject at great length, when Messrs. Toucqneville, Beaumont, and others, were heard. The first fact resulting from these debates is, that there is in France an act of the Legislature relating to these subjects—viz., that of 14th Floréal on XI. Some, however, thought that this law is rather for preventing the bank-people (riverains) availing themselves of the hydraulic advantages of their position in the improvement of their lands. The congress, in fine, emitted several opinions, which will have some weight on the legislature and the government. Amongst these, was the suggestion that the government would watch the execution of the laws relating to the *curage* (flowing) of water not available to navigation—lakes, ponds, and brooks; that the former usages, local regulations, &c. of each county, relative to this subject, be collected, and laid before a board of magistrates and proprietors, for bringing them in concert with the general legislation of the land. The congress recommended to government the appointment of regular officers of the *cours d'eau*. It was also suggested, that the forced participation of proprietors interested in the execution of public works—hitherto merely restricted (by the law of Sept. 16, 1807) to the dykeing of the sea shore and the banks of rivers—should be extended to all works relating to the management and distribution of water. The congress likewise requested, that government should direct its attention to the amelioration of bogs and marshes, by the cutting of great draining canals (*fossées d'assainissement*), to allow the escape of the waters and moisture of whole districts—on which account, no legislative enactment has been hitherto made. (*C'est tout comme chez nous.*)

Navigation of the Seine.—Important works have been begun at Paris for improving the navigation of the river. At la Rapée the basin (*port*) is dredged of stone. Nearly at the embouchure of the canal of St. Martin, a jetty is building for the discharge of goods, for which the Boulevard Contrescarpe will be sacrificed, and all its houses demolished. The whole quay on the left bank, from the Pont de l'Archevèché to the Petit Pont, is taken off, and is to be rebuilt with an inclined road.

Strange Inauguration of a Public Building at Constantinople.—The foundation stone of the branch building of the College of Medicine, which is to be erected near the cemetery of Pera, has been laid with much ceremony. The work has been for some time delayed, because the chief astrologer (Mynedjim-Bachi) of the sultan had declared, that no other day than the 20th February would be propitious for that purpose. Still, the atmosphere did not concur with the right reverend gentleman, as the cemetery presented a lake of mud, caused by the incessant rain and snow which fell during the day.

Canina of Rome.—M. Canina is one of the most active and, we may say, most sterling literary characters of modern Rome. Scarcely has he brought out his great work on general architecture, than "Le Basiliche Christiane di Roma" (a work of older date) appears in a second edition. It is hardly credible how such a performance—145 copper-plate engravings and 102 pages of text, in folio—could be completed in so short a period. At the same time, Cavaliere Canina has published a second edition of "Foro Romano," and has nearly completed a description of all the Etruscan antquities, which either have been discovered on Roman ground or are preserved in its museums. And, therefore, while others are fumbling and *shuldering* how and what to produce, this man grasps at once at everything worthy about him—verifying the old axiom, *audere sapere*. The "Basiliche," moreover, are a work of great practical usage, containing a mass of artistic and professional information and hints, which it would, no doubt, have taken most other men years to find out and collect. The text dwells mostly on the statement and elucidation of facts, which none but a practical architect of M. Canina's stamp could give due justice to—he, who has passed all his life amongst the grandeous remains of Rome, and has searched for and studied those traditions and rules of construction, which have been current there for many centuries past. We trust these few hints will suffice to fix attention to the deep study and research of this last production of the Roman *architetto*.

Polytechnics in Austria.—The emperor of Austria has ordered the establishment of polytechnic institutions, at the charge of the state, at Linz, Brünn, Laybach, and Inspruck. They will comprise the usual course of a three years' (mostly gratuitous) tuition, and be provided with chemical laboratories, polytechnic and industrial collections, libraries, &c. By this addition, each of the chief county towns will have its central polytechnic institution; while agricultural schools, which are now to be established throughout the kingdom, will serve as the necessary complement of national education.

Berlin Society for the Improvement of the Working Classes.—When the great Industrial Exhibition of 1844 had led the minds of Prussian philanthropists and statesmen towards this subject, the experience in the mechanism of such huge associations was so little developed, that a great many obstacles presented themselves, which are now, happily, overcome. Last month, a general meeting took place, when the statutes of the Society were confirmed by the home secretary of state. The main difficulty hinged in the wish of the committee to establish branch Societies throughout the country, which would have made them a kind of *corresponding society*. This has been so changed, that these branches will be unconnected with the central body at Berlin.

Hall of Liberty, in Bavaria.—This structure, whose name (*Befreyungs Halle*) we seem to have truly rendered and translated, is now occupying the chisel of Schwanthaler. Four of the splendid cycle of Victory statues, before noticed (*ante* p. 34), which have to adorn the Hall, are already modelled, and will be reproduced in marble by other artists, as their number will amount in all to thirty-two. It has likewise been previously mentioned that they will stand on a continuous circular stylobate, every two holding a shield, &c. It has become known, of late, that the original idea of forming a wreath as it were of statues, placed within the expanse of an immense rotunda, belongs to King Ludwig himself. The relievos of the metopes, for the Hall, in marble, are also nearly completed, as are likewise the four statues for the gable of the building, which will represent the four tribes of the Bavarian nation. Another work of M. Schwanthaler is now completed—namely, the shield of Heracles; it is cast in bronze and gilt. The original is destined for the Emperor of Austria, and four copies for other sovereigns.

A new Theatre at Vienna.—The foundation of a grand new theatre near the Körathmer-Thor, at Vienna, has been laid. The theatre is to bear the name of the National Theatre, and is to be fitted up on a scale of great magnificence. It is to be finished in two years.

Railway in Switzerland.—The project for a railway running from the Mediterranean, through Switzerland, to the North of Germany includes two gigantic works of art, that by most of those who have been consulted are deemed impossible of execution. These are the piercing of Mount Lukmanier (the *Locus Magnus* of the ancients), to gain access from the Valley of the Tessin to the Valley of the Rhine—and that of the Alps for the line which will link Sardinia with France in the portion comprehended between Oulx and Modane. The engineer Ricci, however, to whom the Sardinian government has intrusted the work, and whom the Swiss and Bavarian government have adopted for their respective shares in the undertaking, after a careful study of the ground is of opinion that the boring of these granite masses is practicable; and has invented a mechanical apparatus for the excavation of the huge tunnels, which has been approved by the Committee of Public Works, and is to be put into immediate operation.

India.—The Ganges Canal, on which £20,000 annually has hitherto been grudgingly bestowed, is now to be proceeded with at the rate of £250,000 a year; it will be completed by 1851. It will irrigate 8,000,000 of acres now comparatively barren, and save 2,000,000 of people from the periodical visitations of famine. Another canal, leading from the Sutlej, 90 miles into the Bhuttee country, is being surveyed.

NOTES OF THE MONTH.

The New House of Lords—Mr. Barry has given us what may be called the first instalment of the new Palace at Westminster, in the opening of the House of Lords. Of this building we have engravings in preparation, which we expect shortly to lay before our readers, when we shall proceed to give a description of this great work. In the meantime, we may say that it has been received with much applause, and is considered as justifying the time, labour, and money expended upon it. It is one of the most superb halls in the world, becoming its purpose of the throne and seat of empire of the most powerful and most wealthy nation in ancient or modern times.

Army and Navy Club.—There were 69 designs sent in for competition for the New Club Room. We understand that during the last month the members of the club were regularly besieged with canvassers for favour; such a practice is highly disgraceful to a profession like that of architecture, and ought to be denounced at the Institute as most dishonourable—but will the Institute stir in the affair? Mr. Tattersal is the successful competitor for the first premium, and Messrs. Fowler and Fisk for the second premium. The designs will be exhibited to the public by tickets, to be obtained of the secretary, until Thursday, 6th inst.

The great engineering achievement of the last month is the opening of the Birkenhead docks, which was celebrated by a sumptuous ceremonial.

It seems now to be decided that the railway from Calcutta to the Upper Provinces of India is to be guaranteed by the Government.

The Great Western steamer has been sold to the Royal Mail Steam Packet Company for 25,000*l.*, exclusive of her plate.

In the course of the last month, the new entrance of the British Museum was thrown open to the public. It is on a large scale.

It is understood that Barry has executed for the Baron de Goldsmid a grand ball-room, which no stranger has yet seen, and the opening of which will be one of the attractions of the season. It is said to be one of the best pieces of decoration in this way yet executed, and to be in the most magnificent style—worthy of the great capitalist and the great architect.

Royal Botanic Gardens.—The winter garden of the Royal Botanic Society in the Regent's Park, which is nearly an acre of garden under glass, has, during the spring, assumed a picturesque appearance, and has been so successful, that with the reduction of the price of glass, this kind of construction is likely to exten. At the present moment, however, we have only the Regent's Park specimen by Decimus Burton, and Marnock, to set against the large winter gardens at St. Petersburgh and Berlin.

Kew Gardens.—The great palm-house at Kew, by Decimus Burton, is getting on. The ground part constitutes a hot air vault or chamber, over which is laid an acre of grating, on which the tubs and pots containing the plants are placed. The design is grand and novel.

A vote has been carried through the House of Commons for the completion of the base of the Nelson column.

The foundations of Miss Burdett Coutts's church in Westminster have been laid.

Among the novel suggestions for the improvement of architecture lately promulgated, is one from New Jerusalem by Mr. D'Israeli, who says in his "Tancred"—"What is wanted in architecture, as in so many things, is—a man. Shall we find a refuge in a committee of taste? Escape from the mediocrity of one to the mediocrity of many? We only multiply our feebleness, and aggravate our deficiencies. But one suggestion might be made. No profession in England has done its duty until it has furnished its victim. The pure administration of justice dates from the deposition of Macclesfield. Even our boasted navy never achieved a great victory until we shot an admiral. Suppose an architect were hanged? Terror has its inspiration as well as competition."—The suggestion is novel, but we must leave the profession to decide on its practicability. Perhaps, next time, Coningsby will suggest who is to be the first victim.

Obituary.—It is with deep regret that we have to record the death of Mr. Charles Holtzapffel, of Charing-cross, aged 41, which took place on the 11th ult. His works on "Turning and Manipulation," we spoke of at the time they were published, as most valuable books, and we repeat they are such that no engineer's library ought to be without. Mr. Holtzapffel was a member of the Council of the Institution of Civil Engineers, and chairman of the Committee of Mechanics at the Society of Arts, and stood pre-eminent as a mechanician of inventive ingenuity.

Copper Ore.—M. Dufrénoy presented to the Academy of Sciences, in the name of Messrs. Rivot and Phillips, engineers, a paper relative to a new mode of operating on copper ore. It consists of a precipitation of the copper by iron, and applies principally to the sulphuretted ores.

Water Test.—M. Dupasquier communicated to the Academy of Sciences, a new mode of testing water, in order to ascertain the quantity of organic matter held in solution. He puts into a glass globe from one to two ounces of water, to which he adds a few drops of a solution of chloruret of gold, sufficient to give it a slight yellow tinge. He then boils the water. If it contains only the ordinary quantity of organic matter of potable water, the yellow tinge remains as it was, even if the ebullition be prolonged. If, on the contrary, the quantity of organic matter be in excess, the water becomes first brown, and then assumes a violet tint, which announces the decomposition of a salt of gold by the organic matter. By prolonging the ebullition, the violet tint becomes deeper and deeper if the quantity of organic matter be considerable. But the mere brown tint alone serves to show that the quantity of organic matter exceeds the ordinary proportion.

Flax Adulteration.—At the Academy of Sciences, Paris, M. Boussingault read a report of a committee on a paper by M. Vincent, relative to the means employed in detecting by a chemical test the admixture of *phormium tenax*, or New Zealand flax, with the hemp and flax of European growth and preparation. The *phormium tenax* does not possess certain qualities essential for naval cordage, and it was considered important to discover the means of detecting its presence. M. Vincent has found that if the *phormium tenax* be immersed in pure nitric acid, its fibres, owing to the presence of some azotic substance, take a blood-red tint; which is not the case with the hemp and flax admitted for use in the navy. Thus it is very easy, by subjecting a rope to the action of nitric acid, to discover whether there has been any admixture of *phormium tenax*. The report of the committee confirms the statement of M. Vincent.

Manures.—At the Academy of Sciences, Paris, a paper was received from M. J. Persoz relative to the influence of certain manures on vegetation. He states that a mixture composed of potass, dried blood, and goose dung was found to have great effect upon vines. He also mentions a manure for hortensias, composed of potass and burnt bones treated with nitric acid.

Railway Abattoir.—At the Trowse station, Norfolk, an abattoir, consisting of two sets of slaughter-houses, has been built and fitted up with every convenience for slaughtering 100 beasts and 300 sheep daily. The buildings and yard are enclosed within high brick walls, and the yard has been divided into compartments or pens for the beasts and sheep. Adjoining the slaughter-house, there is a large tank to supply water. Close to the open end of the houses there is a siding to and from the railway, on which the trucks run to be loaded with carcases.

Iron Bridge Rails.—Mr. Wood, of the British Iron Company's Works, Abersychan, has succeeded in rolling bridge-rails weighing 90 lb. per yard, 30 feet long.

The Admiralty Electric Telegraph.—The lords of the Admiralty have at length directed the extension of the South Western Railway subterranean electric telegraph to the Admiralty at Whitehall. It will branch off in the Strand near the company's present offices.

The "Prince Metternich" Steam Vessel.—This splendid steamer, of 600 tons, and 200-horse power, fitted with Morgan's patent wheels, made her trial trip on Thursday, April 1st, for the purpose of ascertaining her draught of water and average speed, at the standard mile in Long Reach. This vessel and her machinery are the joint production of Messrs. Ditchburn and Mare, of Blackwall, and Messrs. Penn, of Greenwich; she was built for the Danube Steam Navigation Company, and constructed expressly to navigate between Galatz and Constantinople, and it is intended she should combine the properties of a sea-going and river steamer, as far as these qualities can be united. The contractors were bound by special agreement to produce a vessel that should realise an average speed of 15 miles per hour, and not to draw more than six feet water with 120 tons of dead weight on board—which she more than realised. At the trial trip she passed up and down the mile six times, with and against the tide, at an average speed of 15¾ miles per hour.

Important Saving in Draining.—A correspondent of the *Nottingham Mercury* states that an enormous saving is to be effected by the use of pipe-tiles made by machinery, instead of horse-shoe tiles made by hand. "There are at this time," he says, on the authority of the chairman of Excise, "in the county of Nottingham, 97 brick and tile-yards, making in the year, by hand, not less than 8,000,000 drainage tiles." The cost of 8,000,000 horse-shoe and 4,000,000 flat tiles is about £16,900, while 8,000,000 pipe-tiles—with which flat ones are not required—may be made for £6,034, or at a saving of £10,866. The writer adds that last summer he made 500,000 pipe-tiles at from 10s. to 12s. per thousand, by a machine which cost him no more than £35. The superiority of pipe-tiles is very great. "They are stronger and less liable to break, both in carriage and in use. They require no flats; they lie more evenly and securely in their bed. No vermin can get into them. They form a better channel for the water, and scour themselves clear of silt. They are much lighter and more portable."

Durham Cathedral.—The inappropriate wooden screen which separated the nave from the choir, and which was placed there by Prior Wessington, between the years 1416 and 1445, together with the great organ immediately above it, has been removed. The organ is to be placed on the north side of the choir, immediately opposite to the bishop's throne, where it will remain permanently if the situation on trial proves suitable. The end stalls will then be thrown back, so as to make more room in the choir —a change long wanted—and a temporary iron railing will be run across to separate the choir from the nave, which railing will be replaced by a permanent screen, when it shall have been determined what description would be most appropriate. A low stone Gothic screen is contemplated. The visitor, on entering the cathedral, will now be struck with the uninterrupted and magnificent view which he obtains of the interior from west to east.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM MARCH 27, TO APRIL 22, 1847.

Six Months allowed for Enrolment, unless otherwise expressed.

Charles May, civil engineer, of Ipswich, Suffolk, for "Improvements in railway chairs, the fastenings to be used therewith, and in trenails."—Sealed March 27.

John Henry Griesbach, of Carlton Villas, Maida Vale, for "Improvements in the construction of railways, and in engines and carriages to run thereon."—March 29.

Alexander Morton, of Morton-place, Kilmarnock, for "Improvements in printing warps."—March 29.

John Fisher, the younger, mechanician, of Radford Works, Nottingham, for "Improvements in the manufacture of lace or weavings."—March 29.

Samuel Hardacre, machinist, of Manchester, for "certain Improvements in machinery or apparatus for opening and for carding cotton and other fibrous substances, and for grinding the cards of carding engines." (Partly a communication.)—March 29.

Henry Woodfall, paper maker, of Footscray, Kent, for "certain Improvements in paper-making machinery."—March 22.

Samuel Millbourne, paper-maker, of Saint Mary's, Cray, Kent, for "Improvements in the manufacture of paper."—March 29.

[The above two patents being opposed at the Great Seal, were not sealed till the 29th March, but are dated the 3rd October, 1846, the day they would have been sealed had no opposition been entered by order of the Lord Chancellor.]

Robert Jones, hot presser and finisher, of Wardour-street, Soho, for "certain Improvements in dressing or finishing goods or fabrics."—March 29.

George Robert Skene, Esq., of Bedford, for "Improvements in making and refining infusing and decoctions."—March 30.

William Phillips Parker, gentleman, of 48, Lime-street, in the City of London, for "an Improved mode of manufacturing cigars." (A communication.)—April 1.

Benjamin Tucker Stratton, agricultural machinist, for "Improvements in railways, and in wheels and other parts of carriages for railways and common roads; partly applicable in the construction of ships or other vessels, and improvements in the machinery for manufacturing certain parts of the same."—April 6.

Charles de Bergue, of Arthur-street, west, in the City of London, engineer, and John Coope Hadden, of No. 11, Upper Woburn Place, in the county of Middlesex, civil engineer, for "Improvements in wheeled carriages, and in panels and springs for carriages and other purposes."—April 8.

William Tharge Stevenson, of Upper Baker street, Lloyd-square, Middlesex, gentleman, for "Improvements in regulating the generating of steam in steam-boilers."—April 8.

David Napier, of Glenhellish, Strachen, Argyleshire, for "Improvements in steam engines and steam-vessels."—April 8.

Stephen Moulton, of Norfolk-street, Strand, Middlesex, gentleman, for "Improvements in the construction of bridges." (A communication.)—April 8.

Patrick Moir Crane, of Yniscedwyn Iron-works, near Swansea, for "Improvements in the manufacture of iron."—April 8.

John Mollett, of Austin Friars Passage, for "Improvements in fire-arms and in cartridges." (A communication.)—April 15.

Peter Claussen, of Leicester-square, Middlesex, gentleman, for "certain Improvements in weaving machinery, and in the preparation of the materials employed in weaving." (A communication.)—April 15.

Charles Minors Collett, of Chancery-lane, gentleman, for "certain apparatus and arrangements for affording additional security in locks." (A communication.)—April 15.

James Bobson, of Dover, engineer, for "a new and improved instrument to be used in crushing or expressing oil from vegetable and other substances, and in making oil cake, and which instrument is applicable to the moulding, pressing, and manufacturing the same and other articles from plastic materials."—April 15.

Stephen White, of Winchester-row, New-road, clerk, for "a new means of producing gas, both as to apparatus and materials, from which the gas is produced."—April 15.

Alfred Vincent Newton, of Chancery-lane, mechanical draughtsman, for "Improved apparatus to be applied to steam boilers." (A communication.)—April 16.

Samuel Childs, of Earl's-court-road, wax chandler, for "certain Improvements in the manufacture of candles, and in preparing and combining certain animal, vegetable, and mineral substances, applicable to the manufacture of candles and other uses."—April 15.

George Holworthy Palmer, of Surrey-square, Old Kent-road, civil engineer, for "an Improved method or mode of producing inflammable gases of greater purity and higher illuminating power than those in use, and also in the arrangement of the apparatus employed for the purpose, and which apparatus may be applied to other similar purposes."—April 17.

Joseph Woods, of Bucklersbury, engineer, for "certain Improvements in springs for supporting heavy bodies and resisting sudden and continuous pressure." (A communication.)—April 20.

Osmon Giddy, of Hereford Lodge, Old Brompton, gentleman, for "Improvements in apparatus for sweeping and cleansing chimneys and flues."—April 20.

Philip Burnard Ayres, of Holland-street, Fitzroy-square, doctor of medicine, for "certain plans and improvements in preparing putrescent organic matters, such as night-soil, the matter in suspension in the water of sewers, and other similar matters, for the purpose of manure or for other purposes, and for apparatus for the same."—April 20; four months.

John Walker, of Crooked-lane, engineer, for "Improvements in certain hydraulic and pneumatic machines, and in the applications of steam or other power thereto."—April 22.

John Fisher, the younger, of Radford Works, Nottingham, mechanician, for "Improvements in arranging or folding certain narrow fabrics."—April 20.

Samuel Kenrick, of Handsworth, Stafford, iron founder, for "certain Improvements in preparing or forming moulds for casting metals."—April 20.

George William Rowley, of Welbeck-street, Cavendish-square, gentleman, for "Improvements in the construction of carriages, and in apparatus to be used with omnibuses and other carriages."—April 20.

Thomas Brown, of Muscovy-court, Tower-hill, for "Improvements in machinery for raising and lowering weights." (A communication.)—April 20.

ERRATA.—In the article "Combination of Telescope," &c., in our last number, page 102, line 29, *for* "instead of telescopes—microscopes will come into use," *read*—"instead of microscopes—telescopes."

GLANCE AT SOME OF THE ATTRIBUTES OF ARCHITECTURE.

By Frederick Lush.

O noble Art! to honour whom unite,
Beauty, with Grandeur and Simplicity,
And bright-cheek'd Colour, lovely child of Light,
Link'd by the fairy hand of Symmetry.
O noble Art! how much we owe to thee,
Of calm and holy thought, of feelings high,
When in some splendid pile thy power we see;
Whether the broad-brow'd tower that dares the sky,
The hall by Commerce, or by Science trod,
The palace home of kings, or solemn house of God.

Anne A. Fremont.

Sensible of the influence of the beautiful, all highly civilised nations have surrounded themselves with it as much as possible. The Greeks continually placed before their eyes the statues of their most famous sculptors and the creations of their most famous painters; art and nature reciprocally acted upon each other;—the lover of art, quick in his perception of beauty, grew inwardly like what he beheld; whilst the natural symmetry of the sons of Greece, the grace of the female form, and the proportions of their athletæ, filled the soul of the artist with those vivid conceptions which we see embodied to a great degree in the Apollo, the Venus de Medicis, the Gladiator, and other well known statues of antiquity; and in the highest degree in the works of Phidias. So Michael Angelo imbued his mind with grandeur by the incessant contemplation of the renowned Torso;—so the pictures of the Venetian masters seem as though steeped in their city's rosy twilights and splendid sunsets. Still, beauty will not incorporate itself with the feelings of man, nor shape his works, if he be insensible to its charms. A country has boasted the finest productions of art, whilst her people remained unexcited by an admiration for them. At a period when Italy, for instance, was in possession of her exquisite monuments of taste, and abounded in all the luxuries of its climate, her people sank deeper and deeper into barbarism.

The loss of the advantages derivable from magnificent scenes, owing to a perverted temper of mind through which they are regarded, is eloquently described by Sterne:—"The learned Smelfungus travelled from Boulogne to Paris; from Paris to Rome, and so on; but he set out with the jaundice, and everything he saw was discoloured and distorted: when he returned, he wrote an account of his travels; but 'twas nothing but the account of his miserable feelings." It is not unusual to meet with those who presume to be critics, but show themselves to be only cynics. These are men with hearts too much hardened, and with eyes too much blinded, to enable them to recognise the intrinsic greatness of an object. But the beautiful cannot be justly appreciated, if the mind be not in harmony with it. We can only form a judgment of a work whilst we are in similar disposition with its author; and in possession of the same, or a superior, taste and intelligence to that which it displays. Criticism, as it relates to the fine arts, requires the exercise of the finest, the kindest, the most generous, and the most exalted sentiments and attributes of our nature. It depends upon a knowledge of our internal nature,—upon a habit of turning the mind inwardly upon its own operations, with a frequent observance of external objects. The ancient metaphysicians threw great light on the theory and practice of art,—grounding it on the philosophy of the human mind, as the moderns—especially the Germans—have done;—and a theory that would repose in security, must rest upon such a basis. Our notions of what is good in art are to be built upon certain great truths, and upon unchangeable principles: for the proof of the goodness of all principles consists in their durability; and such laws and elements of beauty can we only consider fixed and settled as are deducible from, and conformable to, the nature of the human mind.

Truth—Utility—Adaptation.—Truth is defined the standard of right reason, the perfection and the end of mind. It is as important in art as it is in morals. We prefer real to fictitious materials, the evidence of a pure taste to what is only the semblance and affectation of it, because "true and just things are in their nature better than false and unjust."* Rochefoucault says,—"*La verité est le fondement et la raison de la perfection et de la beauté; une chose, de quelque nature qu'elle soit, ne sçauroit être belle et parfaite, si elle n'est veritablement tout ce qu'elle doit être et si elle n'a tout ce qu'elle doit avoir.*" [Maxim 294.] Truth and beauty do not differ but concur in one; the real and the ideal, of which they are types, supply the one the means and materials to a work of art, the other the spirit which informs it; the former selects what is most suitable and appropriate to its purposes; the latter gives to the production the utmost perfection of which it is capable.

It was always considered that whatever is useful in architecture, should be rendered pleasing, and what is beautiful should be necessary. The *uses* of a building must be studied before its ornaments; and ornaments, however small or subordinate, must contribute to the general effect, and arise out of, or be grafted upon, the construction itself. Beauty of architecture is greatly dependent upon construction. The figures that give such sublimity to our churches and all our vast edifices, are vaults and domes; and these, at the same time, confer upon them their most essential and most noble attributes. A building may admirably fulfil its intentions in respect of utility, but it would be cold without the additional charms of painting and sculpture;—yet these arts, and all decoration, should never screen any imperfections, but should heighten the general character and mark its destination. It requires for its perfection the introduction and union of all the arts; and such a skilful management of these, that the effect of one shall not impair the effect of another,—but each aid the other and add to the great impression of the whole. In a perfect cathedral, we see the most successful achievements of the grand requirements of architecture—the profound significance and meaning of everything—the highest utility and beauty combined;—materials invested with all the magic hues of poetry, and in their forms and colours so beautifully symbolling forth the religion, as to be called by Coleridge "petrifactions of Christianity."

The architect first adapts the plan and design to its site, and to other circumstances; because the want of good arrangement, of convenience, accommodation, or of stability, and other important requisites, can never be compensated by any pictorial effect. *Vanum est quod non ad finem valet.* Besides, these defects and deficiencies always betray the absence of the necessary qualifications on the part of the designer. Without the fulfilment of the first requisites of art—without that knowledge of statics which is essential to the security and duration of a structure, the character of durability can never be impressed upon it. What makes the churches of Sir C. Wren so beautiful but their poetry?—he proved himself nevertheless to be a great master-builder. Whatever may be the style of architecture, or however various the treatment and execution of its materials; whatever perfection of forms it may exhibit; whether it present itself in the manly simplicity of the Grecian, or the rich profusion of the Gothic; its claims upon our admiration will be in proportion to its durability;—eternity being its sovereign attribute. What would be the long colonnades of antiquity, and the groining and aisles of a York Minster, if the great stones were not indissoluble and the arches in perfect equilibrium? This is their principal source of sublimity. But every work of man that is feeble and perishable suggests feelings similar to those we experience in looking on a human body that is consuming away, and in that process indicating a dissolution of that symmetry and harmony in its fabric which is the cause of its health and strength.

Symmetry—Proportion.—Symmetry produces at regular or proportioned distances of an edifice a unity of features, maintaining order and congruity, amidst, it may be, the greatest variety. The rules of

* Aristotle.

proportion, as applied to the entire design as well as in the minutest ornaments, are observable both in ancient architecture and in the Pointed style of the middle ages. Alberti, Cicognara in his work "Sull Bello," and others, give examples of arithmetic and geometric proportions for halls, apartments, &c. Different proportions belong to different edifices; and one of small dimensions, if its parts are symmetrically disposed, will affect the mind with a greatness of manner which impresses us with an idea of something superior to works bulky in themselves, though ill-contrived. The art of adjusting quantity to various circumstances is noticed by Hope in his "Historical Essay,"—"The Greeks reserved to themselves the right of giving to each, forms more restricted or multiplied, more simple or rich, and proportions more sturdy and delicate, according to the peculiar exigencies of the edifice or situation. To so great a degree was this their practice, that in these respects, between each order and the two others, an almost insensible transition exists, and that every individual instead of uniformly maintaining a vast interval between itself and the two others, such as all extreme specimens of every style present, borders closely upon the next in succession, and almost appears amalgamated with it."

In great works some disproportions far removed from the eye are not discernible; because *la grand' aria mangia.* Without this exaggeration, small parts are swallowed up by the ærial perspective, and no grand effect is produced. Hogarth in his "Analysis of Beauty," refers to the marked variety and relief given by Sir C. Wren to his spires, especially that of St. Mary-le-bow, as proofs of his superior skill on these points. The ancients, and also the mediæval builders, enhanced the importance of their works, and made them at once striking and eloquent, by the care they bestowed on certain features; the power of which spoke immediately to the soul, and excited not merely admiration, but wonder. Yet these things were dictated by optical considerations. "Objects do not appear as they are in reality, therefore the architects endeavour to make their works appear not in their true proportion, but in what they should appear."—(Ancient Maxim.) In our observations of ancient constructions, we must have remarked the various artifices had recourse to for increasing the effect of the ornaments; of boring deep holes by a drill in some parts in order to give them a more decided character when seen from the point at which they would be mostly viewed; of making certain masses stand prominently in advance of the groundwork, and the habit of working the ornaments on their plain blocks in the places they occupy in the building.

Novelty—Variety.—We estimate an architect according to the taste he evinces in forming new and pleasing combinations,—combinations in which we see the feelings which characterise the poet—which bespeak an imagination analogous to that of the poet: the goodness of the originality is the criterion of their talent. *Mens hominis avida novitatis est;* and a necessity forces itself upon the artist to supply this want,—a power of invention which does not imply a neglect of what our predecessors have done, but on the contrary, a profound study and love of their best works; as there was scarcely, for instance, any one so versed in, and so thoroughly pervaded by, the spirit and principles which animated the ancients, as M. Angelo; yet no one so independent of them—always their equal, often their superior. It is in the command of beautiful forms—in breathing new life and vigour into the marble, that man shows his sovereignty as a poet. The attempt at novelty will often yield more delight than an affectation of taste which is foreign to us; for it is an evidence of the exercise of thought, a desire to create, and a disdain of mere imitation. The mind sometimes embodies ideas which are nothing less than mental phenomena, or the effects of a peculiar organisation; which the reason finds it difficult to account for, and the judgment to approve; yet they are valuable on account of their power of awakening curiosity and stimulating reflection. Stewart in his "Philosophy of the Human Mind," speaking of the power of Imagination as connected with Fine Art, says:—"Without taste, imagination can produce only a random analysis and combination of our conceptions; and without imagination, taste would be destitute of the faculty of invention. These two ingredients of genius may be mixed together in all possible proportions, and where either is possessed in a degree remarkably exceeding what falls to the ordinary share of mankind, it may compensate in some measure for a deficiency in the other. An uncommonly correct taste with little imagination, if it does not produce works which create admiration, produces at least nothing which can offend. An uncommon fertility of imagination even when it offends, excites our wonder by its creative powers and shows what it could have performed, had its exertions been guided by a more perfect model."—Art that is the result of this uncontrolled imagination, must be tested not so much by rules and precedents to which it does not profess strictly, if at all, to adhere, as to the feelings or impressions which its effects make on our minds. Our attention must not be drawn to little errors, but to the prevailing beauties which atone for them. Small blemishes are excusable in a grand building—though of course the fewer the better; yet a building, faulty in parts, the great effect of which is imposing, is greater in art than one whose only praise is, you do not see any faults, neither do its beauties impress you. We must adjudge an architect's place in the rank of artist, by virtue of the quantity of sound intellect and true taste which he displays. On this subject Sir C. Wren says:*—"An architect ought to be jealous of novelties, in which fancy blinds the judgment; and to think his judges, as well as those that are to live five centuries after him, as those of his own time. That which is commendable now for novelty, will not be a new invention to posterity, when his works are often imitated, and when it is unknown which was the original: but the glory of that which is good of itself is eternal."—Hence the necessity of referring to and studying those principles of grace, harmony, and proportion which exist in the human mind, and making them the foundation on which we proceed in all matters of design.

* "Parentalia."

HISTORY OF ARCHITECTURE IN GREAT BRITAIN.

A Brief Sketch or Epitome of the Rise and Progress of Architecture in Great Britain. By JAMES ELMES.

"Epitomes are helpful to the memory, and of good private use."
SIR HENRY WOTTON.

Although the ancient Britons may have dug caves in their hill sides and built huts in their woods for dwellings, like most aboriginal people, and formed temples from the interlaced boughs of trees in their groves—all of which are types and prefigurations of styles in architecture; yet its first approach to the dignity of a Fine Art in Britain must be attributed to its Roman discoverers. This great and powerful people carried their arts into every country they subjugated, and civilisation followed their eagles among the remotest barbarians of the North. When Cæsar landed in Britain, he found its inhabitants in as rude a state of barbarism as we did the New Zealanders or the inhabitants of Tahiti, on our first visit to those places. The newly discovered country benefitted greatly by the arts, learning, and civilisation of their invaders, who, wisely appreciating the natural wealth and resources of the country, planted it as a Roman colony, —to the reciprocal benefit of both people.

From the period of the establishment of the Romans in Britain to about the middle of the fourth century, the arts of civilised life made rapid progress; domestic architecture brought comfort and taste into their dwellings; and the sister arts of painting and sculpture added taste and elegance to the most wealthy. A Roman army always brought in its train a body of artists, artisans, literati, and priests. Their commanders, who were always liberal and well educated men, of the equestrian order, were often, like

Julius Cæsar, their own historiographers, or were accompanied by historians and poets to celebrate their achievements. In addition to the Roman and native writers, Britain furnishes in every corner of its island architectural and sculptural remains of much grandeur, whilst tesselated pavements of exquisite designs, pottery, arms, and other relics of the Roman period of British history, attest their accuracy.

The same style and taste in art, and that love of convenience, comfort, and splendour that was found in the chief provinces of Italy and Gaul, which fell short only of imperial Rome itself, pervaded the palaces of the Roman generals and the British chieftains—their coadjutors and allies; and Roman luxuries in architecture, such as hot, cold, and vapour baths, with gymnasia, hyppodromes, theatres, and amphitheatres, were to be found, as their ruins testify, in every Romano-British city or station in the island. Britain abounded at this time with well-built villages, towns, forts, and fortified stations; and the whole country was defended by that high and strong wall, with its numerous towers and intervening castles, which reached from the mouth of the river Tyne on the east, to the Solway Firth on the west.

This spirit of improvement that distinguished every spot whereon the Romans formed a settlement, so much advanced the taste and increased the number of British artists and artificers, that in the third century this island was celebrated for artistical knowledge. When Constantius, the father of Constantine the Great, was about to rebuild the city of Autun, in Gaul, in the year of Christ 296, being well acquainted with Britain, of which country his wife Helena was a native, he procured the ablest of his workmen from there, which, according to Eusebius, greatly abounded with the best artificers.

After the abandonment of Britain by the Romans—whose attention was called by insurrections against their imperial authority in states nearer home to think much of this distant colony, which had been severely ravaged by the Picts and Scots—the classical taste in architecture gradually declined, and was succeeded by various, and in some instances depraved, styles. The country, although divested of Roman armies, had been thoroughly Romanised by the enlightened conquerors; and if no Roman general or person of inferior rank remained behind, the Britons who had been intrusted with command had become half Romans by education.

The earliest city recorded to have been built by the Romans was on the site of our present metropolis, near the spot on which St. Paul's Cathedral now stands, as proved by the remains of a Roman temple discovered when digging for its foundations by Sir Christopher Wren, and others more recently found in taking down a part of old London wall, at the back of the houses on the south side of Ludgate-hill. This city was founded as early as the fifteenth year of the Christian era, and was called Camelodunum; it was destroyed about eleven years afterwards by the Britons, in revenge for the cruel treatment received by Boadicea, queen of the Iceni, from the Romans. It was at that time said to have been a large and well built town, embellished with statues, temples, theatres, and other public structures. From the circumstance of this rapid destruction, perhaps by fire, it is probable the principal buildings of that city were of timber; till the time of Agricola, who finally established the dominion of the Romans in Britain, from which period may be dated the first construction of public buildings in the British capital of brick, stone, and other incombustible materials. Agricola governed the colony during the reigns of Vespasian, Titus, and Domitian, with equal courage and humanity; his residence and seat of government being the new city of Camelodunum, then as now the metropolis of the country.

These points are of some importance, as proving that the Roman style of architecture preceded every other in this island—the hut and cabin alone excepted. The Romans not only erected a great number of solid, convenient, and magnificent edifices for their own use and accommodation, but instructed, exhorted, and encouraged the Britons to imitate them.

At the time when the Saxon dominion was gaining ground in Britain, and before the disturbed times of Hengist and Horsa, public and private dwellings are related to have been constructed with strength and magnificence. In the year of our Lord 480, Ambrosius, a British commander, of Roman descent, who had assumed the regal government of Kent, built for his residence a splendid palace at Canterbury, which he made the metropolis of his small kingdom. During the Saxon heptarchy, domestic and sacred architecture continued to flourish, and buildings of both denominations were erected in the most populous parts of the seven kingdoms. The monks, who were the only architects of the times, and who travelled in fraternities from place to place, as their services were required, were a species of operative Freemasons, keeping their skill and craft within the circuit of their own lodges. In their travels they visited Rome or Roman cities, and the least skilful of them carried away the types of their art in their memories only. From their works arose the style called Saxon, which, as its earliest efforts prove, is a corruption of the Roman style—perhaps provincial, and therefore not in the purest taste,—made by memory, or rude sketches by untaught artists. The Saxon style was called by the monkish writers of those days "Opus Romanum."

The elements of the Saxon style are too well known to the readers of this Journal to need description,—but a reference to the crypt of Lastingham Priory, in Suffolk; the remains of Boxgrave Church, near Chichester, Sussex; Waltham Abbey Church, in Essex; among many other very early specimens of this style, undoubtedly well known to our archæological readers, bear witness to this hypothesis. In these examples will be found rude imitations of bad specimens of Tuscan, Ionic, and Corinthian capitals, with or without entablatures, and with or without archivolts, as seemed best suited to the architect's purpose or his erratic fancy. Bound by fewer rules than the architects of ancient Rome and Greece, the builders of these structures, by giving way to their own picturesque fancies, choosing or rejecting what they had seen at pleasure,—following however the best constructive rules, among which "*a little stronger than strong enough*" was not among the least,—they erected buildings which are still in efficient use; and created a style which is at once picturesque and, with certain effects of natural scenery, worthy the living architect's attention, from its majestic simplicity in some portions, and its singular richness of sculptural embellishments in others.

This native Anglo-Saxon style is well suited for entrance lodges on a large scale, or prospect towers appertaining to an extensive demesne, where the scenery is grand and majestic. Its preponderating, massive, and gigantic features, if well applied, accord with such purposes; particularly where the material is solid and durable, and of rather sombre hue in its *colouring* tints. A Saxon castellated entrance tower and portals of dark blue limestone, so common in the mountainous districts of North Wales and the central parts of Ireland, would form an appropriate adjunct to any of those romantic spots with which these islands abound.

As excellence is always advancing, so did architecture and its sister arts advance with varied steps in this country. Its vicissitudes may be arranged into epochs or eras in somewhat like the following manner, and will be so considered in this inquiry. Namely, from the splendour of the Augustan age—an emanation of which had reached us during the administrations of Claudius, Antoninus, and Agricola—till the declension of pure taste by the expulsion of the Romans, and the substitution of other arts, literature, and customs, formed by the association of the ancient Britons—their Saxon colleagues, which completely established the style called Saxon.

Next arrived that state of transition in which the art continued from the pure Saxon times till the rise, progress, decline, and fall of that eminently beautiful style called Gothic. This style is so varied and so expansive, that it is nearly impossible to catch it within the limits of a definition—it almost eludes description, and has occasioned more schisms among writers on art than other style of architecture extant. It has rules—but they are so discursive and ideal that no true code, like the Vitruvian or the Classical styles, has yet been formed. Some admirers of this style object to the epithet applied to it as derogatory to its importance;—but the Society of Friends scarcely ever object to the title given them originally in derision, and are not offended as being described as the people called *Quakers*. However objectionable the title may appear, it has become too general now to be altered; and the *friends* of the style are bound to receive it as an honourable distinction. Perhaps a more satisfactory title may be obtained by calling it the Anglo-Germanic style. The late Sir John Soane used to tell us students of the Royal Academy, in his lectures, emphaticly that *Gothic* architecture was any thing that was not *Grecian*. Wren unfortunately called it "a gross concameration of heavy, melancholy, and monkish piles." But Wren was blind to the beautiful details of Gothic architecture, although he appreciated those of its scientific construction and its general forms, as his well known reverence for King's College Chapel, Cambridge, which he declared to be inimitable; and his clumsy imitation of York Minster in his west front of Westminster Abbey; his pseudo-Gothic of St. Mary, Aldermary; his almost beautiful imitation of Magdalen Tower, Oxford; in that of St. Michael, Cornhill, tacked by the way to a Doric interior; and his singularly beautiful spire of St. Dunstan in the East, although disfigured by Roman mouldings,—abundantly testify. Nor must the

Gothic construction of some of the concealed parts of St. Paul's Cathedral be omitted in this category of Wren's blindness to the beauty of this style, or of his willingness to be taught by such an enemy to the taste he revered. It is painful to speak thus of a man like Wren, but his fame as a mathematician, and as the greatest constructive architect that England has produced, besides his many other eminent qualities in the highest branches of learning and science, will more than counterbalance this defect, although not a small one.

An eminent living architect and writer on his art, has, on the contrary, pronounced his fiat *ex cathedra* (that is of his own chamber) that Grecian, Roman, Byzantine, or such like architecture, used in ecclesiastical edifices is Pagan and unchristian; as did Taylor the Platonist declare, in as dictatorial a manner, that all who did not believe in the religion of the Platonic school were infamous, daring, and Galilean. What says the anathematizer of Pagan and unchristian edifices, to the "Pagan and unchristian" style of the (so called) Cathedral of the Christian world, the throne of gods, vicegerent upon earth; whence in by-gone days were fulminated the anathemas of the head of the Christian church against all heretics and unbelievers? or, of any other of the Christian churches in that self called capital of the Christian world? or, of the beautiful Christian churches of Michael Angelo, Raffaelle, Bramante, Palladio, Scamozzi, and other Christian architects of the Medicean period of Italian art,—to say nothing of the more recent Christian church, designed and executed by the catholic and tasteful Canova?

William Hazlitt justly compares the correctness and chastened rules of Grecian architecture to those of the Greek tragedians, and the elements of its style to the purity of their incomparable language. "A Doric temple," observes this discriminating critic, "differs from a Gothic cathedral, as Sophocles does from Shakspeare." The principle of the one being simplicity and harmony, governed by severe rules; that of the other richness and power directed more by fancy and taste than by too rigid an observance of scholastic discipline. The one relies on form and proportion, the other on quantity and variety, and prominence of parts. The one owes its charm to a certain union and regularity of feeling, the other adds to its effects from complexity and the combination of the greatest extreme. The Classical appeals to sense and habit, the Gothic or romantic strikes from novelty, strangeness, and contrast. Both are founded in essential and indestructible principles of human nature.

If the Gothic style be considered as a *genus* in architecture, it may be divided into three *species*:—the *robust*, the *ornate*, and the *florid*. Under the term *robust*, may be classed all the varieties of Saxon or Early British architecture; under the *ornate*, the Anglo-Norman or English; and under the *florid*, the gorgeously embellished works of the Plantagenets and Tudors, which romantic species flourished resplendently till it reached its meridian grandeur in those ages, and may date its decline from the introduction of classical literature in the reigns of Henry VIII. and Elizabeth, when Roman, or rather Italian, architecture began to mix itself with our native Saxon and British styles, as its words did with our language; and we were then, Shakspeare and Bacon excepted, pedants in both.

Various hypotheses have been formed upon the origin of this beautiful and original style. The learned German critic, Dr. Möller, principal architect to the Landgrave of Hesse, in his Essay on the Origin and Progress of Gothic Architecture, traced in and deduced from the ancient edifices of Germany, with reference to those of England; and the English Archæologist, Sir James Hall, in his profound work on the same subject, derived them from a similar source, namely:—

1. From the sacred groves or thickets of the ancient Celtic nations.
2. From huts made with the entwined branches of trees.
3. From the structure of the framing in wooden buildings.
4. From the pyramids and obelisks of Egypt.
5. From the imitation of pointed arches generated by the intersection of semicircles.

Holbein, and other painter-architects, who flourished in the last Henry, and his daughter Elizabeth, introduced the mongrel style affectedly called Elizabethan, which is neither pure nor classical, but a rambling picturesque style of shreds and patches.

Palladio, the father of that style of architecture which was introduced into England by Inigo Jones, read his Vitruvius in the true spirit of its author; and delineated restorations of ruins of ancient Rome in a purer style than perhaps existed in some of their originals. The style of domestic architecture which this great Italian master formed from his study of these splendid ruins may be gathered from the numerous Roman villas and palaces with which he studded almost every part of his native Italy. Two fine specimens of his immediate style may be gathered from Inigo Jones's adaptation of his quadrifrontal villa at Amesbury, in Wiltshire, and Lord Burlington's little gem at Chiswick, now belonging to the Duke of Devonshire; which Lord Chesterfield declared was so pretty, although not large enough for a chimney ornament, was too large for an appendage to his watch chain. Both are masterly imitations of Palladio's villa, which he erected for the Magnate Biaggio Saraceno at Vicenza, and prove, with Sir Joshua Reynolds, that skilful adaptations are not always plagiarisms.

Had Palladio's views been directed to Greece instead of Italy, and had he studied the ruins of Athens, such as they were in his time, instead of those of ancient Rome, and had delineated restorations of the Propyleium, the Parthenon, the Theseïum, the Agora, the triple temple of Minerva Polias, and other gems of that splendid city, with Vitruvius in his mind, instead of the temples of Fortuna Virilas, of Concord, of Peace, the Theatre of Marcellus, and such like coarse imitations of the Grecian style, —or the ruins of the Greek theatres, instead of the Roman,—he would have formed a school of architecture, founded on those structures whence Vitruvius drew his rules, and as much superior to that called *Palladian* as are the works of Ictinus, Callicrates, and Phidias to the Coliseum, the Amphitheatre at Verona, the palace of Dioclesian at Spalatro, the Golden palace of Nero at Rome, and the other canons from which Palladio formed his style.

The Roman style of architecture was more successfully cultivated in England in the reigns of James I. and Charles I. than in any preceding time since the occupation of Britain by the Romans, both of whom were liberal patrons of Jones;—it perished, as did all the tasteful arts, through the fury of the Iconoclasts and Roundheads of the Commonwealth;—rose again under the fostering patronage of Charles II., who possessed some of the taste, if not the virtues, of his father;—was eclipsed by ignorance and bigotry in the reign of James II.;—and from that period till the reign of George III. a mere blank is presented in the history of the art.

Among the best specimens of our earliest domestic architecture, Hampton Court, in Herefordshire, affords a good example. It is cited, from having come nearer our times in an unaltered state than many others of like antiquity. It was erected in the reign of Richard II. (about 1380), by the Duke of Hereford, afterwards Henry IV. The mansion was thoroughly repaired, or rather restored, about a century ago, by Lord Coningesby, it having been the baronial seat of his ancestors. It contained, after the re-instatement, seven very noble apartments of state, richly furnished, and numerous convenient dwelling rooms and chambers, with suitable offices for a large retinue of servants; extensive gardens, well planted and laid out in the formal style of the times; a large park, and noble demesne; a well stocked decoy, for wild fowl; and every advantage both for pleasure and convenience.

The foreign wars, and civil commotions at home, left the English kings, nobles, and people little time for the cultivation of the Fine Arts. Therefore, no great progress was made in architecture, except in fortified residences for the aristocracy, and ecclesiastical buildings, erected or enlarged by pious devotees and profligate soldiers,—who compounded for their sins committed abroad, by erecting or endowing ecclesiastical buildings and religious services at home, for the good of their souls. This state of foreign warfare and domestic insecurity continued during the reigns of the fourth, fifth, and sixth Henries, till the successful establishment of the Earl of Richmond as Henry VII. gave security and much-required peace to the country. Before the time of Richard III., however, Crosby Hall, which has been recently beautifully restored, was erected; it is a splendid specimen of this style, and was in its day a sumptuous metropolitan residence. The same golden age of English architecture produced that delightful miracle of tasteful and scientific construction—King's College Chapel, Cambridge; and other sacred edifices, that do honour to their authors. Henry VII. completed what may be considered the perfection of the Florid style in his mausoleum at Westminster, now called Henry VII. Chapel,—and brought over to this country Tortegiano, the rival and combatant of Michael Angelo, to execute his magnificent tomb of bronze, for the reception of his mortal remains.

The mixed anomolous style that was introduced into England after the sun of the Tudor style had set, by ornamental and scenic painters from Flanders and other parts of the Low Countries, obtained the patronage of the rich for fashion sake, and in imitation of the bad taste of the court from the middle of the reign of Henry VIII. till the time of James I., Holbein, Zucchero, and their royal mistress, Elizabeth, may be esteemed its sponsors; and it revelled in bold misrepresentations of Palladian purity, grafted upon a Flemish stalk; and abounded in orders upon orders, bows, niches, grotesque imagery, and foliage—"gorgons and hydras and chimeras dire," thrown about with all the redundancy of pictorial wantonness;—half-timbered houses of divers colours; "black spirits and white, blue spirits and grey," grinning horrible defiance to good taste, in this pedantic style, which alike infested our language and our architecture. It closed—to show what height architectural absurdity may reach—in the portal entrance of the schools at Oxford, where the five orders of Italian architecture, caricatured in the worst taste, are piled one upon the other—the brawny Tuscan at the bottom, almost crushed by the superincumbent weight, and the lanky Composite at the top.

This aberration—for style it cannot properly be called—thanks be to the improved taste acquired by Prince Charles and his gay companions, who rubbed off their pedantic rust by continental travel, a better style in art prevailed;—Vandyke superseded Holbein, substituting nature for dry affectation; and Jones threw the nameless and irresponsible architects of the monstrosities of the Elizabethan period into that obscurity which all the endeavours of the elegant pencils of modern draughtsmen have not been able to revive.

The Roman or Italian style of architecture, adapted to domestic economy, was first introduced with classical purity into this country by Inigo Jones, who flourished in the reigns of James I. and his son Charles, and died neglected in the tasteless times that succeeded the beheading of his royal patron. The most distinguished works of this eminent English architect, are the before-mentioned mansion at Amesbury, in Wiltshire; that on the northern side of Greenwich park, which now forms the central building to the Royal Naval School; and at the same time, an appropriate centre to the Royal Hospital as viewed from the river; Shaftsbury House, in Aldersgate-street, formerly the town mansion of the nobleman of that name, and now subdivided into a series of shops and the establishment of the General Dispensary; some town houses on the southern side of Long-acre, the pilasters and Corinthian capitals of which are still in existence; some mansions on the west side of the square called Lincoln's-inn-fields, the ground plot of which he set out the same size as the large Egyptian pyramid; and the grand piazza of Covent Garden, which is fast disappearing under the hands of the building innovators. Among his most celebrated town mansions, may be mentioned that of the Duke of Bedford, on the north side of Bloomsbury-square, which, with its gardens and pleasure grounds, occupied the whole areas of Russell and Tavistock squares, almost up to the New road. It was taken down to make way for the profitable improvements by building speculators of that brown brick suburb of the metropolis. It was a perfect Italian villa, carefully adapted to our climate, and contained among its state apartments an extensive picture gallery. Among its pictures was that fine set of copies from the cartoons of Raffaelle, made on canvas in turpentine colours by Sir James Thornhill, and presented by Francis, Duke of Bedford, to our Royal Academy of Arts.

For the satisfaction of such of our architects who have not yet learned to despise old "Iniquity Jones," as Ben Jonson called him in one of his satires, Harcourt House, on the west side of Cavendish-square, still remains in almost its pure pristine state, for their contemplation. But let them be quick about it, for it has already been looked at by the architect of an innovating Joint Stock company, for the purpose of converting it into a series of club chambers, like those of the Albany, Piccadilly. It is not an upholsterer's mansion—all carpeting, flock papering, gilt papier maché, and gewgaws; but a solid substantial structure, of sound brick and stone, marble sculptures, and fine oak carvings; built for ages and for the occupation of a noble English family, who could boast, like the Italian notables, that it was built by their ancestors, generations ago, and had never been occupied but by their own race. The noble founder, to do justice to his architect, has placed his bust in a conspicuous part of the principal front.

Among his works that are still extant is the Dormitory, at Westminster School; its exterior is strongly marked by the prevailing character of his style—a correct manly simplicity, and a just proportion of the component parts characteristic of its use; the interior of the upper story is well enough for the use of the scions of aristocracy who occupy it, and is annually used as the theatre for the performance of the Latin plays by the Westminster scholars.

In enumerating the works of Inigo Jones, his vast and splendid portico to the old cathedral of St. Paul, that was destroyed by the great fire of London, must not be forgotten. Its proportions and dimensions may be seen in Kent's publication of his works; but the vastness and grandeur of this stupendous portico, so far superior to any other in England, and perhaps in Europe, can be better imagined than described. Of the propriety of adding a Roman portico to a Gothic cathedral, much cannot be said; but perhaps the architect contemplated the completion of a Christian cathedral in a similar style with his portico. It has been compared to a pension given by a profligate king to a parasitical favourite, as being a good thing ill applied. Lord Burlington said of it, on viewing the new cathedral—"When the Jews saw the second temple they wept."

These works, and some unexecuted designs, published by Kent at the expense of the Earl of Burlington, show the fertility of this architect's mind, and the skill with which he adapted the best styles of Roman architecture to the domestic conveniences required by an English family in our variable climate. His church of St. Paul, Covent Garden, which he built for the parsimonious Duke of Bedford, who desired a mere barn for the use of his Covent Garden tenants, and was informed his desire should be complied with it, but it should be the finest barn in Europe, also shows the dexterity with which Jones could use the plainest materials. It produced the desired effect, and stands alone as a masterpiece of Feudal architecture, proving how the mind of a man of genius can overcome difficulties. It is the only specimen of the true Vitruvian Tuscan ever known to have been executed. The late Mr. Hardwick displayed becoming reverence for the master mind of his great predecessor, by attempting no improvements upon this singular example of church architecture, when he repaired it after a destructive fire.

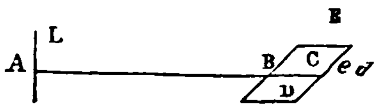
Heriot's Hospital, near Edinburgh, an early work of this architect, before he had matured his taste by foreign travel and the study of the great Italian masters, has little to recommend it, excepting the simplicity and aptitude of the plan to its purpose. The architectural world is indebted to Mr. Goldicutt for some tasteful etchings of the plan and details of this building. The only other work of Jones in Gothic architecture is the Chapel in Lincoln's inn, and proves that neither he nor Wren comprehended the spirit of this beautiful style.

His greatest work, however, was the magnificent palace which he designed for James I., the Banquetting House, Whitehall, now used as a military chapel, being the only part executed. It was to have covered an immense plot of ground, extending from Charing-cross on the north, to Richmond-buildings, Parliament-street, on the south; and from the river on the east, to the Parade in St. James's-park on the west. Four such buildings as the present chapel were designed: one opposite to it, near the site of Melbourne House; the other two, one in a line with it, near Scotland-yard, and the other opposite thereto, on the site of the Admiralty,—and were to be used as a banquetting room, a royal chapel, a throne-room, and a hall of audience. They were to be connected by a variety of state and domestic apartments, official residences, spacious courts for air and light, and every accommodation for a royal palace, suited for the greatest monarch in Europe. The circular court surrounded by an arcade supported by statues, thence called the court of the Caryatides, was one of the finest conceptions that ever emanated from the mind of any architect—ancient or modern. The whole design, which, thanks to the liberality of the great Earl of Burlington, has been published, with numerous and ample details of all its parts, is a perfect school in itself for an architectural student: the masterly skill with which the architect has conquered the difficult arrangements of the state and private apartments, without unnecessary interference with each other,—the manner in which he has arranged the various courts for light and air,—and the underground apartments for domestic use,—and complete drainage necessary for the salubrity of such a vast assemblage of buildings, combined with consummate skill into one perfect whole, should form, with his mansions and villas, the study of every aspirant to architectural honours. These works of Inigo Jones would alone furnish a series of lectures on the skilful adaptation of architectural grandeur to domestic comfort and internal convenience, worthy the talents of the greatest master of the present day. This great English architect and his worthy successor, Sir Christopher Wren, are, to our national disgrace, better understood and more highly appreciated in France and Germany than in their native England.

The only executed portion of this magnificent design—namely, the military chapel or banquetting house—is, like the part from which it is detached, grand in style, but unequal in some of its less important details. The conception of which, considered as the small part of a mighty whole, is in itself noble; its primary divisions are few and simple; its openings large and handsome;—but as a whole it is unequal in composition and in style. The play of light and shade produced by the breaks over each column is, in a minute taste, the very opposite to grand. The Ionic specimen—the invention of which is attributed to Scamozzi, but is really a corruption of the angular capitals of the temple of Minerva Polias—is one of the worst and the most impure that he could have selected; the modillions do not belong to the order, and approach too nearly to those of the Corinthian. If one order upon another be ever admissible, the Corinthian should not have been excluded for the purpose of introducing the Composite.

ON THE SCREW PROPELLER.

In the following paper we propose to examine theoretically the best angle for the worm of the screw-propeller—taking for granted the theoretical formulæ for the resistance of fluids. At some future opportunity, we propose to investigate the problem in a more practical manner, and to supply conditions for the best form of the screw itself, with reference to strength and useful effect.



Let B E D be a small plane rectangular lamina of rigid matter, attached by means of a rigid rod A B, without weight, to an axis A L, which is horizontal, and about which the rod A B can revolve in a vertical plane. Let the rod A B be in the plane E B D and perpendicular to the side E C D; also, let the small lamina E B D make an $\angle\ \theta$ with the vertical plane in which A B rotates; and let the area of the plane E B D $= k$.

If the axis A L be fixed to a vessel floating in water or any other fluid, and the point A be at such a depth below the surface that E B D will always be in the fluid, and A B be made to revolve rapidly in the direction C d,—the resistance of the fluid upon B E D, resolved in a direction parallel to A L, will cause the vessel to move in the direction A L.

Now, the worm of a screw, having A L for its axis (the plane of any element of the worm being supposed to contain the line A B), may be supposed to be made up of an infinite number of small elements, similar to E B D. The rotation of such a screw would, therefore, cause the vessel to move through the water. If the propulsion were caused not by one unbroken worm, but by several portions of the same worm, symmetrically and oppositely disposed about the axis, the resolved parts of the resistances perpendicular to the axis will destroy each other, and the motion of the vessel will be steady and in a straight line. When the vessel is moving with an uniform velocity, the resistance of the water to its motion will exactly equal the resistance to the screw, resolved in the same direction; and the sum of the moments of these two resistances about the centre of gravity of the vessel will be zero.

To return to the consideration of the single element E B D, supposing the vessel moved has a velocity v, and the resistance to its motion is R, let us determine the value of the $\angle\ \theta$, when the amount of moving power expended is a minimum. Let ρ be the density of the fluid; $r =$ distance A B; m the angular velocity of E B D. Let Fr be the moment of the pressure about A L, E B D exerts when moving with an angular velocity 1; then, if the moving power be constant, $\frac{\mathrm{F}r}{m}$* will be the moment of the pressure exerted by E B D when moving with an angular velocity m. Consequently, the resolved part of the velocity of E B D perpendicular to E B D is $(m\,r\,\sin.\theta - v\cos.\theta)$; and the resistance against E B D $\frac{1}{2}\rho k\,\{m\,r\sin.\theta - v\cos.\theta\}^2$; B C being supposed indefinitely short compared with A B.

The resolved part of the resistance parallel to A L is

$$\tfrac{1}{2}\rho\,k\,\{m\,r\sin.\theta - v\cos.\theta\}^2\cos.\theta = \mathrm{R},$$

since v, the velocity of the vessel, is by hypothesis uniform. Also, since the motion of A B is uniform,

$$\tfrac{1}{2}\rho\,k\,\{m\,r\sin.\theta - v\cos.\theta\}^2.\sin.\theta \times r = \frac{\mathrm{F}r}{m};$$

$$\therefore \frac{\mathrm{R}m}{\mathrm{F}} = \cot.\theta;\ \therefore m = \frac{\mathrm{F}}{\mathrm{R}}\cot\theta;$$

$$\therefore \tfrac{1}{2}\rho.\,k.\,\{\frac{\mathrm{F}r}{\mathrm{R}}.\cos.\theta - v\cos.\theta\}^2.\cos.\theta = \mathrm{R};$$

$$\therefore \mathrm{F}r = \mathrm{R}v + \sqrt{\frac{2\,\mathrm{R}^3}{\rho\,k.(\cos.\theta)^3}}.$$

In this expression, it is clear that F is least when cos. θ is greatest—that is, when $\cos.\theta = 1$, and $\therefore m = \infty$. The interpretation of this apparently paradoxical result shows that the smaller the angle of the worm of the screw, the less is the power lost in transferring motion to the vessel. There are, however, certain practical considerations which cannot be neglected in determining the best value for θ. In the first place, we have supposed the lamina E B D to be indefinitely thin, and that all the resistance is perpendicular to E B D; this, in practice, is not the case:—the resistance against E B D being very considerable, it follows that—in order for the material connection of E B D with A L not to be destroyed by so great a strain—E B D must be of appreciable thickness.

Let the area of edge of E C B $= h$; then neglecting the effect of the mass of E B D and its weight, we should have the following equations:

$$\tfrac{1}{2}\rho k\,\{mr\sin.\theta - v\cos.\theta\}^2\cos.\theta - \tfrac{1}{2}\rho h\,\{mr\cos.\theta + v\sin.\theta\}^2\sin.\theta = \mathrm{R}$$

and, $\tfrac{1}{2}\rho k\{mr\sin.\theta - v\cos.\theta\}^2\sin.\theta + \tfrac{1}{2}\rho h\,(mr\cos.\theta + v\sin.\theta)^2\cos.\theta = \frac{\mathrm{F}}{m}$

In these expressions we find that R is diminished, while F is increased; consequently, there is a double loss of power. F must be increased to balance a resistance which not only does not accelerate, but actually retards, the motion. Also, the new terms introduced rapidly increase by diminishing θ: a value of $\theta = 20°$ would probably make F nearly a minimum.

The whole theory of resistances is, however, so little to be depended upon, that the results we have obtained can only be regarded as a rough method of approximating to the truth. In a future number of the Journal we hope to be able to continue the subject, founding our investigations on data of observation and experiment.

[In the number for April, in the article "On the Motion of Fluids," p. 98, for "the equal number for v,"—read, "the equations for v;" and, p. 98, col. 2, for the "mean vertical velocity of the particles,"—read "the mean velocity of the particles in direction of the tube."]

* We here suppose that no part of the power of the engine is expended in overcoming the friction and resistance to motion of its several parts.

SEWAGE AND DRAINAGE.

Since our last number, we have seen with the deepest regret, that the Government have agreed to leave out from their sanitary measures for the present year the metropolitan districts. It is most painful to reflect that two millions are left exposed to the evils of a most inefficient system of sanitary administration, at a time when the scarcity of food is sure to produce severe disease, and when there is every likelihood of the Asiatic cholera spreading through Europe to this country.

If there be one fact that admits of no doubt in the public mind, and of no doubt in the minds of any but aldermen and commissioners of sewers, it is that the sanitary administration of the metropolis is most shamefully misconducted, while it is imperative that the administration should be concentrated and carried on with vigour. Whatever superiority we may have over other countries in such matters, it is nevertheless true that we are miserably behind-hand, so far as our own enlightenment is concerned. We want no facts to prove this beyond the experience of every individual, though the reports of the Registrar-General and of the officers of sewers are convincing.

One great good we expect from the abolition of the present system—or no system—is full scope for the exertions of able and intelligent engineers and surveyors. Indeed, it is by such only that any amendment has been effected, as the labours of Mr. Roe, in the Finsbury Division, and lately of Mr. Phillips, in the Westminster Division, fully show. We have now before us a report of the latter gentleman, to which we shall direct attention in preference to any other branch of evidence.

This report is produced in pursuance of an order of the commissioners of sewers, on the 1st May, 1846, and ordered to be printed 16th April last, to ascertain the condition of a part of the eastern division of the sewers north of Oxford-street, and east of Portland-place and Regent-street. This district (called All Souls) contains an area of about 130 acres, with a population of 27,000 persons residing in 3000 tenements. The density of the population is not great, considering the extent of the district and the number of houses inhabited—being on an average nine persons to each house. Mr.

Phillips says, that the situation of this district, although not quite so airy and salubrious as others in the parish of St. Marylebone, is far from being close and unhealthy. The houses generally are large, being chiefly third-rate, and narrow streets, courts, and alleys are not numerous. The streets indeed are most of fair width, running in straight lines north and south, and east and west, and communicating with other wide streets running in those directions; and having therefore currents of air running freely through them, and keeping up good ventilation. The district is, further, seventy-four to eighty-three feet above the level of Trinity high-water datum in the Thames. The paving is generally in good condition; and being well supplied with gully drains, the surface water is carried off speedily. Nearly all the public ways have sewers running under them.

The above description appears to be that of a healthy and comfortable district, but Mr. Phillips gives full proof of its real state, and of the operating causes. He contrasts it with the neighbouring district of Cavendish-square, and he finds from the return of the Registrar-General in 1845, that whereas in Cavendish-square the mortality was one in fifty-nine, in All Souls it was one in twenty-eight, or more than twice as great. The rate of mortality per hundred stands thus—

Cavendish-square	1·7
All Souls	3·6
Excess on latter	1·9

The excess of mortality in All Souls district is more than equivalent to that of a healthy district; so that, literally and truly, the Cavendish-square people have twice the health of those of All Souls. The number of persons murdered in All Souls district cannot be calculated at less than 200 persons yearly, whereas it is very likely 500. The average per centage of mortality in the parish of St. Marylebone is one in forty-four, or 2·27 per hundred, which average, of course, is made up by such districts as those of All Souls. The fact that the population of All Souls is of a poorer class than that of Cavendish-square, is not enough to account for the greater mortality of 520 persons yearly, or 10 weekly.

The cause of this wholesale murder is the neglect of the sewers by the Westminster commissioners. The sewers appear to have been built between seventy and a hundred years ago, and are all built with flat paved bottoms and upright sides, spanned by half-round arches. They vary from 4 feet to 5 ft. 6 in. in height, and from 3 feet to 4 feet in width—being of ample size; but all the junctions are formed at right angles, many of them being broken through the side walls and not made good. The materials used in their construction are the worst of their respective kinds, being place bricks, and mortar composed of chalk lime and loamy pit sand. They are now, Mr. Phillips says, "very much dilapidated, considerable lengths of the side walls being now in ruins, and the remainder falling fast to decay."

As a fit appendix to this, Mr. Phillips states that—"It would appear the court of sewers exercised little or no authority over either the arrangement or construction of these old sewers; as the only record respecting them that I can discover in this office, is the report of a committee, on view in August, 1786, stating that the side wall of a sewer at the north end of Norton street had bulged for a length of ten feet; that the sewer at the north end of Titchfield-street had been built with place bricks, that the arch had fallen in in several places, and that a great quantity of rubbish was in the sewer." Thus, what the sewers were sixty years ago they are now; and during that period, at least, their neglect by the commissioners has been consistent—which is the most corteous term we can employ. We cannot, however, find that the inhabitants have been exempted during that time from sewers rates—that would be too much to expect. Indeed, when we look at the further evidence, we cannot but think that the inhabitants would have been better without sewers, and that they only paid for being poisoned. In Lisbon, and other unhealthy cities, they have no sewers—and yet the mortality is not higher than in All Souls, Marylebone, where the sewers can only be regarded as what Mr. Phillips in one place calls long and narrow cesspools.

Mr. Phillips informs us, that for many years past, the inhabitants have complained of these sewers being choked up and stopping their drains, and of noxious exhalations arising in the streets and houses, and that they still continue to do so. Mr. Phillips confirms these complaints—having, in order to acquaint himself with the extent of the evils, on numerous occasions passed through the sewers. In doing this, he waded and crawled, sometimes in darkness, through vast accumulations of half-fluid black matter, and his health suffered greatly in consequence.

It seems, that from 1834 to 1844, 185,058 cubic feet of soil or poison were taken out of the sewers, and carted away, at an average annual cost of £118 9s.,—besides contingencies, which perhaps doubled the outlay. The relief, however, was but temporary, and the disbursement of this trumpery pittance did not abate the evils.

These sewers are described as containing, throughout, an immense accumulation of detritus and decayed animal and vegetable matter; and they are thus becoming worse every day. From their bottoms being flat and broad, and the fall but little, and that irregular, directly they are cleansed they begin choking up again. This, Mr. Phillips says, goes on increasing backwards, until the surface of the soil forms an artificial fall, whereby the water gains sufficient force to prevent any further deposit from taking place. This is in obedience to a natural and well-known law, and it illustrates the futility of laying down sewers with too little fall—for if the fall be not given to them, they will make it for themselves. On account of this "grading," as the Yankees call it, of the main sewers, the soil in many of them is now on a level with, and in others it is above, the mouths of the house drains, which are in consequence fast choking up, many being stopped already. This is the state of affairs in a large and wealthy parish, paying a large sum to the sewers rates—and certainly willing to pay for health and life.

The house drainage, as may be expected, is most defective. Cesspools and common privies abound. Some of the cesspools have no overflow-drains, so that the more flowing portion of the matter soaks away through the neighbouring ground, choking it with filth, and leaving the solid matter to rot. Those having overflow drains are always full of soil, and send forth such pestilential exhalations as almost, in many instances, to prevent any one from going near the privies. The side drains from the houses are large, and have flat bottoms, so that the small quantity of water flowing from the houses cannot keep them washed out; and they consequently choke up, requiring often to be broken into so that they may be cleansed—thereby causing outlay and annoyance. As often, however, as they are cleaned, voids are formed, which are again and again filled up.

Mr. Phillips, we are glad to see, agrees that it is needful that house drainage should be a part of the entire sewerage,—and says that "the sooner the legislature place house drainage and sewerage under the same control, the speedier will be the removal of many and glaring evils. A skilful combination into one system of house and street drainage, conjointly with a full and efficient supply of water, would ensure the removal of filth and waste water into the sewers, nearly as fast as produced, instead of being detained as at present in the drains and cesspools in and about the houses, for months and years together." Certainly until this is done, nothing is done; and uniform sewerage is quite as important as uniform postage. To the wealthy, it is essential that the houses of the poor should be drained, for in them are the great seats of fever and disease;—sewerage is not a luxury for an individual, but a duty towards the community; and as the expenses of communicating with sewers are about the same in the case of a poor house as of a wealthy house, none would demur on the whole charge being thrown upon property.

The cleansing of the sewers in All Souls district would require the removal of 50,000 cubic feet of soil—and then only temporary and inadequate relief would be obtained. The sewers are, indeed, in such a shameful condition, as is well known to the officers and workmen employed, that when called upon to make examinations and to work in them, they show great dislike, from the feeling of danger they have. They are fearful when entering them, at every step they take, of setting fire either to explosive gases generated from the soil or escaped from the gas mains in the streets, or of being overpowered by the heat and foulness of the atmosphere, "which, from want of ventilation, causes great dimness of sight, giddiness, and sweating, and also makes breathing very oppressive, as from experience I can testify," says Mr. Phillips. It is right to observe, that the parish and other authorities have complained of such a state of affairs.

Some curious illustrations of the vigorous administration of the commissioners are given incidentally. The great sewer in London-street was rebuilt in 1828, nearly twenty years ago, more than two feet lower than the present one in Cleveland-street, in anticipation of the line of outfall being lowered—and it now contains an accumulation of soil nearly four feet in depth. The sewer in Newman-passage was likewise rebuilt in 1829, between two and three feet below that in Newman-street, for a like reason, and is so full of soil that parties who have obtained leave to lay drains into it have been unable to do so!

Mr. Phillips justly observes, that no temporary expedient can be applied in such a state of affairs, and he proposes to rebuild all the sewers and to improve the outfall through the main Hartshorn-lane sewer by a work of considerable labour, which will need 1,300 feet of tunnelling. Upon this, we cannot help observing, as we did last month, that it is really a pity to see the waste of money and the inefficient measures, which are the result of the present system. We then pointed out that a large sewer, belonging to the Regent's-park and Regent-street commission, runs through the centre of the Westminster district; and yet, that for the latter, distinct outfalls are sought and the channels constructed, at an enormous expense. If an arrangement were now entered into between the two commissions, for the purpose of allowing the sewers in the vicinity of Regent-street to communicate with the Regent-street sewer, a vast outlay would be saved in rebuilding the sewers, no doubt, by partly raising and partly lowering the bottom of all the sewers on each side of Regent-street, to the distance of 500 yards. The accumulation of the filth in those sewers might be got rid of, particularly if a new bottom were made to the sewers of a circular shape; in fact, this latter arrangement could be done to most of the old square-built sewers.

In the present case, Mr. Phillips canvasses the propriety of communicating with the King's College Pond sewer; but he says not one word of the Regent-street sewer, which runs through his district. The drainage of Devonshire-street, which lies on the latter sewer, is therefore proposed to be carried through several bends and at right angles, down to Broad-street, Bloomsbury, a distance of many thousand feet—when the Regent-street sewer can be entered at the bottom of Devonshire-street. We say nothing as to the necessity for improving the Hartshorn-lane sewer and outfall; but we do urge, so far as the streets in the neighbourhood of the Regent-street sewer are concerned, that the Westminster Commissioners should have a conference with the Commissioners of Woods and Forests, and come to some arrangement.

Mr. Phillips estimates that his plan will require the rebuilding of 25,176 feet of sewer, at a cost of £20,140 16s.; but he does not dare to recommend the immediate execution of his plan and the disbursement of this sum,—but proposes, as a first instalment, the outlay of £4,057. Supposing this to be one year's outlay, and that the saving of human life should be in proportion to the average of Cavendish-square, and to the gradual extension of the sewers,—the number of persons destroyed during the gradual execution of the plan would not be much more than 1,539, or the population of a good sized market-town; whereas, by the immediate disbursement of about £13 a-head, the destruction of so many human beings might be averted. Supposing the money borrowed at 3 per cent., for the purpose of making the immediate outlay, the additional charge for this would be about thirty shillings per head on the whole number of individuals proposed to be murdered. Perhaps the Humane Society, or some other Society, might think it worth while to advance the money as a gift, and thereby save so many human lives.

The public have been greatly scandalised by the promulgation of the fact, that the mortality in parts of Whitechapel and the eastern districts is 1 in 24 yearly;—but we believe they were not prepared for a mortality of 1 in 27 in Marylebone—and that mortality, as a public officer has shown, caused by the shameful state of the sewers alone. It is in the presence of such facts, that Lord Morpeth has taken on himself the responsibility of withdrawing that measure of legislative relief, to which the inhabitants of the metropolis have so long looked forward; and he has thereby taken the further responsibility of sanctioning a system of administration which the medical profession, the engineers, and the press have justly pronounced a system of wilful murder.

After the engineering profession have so long exerted themselves for the improvement of the state of the metropolis, it is quite disheartening that they should be deserted by the minister of the department which professes to take charge of the subject. So long as there was a prospect of a Government job in employing military engineers to make a metropolitan survey, to superintend civil works, and to receive the emoluments of civilians, the government were zealous enough; but when this inducement is taken away, the commissioners of sewers are allowed any reprieve they choose to claim.

If the removal of the filth of the metropolis be an important object, the saving of the valuable manure which is now wasted is no less deserving of consideration: but we are afraid this also is likely to meet with the fate of other measures of improvement. The Metropolitan Sewage Manure Company have this session applied for a new act to enable them to lay down a receiving sewer, which shall cut the sewers at a mean distance of 620 yards from the river, involving very expensive works. To this, Mr. John Martin, the founder of the company, objects,—and proposes an alternative plan, for receiving the contents of the sewers near their outfall, which certainly appears the more rational plan—and we can conceive, from such evidence as we have before us, no reasons for the company's plan. 620 feet would be a great distance from the river, but 620 yards seems monstrous—for thereby the large intervening district is left unwrought.

We may here observe, that we look upon the useful application of the manure of towns as a great boon, which engineering knowledge will confer upon the tillage of this island. From a town population of four millions, and with the great body of horses employed by them, a quantity of valuable manure is obtained, which cannot be reckoned at less than equivalent to the production of half-a-million of quarters of corn yearly, or the yearly food of half-a-million of human beings. When it is considered how the refuse of the dustyards of London is economised, it is strange that the produce of the sewers should be wasted. The old metals, the broken pots and pans, called pickings, the rags, bones, cinders, small coal of the dust bins, are all saleable; the produce of the cesspools is made a lucrative branch of business, and manures are made from it in London which are sent out even to the sugar plantations in the West Indies—but the greater part of the manure of the metropolis is sent into the Thames to pollute its waters.

MEASURES OF FORCE AND LAWS OF MOTION.

SIR—In your last number, you state (page 129) that—"If when a body is in motion, it be acted upon by an invariable force, in the direction of its motion, the quantity by which the velocity of the body will be increased or diminished (according as the force is accelerating or retarding,) will always be the same in the same time; and is quite independent of the initial velocity which the body possessed before it was subject to the influence of the force." Further—

"This fact at once furnishes us with a convenient dynamical measure of force, known by the name of the measure of accelerating force." . . . "Thus gravity accelerates the velocity of a body falling in vacuo by 32¼ feet a second; taking feet and seconds as units of space and time, the accelerating force of gravity is represented by 32¼."—This is all perfectly true; but there is considerable danger of an erroneous inference of great practical importance being drawn from it, which it is well to guard against.

Suppose a heavy body to fall from a height so as to occupy several seconds in falling; the effects may be tabulated thus:

Seconds occupied in falling.	Space fallen through in each second.	Total space fallen through by the end of each second.	Acceleration during each second.
	Feet.	Feet.	Ft. Ft.
1	16	16	from 0 to 32 = 32
2	48	64	from 32 to 64 = 32
3	80	144	from 64 to 96 = 32
4	112	256	from 96 to 128 = 32

Now, as the amount of *acceleration* communicated to the falling body by gravity in any one second is precisely equal to the amount so communicated in any and every other second, an unguarded reader may easily fall into the error of supposing that the amount of *gravitating force* expended (if I may so term it) upon the falling body in any one second is, in like manner, precisely equal to the amount so expended in any other second.

In fact, not only unguarded readers, but also very able writers, appear to have fallen into this error; imbodying it in the untrue doctrine, that the momentum* of a moving body is as its weight (or mass) multiplied by its velocity. The truth being that the momentum is as the weight multiplied by the square of the velocity; a truth of the greatest importance in questions concerning the effects of hammers, fly-wheels, ordnance, &c., and of winds, waves, and currents of water,—the resistance of water to the passage of vessels, &c.

If it be necessary to prove this truth, a mere inspection of the foregoing table is enough, as respects falling bodies; for it is therein seen that while a fall of 16 feet produces the velocity of 32 feet per second, a fall of 64 feet, that is four times the fall, only produces double velocity; nine times the

* Perhaps the real difference may lie in our differently understanding the word momentum. My understanding of the term is at least a practical one, viz.: that it means the amount of power which can be communicated to a body by putting it in motion, and which can be taken back from it by stopping its motion; this amount of power being measured in the manner in which the animal power, mill power, &c., are ordinarily measured.

fall = 144 feet, only triples the velocity; sixteen times the fall, or 256 feet, produces only a four-fold velocity, &c.

As to other moving bodies, Smeaton's experiments upon flies, prove beyond all doubt, that they are subject to the same laws—viz.: that to *double* the speed of a given fly, requires the expenditure of *four times the power* which produced the original speed; while to triple the original speed, requires the expenditure of nine times the original power, &c.

Subsequent experiments have shown that a fly, running round at a given speed, produced four times the effect (in rolling long strips of lead) which it would produce at half the speed; nine times the effect it would produce at a third of the speed, &c. In short, if we take units of *time*, and subject a body to the action of an invariable impressed force during one, two, three, four, &c. of such portion of *time*, we shall find that the spaces traversed by each body in these times will be as the squares of the numbers denoting such times. While, if we take units of *space*, and subject a body to the action of an invariable impressed force, while it moves through one, two three, four, &c. of such portion of *space*, we shall find that the times occupied by such body in traversing such spaces will be as the square roots of the numbers denoting such spaces.

In relation to mechanics, I think that the correct mode of measuring force is that last-named—viz.: to take the *space* through which a given pressure acts, as the measure of the force expended; because all power which is under our control, is naturally so measured.

To wind up a given weight, 16 feet, requires a given power p, whether animal or mill power, and whether the weight be wound up slowly or with moderate rapidity. Release the weight and it falls in one second of time, obtaining an acceleration of 32 feet per second, which call a.

To wind up a like weight 64 feet requires $4p$; release it and it falls in two seconds, obtaining an acceleration of $2a$ only.

A like weight wound up 144 feet requires $9p$, and will fall in 3 seconds, obtaining $3a$ only of acceleration.

The time occupied in the fall of the weights being respectively 1, 2, and 3, and the amount of acceleration being also respectively 1, 2, and 3, while the power expended in raising the weights is respectively as 1, 4, and 9, it is clear that neither the time nor the acceleration affords a measure convenient for mechanical purposes; but the *spaces* traversed, viz.: 16 feet, 64 feet, and 144 feet, are in the same proportions of 1, 4, and 9, as the respective quanties of power expended; therefore, the length of the space traversed by a body while acted upon by a given power is the true measure of the power expended by the mover; and with a freely moving body it is also the true measure of the force which is absorbed by such body, and which that body will discharge upon any obstacle which shall stop its progress. A falling body, for instance, must discharge upon the earth just the power expended in winding it up; and it is obvious that this *charge* and *discharge* (if I may so term it), can be repeated at pleasure, and that the power first communicated and then discharged is precisely measured by the vertical space through which the weight is first raised and then allowed to fall.

A hammer of a given weight being wielded with double speed will strike four times as hard a blow.

A bullet being shot off with triple velocity will penetrate with nine times the force.

An engineer wishing to quadruple the power of his fly may either procure a wheel four times as heavy, retaining the present speed, or he may double the speed of his present fly without adding to its weight; in either case, his object will be equally attained.

Upon a future occasion, I propose to adduce instances in which the want of attention to these principles has occasioned lamentable waste of valuable time, exertion, and of money.

I am, Sir, your obedient servant,

E. Hill.

[We have much pleasure in acknowledging the receipt of the above letter, from Mr. E. Hill, in which, as will be seen, the writer animadverts on certain statements and definitions given by us in a paper "On the Laws of Motion," that appeared in a late number of the Journal. In reply to the objections urged by Mr. Hill, we beg again to state that momentum is a term used to denote the product of the mass and velocity of a body; and, moreover, that there is no doctrine involved in it. It is an arbitrary technical expression, and to object to its signification is to dispute about words—not about principles. Mr. Hill evidently confounds momentum with what is called by engineers "power expended," or sometimes "work done"—which no doubt varies as the square of the velocity, as we will immediately show:

Let m be the mass of a body caused to move from rest by a pressure which is X, at the distance x: then if v be the velocity acquired at the distance x, we shall have $m\,v\,dv = X\,dx$, by the equations of motion.

$$\text{Consequently, } \frac{mv^2}{2} = \int^{0-x} X\,dx;$$

but $\int^{0-x} X\,dx$ is the "work done"—which, therefore, varies as the square of the velocity. There is considerable confusion manifested by Mr. Hill in the use of the word "force": he talks of a bullet penetrating with nine times the force, instead of nine times as far;—in this instance, Mr. Hill uses "force" to mean what he misconceives by the term "momentum"—viz., $\int X\,dx$, or "power expended." We are sorrowfully willing to concede, that much time and money have been wasted in engineering matters—not, however, as Mr. Hill would insinuate, from a too rigid regard for the laws of motion and measures of force, but from gross ignorance of both. Unfortunately, the confused ideas of men unacquainted with mechanical principles, by jumbling together force and its effects, and giving birth to vague and useless terms, such as "living force"—and "power expended"—and "power absorbed," and the like—have done considerable mischief to the science of engineering, by divesting it of its simplicity, and basing it upon anything rather than what it ought to be based upon—namely, the six equations of statical equilibrium, and the six dynamical equations of motion.]

ARMY AND NAVY CLUB.

We do not think it needful to make any lengthened remarks on the competition of designs for the Army and Navy Club, or to enter into any detail with regard to them, as the designs were, according to our views, far below the proper standard, and we are glad to perceive that the Committee have had the good sense not to carry out those which received the prizes. So far as the competitors were concerned, the whole affair must be considered highly derogatory from them, for they came before an irresponsible tribunal, they subjected themselves to the consequences of a ballot, and they resorted to canvassing—some of them, we believe, sending round bills and testimonials, like the Morrison's pills or Holloway's ointment sellers. It is in perfect keeping with these proceedings, that some competitors resorted to false perspective views and other tricks to catch the unitiated. Thus ended the lottery at the Army and Navy, or Derby, Club, with the loss of time and money to between sixty and seventy architects.

Prudent men among the architectural profession of course refrained from engaging in a competition which depended upon the votes of a number of members of a miscellaneous club, passed through the dark ordeal of the ballotting box. The Committee Club, we presume, indulged the members in this mock election, as the cheapest way of getting rid of the clamour of those ultra members, who are sticklers in principle for competition and vote by ballot, because of course it could have only one result—the utter impossibility of getting a good and feasible design. A first rate competition is not to be got by such haphazard proceedings, for neither old men of talent, or young men of talent, like to expose themselves to the chances of defeat before an incompetent tribunal, while they are really to afford at their own expense the materials of their own overthrow. A painting executed in competition for a prize, if unsuccessful in gaining the prize, may be exhibited and sold elsewhere; but a design for a club, which has cost weeks of labour and entailed much expense, cannot be réchauffé for an almshouse, a theatre, or a church—though in the paucity of ideas the same Ionic portico, or Italian campanile are made to figure as the stock of all and sundry the compositions of some of our inspired artists.

Southampton Docks.—The Dock Company have, we understand, contracted for and commenced the construction of a second dry dock, to be completed in November next. Messrs. William Cubitt and Co. were the successful competitors, the amount of their tender being a little above £17,000, whilst that of Messrs. G. Baker and Son, the contractors for the new custom-house now so near completion, was we believe near £18,000. The dock is to be 250 feet in length upon the blocks, and hold two 500 ton ships at once, or one of all but the largest of the gigantic steam-ships so familiar to our waters, and one sailing ship of 500 tons burthen.

THE ROYAL ACADEMY EXHIBITION: ARCHITECTURE.

The competition for the Army and Navy Club-house, and the designs having to be sent in only a week before the receiving-days at the Academy, no doubt hindered some architects from preparing anything for the Exhibition;—not that there is this year any deficiency as to quantity, there being no falling off from the usual number of architectural subjects—and as usual, too, a good many of them might, as far as seeing them is concerned, just as well be away. There is, however, less variety than usual, or than used to be the case some seasons ago—since designs for churches greatly outnumber the subjects of any other class. One very uncommon circumstance is the extreme paucity of designs for domestic buildings of any kind—that kind excepted which consists of houses produced by wholesale, under the somewhat dubious title of "Improvements." One design (No. 1077) shows us after what fashion the Castle Hill, at Dover, has just begun to be improved; and another (No. 1111), Dover Court new town, near Harwich—as to which last we cannot speak, not having noticed the drawing, wherefore it is perhaps luckier than the other. Churches alone excepted—and of them there is a full quota—there is very little to show us what has lately been done in architecture, or what buildings are either now in progress or about to be commenced. Even among the church subjects, too, we miss one that we should have been glad to meet with here; for the edifice is intended, we presume, to be superior in taste to most of the modern ones in the metropolis—to be a monument of its architect's skill as well as of its founders munificence. The church we allude to is the one which Mr. Ferrey is now erecting, in Westminster, for Miss Burdett Coutts. Therefore, supposing the design to be, as we have no reason to doubt, a worthy one, it would have been no more than a suitable compliment to that lady to have exhibited it. Like a good many others, however, Mr. Ferrey seems to have quite cut the Academy's exhibitions. There is a growing reserve on the part of those who either rank, or would be thought to rank, high in their profession, to contribute anything whatever to the Exhibition. This year there is not a single drawing by the Academy's own professor, or any of the other professors of architecture; and only a very few by members of the Institute. This is not exactly what ought to be, since it bespeaks indolence or apathy, if not contempt; and is, moreover, attended with one injurious consequence—namely, that the number of uninteresting and mediocre subjects can hardly fail to produce an unfavourable impression as to the actual state of the art among us.

It would be a monstrous untruth, were we to say we had some idea of being favoured by Mr. Blore with a peep at his design for the alterations at Buckingham Palace. That gentleman seems determined to carry on his operations with the utmost secresy, and to keep out of harms way—that is, out of the way of criticism—as long as he possibly can;—a species of mistrust that contrasts very strongly with the unquestioning confidence the public reposes in him. To nothing else than perfect confidence can we attribute that universal silence in respect to the Palace, which contrasts so very remarkably with the universal fuss made about a comparatively insignificant matter at the other end of Constitution-hill. We must, therefore, wait with patience till time reveals to us what neither Mr. Blore himself, nor any one of those who pretend to be in the secret—at least, to have seen "a sketch" of the design—chooses to let us know—namely, into what sort of a building the Palace will be metamorphosed. Architectural transformations seem to be just now the order of the day, for while Barry, who is now operating upon the Treasury Buildings, is, it seems, about to undertake the transformation of both the Horse Guards and Treasury, Mr. Sydney Smirke is not only enlarging the Carlton Club-house, but changing it into quite a different piece of architecture, as may be seen by the drawing of it at the Exhibition (No. 1109), which shows what the entire façade will be—and that the east front, if not the south one also, will be similar in design to the Pall-mall one. The change cannot fail to acquire for the Carlton considerable architectural rank and reputation, whereas the present club-house never had, notwithstanding its rank as such, any reputation at all as a building. The new structure will most assuredly add very greatly to the architectural character of Pall-mall; but it is not so certain that it will be altogether favourable to its neighbour, the "Reform"—it being, apparently, intended to eclipse the latter. At all events, the Carlton will present the larger façade of the two, and will be in a more florid style of Italian—in fact, a particularly florid one, the spandrel-spaces over the arches of the second order being entirely filled in with figures in relief—both a degree and a species of embellishment which we as yet possess no examples of in town. The upper or Ionic order is also a peculiar example in itself, at least as regards its entablature, whose frieze is unusually deep—so greatly exceeding the established proportions, that it would scandalise the sticklers for such matters, and bring down their censures upon Mr. Smirke, had he not sheltered himself under the authority and precedent of Sansovino, whom he has on this occasion chosen to follow pretty closely for the whole design of his exterior. Were it not for the drawing we have just been speaking of, there would be nothing in the Exhibition to show any building (besides churches) either erecting or or about to be erected in the metropolis,—if we except No. 1294, a very tiny model of the new Coal Market which is about to built in Lower Thames-street, at the corner of St. Mary-at-Hill. It will have two uniform fronts, on two adjacent sides, with the corner rounded off in the two flower floors of the building, above which that portion will be carried up as a small insulated circular tower or campanile, that will be recessed within the re-entering angle, cut out there between the two fronts. This promises to be a novelty, but the model itself is such a mere toy as to size—as is, indeed, the case with all the models this year—that it is impossible to judge of more than the general shape of the structure. The idea of rounding off the corner of a building in such a manner as to render it an important—at any rate very ornamental—feature in the composition, is also displayed in No. 1284 (E. Christian), a design for the new Imperial Insurance Office, to which the second premium was awarded. There is also another design (No. 1198), by the same architect, for the same building; but we do not find here the design for it, which is to be executed; nor that for the Museum of Geology, in Piccadilly.

While unusual dearth prevails this season in regard to fresh subjects, representing actual buildings, there is the usual show of "old familiar faces"—familiar even to staleness—things that are known by heart: the Temple of Erectheus, the Arch of Titus, the Bridge of Sighs, the Temple Church, with sundry *et cæteras*, whose titles in the Catalogue spare us the trouble of looking at them. We might, perhaps, had we observed its title at the time, have looked at No. 1190, "Edinburgh from the South,"—if only to ascertain whether, as an architectural view, it was more satisfactory than No. 360, Roberts's large oil-picture of the Northern Metropolis, which has obtained from the critics a degree of laudatory admiration perfectly unaccountable to us—it being, in our opinion, neither good as a pictorial composition nor displaying any particular beauty of execution. On the contrary, it is heavy and opaque in colour. To our eyes, the architecture—for the most part very queerish in reality—looks very slovenly executed in this representation of it, and more like the work of a mere landscape painter than of one who has exercised his pencil chiefly upon subjects more or less strictly architectural. But we are playing the truant, so let us return to our own proper subject.

Next year we shall, in all probability, find here several of the designs for the Army and Navy Club-house; in the meanwhile, No. 1121 (W. A. and J. W. Papworth), has got the start of any of the others, that drawing being a coloured copy of the perspective view sent in by Messrs. P. to the competition. We cannot say that we at all approve of the design itself, any more than we do of the license taken in regard to scale, the Club-house being represented two or three feet higher than Winchester House, which innocent (?) species of untruth is contradicted by the proportions of the Pall-mall front—the latter being limited in width to sixty feet; consequently being, in that design, little if at all higher than it is wide—instead of being loftier, it would be about fifteen feet lower than Winchester House. Really, architects seem to be as little scrupulous about scales as they are about estimates. Theirs are not always the scales of justice, or of judgment either. Apropos of estimates—there was wonderful harmony in that respect among the competitors for the Club-house in question: even the estimate for one of the Gothic designs—which certainly looked as if it would cost double, or more than double, some of the others, it being studded all over with statues, canopies, and pinnacles—was only £30,000, although the two fronts and their ornaments were to be, not in papier maché, but in real Caen stone!

No. 1129, "Study for a Portal," appears to be a study for that in his design for the Club-house above-mentioned. It is not very favourably placed, being put over the door, where, though it is a rather large sized drawing, it cannot be fairly seen—and yet seems well worth looking at, the general composition being very happy, and manifesting both originality and gusto. That subject, however, is not the only one that is disadvantageously placed, while many others, that are of comparatively little merit or interest, are perked just in our faces. Nos. 1199 and 1213, for instance, both of them two admirably executed interiors—the only ones of that class in the room—

are hung together, at right angles to each other, quite in a corner, and that an obscure one—so much, too, below the eye, that they cannot be inspected without stooping; and the one and the other is so full of elaborate detail, that if once assumed, the stooping posture is likely to be prolonged to weariness. No. 1199, "Design for the Decoration of the Old Billiard-room at Stapleford Hall," (J. Dwyer), would have been all the better, had the figures introduced in it been omitted—unless the artist had employed some one more *au fait* in figure-drawing than himself, to put them in: but in his own department he is admirable. The other subject, No. 1213, (L. W. Collman), which is simply styled "View of a Library," represents a room which has lately been decorated in a highly recherché manner by Mr. Collman himself, whose taste seems to be far more refined than that of Sang. This drawing has the advantage over the other in having no figures; though we would at any time readily tolerate poorly drawn figures, for the sake of similar subjects—which, being apartments in private residences, cannot be generally seen, or even known of, except they are portrayed by the pencil. Right glad, therefore, should we have been to see here a drawing of the Ball-room which Mr. Barry has just fitted up at St. John's Wood Lodge, for Sir Isaac Goldsmid, and which is reported to be a fine specimen of the Cinque-cento style. Of that style there is a specimen here, viz.: No. 1202, "Ceiling by Pietro Perugino, in the Sala di Combio at Perugia," (D. Wyatt),—an exquisite drawing, that requires to be looked at as closely as the illuminiated arabesque and borders of some precious manuscript—yet here hung where it is hardly observable. A somewhat similar fate attends No. 1233 (J. Thomas), a composition for a magnificent chimney-piece, forming, unlike those of these degenerate days, a stately mass of sculpture.

Churches—both old and new—form the great mass of architectural subjects; nor do they display much variety, or attempt at originality—for they all affect to adhere most literally to the mediæval character, and to mediæval ideas, as if the aim was to resist all further progress in art. At any rate, so many subjects, all of the same kind, gives a great sameness to this part of the Exhibition,—the appearance of much greater sameness than there perhaps really is; because, where so many drawings are so much alike in their general subject, one effaces the recollection of another;—with which remark we will bid adieu to our own subject, if not finally—as may prove the case—at all events for the present.

THE TUSCAN "MAREMME"—AND THEIR IMPROVEMENTS.

These, geologically speaking, recent abodes of, or upheavings from out, the ocean, have of late claimed much of public attention, and many interesting memoirs have been published thereon, in the Transactions of the Academia dei Georgiofili, and elsewhere. The most characteristic of the Maremme is the north-west part on the sea shore, where the river Cecina, descending from the hills of Volterra, reaches the Mediterranean. Those, as well as the Piombino Maremme, were once Sienese territory, and remained deserted and most unwholesome for centuries past. The lower Maremme were still more so—also for the reason, because there are no large swamps north of the lake of Piombino. Beyond that lake and the promontory of Populoniæ, the land assumes a less frightful character, and the awful devastation decreases gradually if we pass the Cecina. The tier of mountains, which south of Leghorn extends close to the sea (the Monte nero), encompasses the flat sea-shore lands, as by a semi-arc; and the river Cecina descends, bifurcate, into the sea; along the coast, water stagnates in numerous bogs, while the more depressed parts are filled with forests. The land of the Maremme belongs, mostly, to a small number of proprietors. It is here where the greatest improvements have taken place. Government having made the necessary arrangements with them, the land was divided into *saccate* (1 = 6,300 square mètres), the forest, or rather shrubbery, cut down, and the land put under cultivation. The worst part of the sea-shore was to be drained and dried by government itself. The dense forest, mostly covered with underwood, and completely in its primeval state, and which, on the slightly inclined terrain, had greatly contributed towards the *embogueing* of the land,—was cut down. The soil which thus was made to appear, proved to be mostly alluvial earth, resting on a stratum of grit, rich in fossil shells—and has already yielded the finest crops of wheat and maize. Drains of all sizes have completed the work of dessication.

Somewhat differently the long seam on the sea shore was to be treated—but here, an elevation of the terrain was to be effected, which was done by using the slime and silt of the Cecina; an expedient which has yielded triumphant results in the Valley of the Chiana and elsewhere.* On this seam, the forest has not only *not* been cut down, but even completed by systematic plantations, for opposing a barrier to the sweeping of the sea breeze. A number of vicinal ways have been opened—all to converge into the splendid Via Maremma, a line of road undertaken at the especial command of the Grand Duke of Tuscany. It traverses these swamps in their whole extent, and abuts at one side at Leghorn, and on the other extends to Florence and Siena—and the Roman road by the southern valleys of Tuscany. The air, most deleterious hitherto, has, on account of the many drains, dykes, and other hydraulic works, of the many fires and other domestic operations, improved most wonderfully, and will, no doubt, improve still more. The projected railway from Leghorn to Civita Vecchia will greatly increase the importance of these new lands.

The products of the Maremme, hitherto of little value for want of communication, consist of timber for construction, charcoal, potash, iron, sulphur, borax, alum, &c.; and the number of ships employed on the coast increases rapidly. The harbours of this coast, however, are in a deplorable condition, as there are none of any importance between Leghorn and Civita Vecchia. That of Piombino is full of sand and slime, but it would be possible to correct it. The embouchure of the swamp of Castiglione della Descaja, hitherto merely used for small coasting vessels, could, no doubt, be also improved. The southern part of the Maremme has three small harbours—Talamone, famous in antiquity, now blocked up with sand and slime, with the pestiferous air resulting therefrom, and Port Ercole. More important is Port St. Stefano, founded by fishermen on account of its healthy situation, which, by the aid of a few judicious constructions, could become very important. The improving of these sea-outlets would much increase the industrial resources of the Maremme, whose mineral riches may be shortly adverted to. The iron stands in the first rank, but the making of borax in the hills of Volterra is also of great importance. Timber of all kinds also abounds, as the forests of the crown alone extend over 10,000 hectares. The clearing of the terrain began here at the end of the last century—first, with the nearer hills, then the slopes of the Appennines. The destruction of these forests was soon followed by great calamities, here and elsewhere. In that of Pratovechio, government has made, of late, great improvements, and during five years, 1,200 hectares have been planted with different sorts of pines. Being placed at a distance of three yards from each other, 3,600,000 trees have been planted, which, in 40 years, will yield 15,000,000 trees fit for construction.

A few observations on the geological character of the Maremme may best conclude this paper. It cannot be doubted, that it was the alluvium poured forth from the rivers, which has filled up the gulph which once occupied this place. This, however, was again modified by the *reaction* of the sea, which formed on the alluvium various dykes and elevations, and thus shaped the whole surface of the land. V. Fossombroni, an author of note, says that this took place in the first centuries of the Christian era—to prove which, he cites the Peutinger tables, &c. Against this, M. Salvagnoti asserts, that along the whole sea shore, in parts quite close to it, there is a dyke of sea sand (at times one mile broad), on which the remains of a Roman road have been found, which is the Via Aurelia, built 100 years B.C.; that parts of it, going in the direction of Rome, have been used for making the new road, &c., in 1826. These latter are forcible facts, and prove—that the formation of the Maremme, albeit recent, still precedes the Christian era. Hence it follows, that the alluvium of the rivers formed that land, and that for draining the swamps, which are the remnants of old gulphs of the sea, the means hitherto employed have been the right ones.

We need scarcely state, that the above remarks will be useful not only in reference to the bog lands of Ireland and Scotland, but still more to many of our distant colonies.

J. L——Y.

* The geological neutralisation, if we may say so, of extensive sand lands with the adjacent bogs and swamps, as is the case in the Mont Brandedburg, as well as near Sidney, New South Wales, has been hitherto quite overlooked. By placing two substances, quite unproductive by themselves, in such close juxta-position, nature seems to have urged men to make them reciprocally available.

There has been a great contest this month about the ventilation of the House of Lords, Dr. Faraday having lectured at the Royal Institution in praise of Mr. Barry's plan, and Dr. Reid having lectured in answer at Willis's Rooms, and in defence of himself.

ON THE INDUCTION OF ATMOSPHERIC ELECTRICITY ON THE WIRES OF THE ELECTRIC TELEGRAPH.

By Professor Joseph Henry.*

The action of the electricity of the atmosphere on the wires of the electrical telegraph is at the present time a subject of much importance, both on account of its practical bearing, and the number of purely scientific questions which it involves. I have accordingly given due attention to the letter referred to me, and have succeeded in collecting a number of facts in reference to the action in question. Some of these are from the observations of different persons along the principal lines, and others from my own investigations during a thunder-storm on the 19th of June, when I was so fortunate as to be present in the office of the telegraph in Philadelphia, while a series of very interesting electrical phenomena was exhibited. In connexion with the facts derived from these sources, I must ask the indulgence of the Society in frequently referring, in the course of this communication, to the results of my previous investigations in dynamic electricity, accounts of which are to be found in the Proceedings and Transactions of this Institution.*

From all the information on the subject of the action of the electricity of the atmosphere on the wires of the telegraph, it is evident that effects are produced in several different ways.

1. The wires of the telegraph are liable to be struck by a direct discharge of lightning from the clouds, and several cases of this kind have been noticed during the present season. About the 20th of May the lightning struck the elevated part of the wire, which is supported on a high mast at the place where the telegraph crosses the Hackensack River. The fluid passed along the wire each way, from the point which received the discharge, for several miles, striking off at irregular intervals down the supporting poles. At each place where the discharge to a pole took place, a number of sharp explosions were heard in succession, resembling the rapid reports of several rifles. During another storm, the wire was struck in two places in Pennsylvania, on the route between Philadelphia and New York; at one of these places twelve poles were struck, and at the other eight. In the latter case the remarkable fact was observed, that every other pole escaped the discharge; and the same phenomenon was observed, though in a less marked degree, near the Hackensack River. In some instances the lightning has been seen coursing along the wire in a stream of light; and in another case it is described as exploding from the wire at certain points, though there were no bodies in the vicinity to attract it from the conductor.

In discussing these and other facts to be mentioned hereafter, we shall, for convenience, adopt the principles and language of the theory which refers the phenomena of electricity to the action of a fluid, of which the particles repel each other, and are attracted by the particles of other matter. Although it cannot be affirmed that this theory is an actual representation of the cause of the phenomena as they are produced in nature, yet it may be asserted that it is, in the present state of science, an accurate mode of expressing the laws of electrical action, so far as they have been made out; and that though there are a number of phenomena which have not as yet been referred to this theory, there are none which are proved to be directly at variance with it.

That the wires of the telegraph should be frequently struck by a direct discharge of lightning, is not surprising, when we consider the great length of the conductor, and consequently the many points along the surface of the earth through which it must pass peculiarly liable to receive the discharge from the heavens. Also, from the great length of the conductor, the more readily must the repulsive action of the free electricity of the cloud drive the natural electricity of the conductor to the further end of the line, thus rendering more intense the negative condition of the nearer part of the wire, and consequently increasing the attraction of the metal for the free electricity of the cloud. It is not however probable that the attraction, whatever may be its intensity, of so small a quantity of matter as that of the wire of the telegraph, can of itself produce an electrical discharge from the heavens; although, if the discharge were started by some other cause, such as the attraction of a large mass of conducting matter in the vicinity, the attraction of the wire might be sufficient to change the direction of the descending bolt, and draw it in part or whole to itself. It should also be recollected that, on account of the perfect conduction, a discharge on any part of the wire must affect every other part of the connected line, although it may be hundreds of miles in length.

That the wire should give off a discharge to a number of poles in succession, is a fact I should have expected, from my previous researches on the lateral discharge of a conductor transmitting a current of free electricity. In a paper on this subject, presented to the British Association in 1837, I showed that when electricity strikes a conductor explosively, it tends to give off sparks to all bodies in the vicinity, however intimately the conductor may be connected with the earth. In an experiment in which sparks from a small machine were thrown on the upper part of a lightning-rod, erected in accordance with the formula given by the French Institute, corresponding sparks could be drawn from every part of the rod, even from that near the ground. In a communication since made to this Society, I have succeeded in referring this phenomenon to the fact, that during the transmission of a quantity of electricity along a rod, the surface of the conductor is charged in succession, as it were, by a wave of the fluid, which, when it arrives opposite a given point, tends to give off a spark to a neighbouring body, for the same reason that the charged conductor of the machine gives off a spark under the same circumstances.

It might at first be supposed that the redundant electricity of the conductor would exhaust itself in giving off the first spark, and that a second discharge could not take place; but it should be observed, that the wave of free electricity, in its passage, is constantly attracted to the wire by the portion of the uncharged conductor which immediately precedes its position at any time; and hence but a part of the whole redundant electricity is given off at one place; the velocity of transmission of the wave as it passes the neighbouring body, and its attraction for the wire, preventing a full discharge at any one place. The intensity of the successive explosions is explained by referring to the fact, that the discharge from the clouds does not generally consist of a single wave of electricity, but of a number of discharges along the same path in rapid succession, or of a continuous discharge which has an appreciable duration; and hence the wire of the telegraph is capable of transmitting an immense quantity of the fluid thus distributed over a great length of the conductor.

The remarkable facts of the explosions of the electricity into the air, and of the poles being struck in interrupted succession, find a plausible explanation in another electrical principle which I have established, namely, in all cases of the disturbance of the equilibrium of the electrical plenum, which we must suppose to exist throughout all terrestrial space, the state of rest is attained by a series of diminishing oscillations. Thus in the discharge of a Leyden jar, I have shown that the phenomena exhibited cannot be explained by merely supposing the transfer of a quantity of fluid from the inner to the outer side of the jar; but in addition to this we are obliged to admit the existence of several waves, backwards and forwards, until the equilibrium is attained. In the case of the discharge from the cloud, a wave of the natural electricity of the metal is repelled each way from the point on which the discharge falls, to either end of the wire, is then reflected, and in its reverse passage meets in succession the several waves which make up the discharge from the cloud. These waves will therefore interfere at certain points along the wire, producing, for a moment waves of double magnitude, and will thus enhance the tendency of the fluid at these points to fly from the conductor. I do not say that the effects observed were actually produced in this way; I merely wish to convey the idea that known principles of electrical action might, under certain circumstances, lead us to anticipate such results.

2. The state of the wire may be disturbed by the conduction of a current of electricity from one portion of space to another, without the presence of a thunder-cloud; and this will happen in case of a long line, when the electrical condition of the atmosphere which surrounds the wire at one place is different from that at another. Now it is well known that a mere difference in elevation is attended with a change in the electrical state of the atmosphere. A conductor, elevated by means of a kite, gives sparks of positive electricity in a perfectly clear day; hence it the line of the telegraph passes over an elevated mountain ridge, there will be continually, during clear weather, a current from the more elevated to the lower points of the conductor.

A current may also be produced in a long level line, by the precipitation of vapour in the form of fog at one end, while the air remains clear at the other; or by the existence of a storm of rain or snow at any point along the line, while the other parts of the wire are not subjected to the same influence.

Currents of sufficient power to set in motion the marking machine of the telegraph have been observed, which must have been produced by some of these causes. In one case the machine spontaneously began to operate without the aid of the battery, while a

* American Philosophical Society, 1846.

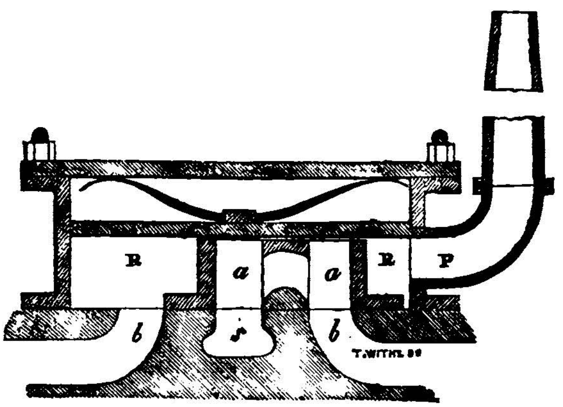
snow-storm was falling at one end of the line, and clear weather existed at the other. On another occasion a continued stream of electricity was observed to pass between two points at a break in the wire, presenting the appearance of a gas-light almost extinguished. A constant effect of this kind indicates a constant accession of electricity at one part of the wire, and a constant discharge at the other.

3. The natural electricity of the wire of the telegraph is liable to be disturbed by the ordinary electrical induction of a distant cloud. Suppose a thunder-cloud, driven by the wind in such a direction as to cross one end of the line of the telegraph at the elevation, say of a mile; during the whole time of the approach of the cloud to the point of its path directly above the wire, the repulsion of the redundant electricity with which it is charged would constantly drive more and more of the natural electricity of the wire to the further end of the line, and would thus give rise to a current. When the cloud arrived at the point nearest to the wire, the current would cease for a moment; and as the repulsion gradually diminished by the receding of the cloud, the natural electricity of the wire would gradually return to its normal state, giving rise to a current in an opposite direction. If the cloud were driven by the wind parallel to the line of the telegraph, a current would be produced towards each end of the wire, and these would constantly vary in intensity with the different positions of the cloud. Although currents produced in this way may be too feeble to set in motion the marking apparatus, yet they may have sufficient power to influence the action of the current of the battery so as to interfere with the perfect operation of the machine.

(To be continued.)

LOCOMOTIVE SLIDE VALVES.

Sir—The following is a scheme for relieving the slide valves of a locomotive engine from the great pressure which is upon them (in the ordinary valves). It is thus:



In this sectional view, the slide will be seen to have two ports a, a' connected with each other, and of equal area to those on the cylinder face, b, b'; c is a plate placed on the back of the valve, and kept there by means of a strong spring, which should be tested, to stand the amount of pressure there would be on a space equal to the area of the two ports a, a'; s is a steam-way, through which the steam is admitted, passing from thence through the ports into the cylinder. The pressure on the space between the ports is neutralised by the strip e, to which I think there can be no objection, as it would only open and shut the steam-way simultaneously with the steam ports in the cylinder; therefore, the supply of steam would be as regular as were it full open during the entire travel of the valve. The exhaust is formed through the chamber R, and the blast-pipe P. The lap of the valve is of course at the will of the engineer. Hoping that the scheme will meet with your approbation and insertion in your next,

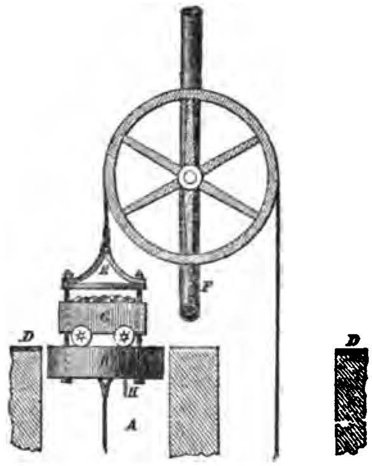
I am, Sir, your's, very respectively,

F. A. Bucknall.

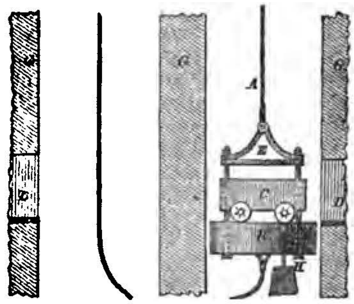
Bristol, May 22, 1847.

WATER-BALANCE WINDING MACHINE.

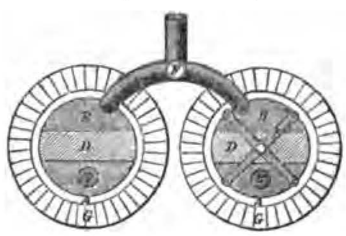
We are indebted for the following description and engravings to the Mining Journal.



Elevation.



Description.—A A A A, the pits; B B B B, plate-iron water-tanks; C C, two wagons; D D D D D D, part of the rails, and the bridge across the top of the tanks; E E E, different views of the cross connecting the tanks and wire ropes; F F, water-pipes, provided with valves, for filling the tanks—to be opened and shut by levers, under the command of the attendant; G G G G G, the walling, or steaning,



Plan.

of the pits; H H, exit valves, at the bottom of the tanks. The large wheel has a groove to receive the rope, or chain, as the case may be, and furnished with a brake, to regulate the motion and gripe tight, as the wagons reach the proper places for pushing off and on. It will be necessary to attach a rope (or chain) to the bottom of the tanks, similar to that annexed, in order to keep up the equilibrium through the whole depth of the pit; for, where the ground is favourable, one elliptical pit will be a saving in sinking and steaning, as well as in the size of the wheel, which may be proportionably less.—The upright pipe, seen behind the wheel, may be surmounted by a cistern, to relieve the pipes and joints from the shock occasioned by suddenly checking the momentum of the water-current along the horizontal pipes.

It should be understood, that guide-rods, though not shown, are necessary to keep the tanks steady.

It is now 20 years since I erected one of these machines, which has been in constant work ever since, and is still raising 500 tons, from a depth of 50 yards, in 12 hours.

Coleford, May 8.

John Walkinshaw,

REGISTER OF NEW PATENTS.

PRESERVATION OF ORGANIC SUBSTANCES.

John Ryan, of the Royal Polytechnic Institution, doctor of medicine, and professor of chemistry, for "*Improvements in the preservation of organic and other substances.*"—Granted Oct. 17, 1846; Enrolled April 17, 1847.

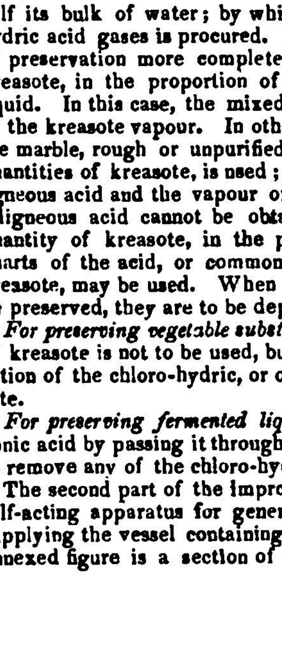
These improvements relate, firstly, to preserving organic and other substances, by supplying thereto a mixture of gases and vapours which are opposed to combustion and decomposition, applied either in combination with air or instead of air. The gases preferred are either a mixture of carbonic and chloro-hydric acids, or a mixture of carbonic and acetic, or pyroligneous acids.

For preserving animal matters, a mixture of carbonic and pyroligneous acids in a gaseous form, is preferred, because of the presence of a small quantity of kreasote; sometimes a little kreasote is added and allowed to pass over with the gases into the vessel containing the substance to be preserved. These gases are obtained from any suitable carbonates, but carbonate of lime in the form of marble is preferred, to which is sometimes added common chloro-hydric acid, diluted with half its bulk of water; by which a mixture of carbonic and chloro-hydric acid gases is procured. If it be necessary to render the mode of preservation more complete, there is added a small quantity of kreasote, in the proportion of half-a-drachm to two quarts of the liquid. In this case, the mixed acids carry off with them a portion of the kreasote vapour. In other cases, to obtain the carbonic acid of the marble, rough or unpurified pyroligneous acid, containing small quantities of kreasote, is used; by which a mixure of carbonic pyroligneous acid and the vapour of kreasote is obtained. If coarse pyroligneous acid cannot be obtained, either acetic acid and a small quantity of kreasote, in the proportions of half-a-drachm to two quarts of the acid, or common vinegar with the same quantity of kreasote, may be used. When organic matters, such as meat, are to be preserved, they are to be deposited in suitable air-tight boxes.

For preserving vegetable substances, or fermented liquids, the vapour of kreasote is not to be used, but carbonic acid alone, obtained by the action of the chloro-hydric, or other suitable acid containing no kreasote.

For preserving fermented liquids, it is necessary to wash the carbonic acid by passing it through a small vessel containing clean water, to remove any of the chloro-hydric or acetic acids.

The second part of the improvements relates to the constructing a self-acting apparatus for generating the gases, and its application to supplying the vessel containing the articles to be preserved. The annexed figure is a section of the apparatus, which may be made of glass, earthenware, iron glazed inside, or pure lead, of a sufficient strength. *a* is a vessel or chamber for holding the acid, and *b* an internal chamber, with a perforated false bottom, for holding broken pieces of marble; *c* is a capping, secured by screw bolts; *d* a bent tube with stop-cock, to which is attached a flexible tube *e*, communicating with an air-tight box or safe, containing the articles to be preserved; *f* is an aperture furnished with a plug, for filling the vessel with acid when required; to fill the interior vessel, it is necessary to remove the capping.



The action of the apparatus is as follows:—when the door of the box or safe containing the article to be preserved is open, the pressure of the air on the acid in the outer chamber *a*, causes the acid to rise among the broken marble in the chamber *b*, when gas is generated and is carried off by the tube *d*, to the preserving box or safe; when the door of the latter safe is closed air-tight, the vessel is filled with the gases, mixed with air, and when fully charged, the pressure of the gas on the acid in the inner vessel, *b*, will force the acid out into the outer chamber *a*, leaving the marble dry; consequently, the action of generating the gases will cease until the door of the preserving box is opened again.

SHIPS AND PROPELLERS.

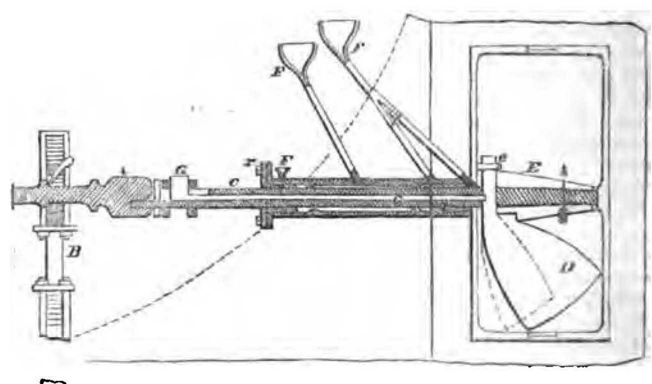
John Buchanan, of Queen-square, Westminster, gentleman, for "*Improvements in ships or vessels, and in the propelling thereof, and in securing the same from fatal damage, certain parts of which machinery may be used for motion on land.*" Granted August 15, 1846; Enrolled February 4, 1847.

The improvement consists, first, in the formation or construction of ships or vessels, by means of lines, as hereinafter described; and, secondly, to the application of a blade or blades for the propelling of ships or vessels, so constructed as to yield to the adverse pressure of the water when required.

The patentee states that the object of the first part of his invention is to enable the lines of a ship or vessel to be drafted so that all the lines will correctly run into each other, and that they will not require adjustment by shifting the transverse sections. The work is done according to true geometrical bases throughout, beginning with the main frame, and in lieu of water lines, ribband lines, and buttock lines, with their necessary accompanying balance and adjusting frames, the patentee only makes use of the midship section, an upper extreme height-of-breadth-line, and one main diagonal on each side of the hull, uniting or fitting in all the transverse sections from the upper height of breadth to the main diagonal, and thence down to the keel, in the same manner as if followed in constructing the main frame, viz., bisecting, or halving the angles contained within the several perpendiculars, (or straight lines approaching more or less to the perpendicular,) and also all the angles within the straight lines crossing these perpendiculars and the diagonals at the points where the transverse sections respectively cross the main diagonals. Lines traced through these bisections of the angles form the outside of the frame of the ship. The longitudinal curves being formed nearly in the same manner, viz., halving the angles contained within the perpendiculars or lines bounding the ends of the oblong figures and sides or bottom of the said figures, whether vertical, horizontal, or diagonal, and lines connecting the extreme points or base lines of these triangles, such being a pure trigonometrical and geometrical formula for determining the transverse and longitudinal lines of a ship or vessel, according to this invention, regulating her form from the straight lines of the stem, stern post, and keel, to the greatest extent of breadth and depth, beautifully proportioning all her lines, and each line relatively partaking of each other's qualities upon the principle of the two sides and base of a cone regulating all the lesser diameters thereof in due proportion.

The second part of the invention is for improvements in propelling vessels, as shown in the annexed engraving:—

Fig. 1.



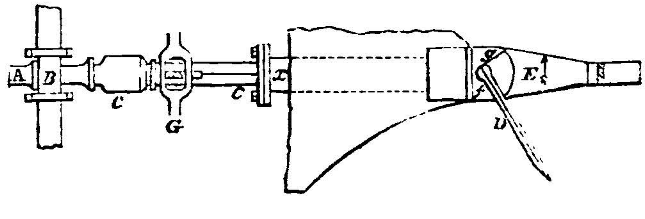


Fig. 2.

Fig. 1 is a section showing the internal construction, and a plan (as it would appear from beneath) of the stern end of a vessel, to which one modification of this part of the invention is applied.

A, represents the revolving shaft driven by the steam-engine, or other power. The bearings are supported on elastic springs, B, so that any bending of the vessel does not bind the journals of such shaft, which are allowed to arrange themselves in a line by the compressing elasticity of such springs. The shaft, A, is connected or coupled at *c*, to the shaft, C, which carries the propelling-blade, D, formed as a cylindrical axis, which passes through the shaft, C, and the boss, E, where it is held by means of the cotter, *e*. The cotter is cut or split in a different direction to that generally practised. This form of cotter is fixed by opening the slit by a drift or wedge, and, while open, rivetting in the small bolt, which leaves the cotter perfectly secure and safe. The blade, D, thus supported on the shaft, C, partakes of the revolution of such shaft at the same time that it is free and at liberty to move on its own axis; so that, supposing the shaft, C, to revolve in the direction indicated by the arrows, the resistance of the water will place the blade, D, in the position represented, resting against the shoulder or face, *f*, formed in the boss, E, as seen at fig. 2; but when the revolution of the shaft, C, is reversed, the blade will vibrate on its axis from the same resistance of the water, and assume the opposite position, resting on the shoulder or face, *g*. The angles formed by the shoulders, *f* and *g*, with the shaft, C, are slightly varied, so that the angle formed by the shoulder, *g*, being more acute, will drive quicker when required, without any increase of speed in the rotation of the shaft, C. By this arrangement the blade, D, having free play on its axis between the shoulders, *f* and *g*, will at all times yield to any adverse pressure which may arise from the superior velocity of the vessel to that generated by the propulsion of the blade, D, itself; so that, supposing sail to be on the vessel at the same time that the propeller is in action, and that the gale should suddenly carry the vessel beyond the speed due to the propeller, it will instantly yield to the adverse pressure, and present no resistance to the course of the vessel. And in like manner, when the vessel is under sail, and no rotation is imparted to the shaft, C, the blade, D, will yield to the adverse pressure of the water, and assume that position which prevents the least resistance to the onward course of the vessel. The shaft, C, is supported in a hollow tube, *x*, *x*, passing through, and firmly fixed in, the dead wood of the vessel's stern, and lubricated at various points by means of pipes, marked F, carried to such an elevation as to support a column of oil sufficient to overcome the pressure of the external water, and ensure the necessary supply of oil where required, which is not always the case in the ordinary arrangements of machinery of this nature. It will be also seen, in this figure, that the force or pressure imparted from the rotation of the blade, D, to the vessel, is received from the boss, E, resting and revolving against the fixed tube, *x*, *x*, which carries the shaft, C, at a point immersed in the external water, which prevents it heating whilst the superior column of oil, supplied by the small tube, F, lubricates the parts in contact. The shaft, C, is formed of two semi-cylindrical halves, the centre or flat surface of each being planed or ploughed out, so that when placed face to face, they form a cylindrical, hollow shaft, through which is passed a rod or bolt, *o*, for the purpose of fixing or bolting the blade, D, when in a propelling position, which bolting or fixing is practised only when backing or sternway is required. The bolt, or rod, *o*, is traversed by the lever, G, and may be put into action, or relieved at any moment, while the blade, D, is resting on either one or other of the shoulders, *f*, or *g*, holes being provided in the cylindrical axis of the blade, D, in the proper position to receive the bolt, *o*, and when bolted, the reverse rotation of the shaft, G, necessarily backs the vessel.

GUTTA PERCHA SAFETY FUZE.

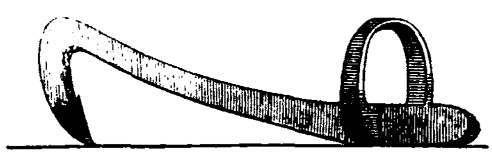
GEORGE SMITH, of Camborne, Cornwall, safety-fuze manufacturer, for "*Improvements in the manufacture of safety-fuzes.*" Granted November 12, 1846; Enrolled May 8, 1847. (Reported in the *Mechanics' Magazine.*)

The safety fuze is to be made in such manner and material, to render them less liable to injury from changes of atmospheric temperature, damp, or the action and pressure of water, when employed in submarine operations, by employing gutta percha to enclose an interior cylinder of gunpowder; or as a coating, or covering, for the ordinary hempen fuzes. The cylinder for gunpowder is made with gutta percha in the following manner:—A cylinder of iron, capable of supporting a pressure of 500 lb. to the square inch, and made at its lower extremity of the form of an inverted cone, is surrounded with a casing, between which and the cylinder steam is allowed to circulate. The lower part of the cylinder—that is, the apex of the inverted cone—terminates in a pipe, which is carried down through a cistern of cold water. A gunpowder chamber, or funnel, is supported by suitable bearings in the centre of the cylinder, and, passing through the inverted cone, terminates in the pipe below the joint. The funnel is filled with gunpowder, having a thread through the centre thereof, to facilitate its passage; and the cylinder with gutta percha. The steam is made to circulate between the cylinder and outside casing, until the gutta percha assumes the consistency of putty. It is then pressed through the pipe, and, passing round the gunpowder funnel, takes the form of a hollow tube, while it becomes filled with gunpowder. The fuze, in passing through the cold water cistern, acquires a degree of firmness, which may be increased by causing it to pass between two rollers, grooved on their peripheries, and made to revolve in opposite directions. The ordinary hempen fuzes are also coated with gutta percha in the following manner:—An iron cylinder, similar to the preceding, and heated in like manner, is filled with gutta percha, which is subjected to the pressure of about 300 lb. to the square inch. The sides of the cylinders are bored with holes of different diameters, to suit the size of different fuzes, to which inlet and corresponding outlet pipes are attached. When the gutta percha is sufficiently softened, a wire, hooked at the end, is made to enter one of the inlet pipes, and, passing through the mass of gutta percha, to come out at the exit one opposite. The fuze is cooled in its passage through the exit pipe by an arrangement similar to the one described.

SHIPS' ANCHORS AND MASTS.

JOHN JAMES ALEXANDER MACCARTHY, of Sidney Terrace, Brompton, gentleman, for "*Improvements in anchors, and fids for masts for vessels.*" Granted Oct. 22nd, 1846; Enrolled April 22nd, 1847.

THE improvements relate, firstly, to an improved form of anchor for ships, as shown in the annexed engraving. It is made with only one fluke, and a stem or shank of the form shown in the engraving,



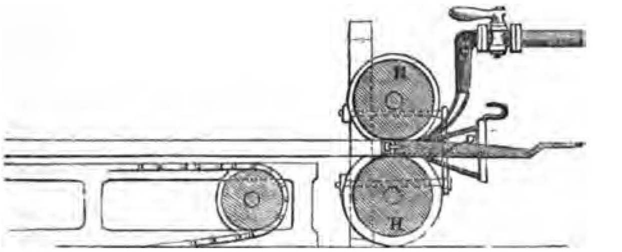
in order that the centre of gravity of the mass shall be as near as possible to a line drawn from the point of the fluke to that part of the shank where the stock is attached. The stock is of a heart shape, made of iron, welded to the shank, or it may be formed separately, and secured by any suitable means. This stock is constructed with the greatest proportion of metal nearest the shank, to render it stronger, and more capable of resisting the shocks and strains it may be subjected to, and, at the same time, it keeps the greater proportion of the weight near the desired point. If an anchor be constructed as described, whichever way it may fall, it will, by its own gravity, take the position shown in the engraving.

The second part of the improvements consists in introducing a ratchet and pall for supporting the top-masts of vessels; the ratchet, being secured to the top-mast, and the pall hinged to the lower mast, the mast is raised and lowered in the usual way by a pulley let into the lower end thereof, the mast as usual passing through holes in the cap and cross-tree; when it is desired to lower the mast, the pall is withdrawn from the ratchet, by means of a cord or rope fastened to the back of the pall, and passes over a pulley in the mast down to the deck. In raising the mast, the rope is slacked; the pall, falling by its own gravity against the top-mast, enters the teeth of the ratchet on the mast's attaining the requisite height, and securely holds it in the required position till again released by removing the pall as before described. Another improvement consists in using a hoop, supported from the cross-tree by staples or hinges, in such a manner that it may be drawn towards the lower mast and from under the upper mast by a chain, the same being lowered by the pulley as usual. When the mast is raised, the chain is slacked, and the hoop or fid falling by its own gravity in a perpendicular position, receives the weight of the mast, and in order to retain it in a proper position, that part of the end of the mast which rests on the fid is cut somewhat shorter, the fid being drawn by the chain against the shoulder thus formed, and retains it securely in the desired position.

IRON TUBING.

JAMES ROOSE, of Darlaston, in the county of Stafford, tube manufacturer, for "*Certain improvements in welded iron tubing.*" Granted August 29, 1846; Enrolled February 27, 1847.

The improvements consist, first, in taking a strip of iron of a required length, breadth, and thickness, according to the size of tube, and bevilling or chamfering the two edges of the lap joint, as is well understood amongst tube manufacturers; then turning the two sides of one end of the skelp or strip when at a red heat, the two edges curling towards each other, and one lapping under the other, so that the first end is made smaller than the size of the tube when finished; the skelp, or partly turned and partly flat strip, is then put into the furnace, and when brought up to a welding state, it is introduced into



a bell or mouth-piece, D, similar to that shown in the engraving, and the turned-up end is sufficiently inserted through the bell and between the rolls, H, H, to allow the plyers on the drawbench to catch hold of the end of the skelp; the chain being then set in motion, the skelp will draw through the bell, and, owing to the ridge on the bell, the one end of the skelp will be caused to overlap the other edge, and when it has left the bell, and it is in the pinch of the rolls, the place of contact of the rolls being the point which gives the welding pressure, the mandril being within and offering resistance to the internal part of the tube. Between the back part or small end of the bell, and the entrance of the rollers, there is a tube, c, through which is conveyed either hot or cold blast, blown by the engine; the end of this tube is fixed over the seam of the skelp or tube. The blast will have the effect of producing the metal at the seam or joint into a partly liquid state, or state of fusion. The rolls revolve by machinery, and traverse at the same surface speed as the chain on the drawbench, so that the draft on the tube is eased, and the draft has not the tendency to stretch the tube more in one place than another, nor to pull the tube in two. The mandril is placed in front of the bell, the bulb protruding through and into the groove of the rolls. By this process, the skelp, with the one end turned up, is produced at one heat, and at one operation, into a lap-joint welded iron tube. This process will be found most advantageous in the production, particularly of lap-joint iron tubes, on account of the small quantity of hands required, the very great facility it offers in their production, and the superiority of the article produced. They will be found to stand a greater pressure on the inch, according to the substance of metal, than other similar tubes produced by any of the other known processes, on account of the properties of the iron being retained, the tube only having been heated once. By other processes the tubes are repeatedly heated in the furnace, which tends to destroy the fibres of the iron. Another very great advantage resulting from this process, is in the blast playing on the seam or joint of the tube before it goes under the welding pressure, so that in all cases dependence may be placed on the joint being in a good welding state, which joint might in some degree have got chilled in the bell or mouth-piece, in the bending.

SHEATHING FOR SHIPS.

George Frederick Muntz, Esq., M.P., of Ley Hall, near Birmingham, for "*An improved manufacture of metal plates for sheathing the bottoms of ships or other vessels.*" Granted October 15, 1846; Enrolled April 15, 1847.

This invention relates to an improved manufacture of the sheathing metal of copper and zinc, described in the specification of a patent granted to the present patentee October 22, 1832, containing 60 parts copper and 40 parts zinc. The present improvements consist of an alloy of 56 parts of copper, 40¾ zinc, and 3¼ lead; in making the alloy, an additional quantity of zinc is used, on account of the loss of that material during the operation, so as to obtain an alloy containing the different metals in the above proportions. The lead acts an important part in the alloy, as, without it, the alloy would not oxidize sufficiently to keep the ship's bottom clean. The alloy, after being cast into ingots, is rolled into sheets (by preference, at a red heat), and then annealed; and, if desired, the sheets may be cleaned with a mixture of sulphuric and nitrid acids, properly diluted.

The patentee does not confine himself strictly to the above proportions, for the quantity of copper may be increased (which will, however, increase the cost of the sheathing metal), or it may be decreased to a slight extent; but it must not be reduced to fifty per cent. of the alloy produced. Although lead is mentioned in the above description, any other suitable metal may be used in place of it, but not with equal advantage.

The patentee claims the manufacture of sheathing metal, by so using other suitable metal or metals, when copper and zinc are combined for the purpose of sheathing, as to allow the mixture to contain a less proportion of copper than about sixty parts of copper and forty parts of zinc, and at the same time attain a sufficient degree of oxidation, and prevent separate action on the zinc.

IRON WIRE.

William Reid, of St. Pancras, Middlesex, engineer, for "*Improvements in the manufacture of wire.*"—Granted October 29, 1846; Enrolled April 29, 1847.—(Reported in the *Patent Journal.*)

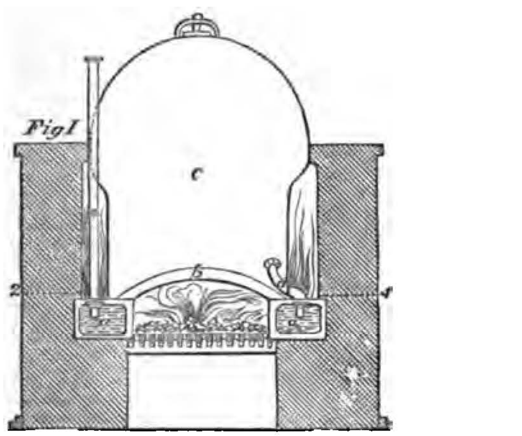
This invention relates specially to the manufacture of iron wire, and also to the cleansing, or preparing the surface of the same, to receive a metallic coating, for the purpose of preventing oxidation, and has for its object the producing wires of greater lengths, and more perfect throughout its entire length, than can be effected by any means at present in use, and consequently better calculated for the purposes to which it is applied; more especially for transmitting the currents in electric telegraphs. For, whereas the bundles of wire, which average about 192 feet in length, and weigh 14 lb., are welded together when reduced to the size which they are intended to remain, the parts joined almost invariably being thicker than the rest, and at the same time rendered more brittle, and not unfrequently unsound. Now, the improvement in the first part of this invention, consists in welding end to end, scarf-wise, two, three, four, or more bars of iron, suitable for the purpose, and afterwards drawing them through the drawing machine, which process not only renders it the same size throughout, but by the strain required, effectually tries the different joints, which, if not sound, will give way, thus detecting any imperfections that arise in the construction. By this means, the patentee states he can readily furnish bundles of wire, of ten times the usual length, or even any length that may be required. After drawing, the wire is submitted to the annealing oven, which renders it as near as may be of a homogeneous quality throughout. With regard to the welding and drawing the iron, he does not lay any claim to the different operations when considered without respect to the order in which they are performed. Although these improvements have been specially mentioned as desirable for the manufacture of iron wire, it may also be equally well applied to the manufacture of steel wire. The second part of these improvements relates to the preparing wire to receive a coating of zinc or tin, in order to prevent it oxydizing; the ordinary method being to immerse it in a solution of nitric or sulphuric acid, from the unequal action of which, or one part remaining longer in the solution than another, the quality of the iron is much deteriorated. Now, according to this invention, the surface of the wire is prepared solely by a mechanical agency, or at least so far as to require only the acid very much diluted, the apparatus for which is as follows:—the coils, as they are taken from the annealing oven, are placed on reels, which revolve freely on vertical spindles, from a suitable frame-work. The form of these reels is the frustum of a cone, the small end being uppermost, so as to admit of the coil of wire being easily placed thereon; the ends of these coils, which may be five, six, or any convenient number, are led round, or rather half round three rollers, whose axes are also vertical; the sinuous route passes throughout, bending the wire alternately in contrary directions, as it turns over each roller; it is then conducted through another series of five rollers, whose axes lay horizontally; the wire, in passing the sinuous course prescribed by them, is bent in a contrary direction to that in passing the previous set of rollers. In order that one wire shall not ride on the other in its passage through the different sets of rollers, the wires are passed through suitable guides, and for the purpose of changing the point of contact on each roller, so that it shall not wear the same into grooves, the first series of rollers is caused to traverse backwards and forwards, in a direction at right angles to the motion of the wire; thus far the process is merely for breaking up any scale or oxide on the surface of the wire; it is then passed between two pieces of wood, faced with leather, or other substance, on which a constant stream of emery is permitted to flow from a hopper above; these pieces of wood are squeezed together with sufficient pressure to clean the surface of the wire, as it passes between them. Instead of leather, he sometimes applies grooved surfaces, cut in the manner of a file, suitable to receive the size of the wire to be cleaned. The wire is next conveyed through a solution of weak sal-ammoniac or muriatic acid; this is effected by passing it down into a trough filled with the liquid, turning it over two rollers immersed therein; it is then conveyed to the bath of metal with which it is intended to be coated, and from thence to reels, on which it is to be wound; these having motion communicated to them from some primary moving power, effectually pull it through the different machines, by which it is cleansed as hereinbefore described.

Having thus set forth the nature of his invention, and the manner of carrying the same into effect, he wishes it to be understood, that although he has described it as being peculiarly applicable to iron wire, used for telegraphic purposes, he does not confine himself thereto, as it is equally well adapted for steel wire; and the second part thereof, preparatory to receiving a coat of other metal, may be applied to various other descriptions of wire. He claims, first, the welding iron bars end to end, scarf-wise, and afterwards drawing them through suitable machinery, with regard to the order in which the same is performed; second, the cleansing the surface of wire by the machinery before described, preparatory to receiving a coating of zinc, tin, or other metal suitable for the prevention of oxidation.

STEAM BOILERS.

George Lodge, of Leeds, Yorkshire, engineer, for *"Improvements in heating water, generating steam, and saving fuel."*—Granted August 10, 1846; Enrolled February 10, 1847.—(Reported in *Newton's London Journal.*)

This invention consists in an improved arrangement of apparatus whereby the heating of water may be economically effected (an increased heating surface being exposed to the action of the flame and heated gases), and a large supply of steam may be quickly generated. The apparatus employed for this purpose is shown in figs. 1 and 2, as applied to a furnace in conjunction with an ordinary wagon-shaped boiler. It consists of two rectangular vessels or chambers of iron, set parallel to each other, one on either side of the fire-place, and connected together in front by a hollow arch, made also of iron. These vessels or chambers are intended to receive the water from the force pump, and, by means of pipes, with which they are provided, to conduct the water over a considerable heating surface before it enters the wagon-shaped boiler. Fig. 1, is a sectional elevation of a furnace,



fitted according to the invention, the front end plates of the chambers before-mentioned being removed; and fig. 2, is a sectional plan of the improved generating apparatus, taken in the line 1, 2, of fig. 1. *a, a,*

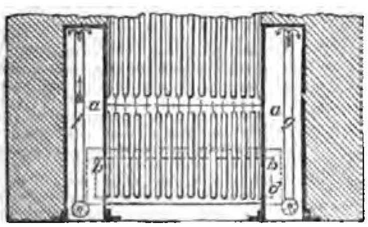


Fig 2

are the two rectangular chambers, through which the water passes on its way to the boiler. It is obvious that these chambers may be of a cylindrical or other required form, but the construction shown in the drawing is preferred, as an extensive heating surface is thereby presented to the fire. *b*, is the hollow arch, connecting the two chambers together, and forming a passage for the water from one chamber to the other; *c*, is the boiler, resting on the chambers *a, a*, and connected to the chamber *a*, by a pipe *d*; *e*, is a pipe leading from the supply-pump to the chamber *a*; and *f*, is a pipe within the chamber *a*, and forming a continuation to the pipe *e*, for the purpose of conducting the water, as it is supplied by the force-pump, to the opposite end of the chamber at which it enters, as shown by the arrows in fig. 2. The other chamber *a*, is similarly provided with a pipe *g*, forming a continuation of the pipe *d*, and having an open end near the back end of that chamber. By this arrangement it will be understood that the water, as it enters at the pipe *e*, will flow along the pipe *f*, to the back end of the chamber *a*; it will then return to the front, and, by the continued action of the pump, be made to rise up the hollow arch *b*, and pass into the chamber *a*. When it has traversed the length of that chamber, it will enter the pipe *g*, and, passing forward, will rise up the pipe *d*, and flow into the boiler in a heated state.

On referring to the elevation, fig. 1, it will be seen that the boiler is fixed so that the play of the flame around it will be precisely the same as in the ordinary mode of setting such boilers; the heat is therefore as economically employed with regard to its action on the water in the boiler as heretofore. The chambers *a, a*, (which occupy the place hitherto filled with solid brick-work for supporting the boiler) will therefore, in exposing the water on its passage to the boiler to the action of the fire, cause it to take up a considerable portion of heat that might otherwise be lost; and as the water is thus submitted to the fire in a comparatively small body, it will become quickly heated, and, entering the boiler in that state, will speedily be converted into steam.

The patentee claims the improved arrangement, above described, for raising the temperature of water on its passage to the boiler, whereby steam may be more quickly generated than by conveying the water directly from the well or supply-cistern to the boiler, and also an economy of fuel will result.

VALVES FOR SEWERS.

James Lysander Hale, of Hackney, Middlesex, civil engineer, for *"certain improvements in sewerage and drainage, and apparatus connected therewith, parts of which are applicable to steam-engines."*—Granted October 27, 1846; Enrolled April 27, 1847.

The improvements relate to preventing the escape of noxious air, vapours, steam, gas, &c., from drains, engines, &c., and obviating the corrosion of the hinges used in apparatus connected therewith. For this purpose, instead of forming the common traps for drains of iron, as usual, the inventor makes the frame of brown earthenware or other suitable lasting and non-corroding substance, placed in the usual way at the entrance to the drain. The valve is constructed of a piece of vulcanized india-rubber, large enough to cover the opening of the trap, and to give sufficient lap; the edge is secured to the frame of earthenware by rivets, or cement manufactured for similar purposes, by the Kamptulicon Company. The sheet of vulcanized india-rubber has a metal plate, or a stone, placed on the back, which, by its weight, keeps the face of the valve close to its seat.

Another trap for sewers is made with a number of bars on the back, instead of the metal plate or stone as above described; the vulcanised india-rubber is affixed to the earthen frame as before; the bars are secured by cement or rivets, in the direction or length of the part secured, forming the hinge; the water, as it issues from the pipe into the sewer, only raises the valve to the extent necessary to admit of the passage of the water escaping; the space between each bar forming a hinge, on which each bar moves, consequently there is no room for the escape of noxious vapours, the valves being always closed down to the surface of the water. The metal for the bars the patentee prefers is galvanised, or tinned iron.

The next improvement is for a ventilator, to be placed on the top of flues leading from places requiring ventilation—consisting of two cylinders of galvanised sheet iron or zinc, of different diameters; the smallest is placed on the top of the chimney; it has several openings in the sides near the upper end; the top is closed by a plate of metal; the large cylinder is only about half the length of the other, but at the same time sufficient to protect the openings in the smaller one (over which it is placed) from side currents, while, at the same time, space sufficient for the escape of smoke or vapour is allowed between the two; the external cylinder is supported from the smaller one by stays, and in such a way as not to obstruct the passage between them.

RAILWAY EXPENDITURE.

Return, *to an order of the House of Commons, showing the Amount of Money expended in the actual Cost of Construction, and of Working Stock (including Locomotive Engines, Carriages, Tools, &c.) of all* Railways *in* Great Britain *and* Ireland, *in each Triennial Period, previous to the 1st day of January respectively, in the Years* 1841, 1844, *and* 1847.—[Fractional Parts of a Pound are omitted.]

Railways Opened.	Construction of Railway.			Purchase of Working Stock.		
	Previous to 1841.	1841 to 1843 inclusive.	1844 to 1846, both inclusive.	Previous to 1841.	1841 to 1843 inclusive.	1844 to 1846, both inclusive.
	£	£	£	£	£	£
Aberdare	—	—	50,580	—	—	7,193
Arbroath and Forfar	117,177	3,981	4,174	14,467	2,563	538
Ardrossan	71,829	26,610	7,971	2,750	2,494	913
Ballochney[1]	57,224	23,717	9,772[1]	5,673	6,355	1,939[1]
Brighton and Chichester[2]	—	—	410,562	—	—	—
Bristol and Exeter						
Chester and Birkenhead	362,137	83,269	162,985	26,670	3,155	20,805
Chester and Holyhead[3]	—	—	1,369,808	—	—	—
Clarence[4]	375,064	127,955	6,328	12,115	1,220	—
Dublin and Drogheda	27,483	282,229	220,379	—	—	68,691
Dublin and Kingstown						
Dundee and Arbroath	88,748	13,145	1,546	14,863	4,565	1,225
Dundee and Newtyle	2,226	2,247	3,737	1,936	1,943	1,786
East Lancashire	—	215	764,851	—	—	49,350
Eastern Counties	1,382,497	1,204,765	2,015,607	46,539	65,462	329,720
Northern and Eastern[5]	146,229	328,160	51,710	24,957	56,292	123
Edinburgh and Glasgow[6]	633,683	828,493	287,788	—	126,640	58,090
Edinburgh, Leith, and Granton[7]	45,872	43,819	203,545	—	1,805	6,091
Eastern Union	—	—	313,229	—	—	23,394
Furness	—	—	111,439	—	—	14,336
Gravesend and Rochester[8]	—	—	71,487	—	—	13,827
Glasgow and Paisley Joint Line[9]	264,744	57,620	5,535	—	—	—
Glasgow, Paisley, and Greenock	507,066	195,142	59,207	7,045	50,391	10,576
Glasgow, Paisley, Kilmarnock, and Ayr[10]	537,957	268,819	41,185 / 265844	32,166	51,738	95,775
Glasgow, Garnkirk, and Coatbridge[11]	123,720	48,685	94,890	13,220	2,980	17,728
Great North of England, Clarence, and Hartlepool Junction[12]	46,043	11,666	33,003	—	—	—
Great Western[13]	4,988,823	1,135,639	271,106			
Cheltenham and Great Western	230,000	150,521	585,146			
Oxford Railway	—	20,029	141,259	299,221	254,444	121,324
Berks and Hants	—	—	444,943			
Oxford and Rugby	—	—	357,586			
Monmouth and Hereford	—	—	102,408			
Great Southern and Western (Ireland)	—	—	1,215,458	—	—	128,260
Hartlepool Dock and Railway[14]	381,724	80,725	15,902	—	—	—
Hayle (now West Cornwall)	93,281	—	—	19,593	—	—
Hull and Selby[15]	484,898	113,569	14,995	35,512	34,284	22,637
Ipswich and Bury St. Edmunds	—	—	301,643	—	—	2,125
Kendal and Windermere[16]	—	—	100,721	—	—	—
Lancaster and Carlisle	—	—	1,105,559	—	—	2,378
Llanelly Dock and Railway	94,541	6,869	1,145	5,829	9,661	2,035
Lancaster and Preston[17]	355,385	85,112	—	1,075	17,991	—
London and Blackwall	238,360	145,843	3 048	47,718	27,880	—
London, Brighton, and South Coast[18]	2,197,089	1,063,596	1,696,306	52,244	140,352	135,860
London and South Western[19]	1,737,095	221,284	25,712	546,743	87,145	16,847
London and North Western[20]	5,442,530	385,240	2,102,621	349,945	—	140,019
Lynn and Dereham	—	—	98,389	—	—	10,077
Lynn and Ely	—	—	215,589	—	—	10,700
Manchester, Sheffield, & Lincolnshire[21]	173,523	533,084	845,826	—	32,840	92,836
Maryport and Carlisle	74,796	166,421	142,291	4,036	8,595	18,756
Middlesborough and Redcar	—	—	60,489	—	—	—
Midland	4,911,846	812,582	1,454,158	333,083	142,962	207,644
Monkland and Kirkintilloch	122,436	48,775	9,464[22]	12,318	11,621	1892[22]
Newcastle and Carlisle[23]	716,252	63,264	91,245	59,434	19,642	44,095
Newcastle and North Shields[24]	254,485	12,768	10,591	15,505	2,895	3,449
Norfolk	—	124,539	792,923	—	—	136,367
North British, including Edinburgh and Dalkeith[25]	—	—	1,045,009 / 141,710	—	—	122,217
North Union[26]	531,715	569,542	1,016,795	38,005	45,292	55,145
Newcastle and Berwick	—	—	682,670	—	—	34,043
Paisley and Renfrew	25 327	—	—	4,030	—	—
Preston and Wyre	268,355	67,293	91,511	6,592	10,963	21,749
Pontop and South Shields[27]	277,850	—	—	27,500	1,725	6,887
Saint Helens[28]	149,168	1,511	14,861	9,080	—	—
Scottish Midland Junction[29]	—	—	167,035	—	—	—
Shrewsbury and Chester	—	—	397,550	—	—	39,313
South Devon[30]	—	—	829,154	—	—	212,950
South Eastern[31]	364,406	2,133,556	2,968,959	—	117,321	304,169
Slamannan	116,368	13,857	3,612[32]	7,526	5,847	122
Stockton and Darlington[33]	23,624	10,733	65,541	15,363	8,440	31,964
Stockton and Hartlepool[34]	229,774	—	—	10,105	—	—
Taff Vale	310,167	127,568	87,298	9,863	19,744	37,992
Ulster	45,556	219,313	57,934	10,473	20,676	15,851
Whitehaven Junction	—	—	109,118	—	—	6,849
Wilsontown, Morningside, and Coltness	—	47,868	28,000	—	—	13,524
York and Newcastle	—	159,576	319,250	—	—	154,065
York and North Midland[35]	370,183	98,101	943,132	28,670	43,102	148,808

Remarks.

1 These sums are the amount expended to the 29th March, 1845; after which the Monkland and Kirkintilloch, Ballochney, and Slamannan Railways were wrought together by mutual agreement. The amount expended upon the whole, since 29th March 1845 to 30th January 1847, is, for construction, 12.542*l.*; for stock, 16,[illegible]

2 This sum includes 220,480*l.* for the Portsmouth Extension.

3 London and North Western Company will probably find working stock for this Line, and take up the contracts of the Company for 50 engines; cost 167,[illegible] None yet delivered, nor any payment made on account. No contracts entered into for carriage stock.

4 Working stock sold for about 9,000*l.* in 1844 to the Stockton and Hartlepool Railway Company.

5 Amalgamated with Eastern Counties, 1st Jan. 1844.

6 Cost of land, compensation, and Parliamentary expenses, are included in the cost of construction. There was also 15,274*l.* paid for Parliamentary expenses for Branch Lines in 1845 and 1846. Cost of formation of Junction with Monkland and Kirkintilloch Railway, 31st Jan. 1844 to 31st Jan. 1845, 2970*l.* Payments in 1846, on account of Campsie Branch, now in course of construction, 3956*l.* Payments in 1845 and 1846, on account of Slamannan Junction Railway, nearly complete, 8,[illegible]

7 Price of land included in cost of construction. Line nearly completed. Works commenced some years previous to 1841, but suspended for a time.

8 Exclusive of cost of Canal.

9 The expenditure is calculated on the return made by the Glasgow, Paisley, Kilmarnock, and Ayr Railway Company. The Line belongs jointly to the Glasgow, Paisley, and Greenock, and Glasgow, Paisley, Kilmarnock, and Ayr, having no working stock of its own.

10 Main Line from Paisley to Ayr, including branch to Kilmarnock. New Branches and Extensions under construction. One half cost of joint Line between Glasgow; other half paid by Greenock Railway company.

11 Amalgamated by purchase with the Caledonian.

12 Engines and wagons for coals, &c. furnished by respective collieries.

13 The working stock for other Lines worked by the Great Western Company is included in these charges. (See separate return for expenditure prior to 1841.)

14 Engines and wagons for coals furnished by respective collieries.

15 Return made up to end of 1845; since which time the Line has been under the management of the York and North Midland Company, to whom it is leased.

16 The working stock of this Line is furnished by the London and North Western Company, at fixed rates.

17 The Company having granted a lease of the Railway to the Lancaster Canal Company in 1842, can make no return of expenditure since that date.

18 This return includes the London and Brighton, London and Croydon, Brighton and Chichester, and Brighton, Lewes, and Hastings. The item in first column varies from printed accounts by 175,780*l.*, amount of Parliamentary expenses of opposing Companies, subsequently amalgamated under the title of London and Brighton Railway; for the aggregate amount of expenditure of which, previous to 1841, see separate return.

19 Including Parliamentary and all other expenses.—(See separate return for detailed account of expenditure prior to the year 1841.)

20 (See separate return.) Southern division, including the following Branches: Warwick and Leamington; Northampton and Peterborough; Aylesbury; Dunstable; Rugby and Stamford; Rugby and Leamington; Trent Valley.

21 The late Sheffield, Ashton, and Manchester.

22 These sums are the amounts expended to 29th March 1845.—(See Ballochney return.)

23 Previous to 1837, 491,257*l.* expended in construction, and in working stock 29,602*l.*; these sums appear in the totals under their proper columns. In the last column an estimate has been made as to how much of the works commenced in 1846, and now in progress, should be therein included.

24 This Line being amalgamated with the Newcastle and Berwick since 30th June 1846, amounts laid out in construction and working stock for this Line, for half-year ending December 1846, are included in the latter Line's return.

25 This return includes a large amount expended at Edinburgh station, and workshops for Hawick Extension, and construction of Branches connected therewith also in surplus property purchased and to be resold.

26 The third column includes cost of Bolton and Preston, then amalgamated with this Line.

27 In addition to the Company's stock, stock belonging to other parties, estimated at 25,500*l.*, was rented by the Company previous to 1841.

28 Original cost of working stock is mixed up with construction, but the return is the ascertained value in 1841

29 No working stock purchased; Line proposed to be worked by a contiguous Line; terms still open.

30 Working stock includes cost of atmospheric tube, &c., and also 2,500*l.* for electric telegraph.

31 Engines, carriages, wagons, buildings, machinery, and tools, included in working stock.

32 These amounts were expended to 29th March 1845 see Ballochney return.

33 Amount of construction not included; chiefly for heavier rails, new bridges, extensions in sidings, &c. &c.

34 Line sold to Leeds and Thirsk for 240,000*l.*

35 Price of land and Parliam. expenses not included.

COST OF VARIOUS RAILWAYS PREVIOUS TO 1841.

RETURN *showing the Sums of Money actually expended by the following Railway Companies previous to* 1841:—Great Western, South Western, Brighton, and North Western (Southern Division); *likewise the Aggregate Sum expended by the above mentioned Railway Companies in each Year previous to* 1841:—

Year.	Great Western.	London and South Western.	London and Brighton.	London and North Western (Southern Division.)
	£	£	£	£
1833	..	..	..	48,943
1834	..	21,754	..	277,742
1835	93,520	150,780	..	727,956
1836	350,983	385,557	..	1,230,679
1837	966,574	385,952	..	1,696,508
1838	1,196,530	609,251	384,831	1,036,990
1839	1,157,893	402,061	548,072	579,723
1840	1,522,544	325,482	758,477	193,934
Total	5,288,044	2,283,837	1,691,380	5,792,475

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

ON THE MANUFACTURE OF CASKS AND VESSELS, AND SEASONING TIMBER.

At the Western Literary Institution, *Leicester-square*, May 3, the following paper was read, "*On the Manufacture of Casks and Vessels, more particularly those used by Brewers, and on the various methods adopted for Cleansing and Purifying such Vessels*":—*

When it is borne in mind that in some establishments in London, there are no fewer than from 70,000 to 80,000 casks employed in sending out beer only; and when it is further believed that in the United Kingdom for public brewing alone, there cannot be less than 2,600,000 of such vessels in use,—the subject of keeping them in a fit and proper condition for the purpose for which they are intended, becomes one of immense importance.

It would be folly to say that the subject has not had much attention devoted to it. Large sums of money have been expended in fitting up various kinds of machinery for this purpose. Many persons incur great expense in removing a head of each cask and thoroughly scouring and cleaning them; also "firing," steaming, the use of chemicals, and other means have been resorted to, in order to effect the great *desideratum* of clean and sweet casks; but after all, the greatest difficulty is experienced in effecting this, and a serious loss of property is oftentimes the consequence.

Before going more fully into the subject, it is necessary that the various methods which have hitherto been adopted and which are still in use, should be fully explained, and we will consider in the first place, unheading casks.

Removing the head of a cask is no doubt the surest and best mode, so far as regards getting it clean, and one which, in many establishments, is carried out completely at no small expense for labour, damage to heads, grooves, hoops, &c. These drawbacks, great as they are, might be overlooked, provided by such means they could be insured as sweet. But this by no means always happens; there is then the alternative of either allowing it to remain (without the head) for a considerable length of time exposed to the sun's rays, or extreme frost, or subject it at once to the—

"Firing process,"—which is that of placing of what is called a "cresset," containing fire inside the cask, and thus heating the wood until the "must," or mouldy smell is destroyed. During this process it not unfrequently occurs that a piece of burning wood drops upon the bottom head of the cask, or perhaps the flame reaches to the sides, and hence charring takes place, in all probability, to a serious extent, and if so, a non-conductor is thus formed, which must necessarily prevent any taint still existing in the body of the wood, from being evaporated. Casks so treated are often found to give out a pernicious flavour to the beer or other liquid, with which they may be afterwards charged, to the serious loss of the brewer, inasmuch as he may have to pay double freightage or carriage on "returned beer," if not the entire loss of it; besides the repetition of the above ruinous process, which is admitted by those who adopt it, as only advisable in extreme cases. The next process is that of

"Steaming."—For this purpose many brewers have boilers of large capacity, in which is generated steam of 3 or 4 lb. pressure, connected to a pipe leading all round, or by the sides of a building, with nozzles inserted in the same, about 2 ft. 6 in. apart, or according to the diameter of vessels requiring to be steamed. These nozzles, on being inserted into the bungholes, have the pressure of the steam forced through them into the casks, in many cases for 3 or 4 hours consecutively, but the more common period is two hours. This is for the purpose of cleansing as well as sweetening casks, and as a substitute for the more expensive process of unheading. Now the effect of this is, in the first place, to swell and surcharge the pores of the wood with moisture, to force into the blisters any mouldy solution, or taint, which may have been previously within a line's thickness of the stave, a considerable distance farther into the body of the wood. As a proof of this being the case, it is perfectly well known that where the system is carried on, casks must not remain beyond 36 hours before being filled with beer, otherwise spots of mould will make their appearance, and all the flavour will again return to the inside of the cask; clearly showing that the germs of the disease have not been destroyed, but simply withdrawn behind the screen, to return in all probability, with increased violence. Can mould and disease be so near at hand and yet the beer not partake of it?

Steaming frequently causes the complete fracture of the staves, on account of the expansion which necessarily takes place; the fibres of the wood are destroyed, the resins and other solid matters which bind the fibres together are gradually washed away, and each successive steaming, when carried to excess, has been known to charge the pores of the wood with 3 lb. weight, or nearly the third of a gallon of water, which on coming into contact with the remains of the beer (after the cask has been emptied) then, most likely, in an acid state, very speedily generates mould, as proved by M. Dutrochet, who says—"that a drop of acid in an ounce of water produced mould in eight days." But independent of the presence of acid, water left in the pores of the wood is sufficient of itself in certain situations to create decomposition, and all the worst evils of which the brewer and others have to complain. But after all, that steaming will not cleanse a cask, has been proved on several occasions. When mouldy casks have been subjected to it for upwards of two hours, it has been found upon unheading them that they have been in a slimy and filthy condition. Scalding and "blowing off," as it is termed, have then been resorted to, but still the casks could not be considered clean inside; that which appeared before the steaming as mould, had afterwards the appearance of glue.

There is another very important matter as regards damp being allowed to remain in any vessel intended for the reception of beer. Take the simple fact of its being put into a wet jug, or glass—do we not at once find it "flat," and out of condition? Indeed, so much so that those, whose trade it is to bottle beer, are compelled to be exceedingly particular in having the bottles perfectly dry. If it is thus necessary in the one case, surely it must be so to some extent in the other.

With regard to the sweetening the casks by chemicals, the methods are as numerous as they are varied. Some use common salt, others soda, lime, sulphuric acid, muriatic acid, leys made of ash, beech, or other hard wood, ashes, together with boiling water in abundance, and many other expedients, all of which are attended with labour in the first instance, and unheading and scouring the cask. Much time is afterwards spent in waiting for these solutions taking effect; and after all this, there is perhaps an odour left quite as bad as the original one which they were intended to cure. The result is, that frequent scaldings with hot water or steam become necessary, and the cask is finally left in the best possible condition to generate mould and other evils.

The machinery in its simplest form for cleansing casks, has hitherto been that of a common chain, or, in some instance, a "mail"-chain, placed inside the cask, with two or three gallons of hot water, and the cask afterwards rolled about in a backward and forward direction, until it was considered to be sufficiently cleansed; but this has been found uncertain in its results, there being no proof whatever of the chain having traversed over the whole of the surface, and particularly in the angles of the heads. This process, therefore, is not to be depended upon.

A piece of machinery was invented a few years since, to work either by hand or engine power. It consisted of frames or cradles at right angles to each other, on one continued shaft, the frames being attached at the diagonal points, the casks thus lying in an oblique position, and secured to the frames or cradles by means of a strap and set-screw; a common chain was placed inside for the purpose of cleansing, but owing to the continuous angular movement of the cask, the chain only acted partially on the surface; it was therefore necessary to shift it several times before anything like a clean cask could, by this method be obtained; so that, from the labour in shifting, added to the uncertainty of having a clean cask, the invention met with very little encouragement.

There was another fitted up some years since at a large establishment in South Wales, at an expense of £1,500, and which is still in use. It consisted of a series of jointed brushes, which are made to revolve horizontally; one head of each cask being taken out, the cask is put upon a truck (or something of that kind), and pushed towards the brush, which, going at considerable velocity, removes the adhering matters, but owing to the inequality of thickness of the staves, the brushes leave a considerable quantity of dirt in the angles, which has afterwards to be scraped or brushed out with scrubbing brushes, the latter operation being performed by women employed expressly for this work; as many as 400 casks per day being thus cleaned, and after being headed up again, are, in cases of must or smell, subjected to steam, the use of soda, &c., as previously alluded to, at no little expense for damage done to casks, besides the wear and tear of brushes, which is very great.

Having pointed out the evil effects of firing, hard steaming, the use of chemicals, and other methods, as well as the attempts which have been made at machinery, to render casks in a fit and proper condition to contain

* We are indebted for this Report to the "Patent Journal."

beer, &c., we will now proceed to describe the process lately invented by Davison and Symington.

The invention relates—1st, to a new method of making casks; 2ndly, to a new method of cleansing casks by machinery; 3rdly, to a method of purifying casks. On the improved mode of making casks;—but first a few words on the present plans. According to the present mode, the master cooper being desirous of sending to his customers only such as are made of pure and well-seasoned wood, is compelled to lay by the wood for a considerable period, in some cases two or three years. Now, after this, the wood is, no doubt, freed from much of its moisture; some of the vegetable juices have been evaporated by exposure to the sun and wind; but it should be remembered that the wood in this state is much harder to bend than it was in its former green state, so much so, that frequent applications of water, assisted by heat, are obliged to be made, before the necessary bending can be accomplished; with all the care that can be bestowed, the staves frequently crack in the cross way of the wood, which, if not through the entire thickness, exhibits itself in the inside in the form of a blister, many of which may sometimes be found in one cask, to the great annoyance of the brewer and those whose business it is to see that the casks are in a fit state to contain beer or other liquids, as it most frequently happens, that when moisture is admitted into these casks, the listers expand, and form a receptacle for any vegetable or other matter which may deposit itself from the contents of the cask, and by subsequent exposure to the atmosphere soon become mouldy, if not in a musty state; hence the plea of the coopers when they say—"We must un-head the cask to chip out the blisters."

To avoid this expensive and injurious process, as well as to render casks in a much better seasoned state than by long exposure to the atmosphere, it is proposed to make use of wood in its new or green state, that is, when the vegetable juices are in the pores, in which state the staves are easily bent to the desired curvature, without cracking or otherwise injuring the staves; after being thus bent in the form of casks with temporary hoops, making due allowance for shrinkage, they are in this state to be subjected to the action of a continuous and rapid current of heated air passing through the interior of the cask (the cask being supplied with a temporary cover over the top end, with a small hole in the same for the exit of the air), until the wood has exhaled all its natural sap or other aqueous matters with which it was formerly impregnated; the staves thus become denser and harder, all the fibres being brought closer together; this done, the casks are finally hooped and finished off in the usual way, the wood of which the heads are composed having been previously seasoned in a similar manner, in chambers properly constructed for the purpose. Casks so made are rendered entirely free from sap and other moisture, hence their peculiar fitness for warm climates; and whilst it is of great importance for some kinds of beer to have the casks free from all coloured juices, it is equally so for other articles, such as bread, beef, &c. In proof of the heated air so removing these aqueous matters, Dr. D. B. Reid, who was professionally engaged to investigate the merits of this invention, states—"A new cask of green wood, subjected to the action of heated air, gives out a volatile matter along with a large quantity of water, which, when condensed in a refrigerator, sustained at a low temperature by a freezing mixture, presents a liquid, limpid and colourless, like water, but strongly impregnated with the odour of the wood. Also, the wood not only becomes denser, but has less taste, at least at first, and must necessarily vary in its texture, according to the extent to which it has been heated, and the amount of moisture expelled."

The new cleansing machines consist of two frames made of iron, one revolving inside the other; the inner may be termed a cradle, in which the cask is secured by means of a chain, lever, and catch; motion being given to the outer frame, either by hand or engine power, causes the inner one to revolve in a contrary direction, which is accomplished by an eccentric next the axis of the outer frame, and to which is connected a set of jointed rods communicating with a ratchet, which is fixed on the axis of the inner frame. The action is thus:—for every turn the outer frame makes in the direction of its length, the inner one, which contains the cask, moves at right angles with the other frame, a distance equal to one tooth of the ratchet, or 1-20th of the circumference of the cask; in this way, by the time the outer frame with the cask has made twenty revolutions end over end, the inner frame has moved the cask round only once sideways. Thus by means of a chain of peculiar construction, attached to a plug suited to the bung hole, which is in the first instance inserted in the cask, together with two or three gallons of hot water, every inch of surface becomes acted upon and freed from all adhering matter in a very short time. For the purpose of more thoroughly cleansing a very bad cask, it is usual, after it has revolved for about a quarter of an hour, to loosen the plug, and allow the first water and dirt to run out; then, from a main over the machines, to let in about a gallon of clean hot water, for the purpose of giving a second rinse. The very worst description of casks are, by this process, rendered perfectly clean in the course of half an hour. It is only necessary further to observe, that any number of machines may be made to revolve at the same time, by applying adequate power.

To test the merits of this part of the invention, a great number of very interesting experiments were gone into, some of which were made immediately under the direction of Dr. Reid, from which it would appear that rapid currents of heated air in passing through a mouldy cask becomes loaded not only with moisture, but also with minute particles of mould, or at all events, with some material from the mould, which is proved to develope mould into other substances; which was ascertained by condensing the vapour which passed from a mouldy cask, by a current of heated air, being found to deposit on the corks of the bottles containing the liquid, a very rich vegetation of mould, whilst no such appearance was traced in the liquid condensed from fresh casks; showing that the fact refered to is one of the greatest importance, as indicating that the action of heated air is not merely exsiccative but that it does dissipate mould.

Dry heat is a well known purifier, it having been satisfactorily proved lately in Syria, that even the clothes worn by persons who had died of the plague, were rendered perfectly harmless by being exposed to 280° Fah.; but lest this should be going too far away from the subject in question, one or two other simple circumstances may be mentioned, as showing that dry heat is the thing needed between the fibres of the wood; take for instance a chip from a musty cask, and carry it in the waistcoat pocket for an hour or more, and it will be found that the warmth of the body alone has materially, if not wholly, removed the unpleasant odour. In the process of firing a cask, it was found that the average heat from the cresset against the sides of the cask, was equal to 350°, and the application of this temperature for half an hour is usually considered sufficient to remove the moisture and smell; but great difficulty is experienced in applying the heat uniformly, and it is at all times too sudden to effect a complete removal of the moisture and taint from the body of the wood, in addition to the ill effects of charring. The new process insures one temperature throughout every portion of the cask, and as it requires only five seconds of time (from the rapidity with which the air is propelled) to give every crevice of a 36 gallon cask a fresh supply of heat, it will be readily understood that by such means, all danger of the wood being burnt is removed, the cask becoming gradually and speedily deprived of all moisture, and with it the complete evaporation of the "must" with which that moisture is impregnated.

Contrary to the opinions of some, this process is not attended with any injurious effects upon the wood, but the very reverse; it being found to close the pores and render the surface much harder, and consequently less susceptible of re imbibing moisture, and which would be particularly so if steam could be altogether abandoned in the process of cask cleaning; the residue of the beer would then become hardened in the pores upon each application of heated air, and would eventually effect an internal protecting crust or glaze on the surface, which would materially facilitate the future cleansing of the casks.

The advantages of the new system are these:—First, that casks can be made out of green wood instead of very dry and seasoned wood, and by this means be free from blisters, and in every way better fitted to resist moisture and its evil consequences. Secondly, that the cleaning of casks may be effected by machinery, with every degree of certainty, without unheading or otherwise destroying the constitution of the casks. Thirdly, that casks may be rendered sweet, pure, and uniformly dry, without the injurious effects of either un-heading, the use of chemicals, or hard steaming. Lastly, that the means by which the whole is accomplished, are not only simple, speedy, and to be depended upon, but at one-fourth the expense of any other system where un-heading is resorted to.

The heating apparatus consists of 15 cast iron pipes of a horse-shoe form—the internal sectional area of each being 12 inches, and the external heating surface 1665 superficial inches—these drop into sockets connected with a horizontal pipe, of 9 inches diameter, which is placed on each side of the surface, and the divisions in the latter are so arranged that the air in its passage towards the nozzles first passes through four of the horseshoe pipes; next five, and then six, pipes; this is for the purpose of making room for the expansion of the air, which, it will be observed, has by this time passed three times over the furnace. The air on passing away from the six pipes immediately rushes through the nozzles, and from thence to the interior of the casks over which they are placed. The air is propelled by means of a fan of 18 inches diameter, at a speed of 1,400 revolutions per minute. The apparatus is also furnished with a boiler which is placed over the heating-pipes, the external heat of which tends greatly to forward the generation of steam, which is used for the purpose of warming and slightly moistening the casks previous to being finished off with the heated air. The water in the boiler serves for charging the casks during the cleansing process, as before described.

An apparatus such as now described, consisting of cleansing machines, and 21 nozzles, for heated air, has been in operation at Messrs. Truman, Hanbury, Buxton, and Co.'s brewery for upwards of two years, during which time upwards of 70,000 mouldy casks have been cleansed and purified; a great proportion of which would have required, under the old system, to have been either unheaded, and remained so for a considerable time, or have been subjected both to "firing" and hard steaming, at an expense of at least 10d. per cask. The apparatus alluded to is capable of cleansing and purifying 230 casks per day, or 1,320 per week, at an expense as under, viz.:—

Fuel for furnace, 2½ tons, at 22s.	2	15	0
Proportion of fuel to engines, 12 cwt.		13	3
2 men and 1 boy, but say 3 labourers, to attend to machines and hot air apparatus, each 20s.	3	0	0
Total	£6	8	3

Or under 1¼d. per cask.

This does not include the interest of money sunk in fitting up the apparatus, or the cost of wear and tear; but including the whole after two years' hard working of the apparatus, it is found that each cask (including butts, puncheons, and the larger description of casks), exceeds little beyond 2½d., or one-fourth what it costs by the present system.

Wood seasoned by this process is particularly applicable to floor boards, and house fittings generally, for cabinet work, musical instruments, carriage building, &c., as shown by the annexed table:—

Comparative Strength of Various kinds of Wood in a "Seasoned" and "Unseasoned" state.

	Names of Wood 1 ft bearing 1 inch square.	Weight.	Weight after Hot Air.	moisture removed	Deflection in inches & tenths.	Breaking Weight in lbs.	
1	Fir seasoned..	1·16	1·09	·07	3·5	201	8·8 or nearly 9 per cent. added to strength of Fir by seasoning.
2	do......	1·17	1·08	·09	3·3	190	
3	do......	1·19	1·1	·09	4·0	214	
4	Fir not seasd. .	1·18	—	—	3·6	190	
5	do......	1·15	—	—	3·8	190	
6	do......	1·05	—	—	4·0	176	
1	Elm seasoned.	1·33	1·21	·12	3·5	120	12·3 per cent. added to strength of Elm by seasoning.
2	do......	1·3	1·18	·12	5·	106	
3	do......	1·4	1 27	·13	4·3	128	
4	Elm not seasd.	1·15	—	—	6·5	106	
5	do......	1·21	—	—	5·7	99	
6	do......	1·36	—	—	6·1	110	
1	Ash seasoned .	1·56	1·44	·12	4·	234	44·7 per cent. added to strength of Ash by seasoning.
2	do......	1·51	1·38	·13	6·8	252	
3	do......	1·46	1·33	·13	6·1	248	
4	Ash not seasd.	1·41	—	—	8·	176	
5	do......	1·38	—	—	8·5	162	
6	do......	1·34	—	—	8·	169	
1	Beech seasond.	1·85	1·71	·14	5·	257	61·9 per cent. added to strength of Beech by seasoning.
2	do......	1·76	1·62	·14	5·	279	
3	do......	1·81	1·63	·18	5·	280	
4	Beech not seas.	1·73	—	—	7·5	176	
5	do......	1·8	—	—	7·	180	
6	do......	1·78	—	—	5·5	148	
1	Oak seasoned .	1·88	1·73	·15	6·	299	26·1 per cent. added to strength of Oak by seasoning.
2	do......	1·88	1·77	·11	5·	270	
3	do......	1·45	1·36	·09	—	—	
4	Oak not seasd.	1·84	—	—	6·2	218	
5	do......	1·89	—	—	6·9	227	
6	do......	1·85	—	—	6·	232	

AGE OF VOLCANOES.

At the Royal Institution, April 30, W. R. Hamilton, Esq., in the chair, a paper was read "*On the Age of the Volcanoes of Auvergne as determined by the Remains of successive Groups of Land Quadrupeds.*" By C. Lyell, Esq.

The region of extinct volcanoes of Auvergne derives its peculiar interest from the circumstance of its never having been submerged beneath the sea during a period in which its geological and geographical structure, and the animals and plants by which it has been inhabited, have undergone a great succession of changes. In the rest of Europe generally the volcanic rocks have either been originally of submarine origin, or the surface since they were produced has suffered so much denudation by the action of the waves of the ocean as to make it impossible for us to ascertain the form and manner in which the eruptions took place, or the relative position which the igneous formations held at first to the hills, plains, and valleys then existing. After describing the several classes of rocks in Auvergne—the granite, the eocene freshwater, and the older and modern volcanic, each depicted by different colours in an extensive landscape enlarged from a view of the valley of Chambon (Puy de Dome) by Mr. P. Scrope.—Mr. Lyell said he should dwell chiefly on the antiquity to be ascribed to the Puy de Tartaret, a type of one of the most modern cones of eruption in Central France. The comparatively recent origin of this conical hill of scoriæ, with its crater at the summit, is proved by its standing at the bottom of a deep valley excavated through the alternating beds of pumice, trachyte, and basalt, belonging to the more ancient volcano of Mont Dor, and partly through the subjacent and fundamental granite. It is farther confirmed by the course of a powerful current of lava; which, proceeding from the base of the cone, flows thirteen miles down the channel of the River Couze, stopping at the town of Nechers, near Issoire. The lava occupies the ancient river-bed, and is observed to contract in its dimensions in the narrow gorges, where it also gains in height, like the water of a river flowing through the arch of a bridge; and to expand again where the valley opens, where it spreads into a broad sheet having a level surface. It also flows up the channels of tributary streams till it attains a level corresponding with the top of the lava at the point of junction of the tributary with the main valley. But although these appearances prove that the lava has flowed as it would now do if it were remelted and made again to descend the same channel, it nevertheless bears in some part of its course the marks of considerable age.

Before considering these, Mr. Lyell entered into a short digression to refute the doctrine of the mediæval origin of the volcanoes near Clermont, advanced by a writer in the *Quarterly Review* for October 1844 (p. 295), where it is pretended that Sidonius Apollinaris, Bishop of Clermont, who flourished at the close of the fifth century, has borne explicit testimony to "the volcanic eruption, the crumbling of the cones, and the heaping up of the showers of ashes and scoria cast forth amidst the fires." The passages relied on occur in a letter from Sidonius to his contemporary, Mamertus, Bishop of Vienne, in Dauphiny, written when Auvergne was threatened with a fresh irruption of the Goths; to avert which danger the Bishop proposes to adopt certain forms of prayer (rogations or litanies), which Mamertus had already introduced on the occasion of some "prodigies" which had happened in Dauphiny sixteen years before. In alluding to these phenomena, Sidonius says that "the walls of the city of Vienne were shaken by frequent earthquakes, many fires broke out, and mounds of ashes were heaped up over the fallen copings of the walls." "Nam modo scenæ mœnium publicorum crebris terræ motibus concutiebantur, nunc ignes sæpe flammati caducas culminum cristas, superjecto favillarum monte tumulabant." Deer also took refuge in the forum, and the people fled; all but the Bishop, who had a right to reckon on divine protection, because, as Sidonius reminds him, on a former occasion, the flames at his approach had miraculously receded out of reverence to his holy person. At the time of the earthquake he (Mamertus) had told his people that their repentant tears would extinguish the fires sooner than rivers of water, and the steadfastness of their faith would cause the rocking of the ground to cease. Sidonius finishes with asking the Bishop of Vienne to send him some relics to make all secure. The style of the whole epistle is so faulty, ambitious, and poetical, as to make it difficult to know the exact value of the expressions, and dangerous to found upon them any philosophical argument about natural events. There is not a word about Auvergne, but simply an allusion to the shocks which appear to have thrown down buildings and caused (as usual in such cases where roofs fall in) great conflagrations and heaps of cinders. The terror of the wild animals when the earth rocks, and their sensitiveness to the slightest movements, are well known. Although the epistle proves Sidonius to have had a fair share of the credulity of his age, both in respect to miracles wrought in favour of a contemporary saint and the efficacy of relics, it would be unfair to charge him with a belief in the occurrence of a volcanic eruption at or near the site of the city of Vienne, which the investigation of the ablest government surveyors, to whom the construction of a geological map of France has been intrusted, has entirely disproved. There are, in fact, no monuments of volcanoes, ancient or modern, in Dauphiny; and if there had been they would not throw light on the date of eruptions in Auvergne.

But to return to the lava-stream of the Puy de Tartaret before alluded to—what geological antiquity can we assign to it? In one of the gorges the entire mass of solid basalt has been swept away by the torrent, so that the former continuity of the stony current is interrupted for several hundred yards, at a point about midway between its efflux from the cone and its termination. This implies a long period of excavation. In another place, about one mile and a half from St. Nectaire, an old Roman bridge, still passable, having two arches, each fourteen feet wide, spans a deep ravine, cut by the Couse through the middle of the lava, which is here of columnar structure. The bridge is supposed by French architects and antiquaries to be of the date of about the fifth century; yet the springing of the arches proves that when it was erected the ravine was of the same width as now. Nevertheless, while signs of denudation such as these attest the vast amount of removal of hard rock since the lava flowed and was consolidated, the contemporary cone of loose, incoherent scoriæ has stood in its exposed position at the very bottom of a valley, entire and uninjured, the rain-water being instantly absorbed by the porous mass; and no rill being allowed to collect on its flanks. It is clear that if any flood of water had passed over Auvergne, if any inundation had raised the Lake of Chambon thirty or forty feet, it must have carried away the perishable cone. The lake alluded to owes its origin to the damming up of the Couze by the volcano and by landslips which accompanied the eruption.

But the most conclusive evidence, according to Mr. Lyell, of the remoteness of the period at which the cone and lava of Tartaret originated has yet to be set forth, and has only been distinctly brought to light since he revisited Nechers in 1843, when the Abbé Croizet pointed out to him a locality near the lower extremity of the great current, where fossil bones of extinct animals had been discovered in a meadow, between the base of the lava and the channel of the Couze, now ten feet lower in level than the lava. In company with Mr. Bravard, Mr. Lyell explored the spot; and they convinced themselves that the bone-deposit passed under the lava, which here forms a mass thirty feet thick. Subsequent investigations not only confirm this view, but have enabled Mr. Bravard to obtain from beneath the stony current a considerable number of additional osseous remains, referable to the genera Equus, Sus, Tarandus, Cervus, Canis, Felis, Martes, Putorius, Sorex, Talpa, Arvicola, Spermophilus, Lagomys, Lepus, and according to Mr. Waterhouse, Cricetus or hamster, and others, besides the remains of a frog, lizard, and snake, and the bones of several birds. Mr. Owen has examined some of these remains for Mr. Lyell, and recognises among them the *Equus fossilis* and *Tarandus priscus*, both extinct species, occurring in the caves of England, with the contents of which generally this assemblage of fossils from Auvergne appears to agree very closely—there being a predominance, according to Messrs. Croizet, Bravard, and Pomel, of species not known to exist at present with an intermixture of a few others undistinguishable from quadrupeds now inhabiting Europe. Among the land-shells associated with the bones, were found *Cyclostoma elegans, Clausilia rugosa, Helix hortensis, H. nemoralis, H. lapicida*, and *H. obvoluta*—all recent, and all, with the exception of the last, now found in the immediate neighbourhood. Mr. Lyell thinks it probable that the deposit of red argillaceous sand under the lava containing these remains, was derived chiefly from volcanic matter, which the eruption of Tartaret threw out, and that the fossil animals perished by floods occasioned by that outburst. That a similar Fauna continued to live in Auvergne after the latest eruptions, is inferred from the discovery of the remains of many of the same group of animals—Spermophilus, Lepus, Castor, and others, in the clefts of a lava current as modern as that of Tartaret, observed at Aubière, near Clermont. This Fauna, so different as a whole from that now living in Europe, evidently inhabited Auvergne, when the valley of the Couze had been excavated down to the same level as that over which the lava of Tartaret flowed:—yet its antiquity must be extremely great—the gradual dying-out of species and the introduction of new ones taking place, according to Mr. Lyell's views, with extreme slowness. The fact that the shells belonged *all* to living species (which possibly might not hold good if a larger number were obtained) affords no presumption against an indefinitely remote origin as compared to the periods of history and tradition, because the lecturer has shown that the ravine of the Niagara ("Travels in N. America," vol. i. ch. 2) and the Delta of the Mississippi (Reports of the Brit. Assoc. for 1846), both of which must have required an enormous period for their formation, are, nevertheless, posterior in date to deposits full of the recent land and freshwater shells of North America, associated with the remains of quadrupeds, nearly all of which are now extinct.

It was shown that all the volcanoes of the modern class of which the Puy de Tartaret is a type, were not formed at once, for the lavas of some (as for example, at Champheix, in the same valley of the Couze) stand at a greater height above the actual river-courses and repose on ancient alluvium formed when the valleys were shallower. To allow time for the ejection of these numerous cones and lava-currents, of which there are several hundreds in Central France, we require a long series of ages, all subsequent to the miocene period, to which another class of monuments of anterior date are referable—as, for example, the bone-bearing alluviums alternating with volcanic formations (pumiceous and trachytic) of Mont Perrier, to which a distinct Fauna (of the genera mastodo, elephant, hippopotamus, tapir, &c.) belongs. Some of the valleys cut out of the still more ancient lacustrine strata were only half eroded to their present depth in the miocene period, and were occasionally filled up with miocene deposits and afterwards re-excavated. It is possible in Auvergne to distinguish the relative ages of a great variety of alluviums containing the bones of terrestrial quadrupeds, in consequence partly of their preservation under lavas of different ages, and partly their position on the sides of valleys which were gradually deepened; no flood or return of the ocean having disturbed the surface and mingled the fossils of one period with those of another, as has happened in England and most parts of Europe. The oldest Fauna of land quadrupeds in Auvergne, that found in a fossil state in freshwater strata or marl and limestone, older than the trachyte of Mont Dor, consisted of species of Paleotherium, Anoplotherium, Anthracotherium, Opossum, &c., analogous, in great part, to those of the Paris basin, with some miocene forms associated and belonging, according to Mr. Lyell, to an upper eocene group, newer than the Parisian tertiaries, or the uppermost freshwater of the Isle of Wight. Hence it follows that the whole succession of revolutions in the animate and inanimate creation which have occurred in Central France since the land emerged, vast as they are in duration, as compared to the era of the more modern volcanoes, is nevertheless, considerably posterior to the marine clay on which London is built;—this last being one of those tertiary deposits which rank as but the monuments of yesterday in the great calendar of geological chronology.

IMPURITIES OF WATER.

At the Royal Institution, *April* 16, Prof. Solly delivered a lecture "*On the Impurities of Water and the Mode of its Purification.*"

Mr. Solly described fresh water as the result of distillation from the ocean. In the progress of this operation, the vapour in the first instance, and the condensed liquid subsequently, must become contaminated with whatever foreign matters exist in the atmosphere which receives the former, and the strata of the earth on which the latter falls and through which it percolates. But even at the outset of this natural chemistry there is impurity. Alkaline salts, as Mr. Solly has already demonstrated, rise in vapour; therefore no water which is evaporated from the sea can be pure. The analysis of water is simple in theory. The gaseous or solid substances contained in, or combined with it, being detected by few tests. Before, however, the analyst has recourse to these, he attends to the physical qualities of the fluid—any odour, or colour, or taste, being at once indicative of impurity. These impurities are either *gaseous, organic*, or *inorganic*.—1. *Gaseous.* If common air be present in the water, it is detected by heat; if carbonic acid gas, by lime-water; sulphuretted hydrogen is discovered by its odour, and by its blackening salts of lead.—2. *Inorganic Matters.* These are either solid substances, as clay, held in suspension by organic matter or else insoluble substances held in solution by the gas that is present in the water. Thus, Carrara-water is chalk dissolved in water by the excess of carbon therein. There remain other inorganic substances, as common salt and some salts of iron, which are essentially soluble. Besides these impurities, water kept in leaden vessels often contains a trace of that metal. Mr. Solly noticed the familiar tests by which these are recognised.—3. *Organic Impurities in Water* are chiefly noxious by the sulphuretted hydrogen and ammonia which they produce, and which is usually perceptible to the senses. The effects of these various impurities were next specified. Mr. Solly explained, from the principle of saponification, how water containing salts of lime decomposes the *soluble soda or potash soap*, and forms an *insoluble lime soap*, which is useless for all purposes of washing. He quoted the opinion of some experimenters, that bicarbonate of lime rather improved than deteriorated the utility of water for culinary purposes; but he maintained that it was injurious to the vegetation of plants, in consequence of the deposit on their leaves which it left on being evaporated. Sulphate of lime is always injurious for culinary uses, inasmuch as it interferes with the solubility of many organic substances, as tea, &c. Having briefly adverted to the injury produced by the earthy impurities of water when they are deposited in water-pipes, boilers of steam-vessels, &c., Mr. Solly lastly suggested various methods of freeing water from the impurities which he had described. Solid matters are separated by filters of sand or of finely-powdered charcoal. The latter substance possesses the additional property of absorbing gases: hence its use in sweetening fetid waters. Carbonate of lime is decomposed by the mixture of muriate of ammonia in the water which contains it. This practice has been found efficacious in preventing deposits in steam-boilers. Gypsum may be thrown down in the form of carbonate of lime by adding carbonate of soda. A very ingenious process for the same purpose was exhibited:—by filtration through oxalate of baryta, sulphate of lime is entirely separated from its solution. This operation may still leave a trace of the oxalate of baryta in the purified water. This small contamination, however, may be entirely removed by making the fluid pass through a second filter of phosphate of lime. The water then becomes perfectly pure. With respect to the most dangerous of all impurities—the salts of lead—Mr. Solly showed that, unless common water contain (as we understood) from $\frac{1}{1000}$ to $\frac{1}{100}$ of its weight of earthy salts—such as sulphate of lime—it ought never to be used as a beverage when kept in leaden cisterns. These earthy salts protect the lead from the action of the water.—Mr. Solly referred to the attempt to render lead insoluble by alloying it with $\frac{1}{500}$ of its weight of arsenic. He then spoke of the signal failure of an endeavour to protect lead from the action of water by placing it in contact with zinc. The result of this experiment was a vastly increased corrosion of the lead by the water in which it was immersed; which was, therefore, rendered additionally poisonous.

VULCANIZED INDIA-RUBBER.

At the Royal Institution, April 20, Mr. Brockedon explained "*The Preparation of India-rubber by Vulcanization and Conversion.*"—Mr. Brockedon's object in this communication was to describe—1. A mode of treating india-rubber by which new properties are imparted to this substance. 2. The new uses in the arts to which these acquired properties now render india-rubber applicable. *Vulcanization* and *conversion* denote that combination of india-rubber with sulphur from which the new properties about to be described result. The process of conversion consists in submitting india-rubber to the action of bisulphuet of carbon mixed with chloride of sulphur. The caoutchouc cannot, however, be penetrated by this process to any depth; and therefore it is inapplicable when the mass to be acted on is thick. The process of *vulcanization*, which seems to be more applicable, is the result of many experiments made by Mr. Hancock; who found that caoutchouc, when immersed in a bath of fused sulphur heated to various temperatures, by absorbing the sulphur, assumed a carbonized appearance, and lastly acquired the consistency of horn. It was in the course of these changes that it attained the state of vulcanization which Mr. Brockedon afterwards described. The same vulcanized condition can, however, be produced either by kneading the india-rubber with sulphur and then exposing it to a temperature of 190°, or by dissolving the india-rubber in any known solvent, as turpentine, previously charged with sulphur. Having thus explained the processes, Mr. Brockedon described the effect which they produced on the caoutchouc. 1. The india-rubber, thus treated, remains elastic at all temperatures. In its ordinary state it is quite rigid at a temperature of 40°. 2. Vulcanized caoutchouc is not affected by any known solvents, as bisulphuret of carbon, naphtha, or turpentine. 3. It not affected by heat short of the vulcanizing point. 4. It acquires extraordinary powers of resisting compression. Thus, a cannon ball was broken to pieces by being driven through a mass of vulcanized caoutchouc—the caoutchouc itself exhibiting no other trace of its passage than a scarcely perceptible rent. The applications of this substance appear to be almost infinite. Our readers are familiar with the usefulness of the "elastic bands"—but they may not be aware that the same fabric, adjusted in size and strength to the purpose required, furnishes springs for locks and for the racks of window blinds. It is also capable of being moulded into the most intricate ornaments; its characteristic elasticity removing all embarrassment in relieving the undercut parts. It furnishes impervious bottles for volatile substances, like ether; as well as an excellent ink-stand. It is adapted to protect from corrosion wires subjected to the action of the sea, as in the case of the wires required for the projected electric communication between England and France. For the same reason, air tubes of vulcanised rubber are better suited for life-boats than those formerly made of canvas, which are liable to be destroyed by the action of the water. A similar tube has been used with success as a substitute for an iron band, as the tire of a carriage-wheel; and it is stated that a vehicle so arranged runs much easier than on the present plan. But perhaps the most important application is in its use in railroads and railroad carriages. In the former, it is laid between the rail and the sleeper, and thus prevents the rails from indicating any traces of pressure; and the springs connected with the buffers of the latter, when formed of vulcanized caoutchouc, can neither be broken nor can their elasticity be surmounted by any degree of concussive violence. In conclusion, Mr. Brockedon exhibited objects illustrative of the great physical change induced on caoutchouc by vulcanisation. He showed a screw, with its recipient, both made of this substance, as well as a form of letter-press (like a stereotyped page) for printing. He also noticed its usefulness in making epithems for surgical purposes, gloves and boots for gouty persons, &c.

SCENERY AND DECORATIONS OF THEATRES.

Abstract of a lecture delivered at the Decorative Art Society, April 14, "*On the Scenery and Stage Decorations of Theatres*," by Mr. JOHN DWYER, V.P.

The author stated that the opinion which he had formerly expressed [see Journal, p. 23] on construction had, in the *Théâtre Historique*, recently opened in Paris, been in many respects exemplified. The criticisms upon this theatre state, that every person obtaining a seat is enabled to see the whole of the stage. With reference to the proscenium, he had become more forcibly impressed with the advantages arising from the form which he had then suggested; and he stated that Mr. Frederick Chatterton had since informed him that his instrument (the harp) was more favourably heard in Covent Garden than in any other of the metropolitan theatres. In an ornamental and artistic view, the form which he proposed combined some very essential properties. The proscenium, he considered, should form a frame to the animated picture on the stage; and the broad equal surface offered through his suggestion afforded an ample and suitable field on which to display rich and fanciful embellishments. The Surrey Theatre has an example of this framelike character,—and, together with the drop scene, exhibits thus far a satisfactory effect; and in the *Théâtre Historique* this has been attended to with success. The usual arrangements within the proscenium of crimson draperies frequently exhibit marvellous compositions—but of that commonplace nature which he would assist in exterminating. A drop-scene, he said, certainly required consummate skill. The pause in the excitement from the stage effects leads to the contemplation of the house in its *tout ensemble*—thus demanding a two-fold consideration; a subject of appropriate and interesting character, together with a proper regard to the general interior of the theatre. Mr. Dwyer noticed several devices which have been applied for drop-scenes, such as the looking-glass curtain at the Coburg some years ago—which he termed a costly absurdity, although at that time thought "a great hit." But a drop scene painted by Stanfield for the opera of "Acis and Galatea," produced at Drury Lane some years ago, he pronounced to be a fine work. It displayed in vignettes ideal scenes by the artist from the opera; and thus offered to the mind's eye congenial Art during the pauses between the acts. Nevertheless, these pictures were placed within elaborate frames, contrasting strongly with the general expression of the theatre. A drop-scene painted by Mr. P. Phillips for Astley's was mentioned as a proper application of art to this purpose. It was intended to harmonise with the general business of the theatre, and was an excellent illustration of it, the subject being "Victoria's return from Olympian games with a procession to the sacrifice." The groups thus brought together had direct relation to the features in the performances on the stage. Mr. Dwyer considered that the composition always ought to have relation to the action on the stage; and observed that this principle has been regarded, in some degree, in the present drop-scene at Her Majesty's Theatre, where the design embodies abstract ideas of opera and ballet, but in connection with a massive architectural representation quite distinct from the general character of the interior, of which it occupies so large a proportion. He contended that more unity in this particular ought to be attempted; and stated that he would treat the drop-scene as a picture to which the proscenium should be an outer framework; but he would have, also, an inner frame, appearing on the scene, and partaking of the style of ornament adopted in other parts of the theatre. As approximating illustrations of his meaning, he mentioned those of the Princess's and the Adelphi, both of which, however, are defective in some minor qualities. This manner has also the advantage of contrasting with the stage scenery.

Mr. Dwyer next directed attention to light. He observed that the reflectors to the foot-lights in our theatres present an objectionable appearance; and he showed a sketch of ornamental screen-work for concealing them. He also suggested that they admit of a very different arrangement on the Bude principle with modifying reflectors; and that it would be advantageous to carry off the noxious result of combustion. He advocated the use of stronger side-lights, having their intensity regulated in accordance with the shadowing on scenery; and he mentioned, with approval, the effects thus occasionally produced in moonlight scenes. Mr. Dwyer then explained the management of colours for artificial light,—the exaggeration necessary,—the vigorous lights and shadows, and the broad and dashing touches which form the scene-painter's art. A slight knowledge of the stage, he observed, would be sufficient to prove that, at the present time, with one or two exceptions, the imitation of outward things is very imperfect. They are but half represented. The banquetting hall is resplendent with gold and silver, and gorgeous magnificence everywhere but on the floor;—and the forest luxuriant with foliage, and intricate with beauties in form and colour, is robbed of half its fair proportion of effect by the poverty on which it stands.

Mr. Dwyer stated that success had usually attended the careful "getting up" of plays; and that taste extended to the merest trifles had generally been appreciated by the public. A description was given of the arrangement of "wings, flats, and fly borders;" and the ludicrous *contretemps* of the scene-shifters in their working dresses appearing on the stage to remove refractory scenery, together with other casualties incidental to the change of scenes during the acts, were adduced as sufficient reasons for advocating a less frequent resort to that practice.

April 28.—Mr. DWYER read the second portion of a paper on the above subject, commencing with an examination of the advantages derivable from placing the scenery obliquely on the stage, referring of course to the wings and set scenes, the flats or back scenes being in the usual position. Some difficulties in perspective having been alluded to, it was stated that for drawing-rooms and apartments, the scenery ought to be arranged with due regard to the ground-plan of what is to be represented. This would enable actors to enter or take leave in a complete manner; they would not be observable by those in the side-boxes when approaching or lingering for that purpose, and their voices would reverberate and be carried into the body of the theatre. A scene in the "Flowers of the Forest," now being performed at the Adelphi, was described as an example, and also as clearly showing that with some attention to ground-plan in setting out an interior, together with an introduction of bay windows, octagonal recesses, &c., the variety and perfection of scenery would be greatly advanced.

Mr. Dwyer then directed attention to the principles of design, which he considered as mainly divisible into two classes, ideal and constructive; the former embodying certain characteristics without reference to natural laws, and the latter demanding strict attention to the fundamental principles of composition in art. Ideality, it was said, had in some extravaganzas been developed in a surprising and ingenious manner, and delicate conceptions in a refined taste were frequently introduced with that remarkable freedom peculiar to the School of Art.

Some chalk sketches, designed for the scenery to the "Enchanted Forest," lately performed at the Lyceum, were exhibited as illustrations of the vigorous manner and spirit of this class of compositions. Constructive design was described as necessary to architectural subjects. The opinions of Prof. Cockerell and others were quoted in acknowledgment of the artistic talent, together with accurate knowledge of the architecture of remote ages, which are frequently displayed in our theatres; and the reader suggested that if the attention of the students in decorative art at the Government School of Design were directed to the contemplation of the better scenic productions, having the beauty and principles of design explained, this would be found one of the most practical and efficient modes of acquiring knowledge.

He regretted that many admirable works of art, executed for theatres should have had such a transient existence, leaving scarcely a trace behind them. The creative fancy and design in numerous instances ought to have been preserved at any cost; and he argued that students in art would, in a careful contemplation of scenery, realise more freshness and originality in ideal and constructive design than from any other class of examples. Knowing its power and vast unexplored range, he felt an earnest desire that scene painting should be fully and properly estimated. Engraved examples might offer an interesting collection of the most ingenious fancies of the most eminent artists.

Perspective, the reader observed, constitutes one of the greatest obstacles to perfection in scenic effects, and he alluded to the defects which ordinarily appear in set-scences, from their being made up of various parts, placed at intervals along the stage, each part drawn, probably, at a different perspective angle. The peculiar manner of treating perspective for theatrical purposes was explained. While the situation of spectators varies greatly, the treatment must necessarily be imperfect. It is, therefore, usual to set out scenery with two points of sight, but he preferred, in architectural subjects, to have *three*, and to have them placed near the centre, so as to counteract the effect of opposition in the horizontal features of the wings, whereby the scenes are frequently made to appear hoisted. Scenes showing ground in perspective, are frequently spoiled by the visible junction of the wings and the floor, thus disturbing the illusion of distance attempted by the artist; and he would tint the lower portion of the scene with colour similar to that of the stage. Architectural drop-scenes were frequently objectionable from the same cause, and he maintained that they should never be thus applied, but only as pictures within frames, if applied at all.

The effect of linear and aerial perspective was adverted to, and the softening influences of colour in aerial perspective were described as pertaining to the highest order of artistic talent. Scenes of this kind are composed of a number of parts, the flats representing sky and extreme distance, while the middle distance and foreground are broken into perspective forms. Float-lights being placed behind these parts, impart brilliant effects that no colouring can attain to, resembling the sunny spots of a landscape.

Linear perspective required, it was said, very great consideration, and failures in street architecture, and similar subjects, are often evident to the least initiated observer. The artist, however, has to contend with serious disadvantages from not being permitted to set out this class of scenes upon the stage instead of in the painting-room; and the manner in which they are produced ought to be borne in mind when judging of their merits. Street architecture offers a peculiar difficulty from the actors influencing the scale by their comparative size; this illustrates the great absurdity of placing a façade of the National Gallery or other well-known building within the area of a theatrical scene, without a proper regard to distance. As an instance of a favourable effect, he named a scene in the "School for Scheming," at the Haymarket, representing portions of streets abutting on the quay at Boulogne, which he considered far removed from a common-place effect, and that it also testified what might be obtained by placing scenery obliquely.

Mr. Dwyer next alluded to the taste and refinement Madame Vestris had first presented to the public in her drawing-room scenes, elegantly and completely furnished; and he also mentioned with commendation some interiors produced at the Haymarket, in a similar spirit. He admired this perfect kind of representation, and was pleased with the manner in which it had been extended to exteriors, garden scenes, &c., and he referred to the garden scene in the "Lady of Lyons," at Sadler's Wells, in which the stage is covered with a painted cloth imitative of gravel walks, grass plots, shrubberies, &c., producing together a very superior effect. In a snow scene in the "Battle of Life," at the Lyceum, the stage was covered with painted canvas very successfully, and in the "Flowers of the Forest," the scene of a village church, with well-worn paths, &c., similarly treated, was equally skilful and pleasing.

Mr. Dwyer commented upon the fits and starts usual to these matters, stating that the better scenes were exceptions, while the imperfect school retained the predominance. As one of the earliest and most perfect illusions ever depicted, he described a scene introduced in the opera of "Acis and Galatea." The last scene in the ballet of "Coralia," at her Majesty's Theatre, was also fully described, as an eminent example of scenic display.

The author then noticed the machinery pertaining to theatres, and recommended the use of painted canvas placed on rollers sufficiently lofty so as to dispense with the series of curved, scolloped, and straight fly borders, ordinarily representing sky, &c. He next reviewed the inconsistencies which occur in scenery and properties being of a different period in character and style to that of historical dramas, mentioning a scene in "Lucia de Lammermoor," at the Italian Opera House, Covent Garden. It represents a Norman interior furnished with one chair of modern French style, and a table of doubtful period, the story of the opera being in 1669. He contended that those adjuncts are important; and that if costume, manners, and customs are rendered faithfully, properties should receive equal attention. The progress in matters of costume from the time of Garrick was noticed, and the properties introduced by John Kemble, Planché, and others, were mentioned with encomiums. The increasing taste of actors, shown in careful dressing and wearing apparel with a bearing in accordance with the period represented, was also favourably commended, as displaying research and accurate study of their art. Mr. Dwyer drew attention to the force with which the varieties of colours in dresses may be developed, by having regard to the background and to the position of the actors. An acknowledgment was made of the elevated taste and artistic arrangements which Mr. Macready had frequently shown in groupings and tableaux, and he concluded with the expression of a desire to find a proper feeling more generally established between the artists, actors, and managers, so that the capabilities of combined talents might produce results at once gratifying, elevating, and promotive of the welfare of the arts.

INSTITUTION OF CIVIL ENGINEERS.

April 27.—Sir J. Rennie, President, in the Chair.

"*On the laws of Isochronism of the Balance-spring as connected with the higher order of adjustments of Watches and Chronometers.*" By Mr. C. Frodsham.

The first portion of the paper gave an historical sketch of the horological inventions and writings of the artists of the eighteenth century; which appear to constitute the basis of all the knowledge possessed in the present day, and the principles of whose school were still followed in the construction of both watches and chronometers of the better sort. It was admitted that, by the aid of machinery, and the practical skill of the workmen, the separate pieces of clocks and watches are now produced in a high state of perfection; but it was contended, that horology, as a science, had declined since the days of Hooke, Bernouilli, Sully, Graham, Harrison, Camus, Mudge, Ellicot, the two Arnolds, Earnshaw, Le Roy, Berthoud, and others, whose splendid talents and scientific attainments were all devoted to the elevation of the art of constructing time-keepers. Among these Dr. Hooke appears to have been the first to bring the force of acute reasoning and pure mechanical genius to bear upon the practice of the art, and from his experiments upon the pendulum and the application of the balance-spring—which latter unquestionably laid the foundation of the chronometric art—it is evident that he partially raised the veil which concealed the laws of the isochronism of the spiral spring; as is demonstrated by his expression "*ut tensio sic vis*,"—and it is extraordinary that so plain a hint was not immediately seized on by the able men who succeeded him.—Arnold appears to have been the first who really practically comprehended the subject; and in the course of his researches he invented the cylindrical spring and compensation-balance, which formed the commencement of a new era in the science. The merit of the discovery of the isochronism in France was contested by Le Roy and Berthoud. Bernouilli noticed, in a paper read to the *Académie* in 1747, the fact of the loss of elastic force in balance-springs, from exposure to heat; and the experiments of Berthoud demonstrated that in passing from 32° to 92° Fahrenheit the loss per diem was 6 minutes 33 seconds.

The paper then considered generally the subject of the isochronism of the balance spring, enunciating isochronism to be an inherent property of the balance-spring, depending entirely upon the ratio of the spring's tension following the proportion of the arcs of inflection: a balance-spring, therefore, having the progression required by the law of isochronism will preserve that property, whether it be applied to a balance making quick or slow vibrations. The elastic force of balance-springs was considered as a constant, because the action is by a number of consecutive impulses following each other in such rapid succession as to constitute an uninterrupted and continuous force. This is shown in considering the accelerated and retarded motion of the balance, when by following it through an entire arc of vibration, it will be seen that if the balance be moved over a given number of degrees, the spring will be wound into a certain tension, and has acquired a certain elastic force due to the angle over which it is inflected. This elastic force being then transferred to the balance, it will be exerted in overcoming its inertia; and at the expiration of the first period will have communicated a slight motion to it. During the next period, its state will be that of comparative and not absolute inertia (for it *decreases* as the motion *increases*), whence it follows that as the spring's force is exerted against a body in motion instead of at rest, it will necessarily accelerate progressively the motion the balance had previously acquired, until the spring arrives at the point of quiescence, where, having lost all its elasticity, it ceases further to urge the balance, and a new relation of power and resistance takes place. The spring's force being transferred to the balance, it assumes a new character, has acquired sufficient momentum to carry it through the second half of the vibration, and to inflect the spring over an angle equal to that first passed over, and to give it the requisite tension to commence a new vibration,—particularly as during the second half of the vibration the spring has so little tension that its force retards but slightly the motion of the balance. After much acute reasoning upon this position, illustrated by numerical examples, the author proceeded to describe the helical and the flat-coiled springs which are used in chronometers and watches, and the manner of regulating their action, so as to take advantage of the isochronism, instancing the advantages to be derived from the innate power possessed by an isochronal-spring of resisting the influences which cause a change of rate—such as change of position, increased friction from dirt, or the viscidity of the oil at low temperature. This was illustrated by an example of three balls falling in equal times through spaces regulated by the densities of the medium, viz., in vacuo, in air, and in water, wherein they traverse spaces equal to the squares of the times.—So, it was argued, it was with increased friction in watch-work; for the elastic forces of the balance-spring being constantly proportional to the angle of inflection, whatever was the amount of friction, the law of isochronism remained unchanged; and friction was only an adventitious circumstance, which affects the extent of the arc of vibration, but not the time of its description.

May 4.—The discussion upon the above paper was continued. The viscidity of the oil, from its nature and from external causes, and the bad effects arising from it, were dwelt upon at great length; but, it did not appear, that either chemistry, or the practical experience of working watch-makers, had as yet either pointed out the true causes of viscidity, or enabled its effects to be satisfactorily remedied. The relative values of various modes of trial of timekeepers were also dilated upon. It was attempted to be shown, but was successfully refuted, that a taper spring would produce the same effect as the isochronal arrangement, and that the tapering could be effected by machinery. Among the external influences affecting the oil in time-keepers, was mentioned the circumstance of the watches belonging to George III., which, being kept in drawer of cedar wood, soon stopped, and it was found that the oil had changed into a substance resembling gum. Attempts had been made to substitute oil of sweet almonds for olive oil, on the recommendation of a distinguished chemist, but they were signal failures. The inefficiency of the remontoir movement was clearly shown, although its ingenuity was fully admitted. Throughout the discussion the great merit of Arnold's improvements seemed to be recognised, and it was generally deplored that a spirit of epiricism has been allowed to stop the progress of so beautiful a science as that of the construction of time-keepers. It was, however, to be hoped that, by the facility afforded by the Institution of Civil Engineers of making known ingenious and recognised improvements, more particular accounts of what was done would be given to the world, and the merits of the scientific constructors of that indispensible instrument, the chronometer, would become generally known.

May 11.—The paper read was "*An Account of the Progressive Improvements in Sunderland Harbour and the River Wear*," by Mr. J. MURRAY.

The memoir commenced with an account of the coal trade, licenses having been granted by King Henry III., in 1239, "to the good men of Newcastle, to dig coals and stones in the common soil of the town and outside the walls." In 1384 permission was given to export the produce of the mines. During the civil wars, in 1644, the export from Sunderland was greatly increased, as no coals were permitted to be brought from Newcastle to London, on account of that town being a stronghold of the royalist party. Between 1704 and 1711, the average annual export had reached 174,264 tons; and that of the last year, 1846, was 1,500,000 tons. The census, in 1802, gave 19,100 inhabitants, whilst the town at present contains upwards of 60,000 persons.

The management and improvement of the River Wear was naturally an object of great solicitude, as its entrance was much exposed. In 1669 Charles II. granted a patent to E. Andrews, to build a pier, and erect light-houses, and forbade the casting of ballast, &c., into the river. An act was obtained in 1717, appointing river commissioners for the conservancy of the harbour, &c., giving power to raise money by tonnage duty on ships entering the port. The jurisdiction of the commissioners is limited by the last acts to an extent of about 11 miles, between Biddock Ford, above the town, and to a distance out to sea of a depth of five fathoms at low water. Little was done to improve the river until 1719; at that time the entrance was very intricate, and the two main channels were both very shallow. The south pier was commenced in 1723, for the purpose of directing the full force of the current against the bar. Busleigh and Thompson's map, published in 1737, shows the bad state at that period. Labelye (the engineer of Westminster-bridge) was called upon for his advice in 1748. He pointed out the principal causes of the then state of the river, and suggested the contraction of the channel at the worst places, so as to increase the scouring power of the stream, deepening the Still by manual labour, and by dredging engines, and constructing a north pier, so as to leave a distance of 200 yards between the point of that and the south pier. He stated, however, that "after all, as no man could foresee the consequences of erecting the north pier, if it caused a greater obstruction than it removed, it must be unbuilt and taken up." He recommended also throwing all the force of the stream into one channel, and cutting away the bar by ballast engines, and cautioned the commissioners against ever permitting sluices or locks to be placed upon their river.

Mr. Vincent, of Scarborough, was appointed engineer to the trust in 1752. Mr. Robin succeeded him in 1755, and under them the south channel was so much improved that the north channel was warped up with sand. Mr. Smith, of Sheffield, proposed sundry further improvements in 1758. Mr. Wooler also reported in 1767 on Mr. Robin's plan of building moles on the north and south rocks. The work was commenced, and was abandoned for reasons which do not appear. Mr. R. Shout was appointed in 1779; and in 1780, Mr. Smeaton's advice was sought. He recommended the prolongation of the piers on Mr. Shout's plans. The consequence of this constant extension of the south pier seems to have been the warping up of sand into the harbour's mouth. Two timber jetties were, therefore, suggested by Mr. Shout in 1786, and were the origin of the present north pier. The effects produced were very beneficial, as in a few months a deep and spacious channel was formed by the rush of the waters. The timber work was then cased with stone, and the work was continued by Mr. Pickernell, who succeeded Mr. Shout in 1795. He also erected the light-house at the point of the pier. The south pier was also extended. Mr. R. Dodd also reported on the works, and recommended chiefly the formation of a wet dock on the present Potato Garth. Mr. M. Shout became the engineer in 1804, and he reduced some of the old works, whilst he extended the north pier. Mr. Jessop made a report in 1807, recommending further extension of the south pier, the reduction of the width of the entrance to 300 feet, and the construction of some embankment walls at various points to increase the velocity of the stream, and at the same time form a scouring basin. Mr. Giles made a survey under the directions of Mr. Rennie, which was completed in 1823, under Sir J. Rennie. This plan is published, and was exhibited. In 1824, Mr. Rennie recommended certain lines of extension of the pier, and the reconstruction of some parts of the works, with sounder materials, with other precautionary measures calculated to improve the port, some of which were carried into effect by Mr. Milton. Mr. J. Murray succeeded Mr. Milton, and carried on the designs of Mr. Rennie and Sir J. Rennie, with great solidity, using the diving-bell for part of the foundations. The north pier was thus extended to a total length of 1770 feet. He also removed, in an entire mass, the light-house to the extremity of the intended pier, an account of which has been already submitted to the Institution. In 1843, the south pier being in a ruinous state, was partially removed and rebuilt, in a direction better calculated to break the swell of the sea. The plans exhibited the changes that had taken place in the estuary, improving the channel, and giving, at least 4 feet of water over the bar at low water of spring tides. It is narrow and shelving, with deep water on each side. Formerly the large ships took in part of their cargoes beyond the bar, but now they all load within it, even when drawing 15 to 18 feet, and as many as a hundred ships have entered and departed from the harbour in one tide. A longitudinal section of the river showed some remarkable changes in the bed, and corresponding improvements in the heights of the tide, affording, at the same time, increased facility for the drainage of the country around. Dredging has been carried on to a great extent, and from 100,000 to 150,000 tons have been raised annually.

The want of floating docks has been much felt, and several plans have been projected for them by Messrs. Dodd, Jessop, Stevenson (of Edinburgh), Giles, Brunel, G. Rennie, Walker, and G. Murray, but none have yet been executed. A small dock, of about six acres in extent, was finished in 1838. A south dock, with tide basins, is now in course of construction, under the direction of Mr. R. Stephenson and Mr. Murray, and by its means it is anticipated that Sunderland will become the first port, as to depth of water at its entrance, between the Humber and the Frith of Forth.

May 18.—"*An Account of the Sarah Sands, and other Iron Vessels, with direct-acting Auxiliary-engines, and Screw-propellers*," by J. GRANTHAM, of Liverpool.

The object of the paper was to show, that a propeller might be constructed of such dimensions that the number of revolutions it would require to make in order to obtain a high velocity would not much exceed that of the ordinary paddle-wheel, and that hence the usual marine condensing engine might be applied direct to the propeller-shaft, without the intervention of a secondary motion. It appeared from the statements in the paper that this opinion was found to be correct, and that Woodcroft's expanding pitch screw-propeller was the best form that had hitherto been employed. In a paper read to the Institution, upwards of three years since, Mr. Grantham gave his views on this subject, and several vessels had been since built—the results of the trials of which were communicated to the meeting. The principal of these were the *Emerald* and *Diamond*, three-masted steamers, of 300 tons, and 60-horse power; the *Nautilus*, of the same dimensions; the *Antelope*, of 600 tons, and 100-horse power; and the *Sarah Sands*, of 1000 tons, and 180-horse power. Drawings of these vessels were exhibited to the meeting. The capabilities and performance of these vessels were described in the paper, but particular notice was taken of the last-named vessel, which had performed a most successful voyage to New York during bad weather and adverse winds. The passages made by the ordinary New York liners, which were out at the same time, were very long, averaging 48 days each, and the Boston and Liverpool steamers were much longer than usual on their passage. The *Sarah Sands* used her steam about 17 days, and sailed the remainder, making her voyage in 20 days 10 hours. On her arrival she had about enough fuel remaining for four days' steaming. The paper did not enter minutely into the particulars of the screw itself, as it was considered that too much attention had been given to that branch of the subject to the exclusion of the consideration of the plans for working it, which, after all, had been the stumbling-block to the general adoption of the system. It was necessary with the screw, the theory of which, as a propeller, was so little understood, to proceed with experiments perseveringly in one direction, as variations in the results were frequently attributed to causes which really did not exist. After describing several interesting details, the paper concluded by expressing a desire that engineers should examine the drawings of the system laid before the meeting, and endeavour to add to the stock of information already obtained.

After the paper was read, Mr. Grantham added some facts which he had recently gathered, and which strongly confirmed what had been stated. The *Diamond* had recently made a very rapid passage to Madeira, deeply laden; but, during the whole passage, the engines maintained a very moderate speed, and quite removed the impression that under such circumstances they would run too fast from their being connected directly to the screw.

An account of the last successful voyage outwards of the *Sarah Sands* was also given, and it appeared that, in spite of most severe gales, which had driven back almost all other vessels, her passage had been made in the most satisfactory manner. In the discussion which followed, several engineers of eminence expressed themselves much pleased with the facts brought forward in the paper, and perfectly concurred with the views put forth. The principle of the following current of the ship, which had a material influence in increasing the efficiency of the screw, was alluded to, and a conviction was expressed that the screw would eventually supersede all other means of propelling vessels on long voyages.

An account was given also of the auxiliary screw-steamers that ply between London and Rotterdam, and some interesting facts were given of the power which these vessels possessed of working to windward in bad weather. The subject was closed by a discussion upon several points that had been started, relative to the size of the screw, the mode of disengaging it, and the prospects which were held out of the final success of the principle.

INSTITUTION OF MECHANICAL ENGINEERS AT BIRMINGHAM.

On Wednesday, April 28, a numerous meeting of the members and friends of the above Institution was held at the Queen's Hotel, Birmingham, for the general transaction of business, and the reception of scientific communications from the members.

In the absence of George Stephenson, Esq., President, Mr. M'Connell was called to the chair, and the minutes of the last meeting having been read by the Secretary (Mr. Archibald Slate),

The Chairman rose and said, the present meeting was one of the four ordinary meetings provided by the rules of the Institution, and required to be held on the fourth Wednesday in April. Since the last meeting, the Council had met on several occasions, and after discussing various subjects of interest to the Institution, they invited the London and Manchester branches of the body to meet them, consider their proceedings, and confirm them if approved of. The gentlemen from Manchester accordingly attended a meeting of the Council, on the 21st April, confirmed the past minutes of Council, and suggested some further improvements in the management of the Institution. The business of the present meeting was to confirm the minutes of the last general meeting, to receive new members and communications, and consult as to future operations; and here, perhaps, before they proceeded further, he might be allowed to say he had a very agreeable piece of intelligence to communicate, which he was sure would be very gratefully received by the meeting. It was the announcement of a handsome donation of 100*l.* to the Institution, by their worthy and highly-esteemed President, to whom he begged leave to propose a vote of thanks for this additional mark of his estimation of the Institution, which was unanimously assented to.

The Chairman stated that the Council was of opinion that the members ought at once to proceed to work and supply information on useful subjects; and, in order make a commencement, they had forwarded the following suggestions to each member of the institution:—

"1. The best form of railway axles and wheels.

"2. The best description of engine and mill for manufacturing iron.

"3. The best form of barker mill or turbine.

"4. The best form of luggage-engine for narrow gauge.

"5. The most economical stationary steam-engine, with coal at 6s., 12s., and 24s. per ton, taken in a commercial point of view.

"6. The best form of air-pump valves.

"7. The best high-pressure marine boiler.

"8. The best description of pumping engine for the thick coal district of Staffordshire.

"9. The flow of water through straight mains and curves."

The following papers were then read:—

1. "*Apparatus to be applied to Railway Carriages for lessening the dangerous effects of Collisions on Railways.*" By Mr. E. Chesshire.

This method has been described in the Journal for September last, p. 285, it simply consists in applying beneath all the length of the body of each passenger and other carriage of every train an inflexible unyielding rod, which is termed a "safety-buffer," of wrought iron, and a tube plugged with wood, supported in suitable bearing-sockets beneath the framework of the carriage, at the middle of the breadth thereof, and left loose in those sockets. The safety-buffer terminates at each end with an enlarged head like those of ordinary buffers, and the heads of the safety-buffer of each carriage correspond to the like heads of the safety-buffer of the preceding and following carriages. When the usual coupling links are screwed up to bring the ordinary buffer heads of the several carriages into elastic contact one with another, as is usual, there will be a vacant space between the safety-buffer head of each carriage and that of the next adjacent carriage, varying from three to six inches, more or less, according to circumstances, and the safety-buffers will not have any effect or operation in the ordinary course of travelling, but only in case of a collision. The safety-buffers in the van, at the hinder end of the train, and in the tender at the front end, are not to extend throughout the whole length of those carriages, and need not have any endway motion, but may be firmly fastened to the framework of those carriages, or they may be applied against strong elliptical springs, placed end to end for expending some of the force of the collision. The van is to be lower than the passenger and other carriages, in order that its centre of gravity may be nearer to the level of the rails. The van at the hinder end of the train is to have its ordinary buffers with easy yielding springs, which, with the same force applied to them, will allow those buffers to move through a much greater space in respect to the van than the ordinary buffers of the carriages of the train, so that, in case of a collision from behind, the ordinary buffers of the van being so yielding, they will not act with much force against the corresponding buffers of the hindmost carriage of the train.

Remarks.—Mr. W. Robinson, of London, said, it might be advanced against the proposed improvement, that every rod being six inches less in length than the side buffer, would lose six inches in every carriage; consequently, supposing a train to be composed of, say 50 carriages, it would require 25 feet for the stroke of the last buffer. It might also be objected that the rod would double up; four or six inches in diameter was not sufficient to take the amount of force imparted by the collision. He would estimate that it would require 13 feet diameter to oppose the force of the shock imparted to it.

Mr. Chesshire replied, that the momentum was communicated to the first rod, and through each individual rod to the last instantaneously, and through it to the hinder van, just as in the case of a number of billiard balls placed in a row. When the first was struck, the last was driven away with all the impetus communicated to the first, leaving the intermediate balls perfectly at rest.

A Member suggested that it would require 300 tons to double up a rod four inches in diameter.

Mr. Chesshire—I take it at that calculation, and say, consequently, supposing the momentum of the collision to be greater than that, it was quite evident that 300 tons must be taken from the amount of collision imparted to the train and expended upon the van behind the train. As the stroke of the side buffer was 13 inches, it was quite clear six inches might be allowed for the stroke of the centre buffer without any injury to the passenger carriage; consequently, if 25 feet were lost in the centre buffer in a train of 50 carriages, 54 feet would be gained by the stroke of the side buffer, leaving a surplus of 29 feet.

2. "*Disconnecting Coupling.*"—Mr. Johnson, locomotive superintendent of the Manchester and Leeds Railway, produced a model of an invention for disconnecting the carriages from the engine, in the event of an obstruction on the line, or any other accident which would cause the engine to run off the rails, by a self-acting disconnecting coupling chain, which he proposed to apply between the tender and the luggage van. It was exceedingly simple and inexpensive, and might be applied to any train with a slight alteration of the present coupling crook of the luggage van or carriages. In case the engine or tender got off the rails from any cause whatever, regardless of the speed, the engine or tender would be immediately disengaged from the train, allowing the latter to remain on the line perfectly uninjured, and thereby accomplishing the object for which it was intended. He had had a working model twelve months, and during that time tried it repeatedly, and could now speak confidently of its merits.

Mr. Middleton, having inspected the model, said he believed a patent had been taken out some years ago for a similar invention. He thought the plan a very good one; but he was under the impression that at the time Dr. Church's carriage was before the public, it was said that such an invention had been patented.

Mr. Beyer was also of opinion that the idea or principle of the invention was not new, as it had been proposed by Mr. Watson Buck, engineer, on the opening of the Manchester and Birmingham Railway.

Mr. Ramsbottom, of the London and North-Western Railway, feared the violent oscillation of the carriages would produce the same result. He had seen carriages vibrate very much when not sufficiently tight.

3. "*Railway Axles.*"—Mr. H. Bessemer, manufacturer, London, produced a model of a railway axle, to do away with the necessity of covering the tire, which the inventor stated caused great tear and wear of the rails and tires, and also a tendency in the carriages to an oscillating or vibratory motion when running on a straight line. Mr. B. stated that the means by which he proposed to effect his object was by cutting the axle in two in the centre, and holding it rigid and in its place by a long coupling, with concentrated grooves, so that each wheel, and the end of the axle, could revolve independently of the other.

Mr. Beyer said an invention for accomplishing the same object had been proposed, and applied before, and in his opinion one more simple had been tried. He had seen the same idea carried out in two different ways. He questioned the desirableness of having such an invention at all.

4. "*Description of a new Railway Break,*" by Mr. F. Knight, was read, which requires a drawing to make it understood.

May 18.—Mr. J. E. M'Connell, in the Chair.

"*On the use of the Fan-blast for manufacturing purposes.*" By Mr. Buckle, the following papers were read:—

1. This paper described a series of experiments on the fan-blast, as applied to manufacturing purposes. They were made for the purpose of guiding the construction of the fan, so that the greatest quantity of air could be accumulated with the least possible expenditure of power. The original application of the fan was for the purpose of separating and dressing seeds, the speed and density of the air being limited to manual power. But since their application to smitheries and foundries, steam and other motive power have been used, their speed so increased that the density of the air ranges from 3 oz. to 12 oz. per square inch. Various forms of fans have been made, but the one generally preferred is called an eccentric, with three or six blades or arms radiating from the centre. This indispensable machine is one that has abridged much time and labour; the uniform stream of air admits of no comparison with the puffing blasts of the bellows or cylinder. The smith can heat his work with precision, proportion the size of his nozzle tuyeres to suit his work, without deteriorating the intensity of the blast, and in some instances it enables him to heat one piece of work while shaping another, the pressure of the blast ranging from 4 oz. to 5 oz. per square inch, with nozzle tuyeres 1½ inch diameter; but in a well regulated smithy, the nozzle is fitted with nose-pipes as ferrules, varying from 1 to 3 in. diameter, to suit the quantity of blast required. An eccentric fan 4 feet diameter, the blades of which are 10 inches wide by 14 inches long, and running 870 revolutions per minute, will supply air at a density of 4 oz. per square inch, to 40 tuyeres of 1½ inch diameter each, without any falling

off in density. In the first six experiments no discharge of air takes place, the velocity of the fan merely keeping the air at a fixed density or pressure per square inch due to that velocity. The remaining 26 experiments show the fan discharging air. An inspection of the table will show that, under various conditions of velocity of the tips of the fan, that density of the air, and theoretical quantity of the air discharged, varies, but not in a direct ratio. The best results are obtained when the velocity of the tips of vanes coincide with the velocity, and 9-10ths of the velocity a body would acquire by falling freely the height of a homogeneous column of air due to its density. This is what we have called the theoretical velocity; or, in other words, the greatest quantity of air is discharged by the fan with the least expenditure of power when the tips of the vanes move at these velocities.

In a recent set of experiments, the inlet openings in the sides of the fan-chest were contracted to 12 inches, and 6 inches diameter—the original diameter being 17½ inches. The results obtained were, that with the 12 inch openings, the power expended was 2¼ to 1 compared to the openings of 17½ inches, the velocity of fan, the density of air, and the cubic discharge being the same. With the 6 inch opening the same results followed as with the 12 inch, only the density of air decreased one-quarter. These experiments show that the inlet openings must be of sufficient size, that the air may have a free and uninterrupted action in its passage to the blades; for if we at all impede this action, we do so at the expense of power. Here follows a copy of the tables of 32 experiments, after which the paper gives the dimensions of fan employed in these experiments—namely, 3 ft. 10½ in. diameter; width of the vane, 10½ inches; and the length, 14 inches. The fan is eccentric 17-16th inches; the vanes are five in number, and are placed at an angle of 6° to the plane of the diameter. The inlet openings on the side of the fan-chest are 17½ inches diameter. The outlet opening or discharge passage is 12 inches wide and 12 inches deep; the space between the tips of the blades and the chest increasing from two-eighths of an inch on the exit pipe, to 3¼ inches at the bottom, in a perpendicular line with the centre.

Mr. Buckle said, that he had found that the area of the discharge and the density of the air corresponded very nearly. His object had been to show the quantity of the air discharged at a certain density, and the power it required to effect that result.

2. Another paper on the same subject, from Mr. Jones, of the Bridgewater Foundry, Bridgewater, was also read.

Mr. Jones observes—"There is, perhaps, no point upon which mechanics have had a greater variety of opinion than that of the application of the fan for manufacturing and other purposes; nor is there any other subject which has caused more disappointment; and I am decidedly of opinion that this has been principally occasioned by constructing the air passages too small in the fans, as well as the passages leading to the tuyeres. Facts are always better than opinions; and in offering the following statement, I merely give the result of six months' constant work. Two points of importance in the construction of fans are, an exact balance of the fan upon the axle, and a careful and judicious arrangement for getting up the speed so as to avoid either tight straps, or any slipping up on the pulleys. With this I forward you a drawing of the fans I have constructed. You will perceive that I have the openings unusually large, but the results have fully justified the proportions. With these two fans we have been melting 50 to 60 tons of iron per day, at the rate of 5 to 6 tons per hour, with a consumption of coke of 208 lb. to the ton of iron; in addition to which there are upwards of 50 smiths' fires blown at the same time. The power required is about eight horses, the motion being taken from a 12-horse power engine by means of a 7-in. gutta percha belt, the shaft running at 72 revolutions per minute: the speed of the fan is about 750. They are driven by a pulley on each end of the spindle. This I think much better than a single strap. The openings at the side of the fans are 2 ft. 4 in. in diameter, and the outlets are 24 inches by 12 inches. The passage from the fan is 2' 9" by 1' 9", leading to a reservoir under the cupola 18' 0" by 7' 0" by 4' 0" deep, from which we have two tuyeres 6 inches in diameter. The pressure of blast is about 5¼ oz. per inch. The only thing to which I wish to call your attention is the increased size of the air passages; and when we consider the large quantity of iron melted, and the small proportion of coke used, the result is very satisfactory."

Mr. Buckle remarked, that his paper had been drawn up for the purpose of recording a course of experiments made during a series of years at his leisure, and which had been executed with the utmost care. The results were important to those who were about to adopt the fan, as teaching them that its size must not be a matter of guess-work. When he himself had a fan made, all the advice he could obtain was, "Make it big enough." The parties who said so knew nothing about it. Had he been then in possession of the results of his subsequent experiments, he should have had his fan made only half its present size. He now found that all required was, that the tips of the fan should revolve with 9-10ths of the theoretical velocity. In driving the fan at that speed they would obtain the largest portion of blast at the least expenditure of power. By driving them at a greater velocity, the power was absorbed without producing a greater quantity of blast.

Mr. Cowper wished to know if the horse-power mentioned by Mr. Jones was indicated or commercial horse-power? Was it the same as that meant by Mr. Buckle?—Mr. Buckle said, he had ascertained the power by a dynamometer, having a spiral spring and a piston attached. Having ascertained the amount indicated by the engine when disconnected with the fan, he had deducted that amount from the amount shown in every experiment. The engine was nominally a 14-horse power engine. He had found that by a succession of fans, the first transmitting the blast to the second, and so on, he obtained by the third or fourth a pressure of 2¼ lbs. on the square inch.

Alderman Geach remarked, that this plan was in use at a furnace fitted up some three or four months since in Derbyshire, where they proved that they could obtain a pressure of 2¼ lbs. on the square inch, and that they could make better iron, and in a larger quantity, than by the old plan.—Mr. Buckle had not been previously aware that the plan had been tried, but he had ascertained that uniformity of the discharge was greater than that of the blowing cylinder, and the quality of the iron would be better.

Mr. Henderson said, that in the works in Scotland with which he was connected, they had a fan so badly constructed that they were about to have it altered, which, nevertheless, turned out 220 to 230 tons of casting per week. They had found that they could get something like double indicated power out of the ordinary Fairbairn's engine, compared with what it was sold for. He should like to know the proper form of the fan, the proper length of pipe, and the size of the pipe which conducted the blast from the fan to the place where they wished to use it. In Scotland they were working a shaft 200 feet long; and he should like to know whether they could effect their object by laying down underground piping, instead of having a shaft to conduct the power to near the place where they wished to use it. They had enlarged the tuyere pipe, having ascertained that, in melting iron, the density of the air was not so important as the quantity, and that it was necessary that the air should be admitted in large quantities.—Alderman Geach knew of one furnace where the cupola was 150 feet from the blast.—Mr. H. Smith stated some experiments, which went to show, as the Chairman remarked, that, putting the case in an extreme point of view, the further the blast was from the fire the better. The discussion was then adjourned, to afford an opportunity for further experiments.

3. "*Heated Air.*" The next paper was from Mr. Wilkinson, who, the Chairman observed, had been so bold as to try a totally new plan for economising fuel, by introducing *heated air into the boiler of a steam-engine*, among the steam, by which the inventor estimated that he effected a saving of 20 to 25 per cent. in fuel. They had had steam and heated air separately, but this was the first attempt to combine them. The following are extracts from the paper:—

"It is an unalterable law of Nature that to produce a given quantity of steam, a given quantity of heat must be imparted to the water, and that in proportion to the steam required. Therefore, under the most advantageous circumstances, to produce an effect, a certain amount of combustion must necessarily be expended. Now I find, from repeated experiments, that water alone is not the most economic agent to work with; and, by way of elucidating this fact, I will explain one, and only one, though not the most successful of my experiments, and this was made on a six-horse power high-pressure engine, working in the manufactory of Mr. J. Burman, Cumberland-street, Curtain-road, London. The principle consists in the injection of a stream of air, heated to the high temperature of 800, into the steam in the boiler—by which means the temperature, and consequently, the expansive force of the steam, was increased. To effect this object, an iron pipe or tube was bent in a serpentine form, so as to present a great extent of surface, and placed under the boiler, there to receive a red heat from the glowing part of the fire, after it had passed the bridge on its course to the flue. One end of this rarefying chamber was connected with an injecting air-pump, proportioned to the size of the cylinder of the engine. The other end was inserted by a continuation of the tube above the surface of the water into the steam in the boiler. The whole capacity of the tube was greater than the volume of compressed air which it received from each stroke of the piston of the pump, so that the air did not enter the boiler until it had acquired the full heat or nearly so of the red-hot tube through which it passed. At every stroke of the piston the same quantity of cold air was injected into the tube. That part of the air which was next to the pump was forced into a hotter place, and the air, which previously occupied that hotter place, was forced on to a still hotter one, and so on, until the farthermost and hottest of all was discharged into the steam in the boiler. The pressure of air in the tube, strictly speaking, exceeded that of the steam in the boiler, for it was an excessive pressure that overcame the resistance in the boiler. That, at the commencement of each stroke the air in the cylinder of the pump was in equilibrium with the external air, and only opposed a resistance as it became compressed, and gradually increased its compressed force until it arrived at its maximum, which was the point of equilibrium with the compressed air in the hot tube and the resistance of the steam. Taking all things into account, the whole amount of power expended in working the pump was about 5 per cent., or 120th of the force which acted on the steam cylinder of the engine, and the result of the experiment showed that the application of the heated air caused a reduction in the quantity of coal consumed of from 25 to 30 per cent., and this was continued for several weeks, the engine of course working at its usual pressure."

The Chairman had had his attention called to the subject by Mr. R. Stephenson, who wished him to try it in the locomotives on the line, but he had preferred to wait till he had ascertained whether the principle was economical, and whether the results could be depended on with a stationary engine.—Mr. Cowper had seen the invention tried, and observed that the engine worked slower with than without it; but, as the inventor considered the engine out of order, he would not express any opinion upon the value of the invention.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

May 17.—Earl de Grey, President, in the Chair.

The President presented to J. W. Papworth, Fellow, the Medal of the Institute for his Essay "On the Adaptation and Modification of the Orders of the Greeks by the Romans and Moderns;" and to James Bell, the Medal of Merit for his Essay on the same subject.

The Rev. Prof. Willis read a paper "*On the Successive Construction and History of the Church of the Holy Sepulchre at Jerusalem, from Constantine downwards.*" After alluding generally to the holy places visited by the pilgrims and grouped together within the walls of the church, and the buildings immediately connected with it, he then proceeded to give a brief history of the church. Constantine raised structures to preserve the memory of three spots,—the birth-place of the Saviour, the scene of the resurrection, and that of the ascension. The second, or church in question, remained till the invasion of the Persians in 614, when it was destroyed. It was re-erected by Modestus, soon after, but was much injured, though not destroyed, in 637, by the Mohammedans. The crusaders made considerable additions to it, and so it continued till 1808, when it was burnt down, and afterward rebuilt in such a manner as to disguise its real character.

The problem was, to discover what Constantine's architects did; and to obtain knowledge of this it was necessary to go to documentary evidence. The writings of the pilgrims, one as early as 333, were of the utmost importance, and had been carefully examined by him. A minute plan of the present church, made by Mr. Scoles, he had found of great service. First describing the church as left by the crusaders, he said he considered the tomb not to be a built structure, as often supposed, but a genuine rock sepulchre, pared down and decorated externally; and he showed the probability of this, by tracing the line of portions of the rock yet remaining at the west end of the circular building. About this the round church was built in the late Greek style, like the church of St. Sophia, and others. The appendage towards the east, added by the crusaders, was Romanesque, resembling many early buildings in Europe, and similar to those we call Norman. It had a semi-circular apse at the east end, with an aisle round it, and radiating chapels.

The original building, according to the professor's views, consisted of an enclosure of columns, with an apsidal termination towards the west (affording the foundation for half the circular building afterwards erected), having at the opposite extremity a basilica, similar in plan to those of St. Peter and St. Paul. To learn what the crusaders added and altered, it was only necessary to look to William of Tyre, who is very clear, and shows how the round church and court towards the east, with other sacred spots, such as the site where the wood of the cross was discovered, were converted by them into a mediæval church of their own fashion. In doing this they exhibited much cleverness. It should be remembered, he said, that the Knights Hospitallers had the custody of the sepulchre, not the Templars; the latter had charge of the site of Solomon's Temple.

For an account of the church raised by Constantine, he of course went to Eusebius, and gave a translation of some passages in that author, who was more an encomiast than an architectural critic, and must, therefore, be listened to sceptically. When Constantine proposed to commence a house of prayer on this site, he found there a Temple of Venus; and on pulling this down, discovered the cave. Eusebius says, that the walls of the basilica were coated with marbles, the roof covered with lead, and the inner ceiling gilded. He describes a propyleum to the east; and the lecturer said a Roman gate had recently been discovered there, which he had little doubt was the very propyleum so referred to. In this basilica the apse was at the west end,—it was not till afterwards that the altar was placed at the east end of sacred buildings. The cave then stood in the open air, surrounded by porticoes, as we have already said; and a passage in a sermon by St. Cyril, preached in this church, bears out this opinion. The professor concluded by soliciting information from any who might visit the spot.

May 3.—W. Tite, Esq., V.P., in the Chair.

The annual general meeting of the Institute was held this evening, to receive the report of the Council on the state of the property and affairs of the Institute, and to elect officers for the ensuing year.

The report showed that the finances were in a very satisfactory condition. Relative to Mr. Weale's proposal to publish annually a volume illustrative of the works of the members, the Council stated, that, as the plan required them to guarantee a supply of matter for the volume by the members, which they had not power to compel, it was necessarily declined.

The Chairman alluded to the difficulty with which becoming papers for the evening were obtained by the secretaries, and called on the members to afford them that assistance which they ought to expect.

The following gentlemen were elected Officers for the ensuing year: *President*, Earl de Grey; *Vice-presidents*, Messrs. S. Angell, A. Poynter, and C. Fowler; *Council*, Messrs. G. Alexander, H. Ashton, C. Barry, D. Brandon, R. D. Chantrell, T. L. Donaldson, J. B. Gardiner, E. I'Anson, G. Pownall, and John Woolley; *hon secs.* Messrs. Bailey and Scholes; *foreign sec.*, Mr. Donaldson.

ROYAL SCOTTISH SOCIETY OF ARTS.

April 26.—George Tait, Esq. V.P., in the Chair.

The following communications were made:—

1. Description of "*a Night Telegraph by Coloured Lights,*" to be used on Railways, Ferries, and in Military operations, &c. By J. Stewart Hepburn, Esq.

This telegraph consists in the employment of various combinations of the only two colours, *red* and *white*, which are distinctly visible at considerable distances. This is effected by the use of a lamp, inclosed in a hexagonal screen, which revolves horizontally on pivots; four of the compartments being opaque, and two furnished with lenses, one red, the other colourless. By the turning of the screen the light can either be masked or shown of a red or white colour as the particular combination may require. Three such lamps are hung on pivots on an arm or beam 15 or 20 feet in length, turning vertically on its centre on an upright post, and made to assume four definite positions, horizontal, vertical, and diagonal, rising from the left or falling from the left. The different positions of this arm, together with the varieties in *colour* and *order* given to the lights by this construction of the lamps, afford at least fifty distinct combinations, to which numbers, or the letters of the alphabet, and arbitrary significations adapted to the particular uses of the telegraph, may be assigned.

2. Description of "*a new method of overcoming an Incline of 1 foot in 12, with a new Locomotive Reversing Steam Engine.*" By Mr. Daniel Erskine.

In addition to the small wheels keyed on the axle outside of the usual large wheels of locomotives, and connected by connecting rods, Mr. Erskine has a toothed pinion on each side of the engine, dropping down betwixt the flange of the small wheels and the large wheels, which, on the locomotive coming to a steep incline, say 1 foot in 12, works into strong pins or bolts, fixed on the inside of the raised rail. The engine and carriages all the while running on the small wheels, by which their whole weight is borne, and the large wheels acting as fly-wheels, leaving the toothed pinions nothing to do but to work in gear with the pins or bolts, thereby effectually preventing slipping. It was shown, by a beautiful working locomotive of about 9 lb. weight, made by Mr. Erskine, and fitted with his reversing pivot valve, that by this means it easily ascended an incline of 1 foot in 10; and on an incline of 1 in 16, the small wheels themselves, without the toothed pinion, easily accomplished the ascent; whereas the engine could not attempt the ascent with its ordinary larger wheels. It was stated that this is not the first time a rack and pinion has been proposed on the inclines of railways, but that it has never been proposed in the way now done by Mr. Erskine, by whose method the power is so vastly increased by being brought to act so near to the centre of the wheel.

3. Description of a proposed "*Plan for arresting the progress of Fire in Dwelling-Houses, Factories, and other Buildings, by means of Fire-Shields.*" By Mr. Alfred Canning, of London.

The invention consists in the adaptation of sheet-iron, copper, or other metallic cases, filled with water, and interposed between a fire and surrounding objects, in order not only to prevent such objects, however inflammable, from ignition, but also to shut out draughts of air from feeding a fire. For general purposes, Mr. Canning proposes the use, principally, of three modified forms of cases or shields, viz., Nos. 1, 2, and 3. No. 1, a sheet-iron, copper, or other metal, case or shutter, about 6 feet long, 3 feet wide, and 2 inches thick, open at one end, intended to be placed, with the open end upwards, against the door or window of a room on fire, or a succession of such shields might be set up against partitions inside of adjoining rooms, and then filled with water by buckets, &c., or by directing the nozzle of a fire-engine hose over the open ends of the shields. Such shields may be secured by proper means to doors and elevated windows of buildings opposite to and contiguous to a fire. Shields Nos. 2 and 3 are cases of similar dimensions to No. 1, but adapted either to protect firemen and engines in approaching a fire, or to be laid flat over the floors of rooms immediately above those on fire, to prevent the fire from communicating with the upper parts of a building.

SOCIETY OF ARTS, LONDON.

April 28.—W. H. Bodkin, M.P., V.P., in the Chair.

The following communications were read:—

1. By Mr. T. Drayton, "*On his patent process for Silvering Glass with Pure Silver.*"—"The table used by me (observes Mr. Drayton) in silvering is of a similar description to that ordinarily used, the glass to be silvered being fixed horizontally upon it by means of machinery. It is necessary that the piece of glass should be perfectly level, so that the liquor poured on shall act equally on all parts of the surface. The material used consists of nitrate of silver, to which is added ammonia, water, spirits of wine, and thirty or forty drops of oil of cassica; in this state, the liquor can be kept for a long time without deteriorating. When it is required for silvering, oil of cloves is to be added to it; and in proportion to the quantity of oil of cloves added, is the length of time required to perfect the deposit. The deposit takes place equally well whether the surface is

flat or of any other form; after it is silvered it is washed, to remove the impurities which have been deposited with the silver, and then placed in a hot-air closet, where it remains for a few hours until perfectly dry; it is then varnished, to protect it from the action of the air, and also from being scratched. Glasses of any dimensions may be silvered in the most perfect manner in 48 hours. The silver deposited by this process adheres more firmly than does that by the old method; it is also less injurious to the health of the workman, as mercury is not used; and the cost of production is not increased."

Mr. WINKWORTH stated that he considered the invention as one of the most beautiful and most valuable of the present day, as the silvering can be applied to any surface without difficulty.

Mr. NEWTON observed, that as it is a solution of silver that is used, there is no other method of obtaining such fine particles; the adhesion is firmer, the use of mercury is dispensed with, and the whole process is completed without increase of cost.

2. By Mr. BRETT, "*On his Electric Printing Telegraph.*" The apparatus was exhibited.—The author commenced by stating, that in July, 1845, he endeavoured to introduce to the government his printing telegraph, and to urge on them the importance of adopting some such plan as his, in the place of the semaphore. The great advantages of the electric printing telegraph, either for government or other purposes, are its great simplicity, certainty of action, and economy. The instrument consists of two parts; one having a row of ivory keys, with the letters of the alphabet, words, or other characters, marked upon them, and is connected with one end of the telegraphic wire, the other end being connected with the printing machine. The printing machine contains a type-wheel, having on its circumference corresponding letters, words, or signs with the key-board, and by means of weight movements and an escapement, a very slight power is sufficient to regulate the whole; so that the instant a key, representing any letter, &c., is pressed down, the corresponding letter, &c., is printed and a bell rung at the other end of the instrument.

Mr. Brett stated that he considered the advantages of his instrument to consist in its making a permanent register of the communication transmitted, it being printed on paper supplied from a roll of unlimited length, from which any portion of the correspondence may be cut off at pleasure.

3. By Mr. F. WHISHAW, "*On the application of Heated Currents to Manufacturing and other purposes.*"—"In November, 1844, (says Mr. WHISHAW) I read a paper on the manufacture of casks, more particularly those used by brewers, with remarks on the various methods adopted for cleansing and purifying such vessels. The object of the present paper is to show the advantages arising from the application of the same patent, viz., that of currents of heated air to the following purposes:—1. Seasoning timber generally. 2. Preserving timber. 3. Purifying feathers, blankets, clothing, &c. 4. Drying coffee. 5. Roasting coffee. 6. Japanning leather for table covers, and other purposes. 7. Drying silks. 8. Drying yarn. 9. Drying distillers' tuns. 10. Drying papier maché. 11. Drying vulcanized India rubber. The process has also been successfully tested for the following purposes:—12. Drying loaf sugar. 13. Drying printing paper, or setting the ink to enable books to be bound more quickly than usual. 14. Drying starch, and converting it into dextrine or British gum, and also, 15, for preserving meat." The paper then proceeded with a very lengthened account of the action of heated air on the various kinds of timber, and the success which had attended its adaptation for that purpose. It was also stated that sixty suits of clothes, which had belonged to persons who had died of the plague in Syria, had been subjected to the process of purification, at a temperature of about 240 degs., and afterwards worn by sixty persons, not one of whom ever gave the slightest symptoms of being affected by the malady. The author concluded by referring to the mode adopted by the North American Indians, for preserving the flesh of the buffalo, viz., that of drying it in the sun, and stated that heated currents had been applied successfully. "How important for shipping? Instead of sailors consuming salted provision from one month's end to another, to have an occasional supply of fresh meat." It is important also in other respects, as meat treated in this way occupies much less space, and is much lighter in weight. It is believed that the juices of the meat contain about ⅘ths of watery moisture; this the current of heated air removes, and leaves the albumen, and all the flavour and nutrition behind.

May 5.—Sir JOHN BOILEAU, Bart., V.P., in the Chair.

1. By Mr. DEFRIES, "*On his new Patent* (*3rd*) *Dry Gas Meter.*"—It is notorious, observes Mr. Defries, that the gas supplied by some London and provincial companies, contains sulphuretted hydrogen and ammonia, and these tend to impair the gas meters and prevent correct registration. The object of the present invention has been to place the more delicate and working parts of the meter beyond the reach of the gas and its injurious action; and has been accomplished in the following manner—viz.: by shutting of the machinery in the upper chamber of the meter, by means of a rotary air-tight valve, which allows the gas to pass from the main to the meter, and from the meter to the supply pipe, without even coming in contact with the vital parts of the machine. The valve and gearage are also made of an amalgam of metal, upon which the ammonia and sulphur of the gas do not act. Gas meters on the old and new principles were exhibited, as well as numerous specimens of the metals, which had been rendered useless from the action of the impure gas.

Mr. NEWTON said, he did not consider Mr. Defries entitled to the merit of the invention of the rotary valve, as it had already been patented by Messrs. Edge and Wright.

Mr. WRIGHT was present, and exhibited one of his valves. He also stated that Mr. Defries' meter had still about twelve of the working parts exposed to the action of the gas.

Mr. DEFRIES, in reply, stated that he was quite aware that the rotary valve had been previously patented by Messrs. Edge and Wright; but there was this difference between his and theirs—viz., that theirs was a three-throat valve, and does not shut the gas off from any part of the works, while his is a six-throat valve, and excludes the gas from all the more delicate parts of the machine.

2. By Mr. T. BOCCIUS, "*On his improved Gas-burner.*"—The two most important points in the combustion of gas, are economy and perfect light; "and these desideratum combined, I believe I have attained," says Mr. Boccius, "with my burners." The patent for the present burner was taken out in 1843; and the burner is so constructed as to admit such an amount of atmospheric air as will completely oxygenate the burning hydro-carbon, at the same time keep up the same amount of intense heat, even to the apex of the flame, which is necessary to the incandescence of the solid carbon, in order to obtain luminosity.

"In the patent of 1843, (Mr. Boccius says) I did not confine myself to any given form of burner, as my apparatus can be adapted to all forms, whether flat, half-circular, triangular, circular, &c., the result always being the same."

It consists of a series of concentric rings, from the centre of which rises a crescent-formed tube, with other concentric rings. These latter serve to keep up the required heat at the apex of the flame, and also to steady the light. From the form of burner, it is shadowless, no portion of the light being obstructed either above or below the flame.

Mr. NEWTON and Mr. ROBERTS then alluded to the tulip-shaped burner, for which a patent had been taken out, that particular form being given to the flame by means of a current of air passing through a perforated button or inverted cone, into the body of the flame.

Mr. BOCCIUS stated that the inverted cone was included in his patent; that no action took place from the passage of air, as stated, the flame being expanded more or less, according to the height at which the cone is placed in or from the flame.

The Secretary described "*An Excavating Machine,*" by Mr. PRIDEAUX. (See Journal for July last, page 219.) The machine consists of a series of scoops attached to arms fixed on an axle driven by a steam-engine. As the scoops revolve, they slice off the earth, and discharge it on to an inclined plane, on which it is removed to the wagon. The whole apparatus bears a resemblance to the ordinary dredging-machine, and is worked by a steam-engine.

Mr. W. E. NEWTON stated that an American machine, for a similiar purpose, had been used on a railway at Brentwood, and succeeded very well. It cut some millions of tons of earth away in the United States. The greatest difficulty they met with, was getting the wagons up to, and away from, the machine.

Mr. PRIDEAUX stated that two wagons could be brought up at one time, and there would be no difficulty in changing them as fast as the machine could fill them.

REVIEWS.

Practical Observations on the Present State of the Steam Engine. By G. V. GUSTAFSSON, late engineer R.N. London: George Herbert.

Mr. Gustafsson's work is a small pamphlet of 36 pages—the purport of it seems to be to show that much power is lost in the present existing forms of marine steam engines; as a substitute for which the author proposes an improvement, or rather modification, of his own. The most valuable part of his treatise is a table of the rates of motion of the steamer Acheron, and of the angular velocity and extent of immersion of her paddle-wheels—the result of experiments instituted during the three years that Mr. Gustafsson was her acting engineer. This alone, as furnishing very useful and important data for subsequent investigations, we consider a sufficient recommendation of the work to the notice of our practical readers; although we must at the same time caution them against adopting the author's mechanical views—which, in statement at least, if not in conception, appear to us extremely confused. The reasons assigned for the frequent occurrence of breakage in the various parts of marine engines, exhibit the too common incorrectness of thought concerning pressure and impact which is constantly displayed by men not thoroughly versed in the principles of mechanics. The casualties above alluded to are easily explained, and are not at all owing to any peculiar mode of construction in the engines. Marine engines are especially subject to impulsive strains, the amount of which is not easy to calculate before hand; they have no relation whatever to the horse power, or any thing of the kind, but are chiefly caused by heavy seas breaking against the vessel—and above all, against the paddle wheels. The ordinary strains of tension are, besides, continually varying; and these causes combined continually tend to loosen and weaken the several parts of the machinery, and ultimately to produce disrupture. The evident and only way to lessen the probability of such accidents is to make the parts most liable to strains as massive as possible, and to avoid all unnecessary gearing. But the most serious objection which the author urges against the present forms of marine engines is the alleged enormous absorption of power by them, and consequent loss of useful effect. The method he adopts to estimate this loss is confessedly merely an approximation—and, as we hope presently to show, an approximation which, being based on unsound principles, is altogether wide of the truth. The resistance of water to a moving surface having previously been determined by experiment for a given velocity—and resistance being assumed to vary as the square of the velocity—it is clear that if we know the rate of the vessel's motion, and also the rate of motion and the diameter of the paddle wheels, and the depth to which they are immersed, we can calculate the "work done" during a given time. As the subject is one of considerable importance to engineers, we shall proceed to investigate formulæ for the amount of work done, and useful effect produced by the rotation of a single paddle board. We shall suppose the paddle boards rectangular and perpendicular to the edge of the wheel, so as to radiate from its centre. Let $2\alpha = \angle$ of the wheel immersed; $\omega =$ angular velocity of the wheel; $\lambda =$ length, $b =$ breadth, of paddle boards. Let $f =$ resistance against an unit of surface for a velocity 1; $v =$ velocity of vessel; $\theta =$ angle passed over from the vertical by the given board at time t. Then the resistance against a thin slip of the board, at distance r from the centre, will be $bf(\omega r - v\cos\theta)^2\,\delta r$; and the work done while it passes through a very small angle $\delta\theta$ will be $bf(\omega r - v\cos\theta)^2\, r\,\delta\theta\,\delta r$; also the useful effect—that is, the portion of the work done that propels the vessel forwards, will be $bf(\omega r - v\cos\theta)^2\, r\cos\theta\,\delta r\,\delta\theta$. Therefore, integrating between proper limits, the total work done by one paddle board for one revolution of the wheel is

$$bf.\left\{\frac{2\alpha\omega^2}{4}\{(l+\lambda)^4 - l^4\} - \frac{4\omega}{3}.\sin\alpha.\, v\{(l+\lambda)^3 - l^3\}\right.$$
$$\left. + v^2\left\{\alpha + \frac{\sin 2\alpha}{2}\right\}\left\{\frac{(l+\lambda)^2 - l^2}{2}\right\}\right\};$$

and the useful effect—

$$bf\left\{\frac{2}{4}\{\omega^2\sin\alpha\ \{(l+\lambda)^4 - l^4\} - \frac{2\omega}{3}.\, v\alpha\ \{(l+\lambda)^3 - l^3\}\right.$$
$$\left. - \frac{\omega v}{3}\sin 2\alpha\{(l+\lambda)^3 - l^3\} + (2v^2\sin\alpha - \frac{2v^2}{3}(\sin\alpha)^3\,\frac{l+\lambda)^2 - l^2}{2}\right\}.$$

If λ be very small compared with l, these expressions become

$$bfl\lambda\left\{2\alpha\omega^2\ l^2 - 4\omega\ l\ \sin\alpha.\, v + v^2(\alpha + \tfrac{1}{2}\sin\ 2\alpha\ \right\};$$

and $bfl\lambda\left\{2\omega^2 l^2\sin\alpha - 2l\omega v\alpha - l\omega v\sin 2\alpha\right.$

$$\left. + 2v^2\sin\alpha - \frac{2v^2}{3}(\sin\alpha)^3\right\}$$

The expression, which Mr. Gustafsson obtains by an empirical and not very intelligible method, is equivalent to—

$$bf\lambda\left(l + \frac{2\lambda}{3}\left\{\left\{l + \frac{2\lambda}{3}\right\}\omega - v\frac{\sin\ \alpha}{\alpha}\right\}^2 \times 2\alpha\right.$$ for the work done.

When λ is small, this becomes $blf\lambda\left(l\omega - v\frac{\sin\alpha}{\alpha}\right\}^2 \times 2\alpha$.

This subtracted from the correct formula, gives

$bfl\lambda\ v^2\left(\alpha + \frac{\sin\ 2\alpha}{2} - 2\frac{\sin^2\ \alpha}{\alpha}\right\}$; which deficiency will account for, at least, some of the power Mr. Gustafsson asserts to be lost in marine engines.

If $\alpha = \frac{\pi}{2}$ the above difference $= blf\lambda v^2\{\frac{\pi}{2} - \frac{4}{\pi} = blf\lambda v^2 \times \cdot 3$ nearly; a large quantity, when we consider that in most of the experiments on board the Acheron $l\omega - v.\ \frac{\sin\alpha}{\alpha}$ would, probably, for $\alpha = \frac{\pi}{2}$, be less than $\frac{v}{2}$, and therefore, the result obtained less than half what it ought to be.

Some credit, however, is due to the author for his ingenuity and perseverance in availing himself of the means of experiment within his power. That more power is expended than useful effect obtained in sea engines, no doubt is true—but the loss is not so much in the machinery itself, as in the mode of propulsion. If the floats be radial, the paddle wheels deeply immersed, and the velocity of the boat nearly equal to the relative linear velocity of the floats,—the resistance against the floats will be most powerful when their useful effect is least, and the greater part of the power will be lost. To remedy this, has been the subject of frequent patents;—various contrivances have been proposed to cause the floats to enter the water always vertically, and to preserve as much as possible their vertical position when in the water. But we believe the complexity of the machinery necessary to effect this kind of action, has hitherto been a bar to its adoption. As to the merits of Mr. Gustafsson's proposed form of an oscillating engine—and his new method of feeding the furnace—we leave our practical readers to judge for themselves—we having already overstepped the limits we had assigned to the present review.

A short Treatise on the Steam Engine. By James Hann, A.I.C.E., Mathematical Master of King's College School. London: John Weale, 1847. Part I., 8vo., pp. 102.

Mr. Hann's mathematical abilities are so well known, that his name alone is sufficient recommendation to any work he may publish. He has evidently presumed that his readers are sufficiently well acquainted with mechanical principles, and especially with the theory of the steam engine, to render superfluous any explanation of technical terms connected with those subjects. In fact, the work before us is rather a class-book of reference than an elementary treatise—and as such in a compendious form, comprises nearly all the facts that can be arrived at by purely mathematical investigation, with reference to the application of steam power.

We wish, however, that Mr. Hann had been more rigid in his demonstrations, and had based them more directly on the dynamical equations of motion; for instance, in finding the relation between the pressure of the steam admitted, the load, the length of the stroke, and part of the stroke when the steam is cut off—he assumes "the work of the steam must be equal to the work done upon the load," and apparently as though it were axiomatic, instead of being a proposition capable of a proof, which is very short, and as follows:—

Let X be the pressure of the steam when the load and piston has been raised through a space x; let $m =$ mass of load and piston; v the velocity of piston; L the load;—then $mv\,dv = X\,dx - L\,dx$:

$$\therefore \frac{mv^2}{2} + c = \int X\,dx - \int L\,dx.$$

Let $l =$ length of stroke; then, when

$$x = o, \text{ and } x = l,\ v = o.$$
$$\therefore o = \int_o^l X\,dx - \int_o^l L\,dx;$$
$$\therefore o = \int_o^l X\,dx - Ll;$$

but $\int_o^l X\,dx$ is the work of the steam, and Ll is the work done on the load: $\therefore$ the work of the steam is equal to the work done on the load. The way in which Mr. Hann has stated this relation, would lead one to suppose that it were true for any portion of the stroke—which is not the case. Again, in finding the velocity v, which we have obtained above, Mr. Hann most unnecessarily makes it depend on *vis viva* and work done—using, not only in this instance, but throughout the course of his book, the former of these two terms as though it implied something more than a merely analytical expression—as though, in fact, it were some independent property of force—"living force," in short, as he translates it. The term *vis viva*, as used by modern mathematicians, is a purely arbitrary and conventional expression for certain algebraical symbols. The old philosophers, however, used it to express some confused or mistaken notion respecting inherent properties of matter. It seems injudicious (to say the least of it) to revive, by translation of the phrase, exploded ideas which were only excusable in an immature state of science.

"*On the Work done by the Engine on the Piston per minute.*

"Let E represent number of cubic feet of water converted into steam per minute, A the area of the piston in square feet, $l =$ actual length of stroke $a =$ that part of stroke before the steam is cut off, P = pressure in the boiler, $p_1 =$ pressure in the cylinder before expansion, $p =$ pressure at the x^{th} foot of the stroke, $c =$ total clearance, N = number of single strokes per minute, $V_1 =$ work of steam on piston per minute.

"Now, each cubic foot of water converted into steam exists in the cylinder before expansion begins under a pressure $p_{,}$, it therefore occupies a relative space by Equation (e), represented by

$$u = \frac{1}{\alpha + \beta p_{,}}$$

"Now, the number of cubic feet of water which is evaporated in the boiler, and passes into the cylinder at every stroke of the engine in the form of steam, is represented by $\frac{E}{N}$; therefore the space occupied in cubic feet in the cylinder when the valve is closed and expansion begins will be represented by $\frac{E}{N}\left(\frac{1}{\alpha + \beta p_{,}}\right)$."

There is an insuperable objection to any measure of the duty of the engine, as estimated by the quantity of water diminished in the boiler in a given time; and that is, that all the water removed is not evaporated. In fact, a large portion of water, called "priming" by engineers, is conveyed from the boiler into the cylinders in a state of fine particles, possessed of no elastic force whatever. The proportion which this bears to the amount evaporated seems to depend on the violence of the ebullition and the form of the throttle pipe. Substances which have a tendency to modify the action of the boiling water, such as butter or potato parings, likewise affect the quantity of priming; and in tubular boilers the priming is found to be greatest when the extent of fire-surface is greatest. All these disturbing causes, which it is impossible to contemplate in theory, render uncertain any formulæ for the work done by the engine as deduced from the decrease of water in the boiler. In p. 65, on the crank, the proof given by Woolhouse, that the power multiplied by the space which it passes over is equal to the weight or resistance multiplied by the space which it passes over, evidently assumes that the mass of the connecting rod may be neglected, otherwise the proof would be incorrect. Mr. Woolhouse, as quoted by Mr. Hann, assumes that the pressure against the crank is the resolved part of the pressure applied at the lower end of the connecting rod. The following is a more accurate investigation:—

Let the length of the connecting rod $= r$; the radius of the crank $= \rho$; and θ and ϕ the angles they make respectively with a vertical through the centre of the crank at time t. Let this vertical be taken for the axis of x. Let $x\,y$ be the coordinates of the centre of gravity of rod at time t; the origin, that point in the vertical which coincides with the lower end of the rod when $\theta = \phi = o$; X, Y, reactions between rod and radius of crank parallel to the axes of x and y; $m =$ mass of rod; and X′, Y′, the pressures at lower end of rod parallel x, y: then,

$$x = \rho\,(1 - \cos\phi) + \frac{r}{2}\cos\theta. \qquad y = \frac{r}{2}\sin\theta;$$

also, $r\sin\theta = \rho\sin\phi$. These are the geometrical relations

For the mechanical we have—

$$\left.\begin{aligned} m\,\frac{d^2x}{dt^2} &= -\,mg + X' - X \\ m\,\frac{d^2y}{dt^2} &= \qquad Y' - Y \end{aligned}\right\}$$

$$\frac{mr^2}{12}\cdot\frac{d^2\theta}{dt^2} = (X + X')\,\frac{r}{2}\sin\theta - (Y + Y')\,\frac{r}{2}\cos\theta;$$

$$x = \rho\,(1 - \cos\phi) + \frac{r}{2}\cos\theta =$$

$$\rho\left\{1 - \sqrt{1 - \frac{r^2}{\rho^2}\sin^2\theta}\right\} + \frac{r}{2}\cos\theta.$$

From these equations, X′, Y′, and Y can be obtained in terms of X, θ′ $\frac{d\theta}{dt}$, and $\frac{d^2\theta}{dt^2}$; also, since $\sin\theta = {}^{\rho}\sin\phi$, θ and its differential coefficients depend only on ϕ and its differential co-efficients; therefore, if the angular velocity of the radius of the crank be given, $\frac{d\phi}{dt}$ is given, and ϕ is given; $\therefore \theta$ $\frac{d\theta}{dt}$ and $\frac{d^2\theta}{dt^2}$ are given; and $\therefore$ X′, Y′, and Y are known. When, however, $m = o$, $X = X'$, $Y = Y'$, $X\sin\theta - Y\cos\theta = o$,—and Mr. Woolhouse's solution is correct.

We must here conclude our notice of Mr. Hann's treatise—Part I. We hope that before long, Part II. will make its appearance, and that the author will be enabled to continue, without interruption, his useful labours, which are alike honourable to himself and to the collegiate body of which he is so distinguished a member.

Practical Rules for Ascertaining the Relations between the Alterations in Gradients, and the Corresponding Changes in the Contents. By Denzil J. H. Ibbetson, civil engineer. London: Weale. 8vo. pp. 24.

To the engineer and surveyor, the object of this little work will be sufficiently obvious from its title. The increase or diminution of earthwork on railways consequent on the alteration of gradients, is here calculated on the supposition that the altered gradient is parallel to the original gradient. It is important to observe that the calculations are based on this hypothesis exclusively, because they are applicable to no other. The case taken is a very unpractical one, and of so rare occurrence, and so simple, that it is a very insufficient excuse for rushing into print. Where gradients are altered at all, it is usually their inclination which is subjected to the alteration. Our author, at page 11, gives incidentally a hint for modifying his formulæ to these more general cases; but the method is unsatisfactory and uncertain—instances might be suggested in which it would give results which were the exact reverse of the truth; that is, results which represented the earthwork to be increased, where it was in reality diminished by the alteration of the gradient; and conversely.

Mr. Ibbetson's formulæ do not suppose the cross section to be known: they depend on the inclination of the slopes, but not on their comparative height on opposite sides of the railway. No distinction is made between a cutting through a hill and one round it; and no special rules are given for sidelong ground or open cutting. It is quite clear that such a rough method of proceeding could never be permitted in making the earthwork for *working* or *contract* estimates. In these, considerable accuracy is imperatively required, and can be ensured by no method but that of taking out the quantities from the cross section.

For parliamentary purposes less accuracy is wanted. In the preliminary investigations the distinction between equal cutting and sidelong ground, is considered unnecessary. Here then, perhaps, the proposed method might sometimes apply. But, unfortunately, the very cause (laxity of investigation) which would palliate the inaccuracies of the method, at the same time excludes its comparatively inconsiderable results. The results of Mr. Ibbetson's formulæ then would generally be too minute for parliamentary purposes, and too inexact for the purposes of the contractor.

However, the methods appear to be in themselves neat and simple enough. The propositions are stated in that precise language which always argues well for the correctness of them. There seems every reason to suppose that if Mr. Ibbetson would write another book on the practical cases of alteration of gradients, and confine himself to objects of practical utility, the result would be successfully obtained. There are no diagrams or demonstrations in his treatise. Against this method of giving mere recipes in the cookery-book fashion we always protest. But he has taken up new ground, and one in which a qualified labourer is much wanted;—if he will permit the above suggestions to weigh with him, he may gain the credit of having effected a work, which though of great value and importance, has been hitherto unattempted.

A Proposed System for the more ready and correct Valuation of Carpenters' and Joiners' Works. By Henry B. Browning. London: Weale.

Though this work of Mr. Browning's is founded on Peter Nicholson's system, yet he has carried it out in a new way, and instead of the labour employed, he proposes to calculate the quantities of materials used, and to give the elements of valuation in such minuteness, as to enable the builder to calculate them in detail. For this attempt, Mr. Browning deserves particular praise, for he has evidently taken conscientious pains in getting up his work, and bestowed great labour upon it; but we doubt whether the work will be extensively used by practical men, for whom the Builders' Price Books are found to contain more conveniently the information they want. The mode of calculating each part is carefully shown by Mr. Browning, and tables and forms are given with each example. In calculating the material for joiners' work, the several thicknesses are all reduced to a standard thickness of one inch, and then multiplied by the value of the inch deal. Thus, according to the price of inch deal, the price of materials will be determined. Mr. Browning does not, however, in the case of joiners' work, give the value of labour and nails, though, in the case of carpenters' work, he gives new tables, instead of the usual estimates.

While we award great praise to Mr. Browning, we must observe, that so far as experienced surveyors are concerned, the same minuteness of calculations is employed; but the reason why builders generally do not apply it, is, not from want of appreciation of its value, or from want of capacity, but because such calculations require special proficiency, and they either use a price-book, or, if the case requires it, resort to a surveyor.

Copyright of Designs as Distinguished from Patentable Inventions. By Wm. Spence, Assoc. Inst. C.E., patent agent. London: V. and R. Stevens, 1847.

The object of this pamphlet is to show the exact degree of protection afforded by the registration of designs, and in particular to show that it does not supersede a patent. It carries out, therefore, the interpretations of the Registration Act, in the same view that we originally took on the passing of the act. We then showed that registration gave no protection for the principle of a design—only for the form. If, for example, a round cullender were registered, an oval cullender would be held to be no infringement. We may observe, by the bye, that the Registrar takes on himself to decide on what designs ought to be registered, whereas his jurisdiction is merely limited to the determination of the class in which the design is to be placed. If, however, a Registrar is to exercise any jurisdiction at all, it is desirable that an engineer should hold the appointment; so that at any rate the services of a competent authority may be secured.

DECIMAL WEIGHTS, MEASURES, AND MONEY.

One of the lesser public questions of the day, which is of special interest to our readers, is that concerning the tithing of money, weights, and measures; and which is the more worthy of notice, as it is making way on the road from theory to practice, as the new rupee, two-shilling piece, or tithe of a pound, will show.

The root of the whole matter is this, that our way of numbering, fixed by our mother tongue, is by tens, as one, two, &c., ten, eleven, twenty, twenty-one, thirty, forty, a hundred, a thousand, ten thousand, &c. We have also other usual ways, such as by twelves, as one dozen, one dozen-and-a-half, two dozen, and so forth; and by twenties, as a score, two score, three score and five, and so forth.

The way of numbering by tens is that followed in most tongues, and by all the higher races of mankind from the beginning of time; whereas some of the lower races can count only by twos or by threes, or as far as four at the utmost—all numbers beyond being out of their power to reckon.

The kind of notations now used, called Arabic, agrees well with the words, as 1, 10, 11, 20, 21, 30, 100, 1,000, 10,000.

All this is so very simple—it is so readily learned in our babyhood—it seems so trifling—that we are likely to be blamed for naming it; and yet what is the answer to what we are going to ask,—"Why do we not follow up the way in which we begin?"

One of the evils we now find in all our dealings and reckonings, is that we have all kinds of weights, measures, and money—only one of which in any way agrees with our way of numbering and reckoning. Some of our ways of measuring or weighing are by twos, some by threes, others by fours, eights, tens, twelves, sixteens, and twenties; in some cases even by fractions. If we buy by weight, we reckon by twenty, by one hundred and twelve, and by sixteen; we pay by twenty, by twelve, and by four; and we do the sum by ten—whereas if we bought by tens, paid by tens, and counted by tens, the operation would be easy, instead of being needlessly troublesome.

It is now some time since the state of our weights and measures awakened the notice of learned men. In the beginning of the last hundred years, a lawsuit showed that the Customs officers were using a wrong measure; while the Royal Society, having turned their attention to the measurement of the earth, found it needful to look into the standards of measurement used here. The Royal Society exchanged, in 1742, with the French Academy of Sciences, a set of standard measures and weights. These proceedings showed great differences between the standards kept at the Exchequer, Tower, Guildhall, Mint, Clockmakers' Company, Founders' Company, &c. In 1758 and 1759, a Parliamentary Committee was named to look into the standard. This Committee had a standard yard, and standard troy pound, made. In 1765, bills were brought in for establishing new standards, but fell to the ground. This Committee wished to use the pound troy instead of the pound avoirdupois.

In 1779, Lord Swinton tried, but fruitlessly, to get the English standards used in Scotland, as agreed in the Act of Union. He wrote a book upon this matter.

In 1798, Sir George Shuckburgh Evelyn made further enquiries into the state of the standards, which he published in the transactions of the Royal Society.

Before this, however, the Rev. Dr. George Skene Keith, who had laboured on the matter for more than thirty years, wrote a pamphlet in 1791, proposing a decimal system of weights, measures, and monies.

In 1795, the French, in their revolutionary madness for sweeping away every old law and custom, decimalized every kind of weight, measure, and money, on a plan which is called the metrical system, its first unit being a metre, the ten millionth part of a quadrant of the great circle. The French supposed they had laid their system on a natural and plain basis; but after investigations have left this a matter of doubt.

Our brethren in America had already adopted the dollar as their money unit, and divided it by tens into dimes and cents; but they have kept our weights and measures.

With the year 1800, a new agitation began for a change here. Professor Playfair and others wanted to have the French system, but happily they did not succeed. It was soon found that the French metrical system, having no fellowship with the old system of weights and measures, was not followed by the people, who could not be made to understand it; and the end was, that while the pure metrical system was kept for scientific purposes, it was for popular purposes provided with old names, and was called the "usual" system; thus a double metre was called a toise, a third of the metre was called a foot, a half kilogram a pound, an eighth of a hectolitre a bushel, and so forth. This was fully established in 1816.

In 1813, a Committee of the House of Commons was named, who published a report, and in 1818 a Royal Commission was named for weights and measures; under which, reports were published in 1819, 1820, and 1821. In 1824 and 1825 acts were passed, which named the standards, called "imperial standards," which abolished all local weights and measures, and reduced the number of standards.

The greatest evil attendant upon the "imperial" measurement is, that the new gallon is made to contain ten pounds avoirdupois weight of distilled water, whereby the size in cubic inches is 277.274, giving a number most inconvenient for calculation.

In 1821, the American legislature took up the subject, and a most valuable report was drawn up by Mr. John Quincy Adams, afterwards President, who was in favour of the French metrical system. No important result has, however, been achieved in America.

Professor Robert Wallace, Mr. John Wilson, of Thornley, and others, proposed modifications of the English system, and published pamphlets upon it. In 1831 and 1832, General Pasley published a work suggesting a new standard and a decimal system, which he further carried in a second edition, published in 1834, and which for the labour bestowed upon it, is well worthy of being read. He proposed as a standard a fathom of the thousandth part of the nautical mile, which he adapted to the present systems of measurement, without causing much change in the value, though he introduces many new terms. His remarks upon the modes of measurement now in use are particularly valuable.

Mr. Babbage has been another labourer on this subject.

Since these, Professor De Morgan has repeatedly brought the decimal system before the notice of the public, and has written upon it. We have likewise made some remarks in a former volume of the Journal.

In the present session, the Chancellor of the Exchequer, having been questioned by Dr. Bowring, has agreed, as a first step, to coin a two-shilling piece.

However desirable it might be, in a theoretical point of view, to carry out forthwith any given system, experience has fully shown in France, that the only practicable way of getting an efficient and working system, is by conforming, so far as possible, with existing institutions and the habits of the people. The French "metrical" system has become the "usual" system, and as such works well, while most of theoretical advantages are already obtained. It is in conformity with this experience that any attempts must be made in England, and indeed this is pretty commonly allowed; although there are many differences of opinion as to details in carrying out a decimal system.

The great difference is as to the units and standards to be adopted. It has been assumed by some that a natural and invariable standard is to be looked for, which can always be referred to; and the measure of a degree of the meridian, the length of a pendulum, a quantity of distilled water, and various other such standards, have been proposed; but the attempt is perfectly futile, for there is no such natural standard. Captain Kater's imperial gallon is just as good a natural standard as the French metre, and it resolves itself into this—that all such units are arbitary; and that therefore, instead of inventing a new arbitrary unit, it is better to adopt an old arbitary unit.

Whatever weight may have been at one time given to the French metrical system, it can no longer be allowed, for it is found not to rest on a natural standard, while the French have failed in enforcing it.

There is no reason either why we should adopt the standards of an inferior people like the French, when our own, adopted in our vast empire, and by our brethren in the United States, of themselves secure a wider adoption.

The introduction of a decimal system must be in conformity with existing units, and it must be gradual. The first thing certainly seems to be a reform in the coinage—and this is determined upon, the pound being taken as the unit.

It need scarcely be said in these days, that a decimal system would diminish the work of children in learning arithmetic, giving them time for other pursuits; it would diminish the work of grown up people in reckoning; and it would enable all ranks to do what they cannot now—to reckon properly; the moral results of which may be expected, so far as prudence, economy, and foresight are concerned, to be much greater than any other.

The pound being taken as the unit, its tenth is the new two-shilling piece. The worth of this is about the same as the rupee, and it is to be hoped that the two will be made to agree, so that our East Indian currency may be uniform. The half-sovereign remains for a half-pound or five-tenths; the crown for a quarter-pound or twenty-five hundredths: the half-crown will, in all probability, be superseded; but while it remains, it causes no interference with a decimal coinage, having a defined value. The shilling is a half-rupee, the sixpence a quarter-rupee, but the fourpence is an anomalous coin, and it is to be hoped will be withdrawn from circulation, so as to leave room for a new groat or hundreth of a pound in silver, which will be the tenth of a rupee and fifth of a shilling. It has been well observed, that a very little change is involved in leaving the copper coinage, making the penny five thousandths, or four thousandths; the halfpenny two thousandths, and the farthing one thousandth.

The effect would be that the decimal monies would be a pound, a rupee, a groat, a farthing, leaving the others as conventional monies, as the crown, half-crown, and groat are now.

A change in the coinage is indispensable in reference to a change in the weights and measures. It is a matter of convenience now, particularly with women, to reckon by the unit, half, quarter, and half-quarter, the division by halves being one of the simplest arithmetical operations. In effecting any alterations, while a full decimal scale is given on a measure, the unit can be divided by halves, quarters, &c., on the other side, as is very common on rules and scales. This is a mere detail of the rule maker. With a change in the coinage the reason for a duodecimal division would drop, for a foot or a pound divided into tenths would readily answer to the parts of a rupee or a shilling.

In long measure the great dispute is, whether the unit or the foot shall be taken as the unit. If the foot be taken as the unit, it will cause little disturbance of the small measurements, but it will interfere with all the larger measurements. The mile must then be a mile of 5,000 present feet, instead of 5,280; the chain will become fractional, and so forth.

If the mile be taken as the unit, it will be divided into 1,000 fathoms, and 5,000 feet, or ten furlongs, one hundred chains, one thousand fathoms, ten thousand links, one hundred thousand half inches. The foot will be ten inches (to the present inch as 1·056 to ·833), and one hundred hundredths. The square mile would be divided into one hundred square furlongs (of 6·4 acres each) 10,000 roods of square chains, and 1,000,000 square fathoms.

With regard to weight, the choice is also disturbed between the pound and the ton. The pound, however, appears preferable. The pound would be of ten ounces, one hundred drams, and one thousand grains; and the rising scale would be a cwt. of one hundred pounds, a last or load of one thousand lbs., and a ton of two thousand lbs. If a load of 1,000lbs. were used forthwith in calculations, this would very much simplify matters.

As to liquid and dry measures, there are still greater discrepancies, but it appears desirable in all cases to employ the lb. or cubic foot, in preference to the gallon or bushel.

In conclusion, it may be observed, that it is particularly desirable that engineers and surveyors, who have so much to do with measurement and calculations, should at an early period direct their attention to this subject, particularly in reference to a choice of the units, as they will, thereby, very much advance the progress of legislative measures, and secure their conformity with the views of practical men.

THE GERMAN OVERLAND ROUTES TO INDIA.

The contest carried on, of old, between the seven cities for the honour of Homer's cradle, cannot be fiercer than that for the Indian route through middle Europe. As, however, that over the Luckmanjier pass (Lucus Major of the Romans) has attracted some notice, we shall briefly advert to it. It is now two years since Colonel Laricca, of the Piedmontese service, made the necessary studies and measurements, which were laid, in 1845, before the Company of Turin. He then proceeded to the northern slope of the Alps, while Inspector Carbonazzi surveyed the southern parts, and made levels and planimetric charts of the whole country, from the valley of the Tessino to the lake of Como.

In July and August last, these surveys were continued by the two engineers, and to which the services of Capt. Ricci, of the Piedmontese corps of Engineers, were added. All of them co-incided in the opinion, that the valley of the Crintallina was the fittest point to cross the Rhetian Alps. A superficial glance at the charts published in the Stuttgard *Eisenbahn-Zeitung* convinces one of the labour, at least, bestowed on that survey.

The plan of the route to be traversed, shows especially that the 34½ German leagues to be laid over with rails, presents no insurmountable difficulties, and has only to pass one *water-way*, while the Trieste line has to pass four. An extent of 23$\frac{3}{10}$ leagues of that line—viz., that from the Boden See to Sunhein (in the Rhine valley), conjointly with that from Progiasca to Locarno, is quite adapted for being passed by locomotive engines. A distance of 6$\frac{8}{10}$ leagues, however, between the above points, is very mountainous, and could not be passed but with gradients of 33·9 to 49·9 in every 1000. Here, therefore, stationary engines are to be used—unless, indeed, some means should be devised for using the water-power, so abundant in these Alpine localities, for that purpose. But even if that space should have to be gone over with the aid of animal power, or on an ordinary road, still the distance from the Langen to the Bodensu (239,435 metres), could be travelled over in 9 hours,—a great dispatch, indeed.

Another difficulty, not to be passed over, is a tunnel of 5,200 metres in length; but as it could be driven through the main rock, without embankments, the engineer thinks lightly of it. Pits, certainly, there could be none, except at the two ends of the shaft, as an enormous mass of rock overlays the projected tunnel.

The difficulty of passing this line in winter (here 8 months out of 12), is alleged to be obviated by covering the places likely to be overspread by avalanches or drift snow with galleries, as has been done on the Splügen, the St. Bernard, &c. While, in fine, this line will have to cope with difficulties of troublesome earth-works, and require every aid engineers can afford—the abundance of stone, timber, &c., may be considered as some compensation. If the Alps *are* and *can* be passed, this line seems to present the easiest access from Upper Italy and Germany, while also the Sardinian government is undertaking important works for the improvement of the now free port of Genoa, and the railway thence to Arone, which will be completed in 1850. At any rate, an important rival to the Trieste route has sprung up in that over the Luckmanjier—although both, perhaps, are not worth the old Marseilles route.

THE LONG RANGE.

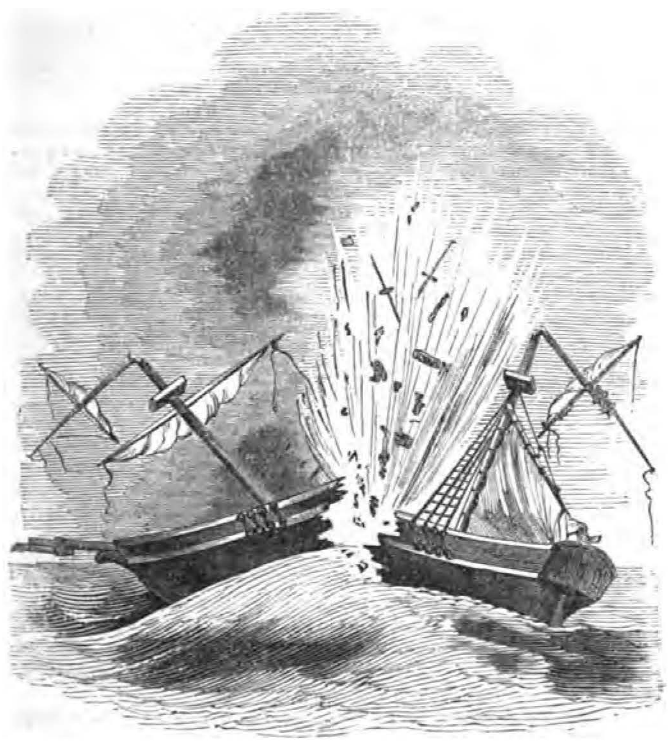
Speech of Lieut.-General Sir Howard Douglas, Bart., M.P., *on* Lord Ingestre's *motion on* Mr. Warner's *alleged discoveries*, July 13, 1846.

If any one doubts that the "long range" is a gross quackery, we recommend the perusal of Sir Howard Douglas's speech. Mr. Warner has said a great deal about official persecution, but we understand it now in another sense. Here is a gallant general, a highly accomplished member of his profession, forced to undertake a most unpleasant public duty, as a commissioner of enquiry into this "long range," and he is obliged to get up and defend himself in parliament, and to publish his speech, by way of making a kind of weapon against any future attacks. Sir Howard's exposure of Warner is complete, while his professional remarks on explosive power are very interesting; and as the subject is very little understood, we shall take the liberty of making a few extracts from the speech and notes. It will be observed, that before receiving any intimation as to the nature of the invention, Sir Howard Douglas expressed in the following speech, the opinion that a balloon was the essential feature of it:—

"Mr. Warner asserts a power which sets the most important laws of nature at defiance. Gravitation, by which the system of the universe is maintained—resistance, by which some of the most benign purposes of Providence are accomplished, are nothing to Mr. Warner. When Colonel Chalmers, a member of the late commission, cautioned Mr. Warner of the prodigious powers of resistance to his long range, he exclaimed, 'Who can frame laws to govern a force which has never before been heard of—a force a hundred times greater than that of gunpowder!' More was urged by the colonel, but, as he says, Mr. Warner was too dogmatical to reason with. Who can frame laws to control such a force as Mr. Warner imagines? Why, the Almighty Maker of the universe........ It is precisely because Mr. Warner's alleged projectile force is, as he says, a hundred times greater than that of gunpowder, that it would be met by a resisting force greater in an increased ratio, by which the projectile would be opposed, controlled, and reduced to moderate velocities and limited ranges. We possess in gunpowder greater force than we require. We reject the random use of it to gain accuracy. The power by which one of the cliffs of Albion was recently blown into the sea, and the Royal George out of it, is more than adequate to any, that war requires, or can be used with advantage in projectiles........ The greatest range that ever yet has been attained was by the mortar or howitzer, the trophy that now stands in St. James's Park, which threw a shell filled with lead about three miles into Cadiz, but with such random effect, as to do little or no harm.

"By using the denser metal, lead, that range was procured, and the momentum of the shell, so filled, augmented. A British 13-inch shell filled with lead discharged from a mortar with the full charge, may be projected about as far as the Cadiz mortar threw its shell. I do not say that greater ranges may not be attained...... No great increase, even of random range could be obtained, by increasing the magnitude of the gun to almost any size. And even then it would be a random range........ My life has been devoted in a great degree to matters of this kind, and I assert, that it is physically impracticable to procure a range of six miles by any projectile force. Mr. Warner first asserted, that his long range was not a projectile, he has since asserted that it is. But it may be a balloon, or a kite: if so it is old, and nothing worth. (It was proposed during the threat of invasion in the late war, to endeavour to destroy the Boulogne flotilla by such agents, but this was laughed at. It is well known that Sir W. Congreve proposed to destroy towns and forts by the aid of kites. They were to be made of canvas, and of a very large size, so as to be able to carry very great weights. When the kite had reached its place of destination, and stood over the devoted fort, camp, or ship, the shell was to be dropped into the midst of the place or vessel.) It may be a compound of projection and propulsion. This were still more ridiculous.

"I do not deny that Mr. Warner may have hit upon some explosive compound more potent than gunpowder, and some improved mode of causing it to explode, either by mechanical or chemical action, but as to the modus operandi, so far from there being anything new in Mr. Warner's process, I hold in my hand a work published at Paris five and twenty years ago,—'Memoire sur les Mines Flottantes et les Petards Flottans, ou Machines Infernales Maritimes; par Montgery, Officier de Marine,'—containing a history of many different modes of blowing up ships by marine fougasses from very early times. This work has for its frontispiece, the destruction of a vessel



'Memoire sur les Mines Flottantes et les Petards Flottans, ou Machines Infernales Maritimes; par Montgery, Officier de Marine.'

by an invisible shell loaded with gunpowder, which did its work more effectually than in the case of the John o' Gaunt. Mr. Montgery details in this work, different processes for blockading vessels in bays or harbours, by laying down 'torpilles à ligne d'accouplement,' across their entrances, these torpilles being made invisible by being retained below the surface of the sea by anchors, and connected with each other by lines, so that no vessel could pass, without coming in contact, either with a torpille, or with the line connecting one with another, causing both to collapse, strike the vessel, and explode. Mr. Montgery likewise details the process by which a vessel in chase of another may be destroyed by the use of two torpilles, connected to each other by a line,—'Vessels of all sizes, but above all steam-boats, may make use of these torpilles connected with each other by lines. A vessel may even sink another by torpilles connected with each other by lines. Vessels or boats chased by superior forces, may deliver themselves from their enemies, by throwing into the sea one or more of these mines flottantes connected with each other. The operation of shutting up an enemy's port, ought to be executed at night, otherwise the enemy having knowledge of it, would easily frustrate the attempt.'

"It were easy to adduce from Mr. Montgery's work, and many others, abundant proofs that there is nothing new in the proposition for submarine mines, as suggested by Mr. Warner........ We find the following in Pepy's Diary:—

"'In the afternoon come the German de Knuffler to discourse with us about his engine to blow up ships. We doubted not the matter of fact, it being tried in Cromwell's time, but the safety of carrying them in ships. But he do tell us, that when he comes to tell the king his secret, for none but the kings successively, and their heirs' (to this Mr. Warner adds prime ministers) 'must know it, it will appear to be of no danger at all. We concluded nothing; but shall discourse with the Duke of York to-morrow about it.'

"To these I may add an infinity of names mentioned by Monsieur Montgery from the earliest times. And in our own refer to Bushnel, 1787; Torpedo war and submarine explosions, by Robert Fulton, Fellow of the American Philosophical Society, and of the United States Military and Philosophical Society, New York, 1810; De la machine infernale maritime, ou de la tactique-offensive et défensive de la torpille, etc. par M. E. Nunez de Taboada, etc. Paris, 1812; Colt, see New York Weekly Sun; Monsieur Jobart, of Brussels, &c. &c."

IMPORTANT EXPERIMENTAL TRIP.

On Thursday, May 13th, there was a grand day with the steam navy at Woolwich, the Lords Commissioners of the Admiralty having ordered an experimental trip with all the steam-vessels at that station which were in a state of sufficient forwardness for the purpose. The vessels originally appointed to compose the squadron were, the Amphion, 36 guns (300 horse-power); Sharpshooter (iron screw st.); Rifleman (wooden screw st.); Minx (iron screw st.); Teazer (wooden screw st.); Growler (st. sloop); Kite (st. v.); and Princess Alice (iron st. packet). Owing to the arrangements being incomplete, the Sharpshooter and Rifleman did not join the squadron. Between nine and ten o'clock the Lords Commissioners arrived. At ten minutes past eleven the signal was given from the Black Eagle to loose from moorings, and in about ten minutes the fleet started from Woolwich in the following order: Teazer (screw) leading the way, followed by the Amphion, Monkey, Black Eagle, and Kite, and in this order they proceeded down Woolwich Reach, and up the galleons. The Amphion was, of course, the principal object of interest, and upon testing her speed, it was found that with the engines making 45 revolutions, and with her jib set, her rate of speed through the water was 6·8 knots. The Teazer proved to be the slowest boat of the fleet. In Halfway Reach the Black Eagle put on her full speed, and soon came up to the Amphion, and then reducing her engines to half speed, she kept within hail of the Amphion during the remainder of the cruise. Their lordships, who took their station on the paddle-box of the Black Eagle, with Sir J. J. Gordon Bremer, paid especial attention to the Amphion, and signalled to hoist the spanker sail, the wind then blowing stiff from the south-east. The log was again thrown overboard, and the speed with the engines at forty-seven revolutions proved to be 7·8 knots. When the squadron reached Erith, the Minx, which is a faster boat than either the Amphion or Teazer, soon headed the fleet, the Amphion holding on her way, with the Kite on her larboard, and the Black Eagle on her starboard, quarter; the Teazer a considerable distance astern, and the Growler (which had been detained at Woolwich) just bearing in sight. The squadron passed Erith at a quarter-past twelve, and a signal was then hoisted from the Admiralty yacht (Black Eagle) to put on more sail; an order which could not then be complied with, as the wind was unfavourable. In Long Reach, the speed of the Amphion was tried at the measured mile, which was done in 8 min. 52 secs., the tide having just ebbed; this gives a rate of speed equal to 6·766 knots, or about 8 miles, with the engines making $44\frac{3}{4}$ revolutions. As the squadron neared Greenhithe, their lordships boarded the Amphion, and ordered all sail to be set. The spanker, jibs, and topsails were then set, and this vessel, under the conjoint influences of wind and steam, careered rapidly on her way. The Growler, which had continued her course at full speed, here overhauled the fleet, and passing the Amphion to port, took up her station as the leading steamer on the starboard side. The squadron stood on through Sea Reach, where the full operation of both wind and tide was felt; and here the log gave a speed of 10 knots. Having reached the estuary of the Thames, their lordships signified their wish to return, and the Amphion was brought round with great celerity, and they embarked at once on board the Black Eagle. It may be as well to state, that this is the first time the experimental trials with the Amphion have proved successful. In all former trials the success was most incomplete, the engines would scarcely work for half an hour without stopping, owing to the canvass collapsing. Metal valves have now, on the recommendation of the authorities at Woolwich been adopted, and the result has proved in the highest degree satisfactory. A correspondent says—"considering the great size of the Amphion, and that her auxiliary engines are only of 300-horse power, a very small proportion for a frigate of 36 guns, her progress through the water was surprising, and leads to the belief that she will prove one of the most serviceable vessels afloat." She carried with her in this cruise, all her guns, with stores, provisions, and water, for three months, and a large supply of coals.

NOTES ON FOREIGN WORKS.

Alpine Vienna and Trieste Railway.—This line, from Cilly to the end of the Saun valley (14 English miles), has been just completed, and ranks now, by the skill employed thereon, as well as the great beauties of Alpine scenery, amongst the most remarkable objects of Styria. The bridge, in fine, which has been thrown across the Saun (near its confluent with the Save), is the culminating point of the whole work. Conformably with the difficulties presented by the ground, it consists of an oblique arch, whose circular opening is 100 cubits. The three minor arches will have a span of 12 cubits in the light, their height being 40 feet. The construction of the protecting dyke was accomplished by iron bars being screwed perpendicularly to the rock-bed of the Saun, on which bars the piles were planted. The difficulty of Alpine ground may be guessed from the fact, that from the watering place of Tüffer to Steinbrücken (a distance of four English miles), the embankments of the road amount to 12,000 cubic klafter. M. Pico, the engineer, is much praised for the choice of the most solid materials, and for the solidity of the works. The Bath of Tüffers was known and resorted to by the Romans.

Great Continental Railway Lines.—A joint meeting of the directors of the different lines forming those from Vienna to Hamburg, and Vienna to Stettin—the first 140, the latter 125, German leagues (15 to a degree), have met at Berlin, and concerted a plan, by which the first distance can be accomplished in 44 hours, and the latter in 40 hours, either going or coming. The train will leave Vienna at 7 o'clock, p.m., arrive next day at noon at Breslau, where it will stop four hours; start at 4 p.m., and arrive at 5 a.m. at Berlin, whence it will start for Hamburg or Stettin at 7. It is stated, that the Berlin and Magdeburg company wish to purchase the interest of the Magdeburg and Leipsig line, at the enormous interest of 250 per cent.; but, however foresighted the plans of the company may be, it is pretty well acknowledged now in Germany, that over-speculating ought to be rather called *under*-speculating.

Regulation and Drainage of the Rhine.—After the terrible disasters which the overflowing of this river caused, last year, near Vaduz (Switzerland), surveys and plans for the above purpose have been made by Colonel Lanicca and a number of Swiss engineers. According to this plan, an area of about 5,000,000 square klafters (cubits) of arable land could be gained in this spot, hitherto considered most barren.

Spanish Surveys.—The activity which reigns in some departments of Spanish science and industry, is fairly exhibited in a gigantic chart just published—"Gran Mape de la Isla de Mallorca." Its dimensions are 67 inches (*pulgadas castellanas*) by 52 inches. Its detail of ports, harbours, bays, and other features of the island of Majorca, are accurately rendered.

Brussels.—M. Peter Dahrren, merchant of Cologne, has been introduced to the king, for the purpose of laying before his majesty his new plan for preventing accidents on railways. It consists of an ingenious plan of suddenly detaching the engine from the train, and bringing it to a stand still. The inventor intends, also, to have his discovery tested in other countries.

Literary and Art Property in Austria.—An imperial decree has been lately published on this subject—the purport of which is consonant with similar regulations enacted previously by the Emperor of Russia. The copyright for any ideal property (*ideale Eigenthum*) lasts during the lifetime of the author or artist, and thirty years, in the main, after his death. Foreign (not German) works are treated according to a standard of "material reciprocity." Austria has not joined the Anglo-Prussian convention of literary and art property—but Saxony, Hanover, and others, have.

The Fossil Sea-Serpent.—Dr. Koch, who brought to this country the Missouri mammoth, exhibited in Egyptian Hall, has also discovered in America the fossil remains of an ophidian animal of immense size, which he calls *Hydrarchos.* It possesses a vast number of very large vertebræ, and is the most extraordinary specimen of the so-called antediluvian creation extant. It has been exhibited at Berlin, and the king has given orders to purchase it, notwithstanding Dr. Koch requires an extraordinary price for it.

Drainage of Land in Dalmatia.—The valley of the Narento (Narona of the Romans) was one of the corn-depots of antiquity, but now presents nothing but a succession of unwholesome bogs and wilds, to which the attention of government has at length been awakened. M. Matteis has been directed to examine and report on the regulation of the river Narenta, the most considerable between Trieste and Greece. It forms a delta at its embouchure, and its inundations have hitherto spread at random, and the mould being best retained between the coppices of vineyards, merely served to increase their fertility. M. Matteis proposes two different systems—first, the so-called *bonificazione per sedimento* stream or warping, similar to the old Egyptian method, by which, during the floods, the water, impregnated with alluvial soil, is directed to and retained in such places where it is most required to elevate and fertilise the soil; secondly, by the usual method of dykes and channels. The first plan is, obviously, the best, as no land is lost by the cutting of canals, &c.; but the expense is very great. Thus, most probably, the second plan will be adopted with the Narenta: one of the principal reasons for its adoption is the attention here paid to the rearing of the silkworm, and as the mulberry trees attain an extraordinary size (some being 15 feet in circumference), it is proposed to plant them along the canals, and thus strengthen and solidify the consistency of the soil.

Australian Antiquities.—Although this title may sound somewhat anomalous, we have assumed it deliberately,—as it can be proved to evidence, that as soon as man transgresses the limits of animality, he becomes a *monumental* being, if we may so term it. Although many other criteria have been assigned to the idea of humanity (speech, using of instruments, &c.), yet it is, after all, *art* of some kind or other which marks the limits between brutes and human beings. In Australia, a continent of extremely novel formation and civilisation, these art-traces cannot be but very faint—still, they exist. We count amongst them those *native roads*, as they are to be met with in many parts of New Holland and Tasmania; and avail ourselves of some notices derived from a colonial publication: "Our savages know of no rule, no system, except where they are absolutely forced to resort to it. In their wanderings through open plains, they follow, even if their numbers be considerable, their own fancy; but, if any locality, which they have to pass, presents any particular feature—for instance, is encompassed by swamp, and the like; then, as a matter of course, a certain direction is given, and must be followed. This is the reason why regular roads (paths) of the Papuas are rather frequently met with. Such are to be found on the coal-sandstone rocks between Botany Bay and Point Haking; but the most remarkable are in Byron's Valley, Australian Alps, where the wandering of tribes of several hundred persons, has worn off the sward of the soil, and even impressed the granite underlaying it. From these to the Llama roads of Mexico and Peru is but one step. These paths are the only historical monument which the Papua leaves behind him—if we except, perhaps, large accumulations of oyster and cockle shells, near the sea shore; and which, as some instruments to open them which have been found amongst the heaps testify, have been thus accumulated by these people frequenting and feeding at such places for a series of years. Transgressing from these aboriginal antiquities to European ones in the Australian colonies, we presume, that a freestone slab above the door of one of M. R. Campbell's warehouses in Sydney Cove, engraved with the date of 1802, will be once valued as the oldest inscription of the kind in Polynesia."

Her Majesty and the Royal Consort's Private Art Collections.—Unostentatious as many other of the Queen's endeavours at general improvement—the establishing of an especial school for the children of the domestic household and the labourers at the royal palace, and other acts—the art collections at Buckingham Palace and Windsor Castle are also judiciously, yet unceasingly, increased. As the sovereigns of this country, fortunately, do *not* possess the power to draw on the Treasury for any amount, their collections do not consist of bulky and costly specimens—but of a number of select and clever engravings, drawings, miniatures, &c., which, while they pleasantly and worthily occupy the leisure hours of the royal couple, will serve as early incentives to their growing-up family, and at a future time (be it a remote one) merge into the general stock of the country's art-trophies.

NOTES OF THE MONTH.

The new Roman Catholic church in St. George's Fields, by Pugin, has been advertised as open to the public.

The Royal Institute of British Architects have published a copious catalogue of their library.

The great east window of St. Peter's church, at Sudbury, is being restored by Mr. Sprague, of Colchester, at the sole expense of Dr. Maclean.

The Bishop of Norwich, at his last visitation, made some very strong remarks against pews, and expressed his gratification that his cathedral was now thrown open throughout to all classes.

The improvements in Durham Cathedral are making most satisfactory progress.

There has been an unfortunate accident on the Shrewsbury and Chester railway, by the falling in of a large viaduct bridge, by a train being thrown into the river.

The great tunnel for the new station at Liverpool, and running from Clarence Dock to Edgehill, has been begun at the surface.

A beautiful iron steamer, named the Oberon, was last month sent out from the yard of the Messrs. Rennie. She is of 650 tons, and 200 horse power.

London, Brighton, and South Coast Railway Company.—The directors having decided upon the competition designs for the terminus at Newhaven, have awarded the premium of £100 to Messrs. J. W. and W. A. Papworth, of Caroline-street, Bedford-square; and that of £50 to Mr. Martin Stutely, of Gower-street, Bedford-square.

The Hanover and Harburg railway has been opened.

The Croydon Atmospheric System.—The Croydon Atmospheric Railway is at an end! At a Board meeting on Tuesday, May 4, it was determined that the line should be shut up; and this was done forthwith.

Prevention of Oxidation of Metals.—A correspondent of the *Mining Journal*, says—"I have been led to adopt a simple method of coating metals, by the agency of an acid, so as to secure them most efficiently from the deteriorating influence of oxidation. The article to be coated is first dipped in a dilute acid, composed of two parts sulphuric acid and one nitric acid, in nine parts water. After immersion in this solution, the article is to be washed in clean water, and then allowed to drain; and so soon as it appears to be dry, it is to be brushed over with copal or lac varnish; the varnish attaches itself firmly to the acidulated surface of the metal, and never peels off. The best species of varnish for this purpose is probably copal, to which is added a little litharge. I have subjected sheet-iron thus treated to the continued action of sea water for several months, without its sustaining any injury. It is, perhaps, worth while for ship owners to consider whether a considerable economy would not result from the application of this method to the copper sheating of ships."

Sawing Engine.—At the Royal Institution, April 16, Prof. Faraday called the attention of the members to a working model of a sawing-engine, invented by Mr. Cochran. By this engine wood can be cut into curves of *double curvature* (*i. e.*, curves in two planes). This is effected by the saw being made to turn on a vertical, while the wood is turned at the same time on a horizontal, axis.

Recent Depressions in the Land.—A paper was read at the Geological Society, Feb. 24, by J. Smith, Esq., on the above subject. Mr. Smith gives the result of careful measurements of the sea-level above the pavement of the famous Temple of Serapis near Pozzuoli. These measurements, made independently in the years 1819, 1826, 1838, 1843, and 1845, by Mr. Smith, Prof. Forbes, and the Chevalier Niccolini, all conspire to prove a gentle subsidence of the land on which the temple stands at a rate of about one inch annually. Mr. Smith gives other proofs of the encroachments of the sea from an engraving in the "Vera Antichita di Pozzuoli," published at Rome in 1652, where the churches are represented as intervening between the three columns and the sea. These churches are washed away, as well as two sea-walls, built one within the other for the protection of the road. Mr. Smith then gives a variety of proofs, historical and geological, of the subsidence of parts of the coast of Normandy, Brittany, and the Channel Islands. The stumps of trees are seen standing in the sea, in spots where, at high water, the sea is 60 feet deep; and Mr. Smith has ascertained, from MSS. of the ninth century in the Library of Avranches, that these forests were tranquilly submerged about that period. Mr. Smith also states, on the authority of Capt. Martin White, R.N., that on the coast of Normandy, lines, evidently artificial, and apparently stone walls, are seen under water running out to sea, and that the lead in sounding on that coast frequently brings up fragments of bricks and tiles, which he is convinced are the ruins of submerged buildings.

Electrical Musical Instrument.—At the French Academy of Sciences, M. Froment presented a little electrical instrument, with a vibrating blade yielding a sound. It is composed of a small electro-magnet of iron, the contact of which oscillates between one of the poles and a stop against which a spring causes it to bear. An electric current, introduced into the apparatus, passes by the contact in iron and the stops in such a way that the circuit is cut off when these two pieces are separated. This last effect takes place when the wire of the magnet is interposed in the circuit; for it then attracts the contact which, in abandoning the stop, interrupts the flow of the current. The magnetic power then ceases, the iron blade pushed by the spring returns to strike the stop, and again closes the circuit. A new magnetic power is again given, and again checked, and all this with great rapidity, so as to cause several thousand beats in a second. By turning the screw which serves to vary the amplitude of the vibration and the immediate force of the spring, the instrument can be made to give out all the sounds upon the musical scale. The instrument being so regulated as to give out a fixed sound, the slightest variations in the intensity of the current employed cause corresponding variations in the sound; and thus the apparatus may be employed to judge of the regularity of the passage of electricity in various instruments used in electrical experiments.

Fresco Painting.—A new method of painting as a substitute for fresco has been discovered by a French artist, M. Chevot. It is called by the author *Fresque Mixturale*, and consists of a composition which effectually resists the action of saltpetre, so fatal to fresco painting wherever there is saltpetre in the walls on which it is laid. The effect of M. Chevot's painting is as bold as that for which it is a substitute, and the colours are as vivid. It possesses not merely the advantage of resisting the effect of saltpetre, but can be washed when dirt or dust has accumulated upon it with quite as much security as oil paintings.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM APRIL 24, TO MAY 18, 1847.

Six Months allowed for Enrolment, unless otherwise expressed.

Theodore Hyla Jennens, of Birmingham, manufacturer, for "an Improved m improved methods of manufacturing papier maché articles, also a new or impr thod of ornamenting papier maché articles, which said method of ornamenti maché articles, is also applicable for ornamental purposes generally."—Sealed A

John Morgan, of East Greenwich, manager, for "certain Improvements in m applicable to preparing and spinning flax and hemp, and other fibrous subst April 27.

Jonathan Atkinson, of Liverpool, in the county of Lancaster, soap boiler, for method of manufacturing soap."—April 27.

Caroline Watson, of Chorley, in the county of Lancaster, for "Improvements ratus for filtering." (A communication.)—April 27.

Alfred Vincent Newton, of Chancery-lane, Middlesex, mechanical draught "certain Improvements in the construction of roads or ways, and in the carria used thereon." (A communication.)—April 27.

Thomas Denne, of Bermondsey, Surrey, strap manufacturer, for "Improve the manufacture of grease or composition for atmospheric pipes, and for lubric axles and moving parts of machinery."—April 27.

John Coates, of Seedley, in the county of Lancaster, calico printer, for "Impr in machinery or apparatus for cleaning the surface of woven fabrics, or freeing from fibrous or other loose matters, previous to printing thereon."—April 27.

George Thomson, of Nottingham, cabinet-maker, for "Improvements in mach sawing wood and other substances."—April 27.

Marie Malanie D'Hervilly Hahnemann, of Rue Clichy, Paris, and Henry Petit Place de Chateau Rouge, Paris, for "Improvements in instruments for writing." 27.

Robert Broad, of Tipton, in the county of Stafford, engineer, for "Improve railway turn-tables."—April 28.

Richard Archibald Brooman, of Fleet-street, London, for "certain Improve railway turn-tables." (A communication.)—April 28.

William Carter Stafford Percy, of Manchester, upholder, for "Improvements chinery for making and dressing bricks and tiles, and in certain sheds and kilns bricks and tiles are dried and burnt."—April 29.

John Spear, of Gloucester-road, Hyde-park-gardens, gentleman, for "Impro in piano fortes, and in the musical scale of notes in use for such instruments, and apparatus to facilitate the action of the fingers on the keys of the piano-fortes." 29.

John Elce, of Manchester, machine maker, and Richard Bleasdale, of Rochd chanic, for "certain Improvements in machinery for preparing and spinning cott and other fibrous substances."—May 4.

William Newton, of Chancery-lane, civil engineer, for "Improvements in m for letter-press printing." (A communication.)—May 4.

Joseph Taylor, of Tipton, in the county of Stafford, engineer, for "a certain I ment or certain improvements in the construction and manufacture of wheels for and other carriages."—May 4.

Gardner Stow, of King-street, Cheapside, gentleman, for "Improvements in struction of steam-vessels, and an apparatus for propelling ships and other vesse communication.)—May 4.

William Henwood, of Portsea, in the county of Southampton, naval architect, provements in propelling vessels, and in steam-vessels."—May 4.

Lemuel Wellman Wright, of Chalford, in the county of Gloucester, engineer, for tain Improvements in machinery, or apparatus, for sweeping or cleansing chimnies and other similar purposes."—May 4.

Fennell Allman, of Charles-street, St. James's-square, Middlesex, consulting-e for "an Improved mode of making, forming, or shaping candles."—May 4.

Conrad Haverkam Greenhow, of North Shields, gentleman, for "Improvements construction of ships or vessels, and in propelling ships or vessels."—May 4.

John Horsley, of Ryde, Isle of Wight, practical chemist, for "Improvements serving animal and vegetable substances."—May 6.

Herbert Spencer, of Lloyd-street, Lloyd-square, Clerkenwell, civil engineer, for tain Improvements in machinery, for planing and sawing wood, parts of which im ments are applicable to machinery for cutting certain other substances."—May 6.

Moses Poole, of London, gentleman, for "Improvements in apparatus for con and disconnecting railway carriages." (A communication.)—May 6.

Charles Fox, of No. 8, Trafalgar-square, Charing-cross, Middlesex, engineer, and Coope Haddan, of No. 11, Upper Woburn-place, civil engineer, for "Improveme railway-chairs, and switches in trenails or fastenings, and in machinery for preparin way sleepers."—May 6.

Joham Gossob Seyrig, of New Lenton, in the county of Nottingham, enginee "certain Improvements in propelling on land and on water."—May 6.

Isham Baggs, of Holford-square, Middlesex, for "certain Improvements in th duction and management of artificial light."—May 7.

Joshua Fielden, Esq., of Waterside, Todmorden, in the county of Lancaster, fo Improved mode of laying and pressing cotton, silk, wool, flax, and other fibrous m into cans, baskets, boxes, and other depositories."—May 8.

Amos Bryant, of Heavitree, in the county of Devonshire, gardener, and Richard hill, also of Heavitree, in the same county, surgeon, for "Improvements in prep constructing, and draining land, and an Improved implement or implements to be therein."—May 8.

William Norman, of Paradise-place, Finsbury, Middlesex, cabinet-maker, for provements in the construction of expanding or dining tables."—May 10.

John Martin, of Allsop's-terrace, Middlesex, for "Improvements in apparat means used when draining cities, towns, and other inhabited places."—May 8.

John Tattersall Cunliffe, of Manchester, hide merchant, for "certain Improveme pickers, for power looms, and also in the tools or apparatus for manufacturing the s —May 14.

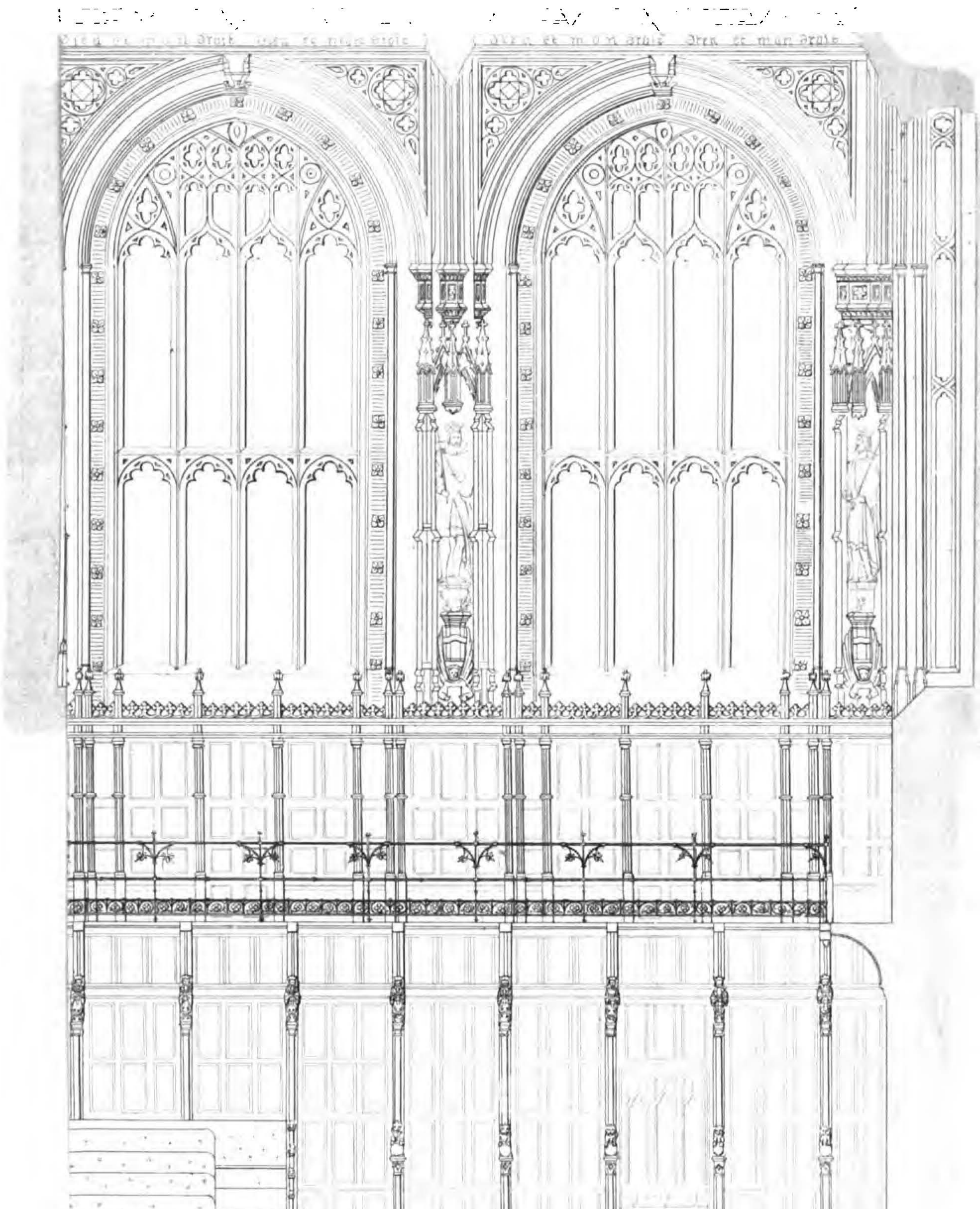
John Thomas Gray, of Wardour-street, Middlesex, bootmaker, for "an Improve and shoe."—May 14.

Thomas Shipp Grimwade, of Sheepcote Farm, Harrow-on-the-Hill, Middlesex, fo new mode of treating milk for purposes of nutriment."—May 14.

Thomas Haseldine, of Brudenell-place, New North Road, Middlesex, enginee "Improvements in the construction of furnaces."—May 18.

Richard Peyton, of the Bordesley Works, Birmingham, metallic bedstead manu turer, Jonathan Harlow, of Bordesley Works, aforesaid, and Thomas Horne, of Borough of Birmingham, brass-founder, for "Improvements in the manufacture of steads."—May 18.

PLATE



30 Feet

THE NEW PALACE OF WESTMINSTER.

THE HOUSE OF LORDS.

With an Engraving, Plate X.

Architecture is pre-eminently a royal art—princes, pontiffs, and prelates have paid more direct homage to it than to any other of the fine arts. In the palmy days of Christian architecture—ere its decay was insulted by the mongrel abortion which *we* call Classic—the spoils of conquerors, the revenues of rich churches, the votive treasures of pilgrims, the dowries of king's daughters, the gains of merchants and burghers, the tribute of provinces, were not considered contributions too munificent for the erection of those stupendous edifices which adorned every town and city of mediæval Europe. In our own country, from the time when the Saxon Ethelbert founded the abbey of St. Augustine at Canterbury, till Henry the Seventh reared the magnificent chapel at Westminster which bears his name, zeal, wealth, and power had scarcely any other historical records but palaces, colleges, and cathedrals. Architecture seems to have been a ruling and pervading idea in the minds of the people of those times. The mailed knight, returning from the wars, made it his chief care to adorn the abbey adjacent to his castle—or, at least, to found a costly chantry in which prayers might be made for him when departed. Rival monasteries strove with all their energy to outvie each other in the magnitude and decoration of their edifices; their brethren travelled far and wide to levy contributions; and every art which zeal and experience could suggest, or superstition and credulity render available, was put in requisition.

All this took place in days when competition designs and tenders for building by contract were not yet invented. The common people shared in the architectonic enthusiasm of their superiors. There were more pennies than golden pieces among the offerings: and they who were too poor to give even pence, freely bestowed their labour—felled trees, quarried stone, dug earth, carried burdens, and considered no task too toilsome, so that they might be gladdened by seeing their beautiful church rising, day after day, before their eyes. It was a sorrowful sight when the work stood still because of war or for lack of means. The pride taken in the task by these men, who were the lowest and humblest that lived in what have since been called the Dark Ages, is now so entirely out of date—so utterly unlike any modern popular feeling—as to seem incomprehensible, and almost improbable. To them the great fabric, as it gradually towered above their cottages, and became the way-mark of the country round, was the chief boast and glory of their native place: and if they might only see with their own eyes the wondrous work at length accomplished, which had slowly grown beneath their hands and the hands of their fathers, and, perhaps, grandfathers before them,—then, indeed, their highest ambition was accomplished. These poor men were very spendthrifts in their love of the Beautiful.

Much of this feeling doubtless was due to the prevaling influence of the church and religious or superstitious motives. But even after making a liberal allowance on this score, a great deal remains which is only explicable on the supposition of a general enthusiasm for noble architecture. The religious bodies themselves had little to gain by the mere decoration of their edifices: they, at least, must have been sincere in their masonic zeal; for had their churches been as hideous as meeting-houses in modern manufacturing towns, or as contemptible as genteel chapels of ease in fashionable watering-places, their own condition would have remained unaffected. They ministered in no way to their personal luxury or love of ease in adorning buildings destined for no private or secular uses. Neither could the laity have been animated by selfish motives alone;—the hope of absolution, indulgence and easy exemption from penance, could not have sufficed alone. The unanimity of purpose throughout widely separated countries, its continuance for centuries in succession, and its universality among all grades and classes, sufficiently show that not external inducements alone, but internal feelings also, must have been in operation. The internal feelings which influenced these votaries of art were chiefly—a strong love of home, an honest ambition for the honour of their birth-places, and a fond desire to raise up something in their familiar haunts which might draw the wayfarer and stranger out of their road, to marvel at its exceeding beauty and excellence.

Accordingly, their architecture was of home-growth and contemporary —it was essentially their own. These men were neither cosmopolitans nor archæologists: they sought neither for exotic importations nor for resuscitated antiquities—had no craving for things removed by either time or distance—read too little to care for the one, travelled too little to attain the other.

It is a long while now since their beautiful architecture fell into decay, and was succeeded by a strange fantastic style—the mingled production of many ages and climates. This medley, as strange as was ever seen in an old curiosity shop, which grew fashionable in England only after architecture became the exclusive luxury of the rich, has been lauded in all the set phrases of the dillettanti, from the reign of Queen Elizabeth to that of Queen Victoria. It has, therefore, been a most happy chance for the Fine Arts, that this confusion of antagonistic principles, exhibited during that long period, in the public edifices of England, has at last been checked, and that in offering designs for so vast and important an edifice as the New Palace of Westminster, the competing architects were restricted to two styles which, whatever their imperfections, possessed in a great degree these essential elements of architectural truth—indigenous growth and the subservience of decoration to construction.

The style actually adopted by Mr. Barry—the Perpendicular—is, of the two styles to which the designs were restricted, the one which most fully satisfies the tests in question. It is not only English, but exclusively English. The change of architecture, after the Decorated period, took in this country a form altogether different to that exhibited in the contemporary change of foreign architecture; so that it is all but absolutely true that the Perpendicular style is not to be found out of England. Again, the style was a faithful one—it involved none of the absurdities arising from the incongruous combination of arches and horizontal architraves. All encomium of the new building, should therefore, as it seems to us, commence from this point—that it developes on a grand scale, for the first time in modern public edifices, the principle of architectural truth. Columns, arches, piers, and buttresses are employed not merely to be looked at, but to contribute each its due share to the support of the building. It is true that this principle has some exceptions. Large iron girders are employed in the construction; and though all attempts to apply modern mechanical skill to the legitimate purposes of art tend to the benefit of art itself, yet it must be confessed that the consistent adaptation to an ancient English style of mechanical appliances so entirely unknown to our ancestors as were cast iron girders, involves considerable difficulties. Among the few exceptions to our commendation of the constructive faithfulness of the architecture of the New Palace must be mentioned certain arch-heads formed by single stones. These stones are to all intents *beams*, and to cut them into the shape of arches is to deceive the eye by an affectation of forms without purpose.

The interior of the House of Lords corresponds well to the character of the external architecture. We find the same rich profusion of elaborate details, the same multitude of rectangular panels, the same minute and careful study of the decorations. The old architects deemed the composition of their buildings the first point for consideration to which the elaboration of minor parts was to be kept subordinate: but the visitor to the House of Lords must not expect any of that massive, bold combination of simple parts by which the older architects produced effect, even with restricted means. Everything here is rich, graceful, and delicate. The severest of critics could not discern one offence against good taste. But there are no towering columns, dark vaulted roofs, piers that seem to have been reared by giants, and broad deep masses of shadow, such as are found in the adjacent ancient building.

The drawing herewith shown is the first of a series, which we propose to give illustrative of the new Houses. It is merely an outline, and must not be considered as giving any adequate idea of the effect of decoration—for every little panel there shown is filled up with carvings and other enrichments, which we shall hereafter give in detail. A work so large as is the House of Lords, so profusely and so minutely decorated, cannot be represented by any drawing which is less than the size of the original; for there is certainly not a square foot of surface, which has not been placed under the hand of the decorator. Our engraving has, by the great kindness of Mr. Barry, been made partly from our own admeasurements and partly from drawings, and we shall endeavour to give a record of this valuable work, which may be received as authentic.

The House of Lords is a double cube of 45 feet, that is to say, 90 feet in length, and 45 feet in breadth and height. It may be considered as consisting of three parts—the southern or throne end, the northern or bar end, and the middle or larger portion, in which are the woolsacks, clerks' tables and seats of the peers.

The House is lighted by twelve windows, six on the west and six on the east; the latter side is the one shown in our drawing. At each end of the House are three archways of the same dimensions as the windows. At the throne end these arches are filled up so as to receive fresco paintings; at the north end they are recessed for galleries.

We shall confine ourselves at present chiefly to the description of the sides. It will be seen that the side forms three tiers, the two lower of which are of oak panelling, and are divided by a projecting gallery. The lower tier is divided into twenty-four compartments or divisions, three under each window, and one under each pier. This lower tier is formed into panels, four high, with a coved panel or canopy under the gallery. The three lower ranges of panels are of the "napkin" style, with V.R., an oak leaf, and crown intertwining in the corners of the folds of the drapery. The fourth range has an ogee arch, crockets, and finials, the arch being divided by quatrefoils and tracery, with a flower ornament at the bottom. The compartments are divided by a pillar bearing a bust. The busts form a series of the English kings. Between the busts is an inscription, in Tudor characters of "God save the Queen" in openworked letters. Above this and below the canopy is a pierced brattishing of trefoils. The canopy is supported by moulded ribs, springing from the pilasters. Each panel of the canopy bears the emblazoned arms of one of the Lords Chancellor of England. The series begins with Adam, Bishop of St. David's, in 1377, and extends to Lord Cottenham, the present Chancellor. The arms of the sovereigns, also richly emblazoned, serve to mark each reign, and to form a chronological division.

The front of the canopy is moulded, having a treillage in the lower moulding. The pendants are carved, and bear a lion's head, above which is the brass railing of the gallery. The lower part of the brasswork consists of roses intertwining. The rest of the brasswork is chiefly twisted. The knobs are enamelled in colour and gilt, and serve to relieve and set off the brasswork.

The gallery only contains one row of seats, intended for peeresses, and is entered by a number of small concealed doors in the panelling under the windows.

The upper tier of panelling is very rich indeed. It is divided on a different plan from the lower panelling, as will be seen from our plate. The upper panels are filled with labels bearing "God save the Queen," upon a ground of vine leaves and grapes in relief. The pillars dividing the panelling are slight and are elegantly carved. They support a cornice decorated with pateræ and embattled. Above this again is a brattishing of trefoils, interspersed with finials corresponding to the pillars below.

The windows are each of eight lights, divided by mullions and transoms, and the upper range of lights subdivided and filled in with quarterfoil tracery. The windows are to be filled with stained glass. On the splay of the jambs the inscription "Vivat Regina," is painted many times, the words being separated by quaterfoils, alternately blue and red.

Between the windows are niches with canopies, in which are to be placed statues of the Barons who signed the Great Charter. The pedestal is supported by an angel bearing a shield, on which is emblazoned the arms of the Baron. The interior of the niche is diapered, but the canopy, pillars, &c., are gilt. Above the niches spring the spandrels, to support the arched ribs of the windows and the ceiling, being filled in with quaterfoil tracery, richly gilt. On the fascia around the House is inscribed repeatedly the motto, "Dieu et mon droit."

Chromatype.—The most interesting process of photography appears to be that of the Chromatype, discovered by Mr. Robert Hunt. It consists in washing good letter paper with the following solution:—Bi-chromate of potash, 10 grs.; sulphate of copper, 20 grs.; distilled water, 1 oz. Papers prepared with this are of a pale yellow colour; they may be kept for any length of time without injury, and are always ready for use. For copying botanical specimens of engravings nothing can be more beautiful. After the paper has been exposed to the influence of sunshine, with the object to be copied superposed, it is washed over in the dark with a solution of nitrate of silver of moderate strength. As soon as this is done a very vivid positive picture makes its appearance; and all the fixing these protographic pictures require is well washing in pure water.

REVIEWS.

The Tradesman's Book of Ornamental Designs. By SAMUEL LEITH. Part I. London: W. S. ORR.

The progress of ornamental design in this country has created its own circumstances; it has now its own artists, its own societies, and its own literature. Whereas, when we began our labours in this Journal, it was difficult for a gentleman to get his house decorated—and then only under foreign superintendence and with foreign assistance; in consequence of which, very few persons of competent means gave any encouragement to decoration: now, as in the case of the Baron de Goldsmid's mansion in the Regent's Park, the most admirable designs can be executed by English aid alone. We are convinced that had the High Dutch party been allowed to have their own way, and to surrender the decorations of the Palace of Parliament to Cornelius and the Munich people, the present progress of the arts in England would have never taken place; and we feel gratified that we were among the earliest to oppose the attempt, and to claim a fair trial for Englishmen on their own ground. We do not regret that we then exerted ourselves, and we may say confidently that every effort that has been made of late years to forward the cause of art, has been fairly met, and that there is every encouragement for future exertion.

Mr. Leith is an artist at Edinburgh, connected with the Board of Trustees for Manufactures in Scotland, and he has been led to bring forward a cheap collection of drawings suitable for tradesmen, with the view of spreading a better knowledge of style and purer elements of taste. In this first number there is, among the examples, some excellent iron work, particularly perforated railing. The carved stand, which is called Flemish, does not seem to us to have any impress of style. An Italian study of angels, from a drawing made by Guido Reni, after an earlier master, is admirable. There is an Elizabethan vignette. We know that a work of this kind is wanted, and we think that Mr. Leith is likely to prove successful. We shall therefore watch its progress attentively.

General Table for Facilitating the Calculation of Earthworks. By F. BASHFORTH, M.A., Fellow of St. John's College, Cambridge. George Bell, Fleet-street.

A table for the calculation of earthworks, of sufficient generality to include all cases—and at the same time of easy application—has long been a great desideratum among engineers. The two tables which have been hitherto employed are those of Bidder and Macneill; the great objection to the former is the number and labour of the operations required, and to the latter that they are not sufficiently comprehensive. Neither of these objections apply to Mr. Bashforth's system, which is very simple and easily applied—and moreover has this advantage, that it includes the case of sidelong cuttings. The tables, with the scale for proportional parts, are not much more bulky than those of Mr. Bidder: the mode of using them we now proceed to describe.

Suppose two cross sections, a chain apart, to be made through a railway cutting; and first suppose that the slope on either side is unity, and the heights of the opposite banks equal at the same section, but uniformly decreasing from end to end. If now we suppose the inclined planes to be produced, they will meet in a straight line below the formation level; and the figure included between the two vertical planes of the sections a chain apart, an inclined plane through the summit of the banks, and the inclined planes of the banks, will be a portion of a pyramid. If, morever, a and b be the vertical depths of the line where the planes of the banks or slopes meet below the summit of the cutting at the two sections, the volume of the portion of the pyramid will be $= \frac{22}{27}\left\{a^2 + ab + b^2\right\}$ cubic yards. If, now, the slope, instead of being $= 1$, had been $= r$, the volume would have been $\frac{22 \cdot r}{27}\left\{a^2 + ab + b^2\right\}$ cubic yards; and if the distance between the terminal sections had been d chains, instead of one chain, the above quantity must have been multiplied by d. In order to find a and b, suppose h and h' the heights of the portion of cutting at the two ends measured from the formation level; c the breadth of the formation level; and r the slope:—then

$$\frac{c}{2r} + h = a; \quad \frac{c}{2r} + h' = b.$$

But the quantity of earthwork is equal to the volume of the above frustum of a pyramid, minus that portion which lies below the formation level; and this latter portion is a prism, bounded by two triangles at the ends, the areas of which are, for a slope 1, $(h-a)^2$; consequently, if L were the length in chains of such a prism, its cubic contents would be $\frac{22}{9} . L\,(h-a)^2$; and for a slope r $\frac{22\,r}{9} . L\,(a-h)^2$:

∴ the quantity of earthwork taken for L distances, a chain apart, and a slope r would be

$$r.x.\ \frac{22}{9}\,(a^2+ab+b^2) - \frac{22\,r.}{9}\,L\,(a-h)^2.$$

In Mr. Bashforth's tables, $\frac{22}{9}\,(a^2+ab+b^2)$ is tabulated for all integer values of a and b, from $a=0$ to $a=65$, and $b=0$ to $b=65$; and a scale of proportional parts is added, to extend the calculation to decimal parts of a foot.

Example for Equal Distances.

To show how to use the tables, we will take out the following example, working it first by Mr. Bashforth's, and then by Mr. Bidder's, method:—

Heights from formation level at distances a chain apart, 30, 40, 25, 35; breadth of formation level, 30 feet; slope, 1¾ in 1.

MR. BASHFORTH'S METHOD.

To find the quantity to be added to each of the heights, divide half the base by the slope: then 14 ÷ 1¾ = 8. Adding this quantity to the heights, and taking the corresponding figures from Mr. Bashforth's table, we have the following scheme:—

Heights.	Tabular Numbers.
38, 48	4540
48, 33	4055
33, 43	3550
	12145
Subtract $\frac{22}{9}$ × length (3 ch.) × square of the additional height (8)	469
	11676
	1¾ (the slope)
	20433 cubic yards. (*Ans.*)

MR. BIDDER'S METHOD.

Heights.	Tabular Numbers for centre.	Tabular Numbers for slopes.
30, 40	85·6	3015
40, 25	79·5	2628
25, 35	73·3	2220
	238·4	7863
	28 (base)	1¾ slope
	6675·	13760
		6675
		20435 cub. yds. (*Ans.*)

Example for Unequal Distances.

In the last example the sections were supposed to be taken at every chain. If, however, we take the sections at unequal distances, the difference between Mr. Bashforth's method and Mr. Bidder's is more apparent. In both, the tabular numbers have to be multiplied by the distances; but as there are *two* tabular numbers in Bidder's table for every distance, the number of multiplications is doubled.

Let the sections be taken at distances 3, 2½, 2, 1, chains, respectively. Let the heights be 40, 30, 20, 15, and 10. The slope 1¼ to 1; the base 25 feet.

MR. BASHFORTH'S METHOD.

The addition to the heights is half 25 ÷ 1¼ = 10. Making the addition, taking the numbers from the table, and multiplying by the corresponding distances, we have

Heights.	Tabular Numbers.	Distances	Products.
50, 40	4970	3	14910
40, 30	3015	2½	7537
30, 25	1854	2	3708
25, 20	1243	1	1243
		8½	27398
Subtract $\frac{22}{9}$ × $(10)^2$ × 8½			2077
			25321
			1¼ (slope)
			31651 (*Ans.*)

MR. BIDDER'S METHOD.

Heights	Tabular Numbers. Centre.	Tabular Numbers. Slope.	Distances	Products. Centre.	Products. Slope.
40, 30	85·6	3015	3	256·8	9045
30, 20	61·1	1548	2½	152·7	3870
20, 15	42·8	754	2	85·6	1508
15, 10	30·6	387	1	30·6	387
				525·7	14810
				25 (base)	1¼ (slope)
				13142	18512
					13142
				Total cub. yds.	31654 (*Ans.*)

Macneill's method does not, like the above, give a general table for *all* slopes and bases and *any* combination of them, but a number of special tables of particular slopes combined with particular bases. This method not being general, it would require not a volume, but a library, to contain tables of all combinations of slopes and bases which occur in railway practice. The cases above taken (for example) are altogether omitted in Macneill's tables. But wherever these tables do apply, the arithmetical operations are nearly the same as Mr. Bashforth's: and consist in multiplying the tabular numbers by the distances, and adding the results.

The great value of Mr. Bashforth's tables is the scale of proportional parts; for the mode of using this, and likewise for the calculation of earthwork in sidelong cuttings, we refer the reader to the next number of the Journal: we cannot, however, dismiss the subject even temporarily, without expressing our conviction that Mr. Bashforth's tables are by far the most simple and generally useful of any that have yet appeared;—such we know is the opinion entertained by men who have for years past been engaged in the computation of earthworks, and, consequently, are best qualified to appreciate the value of tabular modes of shortening the labour of calculation.

The Hand-book of the "Sounder;" or Theoretical and Practical Treatise of the Sounder (or Borer).—Guide du Sondeur, &c. By J. LEGOUSSÉE, civil engineer. Paris: 8vo.; with maps. 1847.

The work of M. Legoussée treats of every subject relating to borings for underground works, and although there has been no lack of detached papers on this head, the work before us comprehends the whole of the facts and reasoning hitherto known. After having briefly sketched the history of the subject, the author proceeds to the geological portion of the doctrine, and first defines what is to be called a geological basin. He describes, then, the aspect of secondary and tertiary basins in different countries, and examines the most favourable localities for the boring of artesian wells, the strata of fossil fuel, rock salt, mineral waters, &c.

After these preliminaries, our author enters on the description of the different systems, and the different applications of sounding; the explanatory apparatus for the study of the ground; the driving of piles, and placing of poles for telegraphic lines; mooring stones, and foundations for suspension bridges; submarine boring for the removal of shoals and reefs, and the improvement of bridges; horizontal boring, and other mining operations—ventilation, and absorbing pits for the draining or absorption of fetid waters; in fine, on artesian wells and the search for underground water.

After having dilated on the different modes and systems of boring, the work passes to the description of the different boring apparatus—as instruments for clearing and emptying, correcting apparatus, instruments for boring horizontally, or for boring in the angles of walls, &c. The author then details several contrivances for tubes and repairing damages, and inserts a journal of a boring operation, indicating with great accuracy the progress of the work through different formations; the accidents which might have intervened, and the remedies resorted to to repair and prevent them. A recapitulation of the results hitherto obtained by boring, and what may be accomplished, follows, and the author concludes this chapter by the description of some instruments which are indispensable for ascertaining the extent and quality of work performed in any given time. The means for obviating the decrease in the flow of artesian wells, as well as absorbing pits suffering under stoppages, are then given. The work concludes by fixing attention on the especial laws of geology and mechanics, which it is indispensable for the borer to know, and for securing a proper execution of the many works in which boring is now used. The plates form a very useful and interesting accessary to this deserving work.

Carpentry in Divisions of A, B, C. A Comprehensive and Useful Work. By Peter Nicholson. In Twenty Parts. Part I. London: Weale.

This is the first part of a new issue of Peter Nicholson's work, with additional plates, and many promised improvements. The work seems likely to be what it is styled, "comprehensive and useful;" but we hope that the redundancy of Mr. Nicholson's style will be carefully pruned, and that unexecuted designs (such as the verandah by Mr. Arundale) will not be published. Mr. Nicholson's practical plates are very good, but his descriptions of them are apt to run to too great a length.

Post Office Railway Directory for 1847.

With the growth of railway kings, directors, and members of parliament, it becomes desirable to know who they are—which is, we suppose, the reason for the present work, which gives an alphabetical list and biography of all these functionaries. Thus we have sketches of the Stephensons, Brunel, Locke, Hudson, &c., and as the book ministers to public curiosity, it will in all probability be a standard. We notice a list of railway engineers and mechanical engineers, with the appointments they hold.

Architectural Maxims and Theorems. By Thomas Leverton Donaldson, Professor of Architecture, University College. London: Weale, 1847.

Mr. Donaldson has published a small work, which consists of two parts—a collection of maxims, and a lecture on the character of architects. It is a work remarkable enough to deter us from reviewing it at the late period at which we have received it.

THE DEE BRIDGE FAILURE.

Considerable interest has been caused among the profession through the failure of a cast iron girder bridge over the River Dee, near Chester, which took place on the 24th May last; and in consequence of the accident involving the death of some individuals, a coroner's inquest has been held, which lasted several days. It not our intention to give the whole of the evidence, as much of it was extraneous; but we shall select those portions which immediately apply to the construction and failure, and then offer some remarks of our own, together with a wood-engraving of the girder, showing the fractures, and a section.

Mr. Thomas Alfred Yarrow, who was selected by the coroner and jury to examine the bridge, said,—I have been a civil engineer for the last 12 years. I have held the appointment of bridge-master for Chester for some time, and have no connection at present with any railway. I have made an examination of the railway bridge over the Dee, and I now read my report of the inspection:—

Report.—"Upon examining the bridge, I found that the masonry and ironwork, with the exception of that part of each which has fallen, were in an apparently sound state. The principle of the bridge is that of trussed girders of cast metal resting upon stone piers and abutments, which are parallel to the course of the river, but askew to the railway above. Each girder consists of three pieces, having vertical flanges, with bolts at the joints, and, in addition to being bolted to the full depth of the girder, each joint is surmounted by a segmental piece, to receive which, notches have been cast in the upper surface of the girders. The tension rods descend in an oblique direction to each joint, and are carried horizontally between them; they consist of separate bars of wrought iron, which are secured to each other laterally by clips. The portion of the bridge which has fallen consists of one outside girder on the Salteney side of the river, with the attached platform and transverse tension rods. Two stones, composing part of the string course, and acting as a bed for the girder on the Salteney abutment have fallen, and also the corner stone at the acute angle of the opposite river pier upon which the broken girder rested. The girder itself is broken, having two fractures in the length near to the Salteney abutment, and one in its centre. Having premised this short description of the construction of the bridge, and its present appearance, I may proceed to detail the facts which I have remarked during my investigation, and which have enabled me to arrive at a confident conclusion as to the cause of the accident. My attention was in the first instance directed to an examination of the fractured ends of the girder, for the purpose of ascertaining whether any defect had existed in the castings. The appearance of the broken surface led me to conclude that the castings had been sound, and the tension bars, as far as they have yet been recovered from the water, are unbroken.

"From calculations which I have made of the strength of the girders, taken from an actual measurement of the section at the point of fracture, I find that, independent of any additional strength that may be obtained from the tension bars, the girders alone are capable of sustaining a much greater weight than could under any ordinary circumstances be placed upon them. The breaking weight of each girder I calculate at 74 tons, supposing the weight to be concentrated over one point, and of both girders 148 tons. But it is an admitted principle that a beam will carry twice the weight, distributed over its whole surface, that it will bear upon one point. We can therefore conclude, that twice the above weight, $148+2=296$ tons, is the breaking weight of one bay or opening of the bridge for one line of rails. The weight of girders and platform is, at a rough calculation, about 90 tons, which must be deducted from the foregoing quantity; we have therefore 296, less 90, equal 206 tons as the breaking weight; and this is altogether without reference to the tension bars.

"From the above facts, I concluded that the accident did not arise from the breaking of the girder as a primary cause, and I therefore directed my attention to the state of the masonry and to a consideration of its sustaining power. Having carefully examined all the displaced stone and their respective beds, I found that one, previously named as forming the acute angle of the river pier, and upon which one end of the broken girder rested, was totally inadequate, in its form and bearing surface, to its important situation. This stone had sustained nearly three-quarters of that portion of the flange of the girder which rested upon the pier. The area of its lower surface is 24 ft. 6 in., of which 11 ft. 6 in. only was bedded on the pier, leaving 13 ft. to overhang as a cornice. The stone was not connected by cramps or ties with the adjoining masonry of the pier. The railway over the whole bridge is curved. The broken girder supporting the outer side, and being subject to a greater lateral force than the girders forming the inside radius of the curve, I consider that this lateral force, acting during the passage of each train, must have so far loosened the inefficient masonry as to cause a displacement of the girder itself and its consequent fracture."

Mr. Robert Board, superintendent of the Mausley Iron Works.—The girders of the Chester railway bridge over the Dee were manufactured at those works. They were tested before sent to the railway. Each girder was placed side by side and tested by 50 tons of iron being put on them in the centre. We took the deflection on every five tons, but have not got the particulars of those deflections. The ordinary pressure on the girders passing over them would not exceed 50 tons. After the girders had been tested we found a flaw in one of them: it was a mere honey-cake, and it was rectified before it was sent away. I have since examined the girder, and found that the accident had not resulted from the flaw. The fractures were in the sound metal. I superintended the fixing of the girders. There are many railway bridges of the same kind. On the Trent Valley line there are eight of the kind. It is not opened to the public as yet, but on the Blackwall railway there are several that have had heavy trains passing over them for years. The one over the Dee is the largest. I never heard of any of them giving way. Had been several times to view the bridge when trains were passing over it, and found the deflection very trivial, not much more than an inch.

Major-General Sir Charles William Pasley.—I was the Government Inspector-General of Railways when the Chester and Holyhead Railway was opened. I surveyed the bridge over the river Dee on October 20th, and reported it as safe. I compared the plans with the actual building, and examined it in such detail as I deemed necessary. It is an iron girder bridge, of three openings or spans of 98 feet each; wrought iron tension rods are used to strengthen it. I always was of opinion, and am so still, that these tension rods are not of great use, because I consider that the expansion of wrought and cast iron from heat differs in some degree, although not very greatly; but that iron girders being very massive and the tension bars thin and of small dimensions, the sun may act on the wrought iron rods very considerably and less on the cast iron girders; and supposing them to be adjusted for a moderate temperature, the intensity of hot weather may destroy their proper proportion and do away with the benefit of the tension. I may here state that wrought iron, when acted upon, will elongate considerably without breaking, but cast iron will not without breaking. There have been a number of bridges of this description erected on railways in various parts of England, both before and after I held the appointment of Inspector-General of Railways, none of which, with the exception of this one, ever failed. They were not quite of the same extent, but I will allude to a cast iron girder bridge at York, over the river Ouse, of the York and Scarboro' Railway, which has two openings of 70 feet span. The least depth of the iron girder on that bridge is 3 feet. The least depth of those on the Dee bridge is 3 ft. 9 in.; and as the bridge at York and other similar bridges have stood, I concluded that this one would, as it had an extra depth. I may also mention another bridge over the Tees, at Stockton, although I have not seen it. I may vouch for what I state to be correct. It has a span of 83 ft. 4 in., and the least depth of iron is 3 feet.

Mr. R. Stephenson said it was 87 feet.

General Pasley.—I thought it was what I stated, but you may be correct. The flange on this bridge is greater than on others. I have frequently mentioned to engineers that wrought iron tension rods would do little good. In my inspection of a cast iron girder bridge, on the Syston and Peterborough Railway, built by Mr. Liddle, the resident engineer, I found that he had omitted tension bars, and in my report to the Earl of Clarendon I approved of the omission, and considered it a preferable construction. It appeared that Mr. Liddle could not get the tension rods in time, and therefore he built the bridge without them. Having mentioned this repeatedly to engineers, and having been given to understand that Mr. Bidder and Mr. Gooch have made experiments with a view of testing the strength of girders without rods, I am informed that the trial was in favour of the latter. As to the cause of the accident;—it has been stated that some time after the Shrewsbury and Chester railway was opened, and after I had inspected it, a girder was cracked, and was replaced by a new one. This circumstance, which I did not know, and which was never reported to government, coupled with the fracture of this one, induces me to think they are not safe, and that it is the mere cast of a die between their safety and danger. I consider that the tension rods are of very little use indeed. The tension rods are connected with the girder alone, as if they were part of it. They have no independent support, and there is a difference between this bridge and Mr. Stephenson's former iron girder bridges. In all his former girder bridges there is a connexion from girder to girder, on the central pier or piers, from one end of the bridge to the other, so that when the pressure is on one girder, the other girder in the same line contributes to assist. That is the case with the one on the river Ouse at York. The horizontal portion of these bars appears to be useless. The oblique tension bars would be of use if the upper ends were fixed to some independent support to each pier, and similar independent support on each abutment, and if the standards or support over the abutments had tension bars extending inland to resist the heavy weight going over the extreme bays or openings of the bridge. There is a swing bridge over the river Wensham, at Norwich, strengthened on this principle, and which is extremely judicious. In this case I consider that the girder broke on a train passing over, added to the weight of the ballast that had been thrown on it in the course of the morning. The masonry gave way from the girder breaking, and from that cause alone. I examined the girder; and the castings seemed very good, and I believe it is generally admitted that they are good; but the girder was too weak after the ballast that was put upon it. The girder was far enough in the masonry to support it. There was quite bearing enough to render it secure. I do not think the engine driver suddenly putting on the steam would cause the engine to bound with such force as to break the girder. I saw nothing to throw the carriages off the rails on the bridge, which had strong guard rails. I should say that no girder could have withstood a deflection of 5½ inches. It would have broken short at once. A continued deflection of 4 inches must have broken it long before this occurred.

Mr. Robert Stephenson put in a written report on the accident; from which it appeared that on the day it occurred, and only a few hours previously, he had narrowly inspected every part of the bridge, and saw nothing to indicate weakness. He had carefully examined into every circumstance connected with the disaster, and for reasons which he gave, was satisfied that it arose from a violent blow against the girder, near to the abutment on the Saltency side, caused by the train getting off the rails. The report said:—

"It has been suggested that the unequal expansion and contraction of the girder, during great changes of temperature, might probably interfere with the uniform strength of the metal. It is impossible to deny that this circumstance does sometimes interfere with the strength of cast iron beams, but generally this influence may be regarded as confined to castings where the thickness of the different parts vary considerably. In the present case, the form of the castings was carefully studied, and with only such small deviation from absolute uniformity in all thicknesses of the different parts of the section, as practice has long proved to be justifiable.

"With regard to the competent strength of the structure, I concur generally in the deduction drawn by Mr. Yarrow, in which I am confirmed by an extensive experience in the construction and use of similar structures, tried under circumstances that demonstrate their capabilities to meet all the ordinary contingencies of railway traffic."

Mr. James Kennedy, of the firm of Bury and Kennedy, Liverpool, was recalled, and confirmed the opinion he had given at the last meeting as to the probable cause of the accident. The girder might have given way either from a blow, or the extra weight of ballast and the train on it. Cast-iron girders were capable of sustaining in the centre 70 tons; but if the tension rods were not perfectly adjusted, he did not think the bridge safe for ordinary trains. He did not think damp ballast placed on the bridge would affect the temperature of the girders so as to cause them to break.

Mr. H. Robertson, the engineer of the Shrewsbury and Chester Railway, was next called, and said—I have examined the bridge since the accident. My opinion is that the bridge broke under the weight of the engine and train, increased to a large extent by the laying down of 25 tons of ballast on the platform just previous to the accident. The witness then handed in a lengthened report which he had made to the Directors, respecting the failure of the bridge, in which he stated that the fracture spoken of by Mr. R. Stephenson, as having been produced by a lateral blow, was, in his opinion, caused after the girder had fallen, and that the fracture which caused the bridge to give way was that in the centre. He considered that the tension-rods tended more to weaken the girder than to strengthen it.

Mr. Robertson then read the following report which he had made to the Directors of the Shrewsbury and Chester Railway:—

"I minutely examined the Dee bridge on the Chester and Holyhead Railway on the occurrence of the accident, and have since examined repeatedly the points which bear upon the accident. I have caused drawings to be prepared and also a model, showing the details of the structure and the fragments of the beam, in so far as now discovered; and to these I would refer you, instead of attempting to give a written description of the bridge. (These were produced in Court, for the inspection of the coroner and jury.) You will perceive that there are two principal fractures in the beam—one near the centre, 5½ feet from the west abutment, in the middle portion of the girder; the other in the portion of the girder next to the abutment, and 20 feet from its 'fence.' The latter fracture appears to me, from its form, and especially from the position in which the fragment lay, as shown in the ground plan taken the morning after accident, to have been caused by the fall; any disturbing cause previously to the fall is quite inconsistent with the close proximity of the fragments. The fracture at the centre, from the position of the fallen portion, and of the middle tension-rod wrapped over the girder, and especially from the form of the fracture, appears to me to have first taken place. This fracture I consider to have resulted from the weakness of the top flange, which was compressed and broken by the strain arising from the rolling weight of the engine and tender, and the vibratory motion of the structure itself, increased to a large extent by the deposit of 25 tons of ballast on the roadway immediately before the accident. This compression is remarkably evident by the bulging out of the metal at the point of the parting at the top of the web, or vertical portion of the girder.

"In estimating the strength of the girder, I am of opinion that the tension-rods, from the form of the section of the girder, weakened it, and threw an undue strain, by compression, on the top flange; but, assuming that they did not weaken it, and applying the formula, as given by Eaton Hodkinson, F.R.S., to the girders—by one formula, the breaking weight is equal to 61½ tons; and, by the other, the breaking weight is equal to 76 tons. Now, it has been an established rule in practice, that one-third or one-fourth of the breaking weight is the safe working weight to which a girder should be subjected, and the larger the size, the smaller ought to be the proportion; taking, therefore, one-fourth of 56 (the breaking weight), it follows that the safe weight to which one of the girders ought to be subjected is 18½, and the two girders 37 tons. The weight of the timber, platform, beams, rails, chairs, &c., exclusive of the girder, according to an approximate calculation I made, is 19 tons 6 cwt.; and, adopting the rule that a uniform weight is diffused over the beam, is equivalent to one-half that weight suspended at the centre, this becomes equal to a weight suspended at the centre of 9 tons 13 cwt. The equivalent weight of an engine and tender of 33 tons 10 cwt. 2 quarters, suspended at the centre of the beam, I estimate at 32 tons—making a strain of 41 tons 10 cwt. against 37 tons—the safe working strain to which the bridge ought to be subjected. However, on the afternoon of the accident, immediately previous to the passing of the train, the bridge was subjected to an additional strain, by the laying on of 5 inches of broken red sandstone ballast, amounting to a weight over the bridge of 25 tons, which is equivalent to a weight suspended at the centre of 12 tons 10 cwt. This makes a total of 54 tons against the safe strain of 37 tons formerly stated; and the last addition appears to me to be the immediate cause of the accident. In these calculations, however, it is assumed that everything is at rest, and that the forces applied are those resulting from direct pressure, whilst the evidence shows that there is a vibratory movement of the whole structure to a large extent; and there is, besides, a percussive movement of the engine and tender, which, with a heavy long-boiler engine, with outside cylinder, is considerable.

"The weight of the structure, and of the train in motion, will be about 164 tons in all, and the strain from this cause must be added to that formerly stated. This strain, although it cannot be ascertained by accuracy of calculation founded on experiment, experience shows to be great; and I am of opinion that it formed a large element in the strain which broke the bridge down. There is also the whole gross strain arising from the pressure and the percussion of the structure and its load, with the apportionment of that strain between the girders; for I am of opinion that, from the loose and independent connection of the girders, and the giving of the structure, the strain may have been unequally divided between the girders. These investigations, independently of the evidence of the eye-witnesses, lead me to the conclusion, that the girder broke in the middle from its weakness to resist the strain, increased by the laying on of the ballast.

"The opinions of Mr. Stephenson and Mr. Locke, founded on the alleged facts as to the paint on the tender, the broken carriage-wheel, and the snips in the chairs, appear to fall to the ground, as they must have been misinformed on those particulars, which can all be disproved.

"HENRY ROBERTSON, Engineer."

"*Chester, June* 15, 1847.

Captain Symonds, R.E., and Mr. Walker, who were retained by Government to examine into the cause of the accident, presented to the inquest a very lengthened report, the following are extracts from it:—

"That the bridge was of sufficient strength if the cast and wrought iron be supposed to act together, each taking its equal proportion of the strain.

"That there is great difficulty in insuring the joint action, and that if this is a part of the principle of the bridge, we do not approve of it.

"That neither the wrought nor the cast iron, taken separately, was sufficient for perfect stability; and that, to have insured this, the cast iron girders alone should have been of sufficient strength to carry the whole weight, with an ample allowance for the various circumstances (some of them peculiar to this bridge) which we have explained.

"That, with the exception of the bends, or warps in the top flanges, the castings are of good quality. That the wrought iron is also of good quality.

"That the stonework of the piers and abutments is good; and in no way contributed to the failure.

"We now come to the question, what was the immediate cause of the accident? As the bridge had carried as great or greater loads before, the suggestion that there was something peculiar in this case, as the end of a rail having projected from the straight line and been struck by the engine, or the tender having got off the line and struck the girder laterally, is not improbable. The engineers who were called by the Railway Company considered that the breaking of one leaf of the wrought iron that was next the tender, the piece that was struck out of the girder, and the damage to the abutment wall, are all proof of the fact that the accident was caused by the tender having got off the line, and broken the girder by a heavy lateral blow. We refer to the evidence of Mr. Robert Stephenson, Mr. Locke, Mr. Vignoles, and Mr. Gooch, who were also of opinion that the strength of the girder was sufficient. As to this latter point, we have already stated the principles upon which alone this conclusion could have been arrived at, and our own opinion. As to the tender or the carriage immediately behind it having got off the railway and damaged the abutment walls, there is no doubt; and if the tender struck the side of the girder, when the latter was under great strain, a fracture was the probable consequence. This is on the presumption of the tender having got off the line from some other cause than the breaking of the girder.

"Our own decided opinion, formed from the statement we have made as to the strength of the girder, and from the position in which the broken pieces were found, the two halves being each in a straight line, or nearly so, but at an angle with one another, is that the first fracture took place in the centre of the girder, and not at the end which rested on the abutment.

"In corroboration of this last view, the addition that was made to the permanent weight of the bridge, immediately before the accident, by the ballast spread over it, and the fact that when a weight, partly permanent and partly passing, but which together formed a considerable portion of the breaking weight of the girder, are in continual operation, flat girders of cast-iron suffer injury, as their strength becomes reduced; and if, when this has taken place, the *momentum* of the passing weight is increased by an irregularity of the rails, or in the motion of the engine, to which the best made and managed railways are subject, a fracture is likely to follow. The probability of this having been so in the present case, and the fact of the tender having been off the line, and having been drawn up with great violence, so as to break the end piece of the girder by the blow, are to be weighed against each other in assigning the cause of the accident.

"Having reference to other cases, it is proper to state that Mr. Robert Stephenson stated in his evidence that he had erected a number of bridges on the same principle as this, and that this was the first failure. We have not examined these bridges; they are stated to be all of a less span than the Chester bridge, but that the dimensions of the parts are proportionally less; and it may perhaps be argued from the above numerous examples, and the opinions of the eminent engineers opposed by this one failure, that we are mistaken in considering the weakness of the girder to be the cause of the failure in the present case, and unnecessarily cautious in the objection we entertained, and have expressed, as to the principle of this bridge and its security; but, as we entertain these opinions very decidedly, it is our duty (by no means an agreeable one) to express them."

The Verdict of the Jury.

After an hour's deliberation, the foreman, Sir E. Walker, returned the following as the unanimous verdict of the jury:—

"We find that George Roberts, John Matthews, and Charles Nevitt, were accidentally killed on the evening of the 24th of May last, in the parish of St. Mary-on-the Hill, in the city of Chester, by being precipitated along with a train of carriages on the bank or bed of the river Dee, from the breakage of one of the 12 cast iron girders constituting the railways-bridge over that river.

"We find also that Isaac Powis died on the 26th of May from injuries he received at the same time and place, and from the like cause; and we find that Thomas Anderson came by his death on the 24th of May last, in the parish aforesaid, by being accidentally thrown from the tender on to the rails.

"We are further unanimously of opinion, that the aforesaid girder did not break from any lateral blow of the engine, tender, carriage, or van, or from any fault or defect in the masonry of the piers or abutments; but from its being made of a strength insufficient to bear the pressure of quick trains passing over it.

"We feel that the 11 remaining girders, having been cast from the same pattern and of the same strength, are equally weak, and consequently equally dangerous for quick or passenger trains as was the broken one.

"We consider we should not be doing our duty towards the public if we separated without expressing our unanimous opinion, that no girder bridge of so brittle and treacherous a metal as cast iron alone, even though trussed with wrought iron rods, is safe for quick or passenger trains; and we have it in evidence before us, that there are upwards of 100 bridges similar in principle and form to the late one over the river Dee, either in use or in the course of being constructed, on various lines of railway. We consider all these unsafe, more or less, in proportion to the span; still, all unsafe.

"We therefore call upon her Majesty's Government to institute such an inquiry into the merits or demerits of these bridges, as shall either condemn the principle, or establish their safety to such a degree, that passengers may rest fully satisfied there is no danger, although such bridges may deflect from 1½ to 5 inches."

The Coroner stated that that portion which related to the death of the deceased could only be taken as their verdict. Their recommendations, however, he would forward to the Railway Department of her Majesty's Government; and no doubt the press would give them due publicity.

The bridge crosses the Dee river at an angle of about 48°, and is constructed with three spans—skewed to the same angle—of 98 feet each in the clear; each span being sustained by four trussed girders, 109 feet long, one on each side, and two in the middle, making the two roadways independent of each other; on the inside of the bottom flange of each pair of girders, shoes are cast, having a dove-tailed socket, into which wrought iron cross ties are fitted, to secure the girders from springing outwards at the bottom. Between these, and resting upon the same flange, are strong timber bearers or joists, upon which a flooring of four-inch planks is laid; on this the longitudinal sleepers are fitted, carrying the rails and check-rails, the latter being continued 26 feet beyond the span of the bridge each way.

The train passing over the bridge at the time of the accident consisted of the engine and tender, following which the carriages were arranged— 1st. One first-class: 2nd. One second class (with break and guard-box): 3rd. One second: 4th. Luggage-van: 5th. Second-class.

Each girder is in three lengths of cast iron, bolted together at the joints, making 109 feet in length and 3 ft. 9 in. in depth, and surmounted over each joint by a connecting scarfing, 13 feet long and 3 feet high. The clear span of the bridge is 98 feet, and the bearing 5 ft. 6 in. at each end.

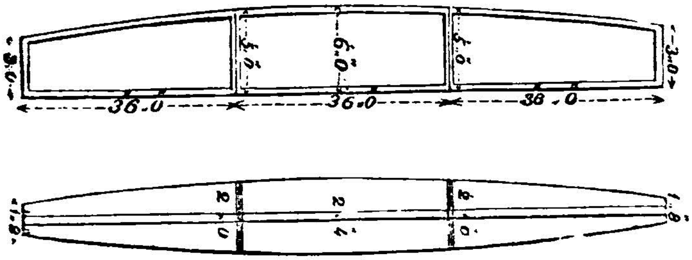
The width of the top flange is 7½ inches, and thickness 1½ inch on the edge; thickness of the web 2½ inches; width of lower flange 2 feet by 2½ inches thick. The top section, including the molding on the underside, contains 14 square inches; the lower flange and molding 66 square inches, and the web 80 inches: making in all 160 square inches. On each side of the girder there are four wrought iron tension bars, 6 in. by 1¼ in, the collected section of the eight bars (four on each side) contains 60 inches. The bars are put together in lengths, as usual for suspension bridges; and at the joints of the cast-iron beam, a wrought iron bolt passes through the eight thicknesses of wrought iron bars and the cast iron girder. To this cross-bolt are suspended two other bolts, which pass through the cast iron dovetailed plate, under the joints, and secured on the underside with screws and nuts, to bring the plate up taut to the flange; and the ends of the suspension bars at the abutment are secured to a cast iron raising piece by cross keys.

It will thus be seen that the girder consists, in section, of a cast iron girder (similar in form to fig. 2) and eight thicknesses of wrought iron suspension bars: these wrought iron bars, from the very flat angle at which they are set and secured to the cast iron girder itself, seem to be a very poor safeguard against the breakage of the cast iron. In fact, on account of the tension bars being inclined at such a small angle, that a displacement of the particles of the cast iron girder, quite sufficient for fracture, would have produced scarcely any extension of the wrought iron bars, and, therefore, hardly called into play any resisting force from their tension: the tension-rods, in short, were of about as much service to the girder as a piece of pack-thread passed from end to end. The scarfing pieces being placed over the joint, also appear to be injudiciously arranged, and are not so good as when an increased depth is given to the casting at the joints, as adopted in some other bridges.

The annexed wood-engraving (fig. 1) is an elevation of a portion of the broken girder; part of one of the lengths, which was not broken, is cut short for want of space. The abutment end of the girder is that portion which laid on the Saltney abutment, and had a bearing of 5 ft. 6 in. on the masonry. There are two fractures—one in the length nearest to the Saltney abutment, and which was of considerable extent, 3 ft. 8 in. wide at the bottom, the fracture running along the web, just on the top of the lower flange, and then upwards in a slanting direction on one side and perpendicular the other side. Fig. 2 is a section of the iron at this fracture, which shows two bolt holes at the top, made for fixing on an eagle ornament, and doubtless considerably weakened the girder, as at these bolt holes the flange was found to be completely crushed. From the appearance of this fracture, upon the whole, we are inclined to assign it as the part that first broke. The other fracture is nearly in the centre of the middle length of the girder, and takes a diagonal direction across the girder upwards, to the extent of 4 feet horizontally.

From experiments that have been made since the accident, the deflection of the girders under different loads is from 1 to 2 inches—the greater the velocity of the train the greater is the deflection: this shows that we must not fix the proportions of a girder at three times the breaking weight; but considerably more must be allowed—it ought to be at the least four, if not five, times.

The question that suggests itself, from the failing of this bridge, for consideration among engineers, is whether a girder, containing the same quantity of metal of wrought and cast iron together, 140 square inches in the section, could not be better arranged than the one before us, so as to form the requisites of crossing over a road or river without interfering with the headway below. From the best consideration that we have bestowed upon the subject, we are induced to adopt a girder of the proportions and form shown in the annexed engravings, figs. 4 and 5. The flanges at the joints



Figs. 4 and 5. Elevation and Plan of Proposed Girder.

tobe wide, and of the form shown in fig. 3, and the surfaces planed; the connecting bolts to be of as large a diameter as the metal flange will allow, the lower bolts being at least 2½ inches diameter; particular attention must be paid to the fixing of these bolts, and the keying of them, to prevent the nuts loosening by vibration.

According to Hodgkinson's formula* $\left(W = \frac{2\cdot166\, a d}{l}\right)$, the breaking weight of the Dee Bridge girder is 60 tons—that is supposing the tension bars to be of no service; whereas, the breaking weight of our proposed girder is 110 tons, and contains four tons less metal than the Dee Bridge trussed girder. The weight of 110 tons is, as near as can be, the strength required for the Dee Bridge span of 98 feet, which will be equal to 220 tons for a pair of girders: taking a fourth of this weight as the safe strain, it will give 55 tons. The calculated strain upon the girder at the time of the accident was 54 tons.

It is the joints of these girders that require the especial attention of the engineer, as we shall next proceed to show.

* W weight in tons, a the area of the lower flanges in square inches, d the total depth of the girder in inches, and l the length in feet in clear of the bearings.

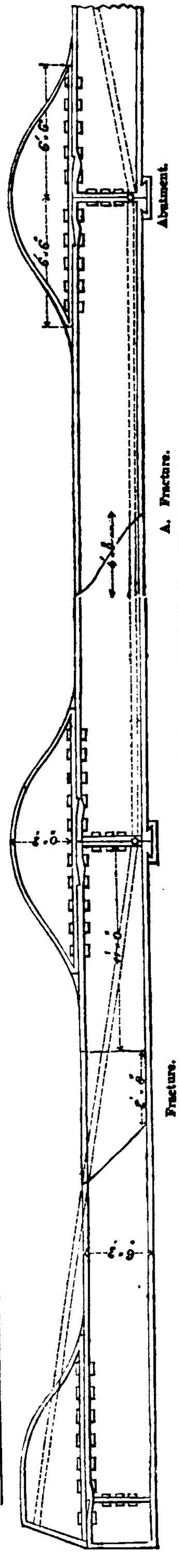


Fig. 1. Elevation of Dee Bridge Girder 109 feet long and 98 feet in clear of the Bearings.

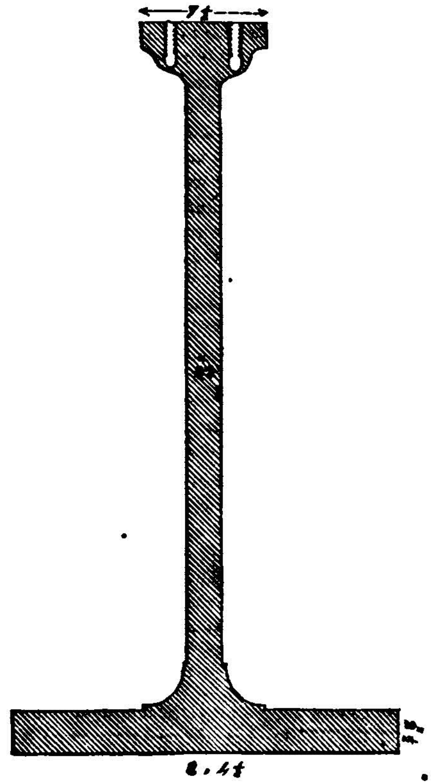


Fig. 2. Section at Fracture A. Depth 3 ft. 9 in.

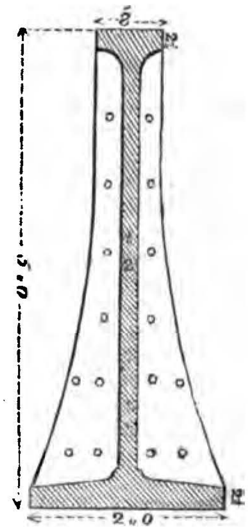
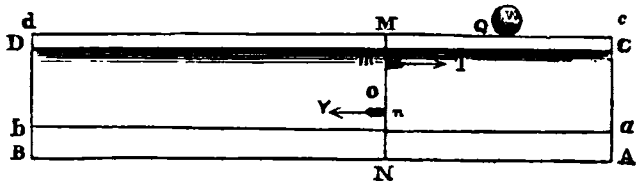


Fig. 3. Section of Proposed Girder at Joint.

The cause of the fracture we believe to be, that the girder was jointed, and that due consideration was not given to that circumstance in assigning their relative proportions to the flanges. As the effect of a joint is one that practical men are apt to overlook, we propose to examine the subject in detail—excluding as much as possible symbolical language, in order that our reasoning may clearly be apprehended. It is well known that there are usually three distinct divisions of a girder, consisting of the upper and lower flanges and the web: the vertical and transverse section of such an arrangement would resemble somewhat an H laid on its back —thus ⌶. The reason of this mode of construction will be better understood when we have determined the nature and amount of the strains and thrusts experienced by the several parts of a loaded girder.



Let A B d c be a vertical section of a girder, resting on the points A and B, and loaded with the weight w at Q. Let cQ $= a$; $c\,d = l$; B $d = b$; c D, the section of the upper flange; C b, of the web; and a B, of the lower flange. Let R = reaction at A; R′ = reaction at B; w' = weight of the girder, which is supposed symmetrical and uniform throughout its length.

Then we shall have these equations, when there is equilibrium—

$$wa + \frac{w'l}{2} = R'l; \quad w(l-a) + \frac{w'l}{2} = Rl.$$

Let us now suppose a vertical section to be made through some point, M, of the girder. Let cM $= h$; C$c = c$; A$a = d$.

Consider now the equilibrium of the part c N: c N is kept at rest by the reaction R at A, by its own weight $\frac{w'h}{l}$, and by vertical and horizontal forces arising from its connection with M B: let Y be the vertical force; t and t' acting at m and n, in the directions indicated by the arrows, the horizontal forces. Let N$n = x$, N$m = x'$:

Then we have for the equilibrium of cN

$$R + Y = w + \frac{w'h}{l}; \; t' = t;$$

also, taking moments about A,

$$Yh + tx = wa + \frac{w'h^2}{2l} + t'x'.$$

$$\text{Now, } t = t'; \; R = \frac{w(l-a) + \frac{1}{2}w'l}{l}$$

$$Y = w + \frac{w'h}{l} - R = \frac{wa}{l} + \frac{w'(2h-l)}{2l}.$$

Substituting this value of Y, we find

$$t(x'-x) = \phi(a, h, l, w, w'):$$

∴ $t(x'-x)$ is known, and depends simply on the weight of the beam and its load, and *not on the shape of the beam*—the only condition to that effect being, that the beam shall be *longitudinally* uniform.

We find, then, that at the upper part of the beam there is a thrust, and at the lower part a tension. Consequently, at the upper part the particles of the beam are in a state of compression, and at the lower in a state of extension. Therefore, between M and N there is some point where the particles are neither extended nor compressed. Let o be this point: o is said to be a point in the neutral axis. If, now, the beam were laminated—that is, composed of parallel laminæ, incapable of sliding over each other, and which obeyed Hooke's law—the amount of the forces arising from the extension and compression of the particles in M N, would vary as their distances from o. This is the law usually assumed for materials of even a crystalline texture; at all events, the probabilities are, that even if the tension and compression do not in all cases vary directly as the distance from o—they vary as some higher power of the distance: according to either supposition, it is clear that the particles near o are not so effective in supporting w and w', as those farther from it; and, consequently, we see the reason why the greater part of the substance of the girder is distributed at the greatest available distance from o, in the form of flanges.

In the case of a cast iron girder like that of the Dee Bridge, it is not necessary to make the upper flange as thick as the lower one, because cast iron exerts a much greater force for compression than it does for extension to the same amount, and bears a much greater crushing than rending strain. Suppose now M N to be a joint, and the connection to be effected by means of bolts let through projecting lips, as was the case in the girder that broke;—the question immediately arises, how would that effect the thrust and strain on the upper and lower flanges? Before we consider this question, it will be advisable to show that in the molecular connection, first noticed, $x'-x$ is either or very nearly a maximum; and, therefore, y either or very nearly a minimum—for $y(x'-x)$ is a constant, as we proved.

In the first place, taking the usual law—and supposing the girder not flanged, but uniform, $x'-x$ would $= \frac{2}{3}.\text{A}\,c$; but when we consider the flanges, the resultants of the strains and thrusts will be thrown much nearer to N and M respectively; and with the ordinary proportions observed for the flanges and web, $x'-x$ would not be less than $\frac{4}{5}.\text{A}\,c$, or $\frac{4}{5}$ M N —and it is difficult to conceive any mode of connection at M N which could make it greater. We cannot, then, suppose that y can be increased; let us, therefore, suppose that y is the same for all modes of connection.

If, instead of the ordinary law, we had assumed any other law for the amount and variation of the thrusts and strains, involving a higher power of the distance from o than the first, (for instance that adopted by Mr. Hodgkinson) $x'-x$ would on such a supposition be still more increased. On the whole, we may fairly suppose y to be constant—certainly not capable of being diminished by any mode of connection.

But although y remains constant, its distribution, both above and below o, will materially depend on the nature of the joint. Suppose, for instance, a single bolt at N; then this bolt will sustain all the tension—and all the particles about N will be exposed to an enormous rending strain. Again, if, as in practice, when the joint is bolted from M to N, the lip gives and is slightly deflected, and the bolts work loose, then, in order to make up the value of y, more bolts than those between o and N may be in a state of tension, and less of the girder than from o to M in a state of compression; consequently, since the area which sustains the thrust is diminished, the thrust per square inch will be increased. Also, if some of the bolts work looser than others, the bolts which work tightest will be in the highest state of tension. Some of these causes of imperfect action may be presumed always to exist; and the only way we know of compensating for their effect, is very much to increase the vertical breadth of the girder at the joint. This, however, was not done in the girders of the Dee Bridge.

To all this reasoning, it may be objected that the girder did not break at the joint. Our reply is, that the strains arising from a bad joint are transmitted to a great distance through the substance of the girder—and where the metal is weakest, there we may expect fracture to ensue. It is not enough to build bridges calculated to endure two or three times the greatest statical strains they can be subjected to—especially when those strains are to be supported by cast iron girders. The continual vibration to which iron is liable, tends to weaken the cohesion of its particles: the alternate expansion occasioned by heat and cold has the same effect.

Lastly, it must never be forgotten that the vibration of a train increases enormously the tendency to fracture, by bringing into play dynamical strains, the amount of which is beyond calculation; and that iron bridges are especially adapted to transmit such vibrations.

Artesian Wells in Volcanic Formations.—The first attempts of this kind in Naples were made, some years ago, near the Campo Santo, by the *Societa Industriale*; they, however, yielded but a small quantity of water, at a depth of 89 or 90 feet. This led to the great undertaking in the Royal Gardens, which, however, is not likely to yield any favourable result. The deeper the boring proceeds, the harder is the appearance of the strata of volcanic *tuffa*—and the only advantage derived is the perfect knowledge of the geological stratification of the terrain of Naples, on which the architect, M. Cangiano (who superintends the work) read a paper at the meeting of Italian *scienziate*, in 1845. As the supply of water for the metropolis (especially near the Posilippo and Vomero) is constantly on the decrease, government will be obliged to erect new aqueducts at an enormous expense, and to convey fresh water from Monte Taburno, or the sources of the Sarno—or even so far as the Tifetini and Trebulini mountains, near Capua. It may be said with certainty, that the volcanic terrain near Naples does not contain a sufficient quantity of drinkable water for its increasing population—even if it be not the case, that the quantity of water is yearly decreasing, for reasons not yet properly ascertained.

HISTORY OF ARCHITECTURE IN GREAT BRITAIN.

A Brief Sketch or Epitome of the Rise and Progress of Architecture in Great Britain. By JAMES ELMES.

"Epitomes are helpful to the memory, and of good private use."
SIR HENRY WOTTON.

(Continued from page 170.)

It has been already mentioned that Inigo Jones had improved his taste by studying the works of Palladio and other eminent Italian architects, in Italy. It is not unlikely that he had met Sir Henry Wotton at Venice, as this tasteful connoisseur and elegant illustrator of the Vitruvian art was then ambassador from James I. to the Doge. James's brother-in-law, Christian IV., King of Denmark, who had heard of Inigo's reputation from that city of lakes and palaces, introduced him to the British monarch, who immediately appointed him his architect.

Jones's style, after his return from Italy, bears marks of much improvement in taste and purity, as may be seen in the works he executed before his visit to that fostering country of the arts, and those which he designed after his return. This eminent architect visited Italy twice, and enjoyed the friendship and patronage of the celebrated Earl of Pembroke, and other tasteful nobility of the period.

Among his works not already mentioned, are additions to Lord Pembroke's seat at Wilton, the porch of which had been designed by Holbein. Jones's classical additions to this edifice are apparent, particularly the triumphal arch and its equestrian statue, that has been lately cited as an authority, among others, in the controversy about Matthew Wyatt's colossal statue of the Duke of Wellington, in Piccadilly. Also, the quadrangle of St. John's College, Oxford, another proof of his want of feeling for the beauties of Gothic architecture, as is the Chapel Royal, St. James's; Coleshill, in Berkshire; Cobham Hall, in Kent; and the Grange, in Hampshire.

Before concluding that portion of our notice that terminates with Inigo Jones, we must revert to some of those less known artists who flourished between the great days of the Tudor style and the expulsion of arts from England by the rough-shod founders and supporters of the Commonwealth.

Whatever may have been the intentions of James I. as to the erection of a splendid palace for himself and his successors to the crown of the two kingdoms, which had been first united in his person, he had strong objections to his example being copied by his nobles. Fearing that if they made their establishments in the metropolis too large and expensive, it might rob the provinces of much of their grandeur, and the country people of their natural protectors, the wealthy aristocracy of their respective counties; he therefore issued edicts against the enlargement of the metropolis, and confirmed the royal will of his predecessor, Elizabeth, that no further mansions or noble residences should be erected but upon ancient foundations. Lord Bacon informs us, that King James was wont to be very earnest with the country gentlemen to abandon London for their country seats; and that he would sometimes say to them: "Gentlemen, at London you are like ships in a sea, which show like nothing; but in your country villages, you are like ships in a river, which look like great things."

Although James attempted to drive his opulent subjects from the metropolis to their country residences, few of our monarchs had a greater number or more splendid palaces in London than the successor of Elizabeth, from whom he probably inhereted this dread of palatial rivalry by his nobles in the metropolis. That powerful queen, who was one of the most absolute monarchs in our history, issued several proclamations, rigidly forbidding the increase of new buildings in London. James did not content himself with merely reproving and exhorting his nobles and magnates, but issued several proclamations to the same purport.

In 1605, when he had been but two years upon the throne, he issued the first of these mandates, which forbade all manner of building within the city, and a circuit of one mile thereof. Among its commands was the salutary one to a wooden metropolis, that all persons henceforward should build their external walls and windows either of brick or stone. The classical reading of the king, who delighted to be compared in wisdom to Solomon, and in the patronage of literature and art to Augustus, probably wished to vie with the Roman emperor in the boast of having found his metropolis of wood, and leaving it of marble (stone). The reason given in this proclamation for building with brick and stone is, "as well for decency, as by reason all great and well-grown woods were much spent and wasted, so that timber for shipping became scarce." James always showed a predilection for the establishment of a powerful navy, both mercantile and warlike, as his founding the corporation of the Trinity House, the cultivation of the royal woods and forests, and this proclamation, testify. This edict produced as little effect as those of his predecessor; he, therefore, issued another, with more stringent penalties, dated October 10, 1607, and on the 16th of the same month, some offenders against it were censured in the Star-chamber, for building contrary to its tenor. By another edict of the same nature, issued in 1614, the commissioners are required to proceed with all possible strictness against every offender of this sort. This had somewhat more effect, particularly as to the mode of building with stone and brick; and from this period may be dated the reformation of the architecture of London, which is so much indebted both to the architect and his royal patron.

The first house of note that was erected in conformity with this proclamation, was one in the Strand, built for Colonel Cecil; after that, one near Drapers'-hall, Throgmorton-street, in the city, is celebrated; another, built for an opulent goldsmith, in Cheapside, opposite to Sadlers'-hall; and one that was built for a leather-seller, in St. Paul's Churchyard, near the north gate of the cathedral, not being in conformity with the king's regulations—being built of timber—was ordered to be taken down, and rebuilt according thereto.

Among the principal mansions of this period, are Hatfield, in Hertfordshire, the seat of the Marquis of Salisbury, and Burleigh, near Stamford, in Lincolnshire, the seat of the Marquis of Exeter, both built in the reign of Queen Elizabeth; and being still in existence, with very little alteration from their original design, are fine specimens of the mixed pictorial style of the Elizabethan period.

James enlarged and improved, in a similar style, Theobald's, near Chesbunt, in Hertfordshire, originally the seat of Elizabeth's great prime-minister, Cecil, Lord Burleigh, who often entertained his royal mistress within its walls. It was a favourite residence of King James, and was the scene of his last moments. It afterwards became the abode of Richard Cromwell, who retired thither after his resignation of the protectorate of England. He passed the remainder of his days in this once royal residence, in peaceful retirement.

Of the principal reformers of taste among the literary men and nobles of the period, the great lord-chancellor Bacon stands in the foremost rank; and his opinions on architecture and gardening are decisive of the character of those arts, which he so much improved, in his days. His maxim, that houses are built to live in, and not to look on, should never be forgotten by the domestic architect; and his description of a palace, in opposition to such huge buildings as the Vatican, the Escurial, and some others, which, he pithily observes, have scarce a fair room in them, is characteristic of the best style of this period, which Inigo Jones, Sir Henry Wotton, and the elegant-minded lord-keeper had so much improved.

That the taste of Jones was influenced by his association in literature and art, with Pembroke, Bacon, Wotton, Ben Jonson, and other eminent Englishmen. as well as with the literati and connoisseurs of Italy, is proved not only by the purer style of his maturer age, but by the unrivalled design for the royal palace, which bears marks of being arranged in the study of the artist, assisted by noble minds, rather than the work of a builder's office, traced by the mechanical hands of architectural draughtsmen.

Bacon's description of what elements an architect should compose a royal palace, with its accessorial gardens, terraces, and courts; royal state, dwelling, and necessary apartments, together with the personal survey that Jones had made, accompanied by men with congenial minds, of the palaces and royal residences of Venice, Florence, Rome, and other parts of Italy, had a powerful effect upon all his designs, and particularly upon that of his unexecuted palace.

The limited space which the pages of this Journal allows to this notice, will not permit the quoting of Bacon's admirable description of a royal palace—not designed for his poetical commonwealth of Eutopia, but evidently for the encouragement of his royal master to commence a palace, which, in two or three reigns, might surpass all the other royal residences in Europe.

Upwards of twenty years ago, the author of this sketch gave Bacon's description entire in the introduction to his Memoirs of Sir Christopher Wren, and said—"This ideal palace would be an excellent task to try the abilities of a young architect to design on paper, and would make an admirable probationary gold medal study for the more advanced students of our Royal Academy."*

With similar feelings, the accomplished Sir Henry Wotton, who imbibed a pure taste in all the arts by his residence, as James's ambassador, at Venice, joins with Bacon in admitting that architecture is worthy the attention of an elevated mind, and confesses it to be an art that requires no commendation, where there are noble men and noble minds. He says that he is but a gatherer and disposer of other men's stuff (*sparsa colliget*); he yet presents his countrymen with the soundest theoretical doctrines, and the purest ideas of taste in this noble art, which Jones carried so beautifully into practice. In Wotton's preface, he fears it may be said that he handled an art no way suitable to his employments or his fortune, and so may stand charged with intrusion and with impertinency. To the first, he answered, "That though, by the ever-acknowledged goodness of his most dear and gracious sovereign, he had borne abroad some part of his civil service; yet, when he came home, and was again resolved into his own simplicity, he found it fitter for his pen to deal with these plain compilements and tractable materials, than with the labyrinths of courts and states; and less presumption in him, who had long contemplated a famous republic (Venice), to write, then, of architecture, than it was anciently for Hippodamus,† the Milesian, to write of republics, who was himself but an architect." To the second, he confesses that his fortune is very unable to exemplify and actuate his speculations in this art, which yet made him rather, from this very disability, take encouragement to hope that his present labours would find the more favour with others, since it was undertaken for no man's sake less than for his own.

Our great architect, Inigo Jones, who stands second to no modern artist in Europe, was, like his illustrious cotemporary, Milton, not only an Englishman, but a Londoner, being born in the neighbourhood of our metropolitan cathedral, to which he had attached the splendid portico that had drawn forth the just eulogium of the tasteful Burlington. He was apprenticed to a carpenter and joiner, who were in those days more of operative artists and carvers than those of the present time. During his apprenticeship, his innate love for drawing and design had sufficient employment; and he obtained, also, a greater knowledge of architectural construction than he could, had he been in the study of one of the painter-architects of the day. He distinguished himself in early life by a general love for the arts of design, and has been much commended for his skill in landscape-painting; and Dr. Chalmers asserts, in his "Biographical Dictionary," that there is still a specimen by him in the latter art at Chiswick-house.

He was destined for higher purposes than or a carpenter's foreman, or a builder's clerk of the works, his talents having attracted the notice of Thomas Howard, the celebrated Earl of Arundel, whose name is immortalized by his inestimable collection of antique sculpture, called after him the Arundelian marbles,—and also of William, Earl of Pembroke, who took him under his patronage, and sent him to France, Italy, and the politer parts of Europe, with a handsome allowance.

After exhausting the classical beauties of ancient Rome, he proceeded through other cities to Venice, then in the zenith of wealth and splendour, whence he was invited, as before-mentioned, to Denmark, by Christian IV., who appointed him his architect. He accompained the King of Denmark in his visit to James I., the husband of his sister, the Princess Anne of Denmark. On his arrival in his native country, he was appointed architect to the queen, and shortly afterwards to Prince Henry, at whose lamented death, in 1612, he re-visited the classical shores of Italy. He gave such satisfaction to his illustrious patrons, that on his departure from London, the king gave him the reversion of the office of surveyor-general of his works.

On his second return to this country, he entered upon his office, and executed the splendid public works already mentioned as being marked by a greater purity of taste than his former productions. Upon the death of King James, he was continued in his honourable post by Charles I., and was associated in his honourable and tasteful employments with Rubens, Vandyke, Chapman, Sir William Davenant, Daniel and Ben Jonson. He designed and executed buildings, for Rubens, the prince of painters, to decorate with his gorgeous pencil; and scenes, decorations, dresses, and machinery for the most illustrious poets of his time. At the death of Charles I., Inigo Jones adhered to the party of his royal master. He was persecuted and fleeced, as a matter of course, and stigmatised as a malignant. He died in grief, poverty, and obscurity, July 21, 1652, and was buried in the chancel of St. Bennet's Church, Paul's-wharf, London.

The brilliant galaxy of philosophy, poetry, and art, which illumined the hemisphere of the Stuarts, with Bacon, Ben Jonson, Davenant, Rubens, and Jones as stars of the first magnitude, set, amidst the clouds and tempests that convulsed the nation, from the first attack upon the monarchy till the Restoration; when elegance again dawned upon the people in the times of the second Charles, which will form the next epoch of this sketch.

Amidst the stars of lesser magnitude that beamed among the cotemporaries and immediate predecessors of Jones, were Girolamo da Treviso, who, like Holbein, practised both painting and architecture—the latter, as an artist, and not as a builder; Richard Lea, an Englishman, somewhat later; and another, named John Thynne, who built Somerset-house, in the Strand, in 1567, in a mixed style of Italian and Gothic architecture. John Shute, an English painter and architect, who flourished in the reign of Queen Elizabeth, was sent by the Duke of Northumberland, his noble patron, to study the art under the best masters in Italy. He published, in 1563, a folio volume of the principles of architecture, as developed in the most celebrated monuments of antiquity. Milezia, in his lives of architects, mentions an Englishman, of the name of Stickles, who flourished about 1596, as an excellent architect. Robert Adams, who practised architecture and engineering, was superintendent of the royal buildings to Queen Elizabeth, and wrote a description of the river Thames, and of the best method of fortifying it against an enemy. In the same period, flourished Theodore Havens, an architect, sculptor, and painter, who affected grandeur on a small scale, and was rich in Italian conceits. He designed Caius College, Cambridge, a fair specimen of the architecture of the age—pedantic, eccentric, affected, and trifling. This college was founded by Dr. Caius, physician to Queens Mary and Elizabeth; and three of its gates are of curious, if not of elegant, designs, being among the first constructed after the Italian manner in England. The first is inscribed, "Humilitas," and, as the Gate of Humility, is of low proportions; the second, which is loftier, and embellished with a portico and emblematical figure, is dedicated to Virtue, and is inscribed "Virtutis. Io. Caius posuit Sapientiæ," and conducts to Caius Court and the public schools; and the third, which is inscribed "Honoris," and is called the Gate of Honour, is of still larger dimensions, and decorated with the various orders of Roman architecture, overlaid with ornaments, in the style of the ecclesiastical monuments of the period.

About the same time, Rodolph Simmons built Emanuel and Sidney Sussex Colleges, Cambridge, and rebuilt the greater part of Trinity College, in the same University.

Bernard Jansen, a painter-architect of the Flemish school, also flourished in the reign of James; he was a disciple of Dieterling, a celebrated architect of the same country, who wrote much on his art. Jansen executed, during his residence in England, the splendid mansion of Audley-End, in Suffolk, and a great part of Northumberland-house, London; but the extraordinary and original façade was designed by Gerard Christmas.

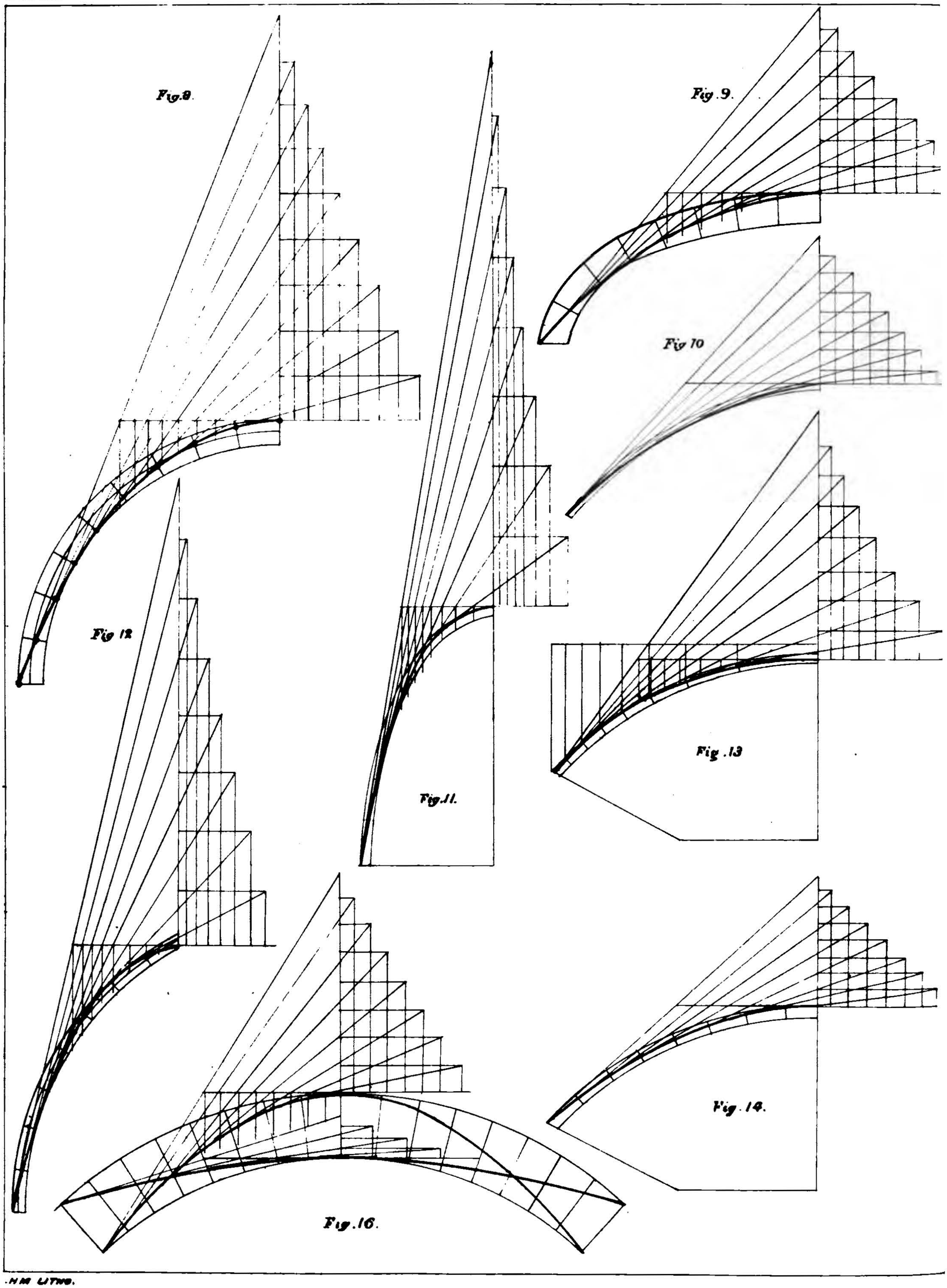
Among the other architects of this period whose names have reached us, are John Smithson, who died in 1648, and who, under the patronage of the Duke of Newcastle, travelled into Italy to improve himself in his art, and to acquire a knowledge of good design. The mansion-house at Welbeck, and the castle at Bolsover, were of his execution. Stephen Harrison must have been an architect of some reputation, as he was employed to design and execute the triumphal arches and other architectural pageantries, erected in London, on the accession of James I. to the throne of Great Britain.

The political struggles that convulsed the reign of Charles I., which began with such flattering prospects for the arts, and which was the epoch of good taste in architecture, has been already noticed. The rulers of the Commonwealth, instead of patronising arts and artists, not only discouraged the living, but destroyed the works of the dead. The destruction of some of the most elegant productions of painting, sculpture, and architecture, by the iconoclasts of the Commonwealth, will ever remain a stigma on the administration of Cromwell: but the reign of Charles II. was favourable to architecture, as much by the dreadful fire which consumed the metropolis, as by the innate love of magnificence and art which distinguished the king and his court.

(To be continued.)

[In the first part of this sketch, in our last Number, page 168, col. 2, line 11 from bottom, for "Tortegiano," read "Torregiano."]

* "Elmes's Life of Wren," Part I., p. xxii. 4to. 1823.
† Aristot. Polit. lib. ii. cap. 6.



H.M. LITHO.

ON THE CONSTRUCTION OF ARCHES.

A paper "*On the existence (practically) of the line of equal Horizontal Thrust in Arches, and the mode of determining it by Geometrical Construction.*" By WILLIAM HENRY BARLOW, M. Inst. C.E. (Read at the *Institution of Civil Engineers.* (With an Engraving, Plate XI.)

The supposition of the existence of a certain curve or line, in which the pressure is transmitted throughout the voussoirs of an arch, is not of recent origin. The theory of equilibration, called the Catenarian, of which an account is given by David Gregory (Phil. Trans. 1697), is founded on this basis; but throughout the investigation, it has been assumed necessary to make the line in which the pressure is transmitted, coincide precisely with the form of the intrados of the arch; a condition which is necessary to stability, only when the arch is infinitely thin.

In the theory promulgated by La Hire and Attwood, familiarly known as the wedge theory, or that in which each voussoir is supposed to act as a wedge, it is considered necessary that the pressure should be transmitted, so that the direction in which it acts at each joint, should be at right angles to the surface of contact, which condition is only necessary to stability, when no friction exists between the surfaces of contact of the voussoirs.

But when the thickness of the arch and the friction at the surfaces of contact of the voussoirs, are both included in the investigation, it has been shown by Professor Moseley, in his able and elegant exposition on this subject, that the two conditions above mentioned, become modified, and that in an arch of uncemented voussoirs, the actual requirements to establish stability are,—

First, That the line in which the pressure is transmitted (which he has named the line of resistance), should fall within the thickness of the arch at every joint.

Secondly, That the direction of the pressure, at each joint, should be within certain limits, depending on the friction of the materials employed.

Coulomb, the first writer on this subject, who based his assumptions on data consistent with practice (Mémoires des savans étrangers, 1773), considered, with Moseley, that there were two causes of rupture; the first arising from the turning over of certain parts of one voussoir on the edges of another; and the second, from the slipping or sliding of the voussoirs on each other; and although the mode of investigation pursued was totally different, yet the results present a complete accordance with those since arrived at by Professor Moseley, so far as they embrace the same elements f discussion. This remark applies also to the catenarian and the wedge theories; for if the thickness of the arch be considered to be infinitely small, the line of resistance becomes the catenary, and if the thickness be retained and the friction omitted, the line of resistance is analogous with the line of pressure as determined by Whewell in the wedge theory; but though the investigations of Moseley leave little to be done in elucidating the conditions of stability in arches mathematically, yet the deductions have not received that attention from engineers which their importance deserves chiefly from the absence of any decided practical exhibition of their correctness and utility, and also from the investigation being surrounded by too much mathematical difficulty, to admit of ready application.

The analogy before-mentioned, as existing between the line of resistance, the catenary, and the line of pressure of the wedge theory, arises from one governing principle, which is general in these curves, and constitutes the essential element of equilibrium when the only force acting is gravity, namely, that the horizontal forces in any part of the curve are equal to each other; by which it must be understood, that not only must the horizontal force, at any part of the curve, be opposed by a horizontal force of equal amount in the opposite direction, but that the horizontal force is equal throughout the curve. This essential element of any curve of equilibrium, though probably known, has not been pointed out; its mathematical correctness is self-evident, and of its existence practically, as applied to the line in which the pressure is transmitted through the voussoirs of an arch, the following experiments give satisfactory evidence:—

In an arch composed of numerous voussoirs, let their surfaces of contact, instead of being planes, be made curves, as in fig. 1. If the original form of the arch be such that the line of resistance passes through the points of contact, no motion will arise among the voussoirs, on removing the centre; but if the arch be a segment of a circle, or any other form which does not coincide with the line of resistance, the voussoirs will take up a new position, the curved surfaces of the voussoirs rolling on each other, to a certain limit, when they come to rest, and if disturbed from this position (unless the disturbing force be sufficient to produce actual rupture), they will return to it.*

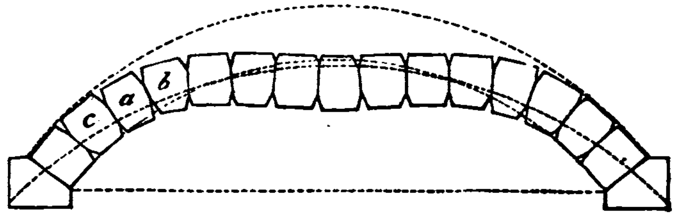


Fig. 1.

In this experiment it is obvious, that the pressure must be transmitted through the points of contact; and it affords a practical proof, that this line is the curve of equal horizontal thrust; for if in any voussoir *a*, the horizontal force at *b*, was not equal to that at *c*, motion must ensue, and as this condition is the same in all the voussoirs, it follows, that the horizontal force is equal throughout. The experiment admits of further application, by loading the arch so as to vary the form of the curve in which the pressure is transmitted, while it of necessity retains the element of equal horizontal thrust; and it will be found, that the limit of stability is when the point of contact of any two voussoirs falls at their outer or inner extremities; thus establishing practically, that the line of resistance, or curve of equal horizontal thrust, must be contained within the thickness at every joint.

The second condition necessary to stability, namely, that the direction of the pressure, at each joint, should be within the limiting angle of friction, is almost always of necessity fulfilled in the forms of arches and with the materials usually employed in practice; this part of the inquiry will therefore be confined to the first condition.

Now the property of equal horizontal thrust, enables a geometrical construction of the curve to be readily obtained in any given form of arch, if two points in the curve be given, and by assuming these two points, it can be ascertained by a tentative process, if any given arch does, or does not, contain the curve.

Proceeding in this manner it is found, that in a semicircular arch, the thickness must be one-ninth of the radius to contain the curve, a result which is completely borne out in practice; for though apparently unnoticed, a semicircular arch cannot be made to stand without foreign support, unless the thickness be greater than one-ninth of the radius.

In like manner, in any other form of arch which does not precisely coincide with the curve of equal horizontal thrust, there is a certain minimum thickness, or depth of voussoir, necessary to obtain stability.

Among various other experiments, made to test the accuracy of the theory, it will be sufficient to give the following. The curve of equal horizontal thrust, when drawn on the elevation of a semicircular arch, of which the thickness is one-ninth of the radius, touches the intrados at 35° above the springing, and the extrados at the crown; and practically, an arch of these dimensions yields, by the crown descending, and the haunches going outwards, the points of rupture, or rotation, being precisely those where the curve touches the intrados and extrados.

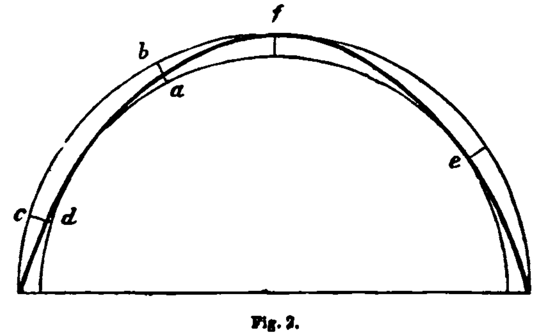


Fig. 2.

* It is necessary that the radius of curvature of the voussoirs be made within certain limits, depending on the depth of the voussoirs and the radius of the arch; if too much curvature be given, the arch will fall, before the points of contact can take up such a position, as to coincide with the line of resistance.

The condition, that the curve must lie within the thickness at every joint was also tested in the following manner. A semicircular arch, of which the thickness was one ninth of the radius, was constructed in four pieces, having the joints *e* and *f*, fig. 2, at the points of contact of the curve of equal horizontal thrust with the intrados and extrados. A similar arch was also made in six pieces, having the joints at *a*, *b*, *d*, *c*, where the curve lies within the thickness. In the first case, yielding took place, by the crown descending and the haunches going out, and in the second, though composed of a greater number of pieces, perfect stability was obtained.

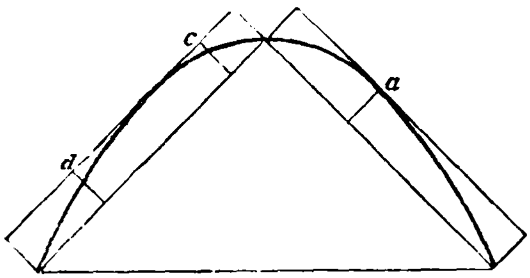


Fig. 3.

Lastly, it being obvious, that these conditions, if correct, must apply to any form of structure whose stability depended on equilibrium; the curve of equal horizontal thrust was ascertained, in a series of rectangular pieces, as in fig. 3, and it was found, that when they were placed inclined to each other at an angle of 45°, the thickness must be ·1464 of the length to contain the curve, and that the point of contact was ·3535 of the length, from the upper extremity; also, that whether the inclination was greater or less than 45°, the curve fell within the thickness. Then taking two rectangular

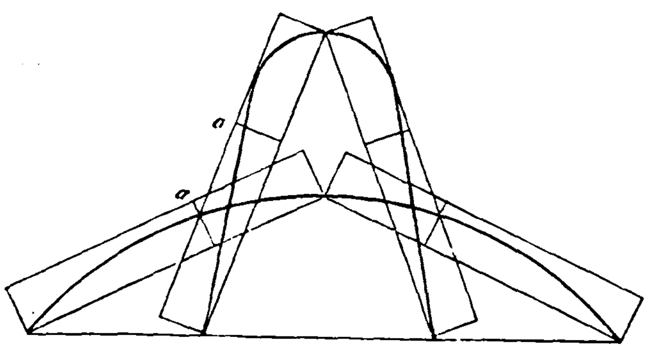


Fig. 4.

pieces of wood of this form, and dividing them where the curve touches the extradosal line at *a*, they will yield by the apex going upwards, when placed at 45°; but when the angle of inclination is made greater or less than 45° as in fig. 4, stability is obtained; and at the inclination of 45°, if the divisions be made at *c* and *d*, instead of at *a*, fig. 3, although composed of a greater number of pieces, stability is also obtained.

Before leaving this part of the subject, it may not be out of place to mention another experiment, which exhibits the analogy between the catenary and the curve of horizontal thrust.—On a vertical plane surface, an inverted semicircular arch was drawn, and divided into eighteen voussoirs of equal dimensions. Through the centre of gravity of each voussoir, a vertical line was drawn, as in fig. 5. From two pins, fixed at *p* and *p′*, a strong fine silk cord was hung, and eighteen pieces of chain, of equal weight, were attached to it, representing the equal weights of the voussoirs. This species of catenary was then adjusted, so that each of the chains hung opposite the vertical lines, and the apex fell just within the thickness of the arch as shown on the figure. The similarity of the curve thus produced, to that of the curve of equal horizontal thrust, was immediately apparent.

Next, one of the pins at *p* was withdrawn, and the cord was lengthened and attached to another pin at P, so as to retain the part *p c p′* in its original position. The line P *p* thus represented the resultant of all the forces acting at *p*, and completing the triangle P *a p*; *a p* the weight or vertical force, was to P *a* the horizontal force as 2·75 to 1, which result was found to accord perfectly with that exhibited in a brick arch which was subsequently turned, in order to ascertain, by actual experiment, the ratio of the thrust to the weight, in a semicircular arch.

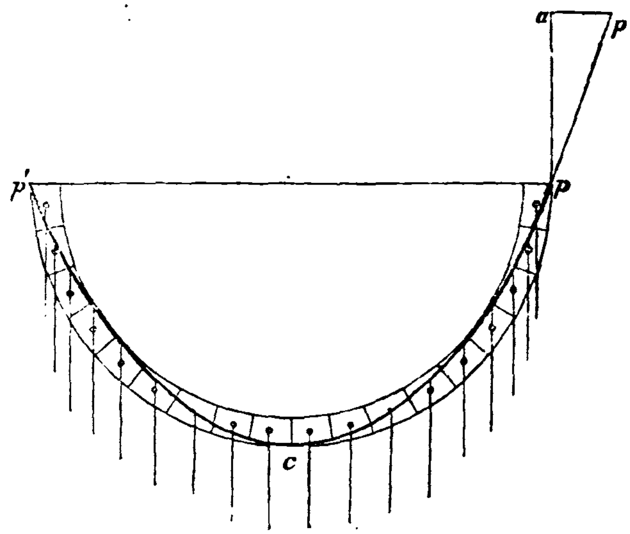


Fig. 5.

Having now, it is presumed, given sufficient practical evidence of the existence of the line of equal horizontal thrust, it only remains to notice, in this part of the subject, that as well as the position of the point of rupture being denoted by it, the direction in which yielding will take place, may also be known. That is to say, it will be outwards, when the curve of equal horizontal thrust touches the intrados, and inwards when it touches the extrados, and before actual rupture, the approach of the curve to either extremity of the voussoirs, indicates the tendency to yield.

Numerous other experiments, of which it is unnecessary to give the details, have shown, that the conditions of equilibrium are the same for the arch and the abutment as for the arch itself; in fact, that the arch and the abutment, when together, may be considered as an arch.

"On the Geometrical Construction of the Curve of equal Horizontal Thrust."

The two half arches being assumed to be symmetrical, the apex of the curve will be in a vertical line equidistant from the springings, and for the present purpose, it will be sufficient to assume one of the two points (supposed to be given), to be in this line. The construction of the curve then resolves itself into two problems.

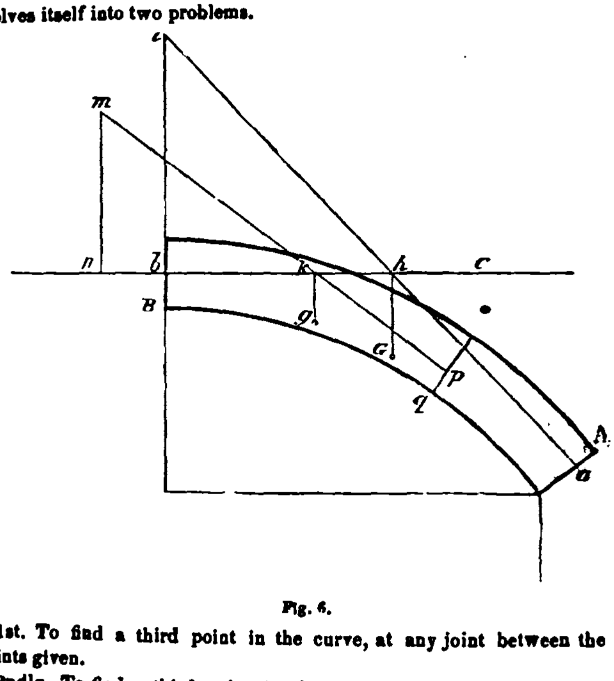


Fig. 6.

1st. To find a third point in the curve, at any joint between the two points given.

2ndly. To find a third point in the curve, at any joint beyond the two points given.

The first of these constructions, is that which is more particularly applicable, in determining whether a given form of arch contains the curve; for by taking each joint separately, the whole curve is obtained. The second is that which is employed, in determining whether a given abutment is of sufficient thickness to contain the curve.

PROBLEM I.—Let a and b, fig. 6, be two points in the curve of equal horizontal thrust in the arch A B; required to find the point at which the curve intersects the joint $o\,q$. Let G be the centre of gravity of the half arch A B, and g that of the portion $o\,q$ B. Through b draw the horizontal line $c\,n$, and the vertical line $b\,l$; also through G and g, draw the vertical lines G h and $g\,k$, intersecting $c\,n$ in h and k; join $a\,h$, and produce it to l; from k set off $k\,n$, equal to $h\,b$, and through n draw the vertical line $n\,m$, making $n\,m$ to $l\,b$ as the weight of the portion $o\,q$ B, is to the weight of the half arch A B; join $m\,k$ and produce it until it intersects $o\,q$; p, the point of intersection, will be the point required.

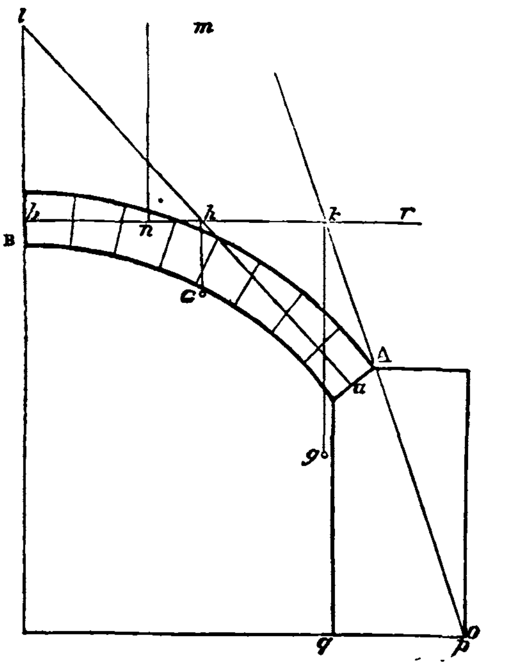


Fig. 7.

PROBLEM II.—Let $a\,b$, fig. 7, be two points in the curve of equal horizontal thrust, in the arch A B; required to find the point at which the curve intersects the joint $o\,q$, being the base of the abutment. Let G be the centre of gravity for the half arch A B, and g that of the arch and abutment taken together. Through b, draw the horizontal line $b\,r$, and the vertical line $b\,l$; also through G and g, draw the vertical lines G h and $g\,k$, intersecting $b\,r$ in h and k; join $a\,h$ and produce it to l, from k set off $k\,n$ equal to $h\,b$, and through n draw the vertical line $n\,m$, making $n\,m$ to $l\,b$ as the weight of the arch and abutment is to the weight of the arch A B; join $m\,k$, and produce it, until it intersects $o\,q$; p, the point of intersection, will be the point required.

It is unnecessary to accompany these constructions with a demonstration, as it is evident, from the nature of the construction in either case, that the horizontal thrust of the portion A B, at the points a and b, is equal to that of $o\,q$ B, at the points p and b.—For a loaded arch the construction remains the same; the centre of gravity of the arch and load being taken, instead of that of the arch only.

These constructions point out, not only the form of the curve of equal horizontal thrust in any given arch, but also the direction and amount of pressure at any joint. For as the perpendiculars of the several triangles represent the weights of the several parts, so the hypothenuse of the several triangles represent the resultant pressures at any joint. From this it appears, that the actual pressure, tending to crush the material of which the arch is made, decreases towards the crown of the arch.

Figs. 8, 9, 10, 11, and 12 (Plate XI.), are drawings to scale, of ordinary forms of arches, showing the minimum thickness that will contain the curve of equal horizontal thrust, and that this is the least thickness capable of standing practically, may be readily tested by models; due allowance being made, on account of the joints not being able to be worked with mathematical exactness. From these diagrams it appears, that the arches which differ most in form from their curves of equal horizontal thrust, are semicircles and semi-ellipses, and that in these forms, there is a tendency for the crown to descend, and the haunches to go outwards. Hence the utility and the general adoption of solid backing and spandril walls in these forms of arches. The pointed arch has a tendency to go up in the crown.

Figs. 13 and 14 show the variations produced in the curve of horizontal thrust, by the addition of the filling in, up to the level of the roadway.

Hitherto, only one line, or curve of equal horizontal thrust, has been spoken of; but if the thickness of an arch be more than sufficient to contain this curve, it is obvious, from the nature of the construction, that more than one such curve will be contained in it, and if the theory advanced is correct, the arch ought to be capable of being supported in any one of these curves.

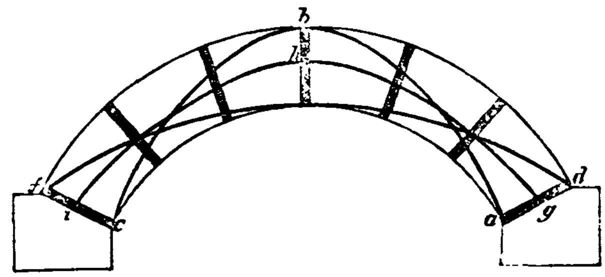


Fig. 15.

The truth of this position was practically tested by the model represented in fig. 15, which consisted of an arch composed of six voussoirs, separated at each joint by four small pieces of wood, each of which could be withdrawn by hand. A curve of equal horizontal thrust was then carefully drawn upon the profile of the arch, as represented in the figure by the line $a\,b\,c$, and it was found that, provided the separating pieces were left in at the points where this curved line intersected the surfaces of the voussoirs, the whole of the remaining pieces might be removed, without producing rupture of the arch; in the same manner it could be supported in the curves $d\,f$ or $g\,h\,i$, or in any curve of equal horizontal thrust, which was contained within the depth of the voussoirs; but that if the separating pieces were so placed, that a curve of equal horizontal thrust could not pass through every one of them, the stability of the arch could not be maintained. Of these curves there are two limits, namely, that in which the ratio of the versed sine to the chord at the springing is the greatest, and that in which it is the least. These two curves are represented in fig. 16 (Plate XI.), and are both determinable by the same process.

The first points out the curve, in which the pressure is transmitted through the voussoirs to the abutment, and is identical with that called by Moseley, "the line of resistance."

The other points out the curve, in which a pressure from without would be transmitted from the springing through the arch; such as would arise from the thrust of a second arch. This line may be called, for the sake of distinction, "the line of impression." The one curve, in short, is derived or generated by the pressure the arch exerts; the other that which it is capable of resisting. In different forms and constructions of arches, the amounts of these forces vary very greatly, and it becomes a consideration of importance, where arches of different sizes are abutted against each other.

In the flat arch, fig. 17, the line of impression is a straight line, and

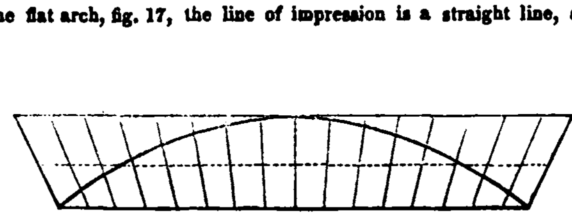


Fig. 17.

therefore, equilibrium could not be destroyed by outward horizontal pressure, until the material yielded by crushing; while by increasing the depth of the voussoirs, the thrust exerted on the abutments may be diminished and rendered comparatively small.

From this, a knowledge of a property in arches is arrived at, which though felt, and to a certain degree acted upon, has not hitherto admitted of a clear explanation.

The annexed diagrams, figs. 18 and 19, exhibit forms of arches, supposed to be loaded with a material of equal weight with the arch, and show the abutments necessary to sustain them. In these, it will be observed that

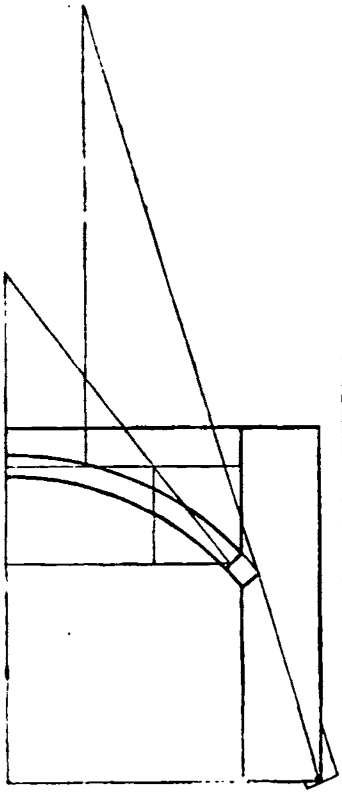


Fig. 18.

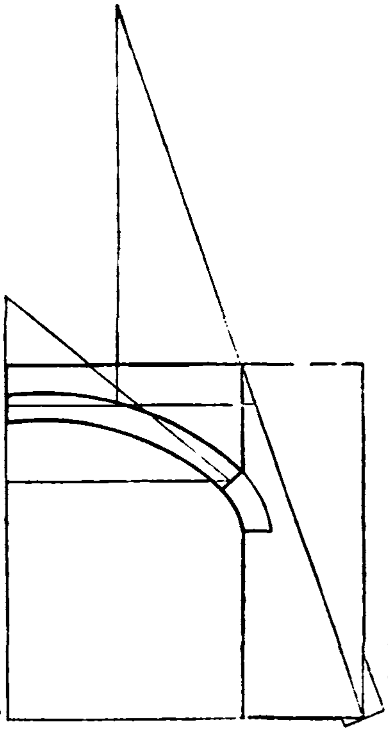


Fig. 19.

the division between the arch and the abutment is not made where the arch, so called, commences. The point of division adopted, has not been chosen on account of the result as to the required thickness of abutment being materially affected by it; but as being the place at which rupture would ensue, if the abutments yielded. In fact, the effective part of an arch is only so much of it as would not stand unless the arch were entire. So much of the arch as lies below this point, would stand of itself, and is practically a part of the pier or abutment, curved out for the arch to spring from. This point of division also permits a readier means of computing the thickness of abutments; as with the exception of the small projection at the springing, the weight of which may be omitted, the abutment is a rectangle, when the roadway is horizontal.

In this manner the following formula is derived, for ascertaining the thickness of the abutments necessary to support a given arch; the height of the abutment being given.

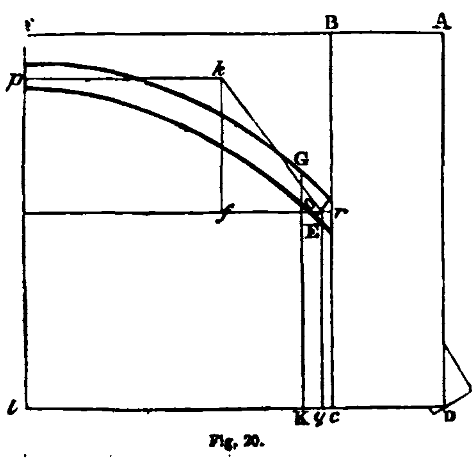


Fig. 20.

If B E F (fig. 20) represent the half arch with its backing, and G is the centre of gravity—assuming p and p' to be two points of application of the pressure, or points in the curve of equal horizontal thrust in the arch—let $pf = d$, $kf = h$, $pq = m$, $pr = n$, $AD = a$, w = weight or area of arch and backing, and $x = DC$ the width of abutment sought; then assuming equal areas to produce equal weights, ax will be the weight of the abutment; and when x is such, that the curve of equal horizontal thrust will meet the base of the abutment at the extreme point D, we have

$$\frac{a x^2}{2m} + \frac{w(x+n)}{m} = \frac{wd}{h},$$

$$\text{or } x = \frac{w}{a} \pm \sqrt{\left(\frac{dm}{h} - n\right)\frac{2w}{a} + \left(\frac{w}{a}\right)^2}$$

Also to find the thickness of abutment when any given additional load is placed on the arch, let B be the load, expressed in terms of the area of the arch and backing, and s its horizontal distance from the point p;

$$\text{then } x = \frac{w}{a} \pm \sqrt{\left\{\frac{(Bs + wd)m}{h} - wn\right\}\frac{2}{a} + \left(\frac{w}{a}\right)^2}$$

In like manner, when the arch and abutment are given, we can find the extreme load which may be placed on the half arch.

Referring again to fig. 20, let G K be a vertical line passing through the centre of gravity of the arch and abutment, and $p'l = H$, $DK = D$, S = horizontal distance of load from the back of the abutment, and W = weight or area of arch and pier; then using the same letters as before for the other dimensions—

$$\frac{WD}{H} + \frac{BS}{H} = \frac{wd}{h} + \frac{Bs}{h}$$

$$\text{or } B = \frac{hWD - Hwd}{Hs - hS}$$

In these cases, the two half arches are assumed to be loaded alike; hence, when the load is at the crown, the result must be doubled, to give the entire load. As regards the positions of the assumed points pp', it is sufficient, in an arch of large dimensions, to take them in the centre of the thickness. Though the extreme limit, theoretically, in an arch turned in one ring of voussoirs, is when the points pp' are in the line of resistance.

In offering the foregoing as a practical outline of the laws which govern the equilibrium of arches, it must be observed, that the most simple conditions consistent with practice, have been assumed as data, and so far as these conditions can be fulfilled, there is no doubt that the principles here set forth will be fully borne out in actual execution. How much further the inquiry might be carried with advantage, it is difficult to say: but there appears to be much connected with the unequal loading of arches, which has not hitherto been the subject of investigation.

Moseley has introduced in his researches, the effect of the adhesion of cements; but he has accompanied it with the remark, that "that structure (being of large dimensions) which would not stand without cement, would assuredly be a perilous one," a remark which applies very properly to arches of masonry; but in brick arches, turned in numerous rings, the adhesion of the cement undoubtedly becomes an element, materially affecting the stability of the structure. Upon such subjects, and upon the varying conditions in which arches are placed, it is in vain to attempt to bring theory to bear. They are considerations which must and ought, at all times, to be left to the skill and judgment of the engineer.

In practice, an arch will exert more pressure and resist less than theory would denote; because the conditions of unyielding materials and mathematical adjustment of the joints, are incompatible with practice. Even in arches of the hardest stone, and with the best workmanship, the lines of resistance and impression must not be brought too near the extremities of the voussoirs; and in brick arches, particularly those turned in separate rings, a much greater latitude must be allowed. It must be evident, however, that it is desirable to form brick arches as much as possible in one bonded mass, using the best cement.

In abutments, a still greater variety of considerations will arise. To render this part of the subject tangible by theory, the abutment must be assumed as standing alone, the foundations being perfect, and the point of rupture being at the base of the abutment. In practice, they are rarely, if ever, without earth behind them, aiding more or less in their support. Some cases, such as in arches under embankments, the force acting to push in the abutment, exceeds the horizontal thrust of the arch, and a tendency has been frequently exhibited in arches so situated, to rise in the crown.

The foundations, the wing walls, the spandril walls, the backing, the nature of the materials employed, and many other practical considerations, all tend to affect the stability, and modify the results of theory; each of which circumstances, acting pro or con, will be made to fulfil its duty to the best advantage, by the skilful engineer. The utmost that theory can do, is to show the conditions of equilibrium, under certain fixed practical data, and there can be no doubt, that the line of equal horizontal thrust in an arch, is analogous to a vertical line drawn through the centre of gravity in a column. That this line should fall within the mass at every joint, and that the position of each joint should be such, that the direction in which the pressure acts should be within the limiting angle of friction, are conditions common to both structures.

[The interesting observations made at the meeting of the Institution, by the members, after the reading of the paper, will be given in the next month's Journal.]

CONSTRUCTION OF SEA WALLS.

A Protest against the Decision of the Members of the Harbour of Refuge Commission present at the Sitting of the 13th January 1846; and Dissent from their Report, on the part of Lieutenant-General Sir Howard Douglas, *one of the Commission—presented to the House of Commons.* (Slightly abridged.) *The annexes referred to will be given in the next month's Journal.*

Attaching the greatest importance to the attainment of certainty in the mode of forming, and of durability in that of executing the extensive works about to be undertaken for the proposed harbour of refuge in Dover Bay, I consider it incumbent upon me to express my marked opinion, in opposition to plans which, in my judgment, are founded on modes of construction not resting upon any proved principle, and untried upon any sufficient scale to warrant their present adoption; which are moreover theoretical in conception, and consequently uncertain in their ultimate result. Such plans are, in my opinion, unfit for the attainment of the great national object which we have in view; and which it is my most anxious wish to see undertaken in such a manner as will leave no doubt of its being successfully accomplished.

Considering, then, that the building of an upright wall in the open sea, in seven or eight fathoms water, is a proposition novel in theory, and never, in so far as I am aware, proved in practice, on a scale to warrant its adoption;[1] and being of opinion that a breakwater of the proposed elevation and magnitude, rising with an upright face, from the depth of 42 feet at low water, would be far less capable of resisting the violence of seas,[2] and especially of broken seas, (exposed as it must, moreover, be to the unremitting action of strong tides and currents) than a sloping breakwater formed in a manner similar to that which has been successfully completed in Plymouth Sound (which is now in a state of perfect repose and stability) (Annex B. D.), as well as similar to others (Delaware Breakwater, Annex L.) constructed on its model; having also dissented from the proposition of the upright wall on a former occasion (31st July 1844, Annex A.), I now consider it my duty to oppose myself, decidedly, to the adoption of that mode of construction, and to the employment of any artificial or inferior material, as a substitute for stone, from mere considerations of pecuniary economy. The latter should I think have no place in a great national undertaking of this description, and I firmly believe that the method proposed with this view would, in the end, prove by far the most expensive.

In the more recent minutes and proceedings of this Commission, I find much to confirm me, practically, in these views and opinions (which I brought before the Commission in July 1844), and I perceive that even the highest acknowledged scientific authorities who adhere or incline to the theory of the upright wall, speak cautiously, diffidently, doubtingly, or ambiguously of the capability of vertical walls to resist the action of waves and seas in all cases and under all circumstances. Some of these maintain that waves in a breaking state do act percussively; that a sloping breakwater is therefore best able to resist the action of seas in that state, and that consequently there should be a sloping breakwater in one part of the proposed harbour of refuge, and a perpendicular wall in others; whilst other high authorities, who incline to the upright wall, admit that this is merely matter of opinion, quite speculative and experimental as respects themselves, and that there can be no doubt that a sloping breakwater would be perfectly secure. Now in my judgment, nothing purely theoretical can remove the strong objections which have been so forcibly advanced by many experienced practical engineers,[3] (and I may add other eminent men of high scientific and practical attainments, naval, military, and civil), against the adoption of a mode of construction difficult if not impracticable, any failure in which would be discreditable to the engineering talent of the country, and in ruining Dover Bay as a natural roadstead and anchorage, be productive of evils the most serious to commercial operations in the Channel.

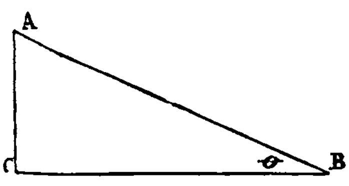
Mr. Alan Stevenson states, that to build an upright wall in seven or eight fathoms water, so far as his experience goes, would be entirely an experimental measure; that to attempt this in an open sea-way like Dover Bay, would be a work of the utmost difficulty, if not wholly impracticable; and that so far from recommending the trial of such a work, he would humbly, but decidedly, dissuade the Government from making an attempt which he was sure would end in failure; and, in reply to cross-questions put to him with a view to shake his testimony against the upright wall, he denies the theory on which that mode of construction is founded. He asserts, on his own experience, that waves are not purely oscillatory, but have onward motion, and consequently percussive force, such, in his conviction, that any attempt to check their force by means of a vertical wall, will prove a signal failure; for that a force would be developed by the collision of the wave with the wall, whose amount will be found to surpass any which has ever been experienced on the face of a sloping breakwater.

In the course of the protracted discussions to which my opposition gave rise, the danger was demonstrated of using, in such a work, a material (concrete) to which I had always objected, as deficient in tenacity, and incapable of resisting mechanical action of water. An opinion of the efficiency of this material was, however, strongly supported by the reference made in an official report, and in a leading question to the use of blocks of concrete for the completion of the breakwater in Cherbourg Bay, which was described as a successful experiment, and one deserving of being adopted by us, as a precedent; but the contrary of both was soon evident; for within the period to which, happily, the proceedings of the Commission were thus extended, an important failure occurred in the works at that place; and the employment of concrete, as a substitute for stone in this climate, has been abandoned by the French engineers.

This failure, and the opinion of Sir R. Smirke against the adoption of blocks of concrete as an artificial stone, which he thought would fail, disposed of this proposition; and it will not be conducive to the public interests, in my opinion, that the other description of artificial material recommended by Mr. Rendel (namely, brick set in cement), which Mr. Corderoy

[1] See Observation on Kilrush Pier, built in only 9 feet 6 inches depth of water.

[2] The application of the theory of the resistance and impact of fluids is no doubt attended with great difficulties and anomalies in this as in many other cases connected with natural philosophy; but whatever results have been derived, either from theory or observation, they all agree in this, that the horizontal impulse of a fluid on any resisting body is increased, in a very high ratio, as the inclination of its surface (A B) to the direction (B C) of the motion increases. The fundamental theorem is, that this varies as $(\sin\theta)^2$ (θ representing the inclination), because the height of the breakwater continuing the same, the quantity of fluid impinging on it will be the same at all inclinations. If the height of the breakwater were variable, the whole impetus would then be as $(\sin\theta)^3$, because in this case, not only is the force of each particle diminished in proportion to $(\sin\angle\theta)^2$, but the number of particles which impinge on the plane varies as $\sin\theta$.



From this resolution of the pressure of a fluid against the surface of a body, whether either be in motion and the other at rest, or both body and fluid be in motion, some of the most useful results of practical science are obtained. By this a ship is impelled forward obliquely to the direction of the wind, even when that direction is before "the beam;" and a like resolution of pressure gives rise to the propulsive force of the revolving screw, or enables the rudder to retain and guide the vessel in her intended course. The oblique action of the water on the side of the vessel or raft, permits a "flying bridge" to be sheered across a river; and not only does that of the wind give motion to the sails of a mill, but by a proper variation of the obliquity of these, according to the distance from the axis of motion, the impelling force is rendered equably on every part.

In the application of this principle to practical mechanics, great difficulties certainly occur from our imperfect knowledge of the manner in which the forces of nature are exerted; and the problem concerning the action of the sea against a wall, can no more be solved by the resolution of forces than the trajectory of a shot, in a resisting medium, can be determined by the parabolic theory, or even by any theory founded on the usually assumed law of resistance; yet such a theory has its uses for the practical artillerist; and a knowledge of the mathematical principles of hydrodynamics is essential to an adequate conception of the means to be employed for resisting the actions of waves.

On the best form for the profile for a "breakwater" a difference of opinion exists; and while, on one hand, it is contended that the exterior face of the wall should be vertical, on the other, a face inclined to the horizon is recommended. The advocates of the former construction seem to consider that such a wall is subject only to the hydrostatical pressure of a fluid at rest, or that the agitations of the water before it, takes place only in vertical directions; but neither of these conditions holds good in Dover Bay, or wherever by the force of winds and currents the waves are impelled with violence against the shore. That loose stones constituting a breakwater, when deposited so as to form an inclined plane, should be occasionally displaced by the action of waves is sufficiently obvious; but that, with equal quantities of material, a vertical wall should resist the concussions produced by such action, as efficaciously as one with an exterior slope, is inconceivable.

It does not follow, however, that the face of a breakwater should have one uniform slope from the bottom upwards; the part lashed by the waves in an open sea requires a longer slope, or a smaller inclination to a horizontal plane, than the part below; and this deduction from scientific principles by many eminent authorities is confirmed by the practice of engineers.

Poisson, Prony, Charles Dupin, Girard, Cachin: Professor Cape, Military Seminary, Addiscombe; Professor Narrien, Royal Military College; General Bernard, United States' Engineers; Commodore Rogers, United States' Navy; Mr. William Strickland. See Annex. (L.), on the Delaware Breakwater, by which it appears that Colonel Jones was misinformed.—See his Report of 1846, Appendix, No. 1, p. 72, by the United States' Engineer, who told him that the long slope was not approved of by American engineers.

[3] 1. Sir John Rennie, Annex (B.) See also his Report and Opinion, No. 4, of plans sent in.

2. Mr. George Rennie, Annex (C.) See also his plan, No. 2, of the Reports; his model and recent examination, Q. 430 to 434, 445 to 447.

3. Mr. Cubitt, Annex (D.) See his Report and plan, No. 6, and recent examination, Q. 210 to 213, 284 to 288; and letter to the Chairman, Appendix, No. 11, Second Report.

4. Mr. William Stuart, superintendent of Plymouth Breakwater, from the commencement of the work in 1811 to the present time, Annex (F.), evidence of June 20, 1844.

An important evidence, showing that the damages which that work had sustained arose from the slope or foreshore not being long enough; stating his practical objections to a more upright slope, and his conviction that it could not stand; and that, if that breakwater had been constructed upright from the bottom of the sea, it would have been incapable of resisting the force of the waves.

contractor, states, would cost twice as much as concrete, and which Mr. Smirke says would be more expensive than stone, should be used.

With respect to the adoption of blocks of concrete;—far "from standing remarkably well in the breakwater at Algiers," the whole mass of the breakwater has settled bodily, not from the effects of gales of wind, but from defects in the material (which time will further show); this, there is no doubt, is occasioned by the chemical action of the sea, "which in the Mediterranean contains 7·02 per cent. of sulphate of magnesia, whereas the water in the ocean contains only 2·29 per cent., consequently, of two moles made of the same concrete, the one in the ocean may last an indefinite period, the other will dissolve in a few years; and even mixing puzzolano with the concrete will not guarantee the lime from solution." Nor can that work, under any circumstances, be cited as an example for our imitation on the coasts of Great Britain. There are no tides in the Mediterranean, and the climate there is well suited to the drying and consolidation of that material, which is not the case in more northern regions.

It may be added, that the form of the work at Algiers is not that of an upright wall, for its face has a slope of 45 degrees; the work, therefore, cannot be adduced as an example in favour of that form of construction.

In support of my dissent from the adoption of the upright wall, I appeal to the debate which took place at the Institution of Civil Engineers, in April 1842,[4] on Colonel Jones's "Observations upon the Sections of Breakwaters as heretofore constructed, with Suggestions as to some modifications of their Forms." This debate may be taken as a very fair exposition of the opinions of practical engineers on the principle of the upright wall.

The president, Mr. Walker, took an important part in that discussion. He said, "It is evident that if the materials are deposited at an inclination, any portion being displaced, is only carried down elsewhere. Although strictly speaking it may not be wanted, it must nevertheless assist in consolidating the mass, and the vacant spaces can easily be filled up. Under similar circumstances (to those which displaced some of the stones in Plymouth Breakwater) a perpendicular wall would suffer more severely, and probably would have fallen entirely. He therefore considered that in situations like that of the Plymouth Breakwater, which was exposed to a heavier sea than Cherbourg, a long slope for the sea face was essential."

Mr. Palmer, vice-president, observed that the form suggested by Colonel Jones for the faces of breakwaters, did not appear sufficiently justified by observed facts; that the idea was entirely of a speculative character, and was contrary to the laws of nature, which should be the engineer's chief guide; and he attributed the failure alluded to by Colonel Jones, in the harbours of Ardglass, Portrush, &c., more to defects in workmanship, than to faults in the principle of the structure.

General Pasley said he conceived that a perpendicular wall, constructed of large ashlar work, well cemented, would assume the character of a rock, and all the prejudicial action of the receding wave would be avoided.

Mr. Bull differed entirely from Colonel Jones's opinion as to breakwaters with vertical or nearly vertical faces, because any disturbance of the footing, however slight, must have a tendency to overthrow the wall.

Mr. George Rennie deprecated in strong terms the upright wall, and stated that the late Mr. Thomas Telford had abandoned that mode of construction.

Mr. Vignoles only agreed to a certain extent, to the form proposed by Colonel Jones, and recommended a combination of a slope below with a vertical parapet above.

Mr. Gordon was in favour of the slope; and stated that a sloping breakwater, composed of *pierre perdue*, with a sloping face, had withstood undisturbed the surf at Madras.

Mr. M'Neill adduced the long slopes of sand, at an inclination of 10 to 1, thatched with straw, which resist the waves of the ocean on the coast of Holland.

Thus we have in this discussion, a majority of speakers of seven to two, in favour of the slope; and of the minority, one was for a combination of the slope with a vertical wall above. Even Colonel Jones suggested this modification. *See* page 125, vol. 2, Proceedings of Institution of Civil Engineers. Plan No. 5, proposed by him for Dover Bay, was of this description.

I object to Kilrush Pier being adduced as a test of the principle of the upright wall sufficient to warrant its adoption in the construction of a harbour of Refuge in Dover Bay. Kilrush is a small tidal harbour on the coast of Ireland for coasting vessels. The piers are built in only 9 ft. 6 in. depth of water, at low tide. The foundations were laid without difficulty by the diving-bell, with large masses of stone, which were easily and quickly deposited. The area of the section of the wall is considerably greater than that of the old work; but so far from the upright wall having been built in consequence of the sloping profile as originally proposed having failed, Col. Jones expressly says "that the old work stood remarkably well." There is nothing in this, therefore, either practically condemnatory of the slope, or sufficient to warrant the adoption of the upright face, on such a scale as to which these proceedings relate. There is no doubt, as Mr. Palmer says, the piers of the small harbours which Captain Washington reports to have been so much damaged by the sea, were constructed in a very defective manner, and with materials of dimensions that ought not to have been put in, and it likewise appears that the damage which these piers may have sustained might easily be repaired; but certainly no such errors would be committed in any new work of this description, far less in that great national work now under consideration.

[4] Proceedings of the Institution of Civil Engineers. See Journal, vol. 5, 1842, p. 318.

The recommendation of a majority of the Commission in favour of the upright wall is stated, in the Report, to have been made on a summary,

1. Of the conflicting opinions entertained by the eight engineers whose plans for constructing a harbour of refuge in Dover Bay were submitted to the Commission; and

2. With reference to the opinions of those persons who had been requested to give their evidence or advice upon this important question.

The following is a list of the engineers whose plans for constructing a harbour of refuge in Dover Bay were sent in to the Commission:

1. James Walker; 2. George Rennie; 3. Captain Denison; 4. Sir John Rennie; 5. Lt.-Col. Jones; 6. W. Cubitt; 7. Charles Vignoles; 8. J. M. Rendel.

1. Mr. Walker, civil engineer, is somewhat inconsistently adduced in the Report as an advocate, in principle, for the construction of a nearly upright wall. The project submitted by Mr. Walker to the Commission, is to build these walls in immense vessels, or as he calls them, "utensils" (caissons), three or four hundred feet long and seventy feet wide, containing two or three thousand tons of ready-made breakwaters, to be towed by steam tugs and stranded in Dover Bay! But we have Mr. Walker's authority, from what he said at the meeting of the Institution of Civil Engineers, on April 12, 1842, that his reason for proposing nearly upright walls in this case, was to avoid the extravagant width which must be given to these huge utensils, if the walls have any considerable slope; for, at the discussion to which I refer, Mr. Walker stated, that in situations exposed, like that of the Plymouth Breakwater, to a heavier sea than that which rolls into Cherbourg Bay, a long slope for the sea face was essential; and that had a perpendicular wall been constructed in Plymouth Sound, instead of a sloping breakwater, it would, in the storms which assailed it, have suffered more severely than it did, and probably would have been entirely overthrown.

The dangerous instability of works executed in deep water, by a system of caissoning, such as that proposed by Mr. Walker, is very generally acknowledged, and is sufficiently proved by the perilous state in which Westminster Bridge now remains, notwithstanding the costly expedients by which it has been attempted to remedy the defects of its original construction. These expedients consist in forming a cofferdam about each pier, pumping out the water, and then driving rows of sheet piling into the blue clay, so as to form a girdle round the base of the original caisson, and thus to prevent the materials of the natural bed of the river from being underwashed by the current, or squeezed out by the weight of the bridge, into the gradually deepening water-courses. But it does seem very strange, that these expedients having failed to arrest the subsidence which is still taking place in Westminster Bridge, the method employed in the construction of that work should be proposed for adoption, on an immense scale, in the formation of a harbour of refuge in Dover Bay.

2. Mr. George Rennie deprecates the upright wall as impracticable and dangerous, and strongly recommends a sloping breakwater, as at Plymouth.

3. Captain Denison is for a vertical wall formed of hexagonal prisms of concrete (proposed by Monsieur Emy, in 1831, but never adopted), 10 feet long, and about 23 tons weight, to be manufactured at Dungeness, and dragged by steam tugs to Dover Bay, by being suspended to rafts formed of two cylindrical pontoons, and there sunk by mechanical means. The wall to be upright from the bottom to about low-water mark, with a superstructure of granite.

4. Sir John Rennie, after deprecating in strong terms all systems of caissoning, and some other expedients, particularly the adoption of upright walls; and after urging the disastrous consequences that may attend any mode of construction which is not recognised as certain of success, proposes the adoption of the principle observed in the breakwater at Plymouth. This he considers as having completely succeeded, and therefore he conceives that it fully justifies the adoption of the like mode of construction for the proposed harbour of refuge in Dover Bay.

5. Colonel Jones is in favour of a combination, of a sloping breakwater, up to low-water mark, with an upright wall of stone erected on it.

6. Mr. Cubitt, after having been a little taken with the theory of the upright wall, and having since bestowed upon this subject the most careful consideration, comes to the conclusion that any attempt to erect an upright wall in Dover Bay would be an undertaking of great difficulty, and that the only safe and practicable mode of execution is by depositing masses of stone, to form a sloping breakwater, as at Plymouth, with stone brought from the Channel Islands, or from Portland.

7. Mr. Vignole's plan is to form a sloping breakwater, by depositing cubical blocks of concrete up to about low-water mark, and upon this to erect a vertical wall.

8. Mr. Rendel is next adduced as an advocate for the upright wall. Now, with great respect for the practical opinion of this eminent engineer, it is of importance to review in detail his several examinations before the Harbour of Refuge Commission, previous to his conversion to, or adoption of, the new theory, and to advert to the circumstances with respect to material, which induce him now to recommend a wall of that form.

In his examination of the 19th of June 1844, Mr. Rendel told us, that to construct a breakwater in seven fathoms water is a very formidable undertaking, especially if caissons or other machines should be resorted to; and that he doubted very much whether if a breakwater is to be constructed in seven fathoms water, the only safe plan would not be, to deposit stones in the usual way from vessels; bringing up the mass to within, say two or three feet of low water; above that, he proposed to construct perpendicular walls, as recommended by Colonel Jones; observing that if stones were deposited in this manner, and allowed to form their own slope, it would in most situations be the most economical plan.

He stated that if he had an unlimited command of materials, he would first begin to deposit those materials so as to form a rough mass, and when he had brought his foundations up to that point (nearly low-water mark) at which the sea would begin to attack him, he would attack the sea, by building with a class of materials that would be its master; adding, that he thought an upright wall in this case might be desirable for a superstructure.

In Mr. Rendel's examination before the Commission, in November 1845, his attention was expressly called to his former evidence by several questions, to all of which he replied that he retained the opinions expressed in that evidence; and also stated that he did not know of any instance in which a breakwater with an upright face, of the magnitude now contemplated, had been constructed in the open sea in seven fathoms water. He added, that so far it is an experimental measure. Mr. Rendel's reasons for adopting the upright wall, in the project which he now proposes, are founded purely on considerations of economy in money and time. He observed, that where there is abundance of masses of stone, fit for constructing breakwaters, he would form them of rubble stone up to low-water mark, with sloping faces, in the manner in which he had just finished a design of Holyhead harbour; but in order to avoid the expense of bringing stone to Dover, he proposed to adopt, as substitutes for stone, rectangular blocks of brick, set in cement, ten feet long, five wide, and three thick, and with these to build a perfectly upright wall in Dover Bay, by means of powerful machines and the use of the diving-bell. On a former occasion Mr. Rendel objected to the employment of machines, and particularly to the use of the diving-bell. This proposition, therefore, resolves itself into the question, whether such a project would be economical.

Mr. Rendel admits that if the execution of the work by means of brick blocks were pressed on so rapidly as to render it necessary to import into Dover bricks, or materials with which to make them, a great part of the economical advantage would disappear. He also acknowledges "that the advantages of that mode of construction, namely, the upright wall, over the common sloping-sided breakwaters, is a mere question of economy in money and time." He has further admitted, that if he had unlimited command of materials at Dover, he would adopt the usual mode hitherto observed in constructing breakwaters. Now Mr. Hartley expressly states, that the expense of providing brick blocks made of the materials that he recommends as indispensable in the construction of such a work, would be greater than that at which granite might be procured from the Channel Islands.

From this and other calculations it appears, that "the mode of constructing breakwaters hitherto observed," with materials of the best description, is preferable, in an economical sense, to that proposed by Mr. Rendel, and this being so that he would renounce it. We have this reliance on Mr. Rendel's discretion and judgment, that he would guard himself against assuming anything where experience, the only safe guide, can be referred to; and, in a great national work like this, would not propose any new-fangled notions that have nothing but their ingenuity to recommend them.

If then the question, whether the theory of the upright wall, or the established practice of the slope, was to be determined by the opinions of a majority of competitors, the Commission ought to have decided the other way, for, of the eight engineers who gave in plans, four recommended the sloping breakwater; and, of the other four, two propose a combination of the slope below, with a nearly upright superstructure; and only one prefers the upright wall, and this provided his proposition for using brick blocks of 25 tons weight as substitutes for stone, be adopted.

The following is a list of the persons whose opinions are adduced as advising the construction of the upright wall:—1. Professor Airy; 2. Professor Barlow; 3. Major-general Sir J. Burgoyne; 4. Sir Henry De la Beche; 5. Mr. Hartley; 6. Major-general Pasley; 7. Captain Vetch; 8. M. Reibell; 9. Mr. Brunel; 10. Mr. Bremner.

1. Professor Airy's opinion in matters of science is unquestionably entitled to the very highest respect. I have studied with the greatest attention and profit the Astronomer Royal's tract, in which the phenomena of tides and waves are investigated by a refined analysis on what is called the "wave theory." It is assumed that in deep water, the motions of the particles are oscillatory, and that the rising and falling of the surface of the sea depend on the horizontal movements taking place alternately in the same and in contrary directions; that these displacements are represented by a periodical function (the sine or cosine of an angle depending on time). The circular or elliptical movement of the particles is shown to take place only when a wave is transmitted along a channel of uniform breadth and depth; and the fact, that, as the depth of water becomes less, waves become shorter and their fronts steeper, is proved to be in accordance with what may be deduced from the theoretical expressions of the displacements. It follows from this, that, as a sea-wave advances into water gradually becoming shallower, it assumes a crested shape, the upper particles moving towards the coast, till at length the top rolls over the base, the wave breaks, and a surf is created. Reference is made in this article to the special treatises on sea-waves by MM. de la Coudray and Bremontier.

When Mr. Airy was Professor of Natural Philosophy at Cambridge, he explained, with success, that waves in a fluid at rest, such as we may conceive to arise from throwing a stone into a pond, or the ordinary waves in a close lake, are more or less superficial undulations, and that in reality no current, or onward motion of the fluid, appears to take place. I well remember, also, that he invented an ingenious machine by which he illustrated this oscillatory motion. But admitting this to be true, to a considerable extent, in a pond or a small lake, it is totally inapplicable to the sea, the open sea, in Dover Bay, where an immense body of water is in constant motion, by tides rising and falling fifteen or twenty feet in the course of two or three hours, and where the surface is liable to be acted upon by heavy gales, which drive in rolling seas in succession with rapid onward motion, and therefore producing percussive force in the direction of the wind. Without however entering here on Professor Airy's theory of waves in deep open sea, but confining myself to deductions from that theory, as to the practical effect of waves in gales of wind on erections in the sea, of a limited depth, it will be seen, that instead of his theory (that the upright wall is in all cases preferable to the slope) being absolute, this eminent authority allows that waves in a breaking or broken state do act percussively and powerfully as hydraulic rams, and not by hydrostatic pressure. How then can that hydraulic action cease and become merely hydrostatical pressure unless it has first exerted a force of impact upon the wall which arrests its motion? Even if the wall should stand after having received the shock, the concussion must be more severe on an upright wall, in the ratio above mentioned, than that which would take place on a sloping wall of equal height.

The question of construction, then, resolves itself into this: in what depths of water do waves assume that form and acquire that percussive force? Where, according to this, should the slope cease and the upright wall commence? The professor says, practical opinion, that of the pilots, can best determine this.

Those whom I have questioned on that subject say, that this will be found to take place, in heavy gales of south-west and southerly winds, throughout nearly the whole of Dover Bay at low water.

However this may be, it is clear from the Astronomer Royal's deductions from his own theory, that there should be a sloping breakwater in the shallower parts of the space to be enclosed, and an upright wall in the deeper.

But with respect to the practical question, Professor Airy states, in reply to question 595, whatever theory may say, "that building an upright wall in the open sea, in seven fathoms water, is so far an experimental measure, that no such work has ever been executed.".

With every respect, then, for the theoretical opinion of this high authority, I cannot consider that it would justify the Government in sanctioning the mode of construction recommended by a majority of the Commission; it may rather be inferred that this is contrary to the deduction of science, and that, if the difficulties of constructing such a wall in deep water could be overcome, it would be incapable of resisting the action of the sea where waves assume that shape, and possess that percussive power, which Mr. Airy admits.

2. Professor Barlow has most usefully applied mathematical investigation to practical purposes, and knows well the difference between theoretical views and practical effects upon a proposition of this description. In his letter of the 5th January 1840, written in reply to the question referred to him, he states, that theory cannot safely settle that question; he avows that he has not sufficient practical knowledge or experience to enable him to speak confidently on the subject; expresses himself diffidently, cautiously, and even ambiguously, as to theory; and recommends that the question be referred to practical men for their opinion, made upon results obtained from actual experience and observation. The learned professor therefore rather declined and disclaimed giving a decided opinion in favour of the upright wall; and I think he will be surprised to find that his letter has been adduced, by a majority of the Commission, rather as conflicting with, than as deferring to the opinion of practical men. Further it appears, by the professor's letter, that he is decidedly opposed to the theory of the upright wall; for he denies the assumption on which it is based: namely, "that waves have no onward motion." He states, "there can be no doubt that waves when acted upon by tempestuous winds, will beat with great violence against any obstacle opposed to their progress; that what we want in breakwaters is, to resist that force; to withstand that momentum; and that much of this direct violence would be avoided, by receiving that action on an inclined surface."

3. I refer with the greatest deference and respect to any practical opinion of so eminent a man as Major-General Sir John Burgoyne; but I do not read his letter on the comparative merits and capabilities of the upright wall and the slope, as containing any very positive or confident preference of the former; and in that letter it is admitted that there can be no doubt as to the security of the slope. This distinguished military engineer says,

"The effort against the upright wall I conceive would be far less.

"In deep water, the action of the wave is, I apprehend, an up and down undulation, the water having very little, if any, forward motion, except where it breaks. A flat piece of wood, floating on the surface, and presenting no hold to the wind, would progress very slowly before the heaviest gale; therefore I consider that there would be no blow or impulse generally on the upright wall, but merely the weight of water from the top of the wave to its mean level, to be supported.

"I should not expect that the wall itself would cause the waves to break, and even those that accidentally did so at that particular place would have much of their force caught by the receding of the previous wave, so as rarely to strike with much force against the wall itself.

"There can be no doubt but that a slope could be given to a breakwater that would be very secure.

"In Holland, the shores, even of sand, are in many parts secured against the whole force of the North Sea by a surface coating of mere clay and straw, but then the inclination is exceedingly gentle quite to deep water, not more, I apprehend, than 1 in 18 or 1 in 24. As the material is increased in size and weight, it is to be presumed that this slope may be increased."

4. Sir Henry De la Beche is adduced as an advocate for the upright wall. Now the theory of the upright wall rests entirely upon the assumption that waves have no progressive forward movement or motion, or percussive force, in acting upon erections in the sea, or on coasts, clifts, or beaches. But Sir H. De la Beche expressly states, that seas in heavy gales of wind are urged onwards in the direction of the winds which raise them; that waves in a breaking state possess enormous force from the weight and velocity of the water thrown forward; and the following extracts from his very able work, "How to Observe Geology," show that he has been erroneously cited, or that he expressed himself in an unguarded manner, when he asserted that upright walls resembling cliffs, are more capable of resisting the percussive effects of waves and seas than slopes."

In the very able work which this eminent geologist published, he delivers the following rules as the result of what he had observed and ascertained with respect to the action of the sea:—

"Properly to estimate the effects of this power, the observer should be present on some exposed coast, such as that of the western part of Ireland, the Land's End, Cornwall, or among the western islands of Scotland, during a heavy gale from the westward, and mark the crash of a heavy Atlantic wave when it strikes the coast. The blow is sometimes so heavy that the rock will seem to tremble beneath his feet. He will generally find in such situations, that though the rocks are scooped and caverned into a thousand fantastic shapes, they are still hard rocks, for no others could continue long to resist the almost incessant action of such an abrading force. Having witnessed such a scene, he will be better able to appreciate the effects, even though the waves be far inferior in size, upon the softer rocks of other coasts.

"The observer should carefully remark the direction of the prevalent winds, and the proportion of those which send the greatest waves, or seas as they are termed, on shore, in order that he may duly appreciate the loss of coast sustained in those directions where the force of the breakers is greatest and most incessant.

"It must not, however, be forgotten that coasts where breakers reach the cliffs at high water, are frequently protected by beaches at low water; and that therefore they are removed from the abrading power of the waves, during all the time that they break on the protecting beaches, a time which varies with the varying state of the tides, and the state of the weather generally.

"Other encroachments are made by the fall of masses of cliff undermined by the waves, the cohesive power of the rock not being equal to its weight, or the action of gravity downwards. If a rock be even sufficiently cohesive in the mass, as to admit of considerable excavation without falling, a time must come, if the breakers continue to work on in the same direction, when the weight of the superincumbent mass would be such that it must fall.

"Where, however, a great mass of cliff does fall, in the manner noticed above, the observer should direct his attention to its conservative influence. To appreciate this, he will consider the hardness of the rock, the position into which it has fallen, and its new power of breaking the waves farther from the coast. If the mass of fallen rock be stratified, much will depend upon the face presented to the breakers; for if it fall so that the plane of the beds remains sloping seaward, it will act as a well-contrived wall erected to defend the cliff; but if the beds should be exposed vertically after the fall, the future destruction of the mass would be far more rapid, and its conservative influence consequently less."

5. No one knows better than I do the ability, the zeal, and the intelligence which Mr. Hartley has displayed in the construction of the Liverpool Docks, and the hydraulic works in the River Mersey; in stating his evidence, as that of a practical man, in favour of the upright wall in the open sea in Dover Bay, I think it best to let him speak for himself.

Question. "You say you prefer an upright wall to any other form for a breakwater; do you know any certain instance of the positive experiment of a wall which has stood the test of time in such an exposed situation, and on such a monstrous scale as Dover Harbour may require?—*Answer.* I do not.

"Is it merely matter of opinion?—That is all.

"This perfectly upright wall in Dover Bay in seven fathoms water is an experimental measure you admit?—Quite so as respects myself.

"With respect to the time that it would take to make a breakwater, is that opinion formed upon any knowledge of Dover, or the difficulties of making a wall at Dover?—No, it is only founded upon a supposition of what the sea is in general, and supposing I was to attend to it myself, and had nothing else to do; but it is a vague sort of idea.

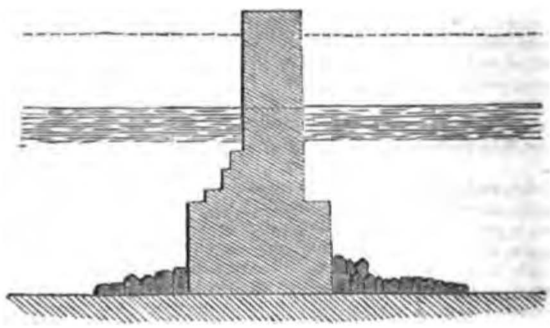
"You are not acquainted with the locality?—No, not sufficiently; I have been there two or three times.

"Have you ever built a wall yourself in such deep water as that?—No, never."

6. My gallant and highly esteemed friend, Major-general Pasley, gives the following account of his conversion to, or adoption of, the theory of the upright wall: "For many years I paid no attention to this subject, but thought that the long flat slope adopted at Plymouth Breakwater must be the best form for resisting the sea, not only from the reputation of the eminent engineer and naval officers by whom this construction was proposed, but also from the circumstance of its having been approved and carried into execution by order of the Government of that day. But in the year 1842, when this question was publicly discussed at one of the meetings of the Institution of Civil Engineers, at which I was present, after a paper of Lieutenant-colonel Jones, R.E., had been read, in which he gave the preference to upright walls, as being much more secure than breakwaters or flat slopes, and stated his reasons for this opinion, the arguments in favour of the former appeared to me to preponderate. I have since given the subject much attention, and have made inquiries and observations, which have confirmed me in this impression."

7. Captain Vetch is the next authority cited in favour of the upright or nearly upright wall, both from theory and practical observation. On account of the extraordinary difficulties of constructing a harbour of refuge in Dover Bay, he thought that the best mode of executing such a work was by the system of caissons which he proposed. With respect to the combination of a slope with an upright or nearly upright face for the superstructure, he Captain Vetch, said it would be highly advantageous; that it would obviate a great many objections to the present condition of the Plymouth Breakwater; it would prevent the waves breaking over, and would give security to erections on the breakwater itself. The works now going on at Cherbourg, which had been erroneously considered to be an abandonment of the slope in favour of the upright wall, is only a combination of both; this he thinks a great improvement, and adds, that such a breakwater at Dover would be very superior to one entirely sloping. Captain Vetch recommends brick in cement for face work, and suggests blocks of brick firmly agglutinated into a mass by means of a cheap flux between the joints; the mass of brick blocks being subjected to the requisite heat by means of flues or otherwise.

8. M. M. Reibell is the next authority adduced in support of the upright wall; and a sketch, of which the annexed is a copy, is inserted in the Proceedings of the Commission to sustain, as it would appear, the



proposition of the upright wall, which it is inferred the French engineers as a body, approve, and would adopt, if the breakwater in Cherbourg Bay were to be commenced *de novo*.

Captain Washington, in his report on the breakwater at Cherbourg states, that "M. Reibell, the present engineer, is decidedly in favour of an upright wall, and recommends the form shown in the annexed sketch as the best for opposing the shock of the waves."

9. Mr. Brunel is next adduced as having given his opinion in favour of an upright wall for the construction of breakwaters. But Mr. Brunel was not examined before the Commission, and the only opinion which he has given upon this subject is that contained in the annexed extract of a letter from Mr. Brunel, addressed to the Chairman, dated 19th June 1844: "Upon one point upon which I understand the Commissioners to have sought an opinion, I have no hesitation in expressing my concurrence in those which I am told have been generally expressed in favour of vertical sea-walls, in lieu of slopes, where the nature of the material to be used, and other circumstances, admit of such a plan being efficiently and economically carried out."

10. Mr. Bremner is next adduced as an authority in favour of the upright wall.

With the greatest possible respect for all these able and eminent men, I must say, that I do not find any thing in what they have adduced that can, in my judgment, warrant the adoption of the mode of construction which they recommend; it does not rest upon any proved principle, is untried upon any sufficient scale to justify its adoption in a great national undertaking, and all agree in designating it experimental.

When I find it stated, in the summing up of the Commission, that the opinion of Mr. Alan Stevenson in favour of a sloping breakwater is the "sole exception" to those of the other men of distinguished science and practical observation, who have been called upon to advise the Commission on this important subject,—I feel bound to interpose against the conclusion arrived at, Sir John Rennie, Mr. George Rennie, Mr. Cubitt, Mr. William Stuart, as well as Mr. Alan Stevenson, who all disapprove of any attempt to construct an upright wall in the open sea at Dover; and they distinctly express their opinion, apprehension, or conviction, that such attempt would end in total failure; and when to this I shall have added what I have yet to say upon the subject of Cherbourg, Plymouth, and Delaware breakwaters, works actually constructed on the principles which the new theory would abandon, and shall have adduced the opinion of the most eminent and enlightened engineer of France, I trust I shall be considered to have made a good case in support of this dissent.

There is no part of the Report of the 28th January 1846 from which I more decidedly dissent than that which refers to Cherbourg Breakwater as a failure, and as "an attempt which may serve as a warning to those who may have to decide upon the construction of such works in this country," that they avoid entirely the principles upon which that work has been constructed.

In the Annex (M.) is a brief historical account of Cherbourg Breakwater from the commencement, together with an extract of the Report of the Commission of the Institute of France, of which Prony and Charles Dupin were members, and Girard rapporteur. These eminent men, after a careful inspection of that work, and after having investigated the whole process of its execution throughout, reported that the failures which had taken place arose, not from its having a sloping face, but that the slopes were not long enough to resist the action of the waves; that no constant degree of slope is calculated to resist the different actions of the sea at different depths; that these actions reduced gradually the masses of stone forming the original dyke, to a profile having different degrees of slope, and that this necessarily diminished the height of the work at different times. They added that the whole mass was thus, at length, brought into a state of the most perfect stability; and all this was verified by the United States Commission.

The first great lesson really taught by the work in Cherbourg Bay, as a warning what to avoid, is that the system of caissoning should not be adopted; the next lesson is to avoid the use of small stones deposited *à pierre perdue;* the third lesson is, not to construct the sea-face of breakwaters in one uniform slope from the bottom, but to form the profile with two slopes, and to make the slope far longer than that which was originally designed for the work. The result of this extensive experiment demonstrates first, how insufficient and incompetent mere theory and speculation are, to fix within precise limits the degrees of resistance which should be given to a work exposed to the violent efforts of the sea.

We find that the mass of materials originally deposited in Cherbourg Bay, was heaped up so as to form too steep a slope, and that the agency of tempestuous waves has disposed of them by reduction to a form which secures their permanent stability:

That the part of a breakwater which is above the highest level of spring tides, is so little exposed to the action of waves (which must have lost by their ascent a portion of their momentum ere they arrive there), that it may be more steep than the part below.

We learn also that the part of the breakwater between low water and high water, spring tide level, is exposed to the greatest violence of the waves during the whole of the rise and fall of tides; and that there the slope should be longest, or the inclination of the face to the horizon should be the least.

Captain Washington states, in his report on the breakwater at Cherbourg, "that the long slope of ten to one, formed by the action of the waves, from low-water mark upwards, has not varied, not even in the gales of 1808, 1824, and 1836, the most memorable on record." There cannot be better evidence of the stability of the long slope.

That the part of the breakwater for a certain distance below the lowest spring tide, is exposed only to the shock of waves towards the termination of the fall and the commencement of the rise of tide; that there the slope may be steeper, or the inclination to the horizon greater; whilst at the lowest part of all, or that which remains permanently submerged, the slope may be still more steep, or have the greatest inclination to the horizon.

With respect to the magnitude of materials, we find that small stones have not sufficient stability to withstand even a moderate action of waves.

That stones of from one and a half to two tons weight, are sufficient to resist the effects of a moderate sea.

That blocks considerably larger are required to withstand violent seas.

That when small materials are used, it is indispensable to cover them with blocks of large dimensions.

That very large blocks should be placed towards the top of the work, to compensate by their weight the loss of stability caused by the total immersion of the materials beneath, for these lose as much of their weight in water, as is equal to the weight of water displaced.

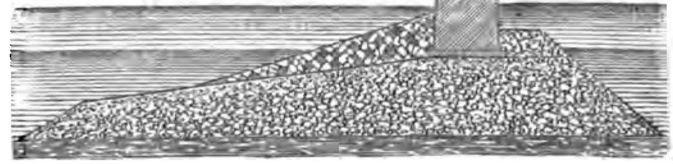
The last fact to be noticed respecting the work at Cherbourg constitutes a very decided warning against the use of blocks of concrete, which was proposed by Captain Denison, November 21, 1845; for the application of this material on a large scale has entirely failed; the blocks of concrete having broken to pieces.

The imperfections of the original project being corrected, the breakwater at Cherbourg is now proceeding rapidly to completion; and far from being a warning that those who have to decide upon the construction of a Harbour of Refuge in Dover Bay, or elsewhere, should avoid the principles and reject the form which has been observed in its construction, it demonstrates in the most forcible manner, that the theory of the upright wall should be rejected, and that in its place should be adopted the well-tried slope, or rather a combination of different slopes; while a nearly upright wall may be formed above, to serve for the facing of a parapet like that which crowns the work at the French port.

Now, persons who read cursorily that part of the Report to which I have referred, may imagine that the old dyke at Cherbourg had been taken down, and that the vertical wall which has recently been built, is raised from the natural bed of the sea, to the exclusion of the slope; whereas it is, in fact, merely a parapet with a nearly vertical face placed on the original breakwater, to prevent the waves from rushing over the terre-plein, after their force had been expended or greatly diminished, in ascending the long slope or glacis in its front.

I repeat now, on the authority of the very highest, the most experienced civil and military engineer of France, or probably that the world ever knew, that "all the enlightened engineers of France do continue to adopt, and will continue to construct breakwaters with inclined slopes, and do reject the theory of the upright wall; that the only alteration they would make if the work were to do over again, is in the degree of slope, which they would make variable according to the nature, specific gravity, and magnitude of the materials used; that the walls now being erected at Cherbourg, are not upright from the naked bottom of the sea, but built as a parapet, upon a well-consolidated basis; this being the breakwater previously formed *à pierre perdue*, whose slope has different degrees of inclination to the horizon, according as the action of the sea has reduced the original mass." That great work now stands in the form of a combination of the slope with the upright face for the superstructure; a profile which Rendel, Rennie, Cubitt, Vetch, Stuart, Colonel Harry Jones, Vignoles, and others recommend, but which Professor Airy says, speaking of an entire breakwater so formed, is, theoretically, "without doubt the worst of all.

That there may be no mistake upon this important matter in reference to Cherbourg Breakwater, unquestionably the greatest piece of hydraulic architecture that has ever been executed, I annex a profile, showing a combination of the long slope with the vertical parapet and its fore-slope of stones;



and I add the reasons which induced the French engineers 14 years ago to recommend such a superstructure. This combination was proposed for the completion of the breakwater, by Mons. Duparc, director of hydraulic works at Cherbourg, and sanctioned without modifications by the Minister of Marine in April 1832, on the advice of a special commission, to which that proposition had been referred; but so far from pulling down the ancient dyke, as stated in the Report, it was raised from the level to which it had been reduced from not having slope enough, by depositing large blocks of rough stone up to the height of low-water spring tides; and on it there was laid a mass of concrete, about 3 feet thick, on which a wall or quay is built to the height of 12 feet above high-water spring tides. The exterior side of this quay or wall, is protected by a fore-shore of great blocks of stone, extending in a slope of 120 feet to the depth of 21 feet below low-water mark. The object of these blocks is stated by Mr. Virla to have been two-fold. The inclined surface of this fore-slope makes, with the face of the wall, a re-entering angle which might have been avoided in part by adopting the concave profile of Mons. Emy, but which in this case was not thought necessary, inasmuch as the artificial beach of great masses of stone the principal object of which was to give to the slope of the dyke perfect stability, produced in addition an important effect in resisting the action of the waves at low water. It is found, in fact, that the waves which break on the surface of a long slope, have time to deaden their force against the asperities of the blocks which form the slope, before they strike the re-entering angle of the foundation; and as the sea rises, and the time of high water approaches, the slope in front produces the effect of an ordinary beach in turning and throwing up the waves, which would otherwise break against the wall with extreme violence at the moment of their maximum of intensity.

Lieut.-General Sir Howard Douglas concludes by giving his dissent to the statement made by the Commissioners in their Report, "that they do not approve fully of any of the plans sent in."

And he objects to the use of blocks of concrete, or of brick set in cement, or to any other artificial material, as substitutes for stone, for the formation of national works, which, if not to be constructed on sound and well-tried principles, with materials of the best and most enduring descriptions, should not be attempted; and he also dissents to the recommendation of a majority of the Commission, for the adoption of masses of brick, as proposed by Mr. Rendel.

And lastly, Sir Howard dissents from any extension of the area to be comprehended by the breakwater, as recommended in the Report of 1844; and more especially from the suppression of the eastern opening; without such opening, the proposed Harbour of Refuge would be deprived of an essential condition which all such harbours should possess, that of facility of egress or escape at all times and tides, and in all weathers; and he is convinced that by omitting to form this opening, the proposed enclosure would become to such a degree a close harbour, as greatly to increase and accelerate the progress of the evil to which all close harbours are liable, that of rapidly silting up.

RENAISSANCE DECORATIONS.

An Account of the Palace of Blois and Palace of Chambord, France, especially as to the Decorations. By JOHN GREGORY CRACE. Read at the *Royal Institute of British Architects, May* 31.

Having been much interested during an excursion made to Touraine, in the autumn of last year, by visits to Blois, Chambord, Chenonceaux, Amboise, and other monuments of the Renaissance style of architecture, which abound in that district of France, I am induced to lay before you a description of what I saw at the two former of those places, Blois and Chambord.

The town of Blois, on the river Loire, is of very considerable antiquity, and contains many objects highly interesting to the lover of mediæval art. It lies between two hills, on one of which is the cathedral, on the other the palace or castle.

The Castle of Blois is supposed to stand on the site of a Roman camp. Mention is made of it in history about the ninth century. I do not attempt to detail to you its various possessors, but merely observe, that in the year 1292 it first came to the De Chatillons, who are supposed to have built parts of the castle. Froissart, who was chaplain to Guy de Chatillon, Count de Blois, says, that it was "grand and strong, and one of the handsomest in France." By this Count Guy it was sold, as indignantly mentioned by Froissart, to Louis d'Orleans, brother to King Charles VI., who took possession in 1397. The Orleans retained the property till their descendant became King of France under the title of Louis XII.; it then remained crown property till Louis XIII. bestowed it on his brother, Gaston d'Orleans, at whose death it seems to have reverted to the crown, and at the Revolution to have become public property. Viewed as you ascend from the town, the castle appears rising from a mass of rock, on which is an imposing base of solid masonry, giving the idea of a fortress of considerable strength. Passing the west front of the building, you arrive at the Place des Jesuites, when the eye is struck with the magnificent north front of the quarter erected by Francis I. This front is entirely of stone; partly in two, and partly in three stories. The windows are in arched recesses, relieved with deep colouring, producing a rich and powerful effect; between the windows are pilasters, and where these are double they are separated by niches and deep recesses. Picturesque bays also project in various parts of this façade. A large circular tower marks the old *tour des oubliettes*, or the *donjon*, considered one of the oldest parts of the building. The roof is separated from the entablature by a series of columns, thus forming an open gallery, and from the pedestals of these columns project tremendous gargels. To my mind the effect of this front is truly beautiful, and a successful example of the introduction of colour to architectural exterior. Part of the building was erected by the architect Mansard, by direction of Gaston d'Orleans, in the reign of Louis XIII., in a style of art seen to great disadvantage beside the beautiful front I have attempted to describe.

Leaving the *Place*, we approach the east front of the exterior, constructed by Louis XII. It is of brick, with ornamental stone dressings. I regret not being able to show a view of this front, which is very picturesque. I sketched one window, and also—what is the principal object—the canopied recess that formerly contained the equestrian statue of King Louis XII. This recess, surmounted by its canopy, is of stone beautifully wrought. I have ventured to restore, in the drawing, the colouring to the back-ground, powdered with gold *fleurs-de-lis*, and to replace the statue as it existed previous to the Revolution, from a drawing in a manuscript by Felibien. On the fascia under the statue was formerly placed an inscription, in Latin, which may be thus translated:—

> "Where by the grace of God Louis was born,
> Here also, with a noble hand, he assumed the royal sceptre.
> Happy the day which announced the coming of so great a monarch.
> France could not have found a king more worthy of her."

That statue and the inscription are alike removed, and on the same fascia is now written "Caserne d'Infanterie." The palace of Louis XII. "the father of his people," is now a barrack.

Under this canopy is an archway, forming the principal entrance to the interior court of the palace. This court consists of an irregular square, the four sides of which are in as many styles of architecture. On the south, the Gothic of the fifteenth century; on the east, the elaborately ornamented Gothic of Louis XII.; on the north, the elegant *renaissance* of Francis I.; and on the west, the Franco-Italian style of Mansard: all these, full of irregularities, produce an *ensemble* picturesque and charming to the eyes of all, and most interesting to the lover of art.

The south side of the building, looking towards the interior court, was altered and partly rebuilt by the old Dukes of Orleans. It is of an unpretending style of domestic Gothic, the outer walls being of brick, the windows and dressings of stone. In this quarter, in addition to various apartments, is the old chapel of St. Calais, which dates from a much earlier period; a view of it can be seen in Androuet Ducerceau.

The east side of the court is the building erected by Louis XII.; it is of red brick, with window dressings, string courses, and enrichments of stone richly carved; above, rises a high roof formerly crested with gilt metal work, from which project dormers in stone of beautiful tracery, the whole resting in front on a colonnade, forming a sort of cloister; the stone pillars being diapered with trellis work, in which were formerly *fleurs-de-lis* and ermines. This quarter contains the apartments occupied by King Louis XII., which, though now under one universal coat of whitewash and all in the occupation of soldiers, were formerly fitted up with regal splendour.

Here, in the year 1501, King Louis XII. received in this building the Archduke Philip of Austria, and a chronicler of the period gives a most complete and interesting description of the palace as it then appeared. The east front was then just finished, its network of stone shown in all its brilliant freshness on its bright brick ground; the carvings were seen in all their perfection; a profusion of *fleurs-de-lis* and ermines, sculptured or painted, were spread over the building; gold, purple, and azure dazzled the eye in every direction, even up to the roof, whose crestings and enrichments were also gilt; over every door was seen the royal badge of the porcupine spreading out its quills, and over the entrance archway was the splendid statue of the king himself, young and handsome, noble and full of grace, as he then was.

Nor was the interior less magnificently decorated: rich tapestries, wrought in figures or flowers, or ornaments, furnished the walls; over the floors were spread thick carpets. The chimney-pieces were blazoned with heraldic shields, paintings, and devices; the joists of the ceilings (for they were unplastered then) glittered with gilding and elegant decoration; furniture, carved with the utmost delicacy of finish; beds, covered in the richest stuffs, embroidered in gold and in silks of all colours—these ornamented the apartments. And as if to recall the salutary thought of death, in the midst of all that was gay and joyful there was painted, as was usual then, the celebrated dance, *Macabre*, on the walls under the piazza or colonnade.

The king was proud of his palace, and right royally did he receive his visitors. Our chronicler, after describing with much interesting detail the procession by torchlight, the reception of the archduke and duchess, and the ceremonies of introduction to the king and queen, continues his description of the apartments of the palace.

"The Grand Hall, by which the archduke and duchess entered, was of great size, and hung with a tapestry of the Destruction of Troy; and in the like manner also a chapel at the end of the hall. The room where the king dined, and where the archduchess was, was hung with a tapestry of a battle. Over the chimney was a grand mantle of cloth of gold, craped very rich. The chamber of young Madame Claude was next to the king's, and was hung with a tapestry of pastorals, all small, with inscriptions, which was very fine. Afterwards came the chamber of the queen, hung with a tapestry of strange beasts and birds, with figures from foreign countries; and in said room was a bed, all dressed out with cloth of gold, and above the bed a canopy of crimson damask. In the lodgings of the archduke there was a gallery, hung with tapestry of the deeds of the Trojans; after that a grand chamber, hung with tapestry of the actions of Alexander the Great, and a mantle over the chimney, of cloth of gold, craped. From ceiling of this room hung two chandeliers, marvellously large, of silver, made crossways, for placing on each four flambeaux, which chandeliers hung by great chains of silver. At the end of this room was the chamber of the archduchess, where the said lady and gentleman slept, which was hung with cloth of gold, wove with black and red. Here were two beds, of which the one in which they slept was of stuff embroidered in gold, and curtains of the same, lined with white damask: and above this bed was a canopy, the top of cloth of gold, the curtains of taffetty, yellow and red.

"The other bed was furnished in the same manner, and on each were coverlets of cloth of gold, and inside them sheets of linen from Holland. All around the beds, and on the buffet were carpets of cloth of gold. In the corner by the bed was a gilt chair, admirably wrought by Italians, of which the seat, &c. was covered with cloth of gold, fringed all round with fringes of gold and silver. Before the chimney was another chair, also covered with cloth of gold, and there was carpet of the same stuff under it; also, there were many rich cushions in the room to sit upon."

And thus goes on our chronicler, describing every room: one hung with crimson velvet embroidered with K's and A's, crowned; another with crimson embroidered with cords and the arms of Burgundy;

another with brocade, yellow and grey, with S's in black velvet; another with crimson satin embroidered in flames of fire, and at the angles and in the centre were lions in wreaths, entirely covered in pearls, and which were mighty rich to see, and cost 40 to 50,000 ducats. And the chronicler further takes care to remark, that all the said stuffs and tapestries were as fresh and good as new, and that the floors of all the rooms were covered with carpets of velvet, so that nothing of the floors was seen.

Thus was furnished this palace of a king of France at a time contemporary with the reign of our Henry VII.

At each extremity of the front of Louis XII., and forming part of the work erected by him, is a square tower of picturesque appearance. It contains a staircase of considerable elegance. The stairs radiate round a centre shaft, which is formed of clustering columns terminating in a crown at top, from which rises a vaulted ceiling. Though the construction and many of the details are Gothic, yet some of the ornaments partake of an Italian character.

From this staircase we pass to the part of the palace the most historically famous, the ancient *Salle des Etats*, a large building, of somewhat plain appearance, dating about the thirteenth century, although several alterations of a later period have been made to its windows, &c. In this spacious hall the three estates of the kingdom used formerly to assemble. It has a rude and bare appearance; down the centre range a series of pointed arches, resting on columns supporting the roof, and dividing the ceiling into two parts, which are arched, and simply covered with flat boards. In the reign of Henry III. the states were summoned to meet here; and it was during their assembly that the powerful Duc de Guise was murdered in one of the apartments of the palace. The hall was then richly ornamented; the walls were hung with splendid tapestry, worked in figures, relieved with gold; the columns covered with purple velvet, powdered with gold *fleurs-de-lis*; and the ceiling was also covered with tapestry. A platform was raised nearly in the centre, behind one of the arches, on which was placed the throne of the king, all being covered with purple velvet, powdered with gold *fleurs-de-lis*, and on this, and on the steps to it, were seats for the blood royal; behind stood the archers of the guard; in front, and on either side, were the three estates, and in galleries at the end were seats for ladies;—the common people were also allowed to enter within certain barriers. The king descended from his apartments into the hall by wooden stairs at the end, but which stairs are now removed.

Adjoining the ancient *Salle des Etats*, and forming the northern side of the quadrangle, is that quarter of the palace erected by Francis I. This front, by the elegance of its proportions, the beauty of its details, and the grandeur of its effect, is by far the most imposing feature in the whole building, and a most tasteful specimen of the Renaissance style of architecture. The exterior front, towards the *Place des Jesuites*, I have already described; this, towards the interior court, is altogether different: here we have more elaborate decoration and greater delicacy of finish. It is entirely of stone, and composed of two principal floors, decorated by pilasters and pannelings; round the windows are interlaced enrichments, and the reveals are panelled, and were, I suspect, formerly relieved with colour. Above is an entablature of considerable richness and beautiful effect. Its modillions project to some extent, and above them is a kind of machicolation, containing shell enrichments in its recesses; over this rises an ornamental balustrade, formed of the letters F and C, for the initials of Francis I. and Claude of France. From the roof project dormer windows of graceful outline; and even the chimney-shafts are enriched, and by no means unworthy of remark. The roof itself was formerly crested with an ornament composed of *fleurs-de-lis*, gilded. Below was formerly a colonnade supporting a gallery, as given by Ducerceau, which, although now removed, is about to be restored. But the principal object in this front, and which gives a charm to the whole, is the grand open staircase, situate about the centre of the façade, and projecting in front of it. This has lately been restored, and now shines forth in the full beauty of all its delicate and tasteful workmanship. The balustrades are formed of open carvings of foliage and the crawling salamander. Niches of most elaborate detail and elegant arabesques adorn the shafts of the pilasters; twining foliage is sculptured round the mouldings of the window openings;—in every part does ornament seem to clothe this magnificent work of art like the delicate foliage and clinging tendrils of the ivy clustering round a tree, yet nowhere does it superabound or appear misplaced.

The interior of this staircase is also ornamented with carved niches and enrichments; mounting its steps, we enter the suite of apartments on the first floor, being those formerly occupied by Queen Catherine de Medici.* The first is called the *Salle des Gardes*, or guard chamber, a room of considerable size. The chimney-piece of stone, though massive in construction, is to be noticed for the elegance and richness of its ornaments; the stair door-frame is decorated, and has over it the salamander in flames, the badge of Francis I. The ceiling here, as in most of the rooms in this building, is formed of beams, which are, in fact, the floor-joists of the room above; the effect of these, when painted, is by no means unpleasing. I made a sketch of the decorations lately executed on this ceiling, in which the initials, arms, and badges are mingled, with forcible contrasts of colour; whether the precise pattern is a restoration or not, I had no means of discovering; but there are many old examples of this mode of ornamenting the ceilings still remaining at Chenonceaux, Fontainbleau, and other places; and in Venice, almost all the older palaces have the ceilings decorated in this way, with arabesques and inlaid ornaments of great variety and beauty. The walls of this chamber are now bare, so they are all, in fact; nothing now remains of the splendour that dazzled the eyes, or the works of art that delighted the mind, during the time of Francis I. We pass through a multitude of rooms, but all are desolate alike—each has suffered the distressing calamity of whitewash—not a vestige of furniture, not a hanging remains. The chimney-pieces alone attest the magnificence and beauty with which the remainder must have been ornamented. I anticipated the pleasure of sketching these, which possess a rich fund of *renaissance* art, but a custodian abruptly prohibited my making further drawings; and I was thus prevented taking many details in the interior that might have proved interesting. The state-rooms seem to have been situated on this court-side of the building; and on the other, looking towards the *Place des Jesuites*, were the large bed-room and private apartments of the queen; amongst others, her cabinet. In this the walls are covered by carved panelling, the details of which are executed with much spirit and taste.

Again mounting the open staircase, we reach the floor above, the disposition of the rooms on which is exactly similar to the one we have left. These were the apartments occupied by King Henry III. You enter first the *Salle des Gardes*, which served also as a council chamber; from hence you pass into the king's bed-room, a very spacious apartment looking towards the *Place des Jesuites*. Here occurred the tragedy of the murder of the celebrated Duc de Guise.

The cabinet of the king is next this chamber; it is a small room, which still retains some traces of decorations. On the ceiling are to be distinguished slight remains of colouring, and arabesque ornament in fresco may still be seen on the linings of the window recess. On the left of the bed-chamber you enter a sort of passage which leads to the old Tour des Oubliettes or Donjon, of which so many horrors are retailed; at present nothing but bare walls of considerable thickness are to be seen.

Above this second floor are a range of rooms in the roof, but these contain no ornamental or interesting feature of any kind except that a most extensive view of the adjoining country is to be obtained from the open gallery outside them.

Of the west front I have little to say; it is that erected by Gaston d'Orleans, in the time of Louis XIII. As a structure away from these middle age remains, it would probably be admired, but here it is thoroughly out of place. It stands on the site of a part of the ancient château erected by the old Dukes of Orleans.

Before leaving the Château de Blois, I must not omit to call attention to an old tower, used subsequently as an observatory and astrological study by Catherine de Medici.

THE PALACE OF CHAMBORD.

Crossing the Loire, you pass along a sandy road through a district of vineyards, till you enter a forest, in the midst of which, and at about four leagues from Blois, lies the celebrated *Château de Chambord*.

It is difficult to describe the effect it first creates upon the mind—it looks so perfectly unlike any thing one has ever seen before. Below—its massive round towers and perfect simplicity give the idea of the strong fortress of ancient date. Above—the wildest confusion and profusion of the most fantastic, the most beautiful, and the ugliest forms, all mingle together, and produce an architectural scene that cannot be imagined.

The building is immense, and has an appearance of extreme grandeur, stateliness, and solidity.

Androuet Ducerceau says, "All this edifice is admirable, by reason of its great massiveness, and presents an effect wondrously superb on account of the immensity of work in it."

It is said to have been begun to be built by Francis I. after his return from Spain, about the year 1526, and that nearly 2,000 workmen were employed on it for many years.

The centre building is in the form of a square, having at the angles four great round towers about 60 feet in diameter. This centre square building is inclosed, as it were, within an exterior court, having at its angles round towers also. Of these, the two in a line with the principal building nearly resemble those of the centre, with which they are connected by a continuation of the front; and the two towers at the other extremities are smaller, and connected with an insignificant range of buildings for stables, offices, &c., and which, though built by Mansard, in the time of Gaston d'Orleans, are a complete eye-sore contrasted with the more ancient building.

I believe it is unknown who was the architect of Chambord. Primaticcio has been mentioned, and it seems to me likely to have been designed by an artist accustomed to flights of the imagination, rather than by an architect who would have studied greater appropriateness in the forms.

Though it is not so stated in any account that I am aware of, I cannot help fancying that the round towers must be the remains of some older building, so completely does the plan resemble the inclosed strong-hold, the old *maison-forte* of the earlier middle ages.

Three ranges of pilasters at almost regular intervals, girt the exterior of the principal building, which is partly relieved with open galleries; above these is an entablature, showing the same kind of machicolation and shell-work as in the building of Francis, at Blois; and above the cornice is a balustrade, which girts the platform on the roof. Towards the interior of the court, the architecture possesses more variety, and at the two angles is an open staircase of beautiful design, resembling the one at Blois.

But the roof is the glory of Chambord. The whole top of the building is one grand terrace, paved like a marble court.

Immense pointed roofs, more than 60 feet high, rise above the towers like ornamented pyramids studded with magnificent dormers and gabels, intermingled with elegant chimney shafts and towers, decorated with niches and flanked with columns in most beautiful proportion.

Elevated above all the rest is the grand centre staircase of the building (of the interior of which I will speak presently). This, as it rises above the platform, is surrounded by columns supporting a gallery, from which spring eight grand flying buttresses, ornamented with gigantic salamanders and supporting the cupola, which terminates in the remains of the famous *fleur-de-lis*, which gave the name to this crowning glory the "*Tour de la Fleur-de-Lis.*"

There are published views to explain, in some degree, the appearance of this wonderful work; but no drawing can convey the full effect of this labyrinth of palaces, seen at different points of view, as you wander about this magnificent platform.

The various towers and chimney-shafts are of most elegant proportion; but the details, though of beautiful design, are rarely executed with the finish of the work at Blois, which they much resemble.

The caps of the pilasters, and the corbels at their base, are of infinite variety.

On the gable and the buttress of centre tower may be remarked dark lozenges and circles, and also a sort of fluting. To these I beg to call your attention; for though looking from below like inlaid marble, they are in fact nothing but pieces of slate nailed on the surface.

The interior arrangement of the château is extremely peculiar. On each floor one vast apartment stretches in the form of a cross, from back to front, and from side to side, of the building; and in the centre of the cross is the celebrated double staircase, rising through every floor, and forming the highest object in the roof above.

In each of the four angles left by the cross is a separate suite of apartments, including also others within the angle towers, and from two of these, again, there is a communication by another suite of rooms with the two outer towers on the same front. The large cross-shaped chambers are called *Salles des Gardes*; but I cannot think that rooms of such magnitude, communicating with every quarter of the château, could ever all of them have been intended as guard chambers. I rather imagine, considering that Chambord was erected by Francis I. as a hunting palace, that it was arranged on this singular plan as a place where state was to be laid aside, and that these halls were places of general rendezvous. Their ceilings are vaulted and divided into panellings, filled with the initial F and the royal salamander in flames alternately. In one of these curious chambers, where scenes of state and ceremony have often occurred, Moliere's play of the "Bourgeois Gentilhomme" was represented for the first time, before Louis XIV.

The grand staircase is wonderful—wonderful for the effect it produces and the beauty of its proportion and its ornaments, rather than for any peculiar difficulty of construction. Its construction may be thus described:—the outer diameter of the staircase is, I suppose, about 30 feet; in the centre of this is an inner wall, in diameter about 10 feet; between these two circles the stairs wind up in a double spiral, commencing at opposite points, so that parties entering at each, in ascending, see each other repeatedly through openings, but do not meet till they arrive at the various floors. The exterior of the staircase is decorated, and the interior wall is also highly ornamented with a variety of beautiful niches. The salamander in flames and the initial F are also introduced, the latter surrounded with a frame of cords—emblem of the Cordilieres to which the king's mother belonged. Of the termination of this staircase above the roof I have already spoken.

Of the four hundred and forty chambers which this mighty château is said to contain, there is not one that has escaped the distressing evil of whitewash, and few of them retain any ornament indicating their former use or recalling their former grandeur. I sketched a ceiling of a small vaulted room, said to be a private chapel, where the panels resembled those in the *Salles des Gardes*; and I remarked a chamber where there were indications that a painted frieze, three feet deep, had been; but everywhere the walls are bare—not a vestige remains of any kind of hanging or decoration. Destruction, the most ruthless that can be conceived, has swept over the whole interior: all the furniture, the paintings, the wainscoting of the walls, the very doors, the windows, were burnt, broken, or stolen at the time of the Revolution.

Yet, what must the chambers have been at the time of the royal Francis, who so loved to surround himself with objects of art!—what thousands of works produced under his fostering care still remain to us! Who can doubt that the rooms, so wretched now, were one blaze of splendour then? that, besides the paintings of Primaticcio, and the frescoes of Jean Coussin, who were engaged there for years, there were assembled there the choicest works of the greatest masters—groups in marble by the rarest Italian hands; bronzes by Cellini, and, equally precious, his tasteful ornaments and vases in gold and silver; delicate carvings in ivory; enamels, by Leonard de Limoges; glasses from Venice. Fancy that the walls were hung with the richest tapestry, or leather, or brocade—that the ceilings were blazoned with colour and glittered with gold—that tasteful furniture, which Il Rosso and Primaticcio disdained not to design, filled the various apartments; picture the king, in the midst of his brilliant court, dazzling the eye with the richness of the costume and the beauty of the ladies—and the mind will indeed conceive a scene at Chambord, in vivid contrast to now what meets the view.

ON THE INDUCTION OF ATMOSPHERIC ELECTRICITY ON THE WIRES OF THE ELECTRIC TELEGRAPH.

By PROFESSOR JOSEPH HENRY.

(*Continued from page 177.*)

4. Powerful electrical currents are produced in the wires of the telegraph by every flash of lightning which takes place within many miles of the line, by the action of dynamic induction; which differs from the action last described, in being the result of the influence of electricity *in motion* on the natural electricity of the conductor. The effect of this induction, which is the most fruitful source of disturbance, will be best illustrated by an account of some experiments of my own, presented to the Society in 1843. A copper wire was suspended by silk strings around the ceiling of an upper room, so as to form a parallelogram of about sixty feet by thirty on the sides; and in the cellar of the same building, immediately below, another parallelogram of the same dimensions was placed. When a spark from an electrical machine was transmitted through the upper parallelogram, an induced current was developed in the lower one, sufficiently powerful to magnetize needles, although two floors intervened, and the conductors were separated to the distance of thirty feet. In this experiment, no electricity passed through the floors from one conductor to the other; the effect was entirely due to the repulsive action of the electricity in motion in the upper wire on the natural electricity of the lower. In another experiment, two wires, about 400 feet long, were stretched parallel to each other between two buildings; a spark of electricity sent through one produced a current in the other, though the two were separated to the distance of 300 feet; and from all the experiments, it was concluded that the distance might be indefinitely increased, provided the wires were lengthened in a corresponding ratio.

That the same effect is produced by the repulsive action of the electrical discharge in the heavens, is shown by the following modification of the foregoing arrangement. One of the wires was removed, and the other so lengthened at one end to pass into my study, and thence through a cellar window into an adjacent well. With every flash of lightning which took place in the heavens, within at least a circle of twenty miles around Princeton, needles were magnetized in the study by the induced current developed in the wire. The same effect was produced by soldering a wire to the metallic roof of the house, and passing it down into the well; at every flash of lightning a series of currents in alternate directions was produced in the wire.

I was also led, from these results, to infer that induced currents must traverse the line of a railroad, and this I found to be the case. Sparks we seen at the breaks in the continuity of the rail, with every flash of a distant thunder-cloud.

Similar effects, but in a greater degree, must be produced on the wire of the telegraph by every discharge in the heavens; and the phenomena which I witnessed on the 19th of June in the telegraph office in Philadelphia were, I am sure, of this kind. In the midst of the hurry of the transmission of the congressional intelligence from Washington to Philadelphia, and thence to New York the apparatus began to work irregularly. The operator at each end of the line announced at the same time a storm at Washington, and another at Jersey City. The portion of the circuit of the telegraph which entered the building, and was connected with one pole of the galvanic battery, happened to pass within the distance of less than an inch of the wire which served to form the connexion of the other pole with the earth. Across this space, at an interval of every few minutes, a series of sparks in rapid succession, was observed to pass; and when one of the storms arrived so near Philadelphia that the lightning could be seen, each series of sparks was found to be simultaneous with a flash in the heavens. Now we cannot suppose for a moment that the wire was actually struck at the time each flash took place; and indeed it was observed that the sparks were produced when the cloud and flash were at the distance of several miles to the east of the line of the wire. The inevitable conclusion is, that all the exhibition of electrical phenomena witnessed during the afternoon was purely the effect of induction, or the mere disturbance of the natural electricity of the wire at a distance, without any transfer of the fluid from the cloud to the apparatus.

The discharge between the two portions of the wire continued for more than an hour, when the effect became so powerful, that the superintendent, alarmed for the safety of the building, connected the long wire with the city gas-pipes, and thus transmitted the current silently to the ground. I was surprised at the quantity and intensity of the current; it is well known, that to affect a common galvanometer with ordinary electricity, requires the discharge of a large battery; but such was the quantity of the induced current exhibited on this occasion, that the needle of an ordinary vertical galvanometer, with a short wire, and apparently of little sensibility, was moved several degrees.

The pungency of the spark was also, as might have been expected, very great. When a small break was made in the circuit, and the parts joined by the fore-finger and thumb, the discharge transmitted through the hand affected the whole arm up to the shoulder. I was informed by the superintendent, that on another occasion a spark passed over the surface of the spool of wire, surrounding the legs of the horse-shoe magnet at right angles to the spires; and such was its intensity and quantity, that all the wires across which it passed were melted at points in the same straight line as if they had been cut in two by a sharp knife.

The effects of the powerful discharges from the clouds may be prevented in a great degree, by erecting at intervals along the line, and aside of the supporting poles, a metallic wire, connected with the earth at the lower end, and terminating above at the distance of about half an inch from the wire of the telegraph. By this arrangement the insulation of the conductor will not be interfered with, while the greater portion of the charge will be drawn off. I think the precaution of great importance at places where the line crosses a river, and is supported on high poles; also in the vicinity of the office of the telegraph, where a discharge, falling on the wire near the station, might send a current into the house of sufficient quantity to produce serious accidents. The fate of Professor Richman, of St. Petersburgh, should be recollected, who was killed by a flash from a small wire, which entered his house from an elevated pole while he was experimenting on atmospheric electricity.

The danger, however, which has been apprehended from the electricity leaving the wire and discharging itself into a person on the road, is, I think, very small; electricity of sufficient intensity to strike a person at the distance of eight or ten feet from the wire, would, in preference, be conducted down the nearest pole. It will, however, in all cases be most prudent to keep at a proper distance from the wire during the existence of a thunder-storm in the neighbourhood.

It may be mentioned as an interesting fact, derived from two independent sources of information, that large numbers of small birds have been seen suspended by the claws from the wire of the telegraph. They had in all probability been instantaneously killed, either by a direct discharge, or an induced current from a distant cloud, while they were resting on the wire.

Though accidents to the operators, from the direct dischage, may be prevented by the method before mentioned, yet the effect on the machine cannot be entirely obviated; the residual current which escapes the discharge along the perpendicular wires, must neutralise for a moment the current of the battery, and produce irregularity of action in the apparatus.

The direct discharge from the cloud on the wire is, comparatively, not a frequent occurrence, while the dynamic inductive influence must be a source of constant disturbance during the season of thunder-storms; and no other method presents itself to my mind at this time for obviating the effect, but that of increasing the size of the battery, and diminishing the sensibility of the magnet, so that at least the smaller induced currents may not be felt by the machine. It must be recollected that the inductive influence takes place at a distance through all bodies, conductors and non-conductors; and hence no coating that be put upon the wire will prevent the formation of induced currents.

I think it not improbable, since the earth has been made to act the part of the return conductor, that some means will be discovered for insulating the single wire beneath the surface of the earth; the difficulty in effecting this is by no means as great as that of insulating two wires, and preventing the current striking across from one to the other. A wire buried in the earth would be protected in most cases from the effect of a direct discharge; but the inductive influence would still be exerted. though perhaps in a less degree.

The wires of the telegraph are too small and too few in number to affect, as some have supposed, the electrical condition of the atmosphere, by equalizing the quantity of the fluid in different places, and thus producing a less changeable state of the weather. The feeble currents of electricity which must be constantly passing along the wires of a long line, may, however, with proper study, be the means of discovering many interesting facts relative to the electrical state of the air over different regions.

REGISTER OF NEW PATENTS.

WAGON COVERS AND WRAPPERS.

Henry Henson, of Hampstead, in the county of Middlesex, gentleman, for "*a new fabric, suitable for goods' wrappers, wagon-covers, and other like purposes; and certain processes employed in the manufacture of the same.*"—Granted November 5, 1846; Enrolled May 5, 1847.

This invention relates to the manufacture of two descriptions of fabrics; one suitable for covering wagons, coaches, or other vehicles, &c., and the other for covering light goods, which are not generally exposed to the weather, and for similar purposes. The base of the first fabric is hempen thread; with which is interwoven, when the fabric is being made in the loom, copper wires, or galvanized iron wires covered with thread (but uncovered may be used, if preferred), or thin strips of cane; the object being to produce a fabric which shall not be liable to be rent or torn. The wires or strips of cane may be inserted at from one to six inches apart, according to the strength required, and the thickness of the wires or strips; and they may form part of either the warp or weft. For ordinary fabrics, No. 28 wire will be found suitable, and inserted at two inches apart. The fabric is immersed in a vat, filled with tanning liquor, of 1½ cwt. of good oak bark to one hundred gallons of liquor; the fabric must be so proportioned to the quantity of the liquor, that for every yard there shall be about two gallons of tanning liquor, and to remain in the liquor for about fifty hours, and kept at a temperature of 150°; it is then removed from the vat, and hung up to dry. If the fabric be required to possess the quality of leather in a greater degree than can be given to it by the above process, this may be effected by subsequently immersing it, for about ten hours, in a weak solution of gelatine or albumen, and repeating this operation two or three times, according to the effect desired to be produced. Instead of the above process of tanning, the well-known processes of tanning by exhaustion, or by hydraulic pressure, may be employed. The fabric is now waterproofed, by first saturating it with a composition called by the patentee No. 1, and, when that has become dry, coating it with another composition termed No. 2. The first composition is formed of one gallon of turpentine, one pound of tallow, and one pound of bees' wax; and the second is composed of two quarts of raw linseed oil, one quart of boiled linseed oil (rendered drying by the addition of litharge), one quart of Stockholm tar, and twenty ounces of lamp-black or ground charcoal. The fabric is placed upon a hollow iron table or chest, heated by the admission of steam into it, and the compositions are applied by means of a spatula or brush; the first composition being forced into and through the fabric, and the second laid on evenly and smoothly.

The second description of fabric is made by pasting, cementing, or otherwise uniting a sheet of paper to a sheet of calico or similar textile fabric, which has been previously waterproofed and japanned.

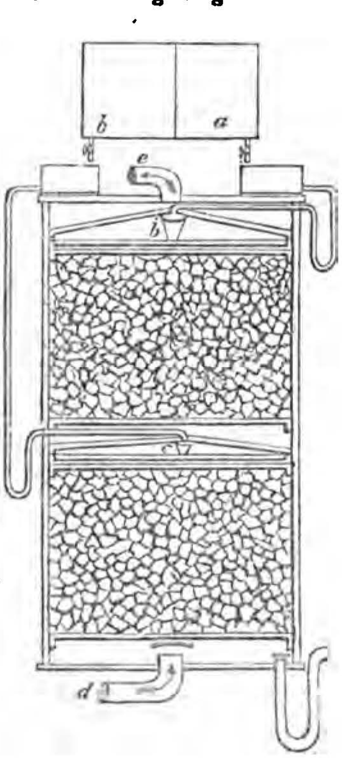
MANUFACTURE OF GAS.

George Lowe, of Finsbury-circus, Middlesex, engineer, for "*Improvements in the manufacture of and in burning gas, and in the manufacture of fuel.*"—Granted Oct. 8, 1846; Enrolled April 8, 1847.

The improvements relate, first, in preparing peat in combination with resin, pitch, oil, fat, or other hydro-carbonaceous matter, and in making gas therefrom; secondly, an apparatus for purifying gas; thirdly, in making gas from coal and other matters, by introducing steam, highly heated, into the retorts used; fourthly, in improvements in Argand gas-burners, whereby the gallery or apparatus carrying the chimney is made to rise and fall on a screw, so as to adjust the admission of the air to the flame; and, fifthly, in manufacturing fuel from peat, by causing dry blocks of peat to be saturated with pitch or other hydro-carbonaceous matters.

The first part of the invention is for saturating blocks of peat with resin, pitch, fat, oil, or other hydro-carbonaceous matters. The peat is cut into blocks, and well dried, and then saturated by piling the peat in a square cast iron boiler, about 18 inches deep, to within a few inches of the top; then melted pitch, resin, tar, or combinations thereof, or other cheap hydro-carbonaceous matter, in a highly-heated state, is allowed to flow into the boiler, and heat is then applied; by such means, the hydro-carbonaceous matter penetrates the blocks, and causes them to be well saturated, the time of such process depending on the character of the peat and the sizes of the dry blocks, but generally about an hour is sufficient. When the blocks are saturated, the remainder of the fluid matter is allowed to run off, and the blocks are removed, and a fresh quantity put into the boiler, and the saturated blocks are placed on edge on open shelves to drain, and afterwards made into gas, by being placed into retorts, in the same manner as coal. The patentee prefers to saturate the dry blocks of peat by placing them within a vessel, such as is now used for saturated wood by the aid of vacuum and pressure. When using tar as the hydro-carbonaceous matter, it is advantageous to combine therewith from five to ten per cent. of quicklime in the state of powder.

The second improvement relates to an apparatus for purifying gas. The annexed engraving is a section of the apparatus, made in two compartments, weak ammoniacal liquor to be used in the lower one, and water or water acidulated with sulphuric or muriatic acid in the other. These two compartments are each nearly filled with lumps of coke, as has before been done in constructing what is called the scrubber; and the improvements consist of the means of distributing the purifying fluid used. *a* is a tank of water or other purifying liquid; *b*, a tank for weak ammoniacal liquid; *b'*, *c*, are two perforated pipes on axes, the perforations on either side of the axis of each pipe being on opposite sides, so that the flow of fluid in streams will cause the tubes to revolve on their axes and distribute the fluid equally on the coke; the gas rising upwards from its pipe of introduction at *d*, passes off, partially purified from ammonia, by the pipe *e*; and it is the use of revolving pipes, *b'*, *c*, which constitutes the novelty of this arrangement of apparatus.



The third part of the invention consists in applying steam, highly heated (after it leaves the boiler or generator), into the retorts used when making gas from coal, prepared peat, or other matter rich in carbon. Steam from a steam-boiler or vessel passes through pipes highly heated, in a like manner to that commonly resorted to for obtaining hot blast in the manufacture of iron, which highly-heated steam is conducted by a pipe into that part of a gas retort most distant from where the gas passes off from the retort. The steam is generated under a pressure about that of the gas, and it flows into the retort freely at the commencement of gas making, after charging the retort, and it is stopped after the most carbonaceous matters have been driven off from the coal or other matter used.

The fourth part of the invention relates to improvements in Argand gas burners, by so arranging the gallery for carrying the chimney for directing the air to the external surface of the flame, that it may rise and fall, and be fixed at the required position by a screw or other means, and thus allow of a nice adjustment of the admission of air to the flame.

The fifth part of the invention consists of treating blocks of dry peat in the same manner as that described under the first part of the invention for gas making.

STEAM HAMMER.

John Condie, of Glasgow, engineer, for "*Improvements in machinery used in manufacturing malleable iron.*"—Granted Oct. 15, 1846; Enrolled April 15, 1847.

The improvements relate, first, to the arranging or constructing steam hammers, that the steam cylinders have the hammer faces applied thereto and move therewith; and, secondly, to the introduction of malleable iron tubes into anvils and hammer and squeezer faces.

Fig. 1 is a front elevation of the hammer and steam apparatus;

Fig. 2. Fig. 1.

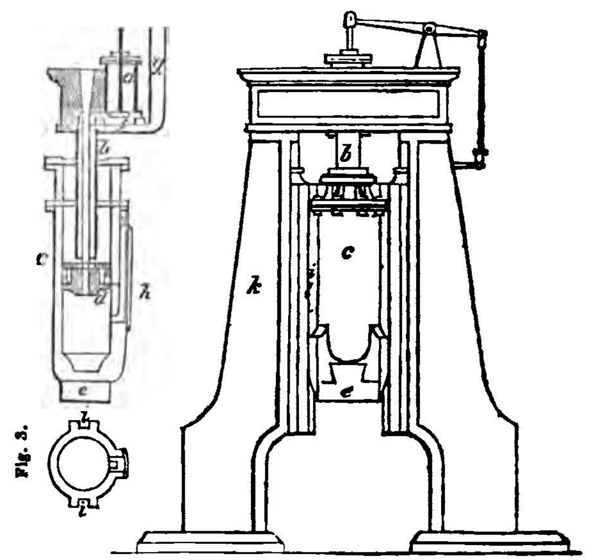


fig. 2 a vertical section, taken at right angles to fig. 1; and fig. 3 a plan of the cylinder. The steam is admitted through the valve *a* and tube *b*, which encases the piston rod, into the steam cylinder *c*, and presses on the piston *d* (which is fixed) and the cylinder top, and raises the cylinder, which is made moveable, together with the hammer *e*, attached thereto, until the steam valve *a* closes, and cuts off the supply of steam, and at the same time opens the outlet port *f*, to allow the steam to escape from the cylinder through the pipe *g* into the atmosphere; consequently, the hammer will then fall by its weight, and when the steam is again admitted the same operation is repeated. Near the bottom of the cylinder, there is a port, or ports, *h*, to allow the air under the piston to escape while the cylinder and hammer are being raised, and also the air to return when the hammer is falling. When the hammer is required to strike with more force than its weight alone, the throttle valve is fully opened, which causes the air port *h* to pass the piston and compress the air under the latter, by which additional recoil will be given to the fall of the hammer. The cylinder is guided by guides *i*, working in grooves attached to the vertical framing *k*.

The hammer may also be worked without the air port *h*, at the bottom of the cylinder; in such case, the cylinder is made longer, and the air under the piston is compressed, as the hammer is raised, until its density is about half that of the steam. When the steam is allowed to escape by this plan, the compressed air gives additiona force to the blow of the hammer.

FIGURED SURFACES.

Arthur Millward, of Birmingham, in the county of Warwick, gentleman, for "*certain Improvements in producing figured surfaces sunken and in relief.*"—Granted October 15, 1846; Enrolled April 15, 1847. [Reported in *Newton's London Journal.*]

This invention is divided into eight parts; it consists, firstly, in the following method of producing sunken designs on metallic surfaces:—The design is painted, drawn, or otherwise depicted on the metallic surface to be ornamented, or it is imprinted thereon by stencilling or transferring; a thin coat of gold, silver, copper, or other metal is deposited by voltaic electricity or other means on all parts of the surface, except those which are covered by the design, or are, to use the patentee's words, "stopped out;" then the colouring or other materials employed in the stopping out are cleared away, and the surface is connected with the negative pole of a voltaic battery, or electro-magnetic machine, in which the solution employed is of such a nature as to act only on the ground-plate, whereby all those parts of the plate which were covered by the stopping out, but are now laid bare, may be decomposed or eroded to any extent required. Instead of a voltaic battery or electro-magnetic machine being employed, the metallic surface may be immersed in any acid or alkaline or other saline solution, capable of acting on the exposed portions of the surface, but not on the precipitated metal. The sunken design may be intersected in different parts by cross lines in relief, so as to present the appearance of "cross-hatching," by inserting such lines with a pencil dipped in varnish, after the plate has been cleared of the stopping out, and before it is subjected to the decomposing or eroding action.

The second improvement consists in producing sunken designs on metallic surfaces, by first covering the whole of the surface, in the manner above mentioned, with a coat of any suitable metal, and varnishing the same; next scraping the design in the varnish; and then subjecting the surface to the decomposing or eroding process, whereby the metal left exposed by the scraping out is removed and the sunken design produced.

The third improvement consists in producing figures in relief on metallic surfaces, by first coating the same with any suitable metal, and painting, drawing, or otherwise depicting the required design thereon, or imprinting the design upon it by stencilling or transferring; the design is then intersected by indented lines and cross lines, after the manner of line engraving (the whole of the colour or other material used in laying on the design being cleared away from such lines); and, after this, all those parts of the deposited metal which are left exposed are removed by the eroding process, and the lines of the design only left standing in relief from the ground-plate.

The fourth improvement consists in the following method of producing designs in relief:—The surface or ground-plate is varnished all over, and at certain parts the varnish is scraped away to form the required design; upon the exposed parts a coat of any suitable metal is deposited, and the remainder of the varnish is then removed from the plate; after which, the unprotected parts of the ground-plate are removed to the desired extent by the decomposing or eroding process.

The fifth part of the invention relates to the production, in metals, of designs which partake of the character of being both sunken and in relief, and are commonly termed "pierced work." To the ground-plate a thin coat of any suitable metal is applied, by electro-deposition or otherwise, and the design is painted thereon; all the parts except those beneath the design are then subjected to the decomposing process, until the said parts (both ground-plate and coating) are completely eaten through. The colour or other material used in laying on the design may be afterwards cleared away.

The sixth part of the invention also relates to "pierced work." A metal-plate, on which a raised design has been stamped out, is covered all over with any suitable metal by electro-deposition; then, by means of a scraper or other tool, the deposited metal is removed from those parts which are to be pierced through; and, after this, the exposed portions of the plate are decomposed or eroded. The same object may be effected by cutting through the metal deposited on the front of the plate all round the design, when so much of the deposited metal as covered the design drops out; and all the parts of the plate from which the deposited metal has been removed are then dissolved or decomposed by the means before mentioned. Any suitable varnish may be used instead of a coat of metal as the stopping-out material in the above processes.

The seventh part of the invention relates to the mattening or deadening of articles with plain or figured surfaces, which have been manufactured by the processes of stamping, embossing, or casting. The portions of the surface required to be mattened or deadened are covered with varnish or other suitable medium, and the remaining portions of the article are coated with any suitable metal by electric deposition; the varnish or other medium being then cleared away, the parts of the plate left unprotected are subjected to the decomposing process. A similar effect may be produced by at once stopping out all the parts but those required to be mattened or deadened, and submitting the plate to the decomposing or eroding process.

The last part of the intervention relates to the production of engraved surfaces, sunken and in relief, from which impressions may be taken on paper, cloth, or other suitable material, by the ordinary modes of printing or embossing. If the design is to be sunken, it is painted or otherwise depicted on a plate or metallic surface; a thin coat of any suitable metal is next deposited upon the uncovered parts; then the colour or other material employed in forming the design is cleared away, and the parts of the plate thus left uncovered are decomposed or eroded to the required depth. When the design is required to be in relief, the plate first receives a coat of any suitable metal; the design is then painted thereon; and those portions of the deposited metal which are not covered by the design are decomposed, leaving the design standing out in strong and clear relief.

The patentee claims, Firstly,—the producing of sunken figured surfaces by the combination of painting, drawing, transferring, stencilling, or other known processes of delineating objects with the direct action of voltaic electricity, in the manner above described. Secondly,—the producing of sunken figured surfaces by the employment of a combination of metallic precipitates or deposits with the direct action of voltaic electricity, as above described. Thirdly,—the producing of figured surfaces in relief by the combination of metallic deposits with painting, drawing, transferring, stencilling, or other known processes of delineating objects, and with or without the addition of the process of line-indenting or engraving, as above described. Fourthly,—the producing of figured surfaces in relief by the combination of the processes of varnishing and scraping out with the metallic deposits, and the direct action of voltaic electricity, or acid or alkaline or other saline solution, as above described. Fifthly, and Sixthly,—the producing of pierced work by all or any of the processes described under the fifth and sixth heads of this invention. Seventhly,—the process of mattening or deadening plain and figured surfaces, above described. Eighthly,—the production of figured surfaces, sunken or in relief, for the purpose of printing from or embossing, by the processes described under the last head of the invention.

SHEET METAL AND PAINT.

Baron Charles Wetterstedt, of Rhodeswell-road, Limehouse, for "*Improvements in the manufacture of sheet metal for sheathing and other purposes, in preventing the corrosion of metal, and in preserving wood and other materials.*"—Granted Nov. 3, 1846; Enrolled May 3, 1847.

This invention consists, first, of a mode of manufacturing lead into sheets for various purposes; secondly, of a mode of manufacturing copper into sheets, and in combining metals to be afterwards rolled into sheets for sheathing and for other purposes; and, thirdly, of manufacturing composition or paints for preventing corrosion of metal and for preserving wood and other materials.

First, for manufacturing lead into sheets, there is to be added to the lead, when in a melted state, a quantity of regulus of antimony, in the proportion of from one to two parts in weight to 100 parts of lead; the same is to be well stirred and the impurities skimmed off, when the mixture may be poured out and rolled into sheets in the same manner as lead.

The second part of the invention is the manufacturing copper into sheets. When the copper is in the refining furnace and just before it is to be run out according to the ordinary process, there is added a quantity of regulus of antimony in the proportion of 1 lb. to about 200 lb. of copper; and at the same time about 2 lb. to 3 lb. of calcined soda, heated to such a degree as to be just previous to melting, and after stirring the whole of this mass together and skimming the surface, it may be run into moulds in the ordinary manner and afterwards rolled.

Another part of the invention is for combining copper and other metals to be rolled into sheets for sheathing and other purposes. Two furnaces are to be used, side by side, one for refined copper, kept ready to be run out into the moulds; and in the other yellow metal (Muntz's patent metal). Take one part of copper and four or five parts of yellow metal, and pour them into a mould of cast or wrought iron coated with clay and sand; and heat the same to a red heat, when the whole mass will be in a fit state for rolling. Instead of yellow metal, brass may be employed. And the same process may be employed with lead and tin, the lead being first poured out, and then the tin, the proportion being four or five parts of lead and one of tin, or tin and lead combined. This sheet metal will be very suitable for water cisterns, &c.

The third part of the invention is for preventing the corrosion of metals, and preserving wood and other materials by combining metals together, and then applying them as a paint on the surfaces of the metal or wood, which paint consists of regulus of antimony and copper, mixed together in the proportion of one part of antimony to two or three of copper; to be well mixed and melted together, and run out into water, and afterwards dried by a gentle heat. Then about two parts of oxide of copper is added, and the whole ground together and moistened during grinding with naphtha, sufficient to bring it into a thick pasty state. A solution, composed of tar and naphtha in equal parts, is then made, and mixed with the metallic compositions, in sufficient quantity to bring the composition into a suitable state to be employed as a paint.

When preparing paints in which zinc or lead is employed, antimony in the proportion of 1½ part of antimony to 1 part of zinc or lead is to be used; and when tin is used, the proportion is two of antimony to one of tin. These materials are to be first melted together, then poured into water, and ground as before described, leaving out the oxide of copper, and when ground they may be brought into the proper state to be employed as a paint, by mixing with either a sufficient quantity of oil and turpentine and suitable drying ingredients, or they may be mixed with the naphtha and tar as before described.

Another composition for the same purpose is prepared as follows:—Take 30 lb. of tar, 30 lb. of pitch, 20 lb. of dried soot, and 4 lb. of tallow or sperm oil, and melt the whole together, adding naphtha to it in the proper quantities, so as to bring it into the suitable consistency required for the purposes to which it is to be applied.

Another part of the inventinn for the prevention of the corrosion of metals, is by immersing sheets of copper or zinc, and also copper and zinc nails, in a solution of muriatic acid and other materials in the following proportions:—Take about 60 lb. of muriatic acid of commerce, about 10 lb. of oxide or old copper, and about 3 lb. of regulus of antimony, and mix the whole well together, and place the sheets or nails therein, and allow them to remain for two or three days—the solution being at a temperature not less than 70° Fah.

SCHINKEL'S REMARKS ON ART, ART-CULTURE, AND ART-LIFE.

By Dr. G. F. Waagen.*

Having been called upon by many artists and art-friends to publish my discourse, uttered on this year's anniversary of Schinkel's birthday, I have undertaken my task the more eagerly, as his remarks possess not only a *subjective* value, derived as they are from such a man, but may also have a great *objective* utility for art-pupils, who earnestly desire to strengthen themselves in sentiment and activity.

That gloomy—yet, after all, elating and fine feeling, of celebrating the memory of a noble mind, which that unavoidable transition to higher existence (called, perhaps improperly, death) has deprived us of,—pervades, I am sure, the breasts of all in this solemn meeting. A nature so rich as that of Schinkel, presents always new aspects for consideration. I intend, therefore, to fix attention to some observations, which have been found amongst the papers of the departed—albeit merely detached leaves; still, most fit to show his character as an artist in a very clear light. I hardly think it necessary to observe, that some slight inaccuracies of diction must not be taken into account; as, in the first place, the handling of the pen may not be considered the very province of the forming artist (*Bildenden Künstler*). What these remarks may want in this respect, a certain touch of genius will greatly recompense.

Amongst one of the most distinguishing qualities of Schinkel, by which his great exertion in art has been caused—is his great moral strength, his healthful and spirited vivacity, his rigid, unrelaxed tendency to progress; on which account, nothing seemed so averse from him as the reposing on one's laurels, the so much wanted *otium cum dignitate*. How much he knew that, how great were his self-imposed duties on that account, his own words will best illustrate. "The conditions of a perfect existence (*Zustands*) are real liveliness and stirringness; phlegma, be it bodily or mindly, is a *sinful* situation for him who lives in a civilised nation—an *animal* for them who live in times of barbarism! Only that artwork, which has entailed the spending of noble forces, and in which appears the highest tendency of man—a noble sacrifice of noble powers—imparts true interest and edification. Wherever it is seen that a master has taken things too easily, that he has not striven after something extraordinary and novel, but has abandoned himself to routine and stale and stable art-rules—even if he has succeeded in displaying all known form-beauties—he will not overcome, it appears to me, the ennui of the beholder; and such works, however superior in many respects to those of inferior minds, are nevertheless unworthy of him who could have achieved more. In the physical as well as art world, we are only then really living when something novel is created; and whenever we go too securely on trodden paths, our exertions become ambiguous, as we then have perfect knowledge of what is to be done—do, therefore, something which already exists: handle something second-hand, as it were—and repeat repetitions. 'This, surely, is already a half-dead vitality.'* Wherever we are yet uncertain, but feel the impulse towards, and the presentiment of, something beautiful, which is to be produced—there, therefore, where we seek, we are really alive and vivified. From these reflections, may be explained the often apprehensive, anxious, and even humble temper of the greatest talents on earth—compared with the bouncing, over-bearing, and self-sufficient contentment of the successful and purse-proud cobbler and handicraft-man."

These forcible expressions of Schinkel are not only most characteristic of the whole art-mind of the departed—but, perhaps, never before has that trepidation and hesitation, those pangs of parturition, felt in the holy privacy of the man of genius—who constantly feels his aim is infinite, merely attained at by approximation—been so truly and concisely expressed as here. If it has been repeatedly remarked, that one of the chief characteristics of Schinkel's art-genius consisted in the combination of the manifold and most pregnant practical creations, together with the unrelaxed study of the general and eternal laws of art—viz., theory—the following extract, derived from an unpublished work of the great architect, will show how early he felt what others never do.

"I perceived, when I began my architectural apprenticeship, a great treasure of forms, which, for scores of centuries past, have guided nations in the various phases of their culture, in the execution of their buildings and structures. But I saw, at the same time, that our use of this treasure was arbitrary, and that what produced a most pleasant effect in its primitive usage, was quite inappropriate in its present application to structures of this age. Especially clear became the conviction to me, that in the *arbitraryism* of form-giving—the real cause of want of character and style in so many of our modern structures is to be sought for. It became a vital question with me to arrive at the bottom of these anomalies; but the deeper I penetrated on this topic, the larger and more comprehensive it appeared to me. At first, I fell into the error of pure, fundamental abstraction, and developed the whole idea of any given structure from its nearest trivial object and scope, and the three laws of construction. In following this course, dry and stiff works will result, wanting in freedom, and excluding the 'two grand elements of architecture—the historical and poetical.' I further inquired in how far the mere rational principle be sufficient for fixing the mere mechanical and trivial basis of an edifice, and how much there be required of the higher influence of the historical and poetical to elevate it to the conception of an art-work. It became clear to me, that I had arrived at that point in architecture, where the real element of art is to be placed, which, in every other respect, 'was and would be but a trade with a scientific basis!' At the same time, it became clear to me, that in this stage of thought (here, as in any other art), the dogmas of a doctrine became difficult to be uttered, and were perhaps reducible to a culture of feeling and intuition—qualities of the mind which comprehend, in architecture, a very wide compass, and require to be much and most variedly developed, if their products are to yield great results.† It appears to me necessary to ascertain properly the different spheres in which the feelings and intuition of the architect are to be developed, which will also enable us properly to survey the extent of this art-branch.

"We have, therefore, to consider, first, what are the desiderata of our time in architecture; secondly, a retrospect on previous periods will show what has been then used for similar purposes, and what of that (considered in its perfection) may be useful and adequate now. Next, the modifications of approved expedients are to be properly weighed. It is, however, chiefly necessary, that (fourth) we inquire how imagination has to act in the assimmilation and modification of these expedients—how, thence, the new product is to be treated in form and essence. This, however, is to be done thus, that it may still possess some historical basis, and that the conception of the new may arise without taking away the impression of an architectural style—by which doing, the combined feelings of style and something primitive, and even ingenious, will arise in the beholder."

From this it is to be seen what general path Schinkel has traced out for the builder of present times. But for complete success, he has pointed to a series of abstract intuitions—from which the principles according to which the artist has to act, are to be deduced. These intuitions are the hidden point of crystallisation (*punctum saliens*) of every mind destined for, or tending after, greatness.

* Einige Aeusserungen K. T. Schinkel's über Leben, Kunst und Bildung. Von Dr. G. F. Waagen. Berlin: Gropius', 1846, 8vo.

* It may be said, that such remarks are unprofitable, as we cannot all profit by them, and achieve so high a pitch of perfection. In reality, they are not so. Every one may reach as high as he can. "It is undoubtedly superiority to know one's own inferiority," and to worthily co-ordinate ourselves to such. It is not honest, unpretending men who have ever injured art and mankind—but the conceited, would-be, and pretending.—[Dr. Waagen.]

† May appear still more discouraging than the previous remarks. Our despondency, however, would not make things different from what they are. It is once in a hundred years or so, that great talents arise, be it in architecture, or otherwise. Fate, like other things, will be led at times, but never driven.—[Dr. Waagen.]

On the other hand, a most detailed study of the architectonic forms of all times and ages, had brought Schinkel to the idea, that the intuition of true principles of art-style had never started so clearly, harmonically, and fairly as with the Greeks—for whom and with whom our departed friend had formed a connection of the most intimate sympathy. And thus, in another of his fragments, he says—"The real study, especially an assiduous exercise of imagination on the terrain of classic art, will alone bring harmony in the general culture of men, belonging to these latter days."† But it was in many other respects that Grecian antiquity attracted him so forcibly. It was one of the most vivid ideas of Schinkel, to think that "the highest and most general signification (Be-*deutung*) of fine art was the ethic education and ennobling of men by the beautiful." But this, certainly, has never and nowhere come into practice so extensively—nowhere been so extensively resorted to—as wherever Hellenic existence has taken root in the world. And thence Schinkel, speaking of Herculaneum and Pompeii, says—"In this buried little town, not even the meanest person's house was without art; every one was so far cultivated, as to surround himself with art-culture,‡ from which thought, ideas, precept spoke to him—and thence was developed an immense treasure and great delicacy of thought and sentiment, which, perhaps, constitutes the very principle of culture (*cultur zustandes*)."—Nay it may be said, that Schinkel's whole life and his tendency in art, were so much identified with the noblest ideas which Hellenic civilisation presented—as well as its various forms of pure and beauteous humanity, that both cannot be better expressed than by the Greek term, *Kallokagathea*, which means the innermost (natural) combination of the beautiful and good.

Notwithstanding this enthusiasm for Grecian art, Schinkel, in his capacity of practical architect, was far from imitating it servilely and in contradiction to the wants of our times, which is evinced in many of his splendid buildings. Alike, this made him not un-susceptible of the particular grandeur and the wonderful mystery of Gothic architecture, as his restoration of Cologne Cathedral, several of his oil paintings—nay, even some of his exquisite designs of churches, fully demonstrate.

It cannot be doubted, in fine, that to a mind like that of Schinkel, the immense disparity of the public taste in our times, and those of Grecian antiquity, should have escaped. He says—"There are few persons who can elevate themselves in the contemplation of art-works, especially buildings, to the standard of general culture or general civilisation. In the main, they find only that beautiful and praiseworthy, which is desirable in their own individual circumstances;—the common, the every-day work, with a certain degree of completion and nicety, is all they ever require. The novel, grand, and uncommon hardly ever pleases the great mass; and if it does not suit their most obvious convenience, it will meet with much opposition and obloquy." Unhappy he—who, has the genius and tendency for art, is obliged to serve such paltry purposes; into which, however, nearly the whole of our architectural and structural endeavours are now resolving.

J. L——Y.

† We think that some of these sayings ought to be inscribed in brass and marble on some of our public buildings.—[Waagen.]

‡ The compounds of the German word, "Cultur," are very difficult to be rendered in English.—[Transl.]

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

June 14.—AMBROSE POYNTER, Esq. V.P. in the chair.

A communication was read from A. H. LAYARD, Esq., relative to further *Discoveries made by him at Nimroud*; particularly as to the fact of the employment of colour by the ancient Assyrians in the embellishment of their architecture and sculpture; describing the mode of construction adopted, and stating that it had been satisfactorily ascertained that the buildings recently brought to light are of various epochs; and expressing an opinion that some of those at Nimroud are of much more remote antiquity than those at Khorsabad—and probably of the age of Ninus or Semiramis.

"*On the Geometric System applied by the Mediæval Architects to the proportions of their Ecclesiastical Structures.*" By R. D. CHANTRELL, Esq.

The chief object of the paper was to prove that in all the mediæval structures a general principle of the most perfect and beautiful proportion pervades the design, and may be recognized by the scientific observer. This system must be adopted by the modern architect in order to produce the same successful results. That some general principle of composition had been adopted by the mediæval architects is an opinion that has been entertained by various individuals for many years past; and attempts have been made by Kerrick, Essex, Browne, and others to develope it. Their endeavours have been attended with various degrees of success; but according to the author of the paper no one but himself has succeeded in discovering the true principle capable of uniform application. Mr. Chantrell exhibited a number of plans and other diagrams in elucidation of his theory; and without which it would be impracticable to convey an adequate idea of the system.

Models of a new kind of brick invented by Mr. Merrell, of Woodbridge, were exhibited and explained. The bricks are so shaped as to form internal channels for the passage of air—and consequently produce a thorough ventilation of the wall.

INSTITUTION OF CIVIL ENGINEERS.

June 1.—Sir J. RENNIE, President, in the Chair.

"*An Account of the iron barque* JOSEPHINE, *of Liverpool.*" By Capt. MASTERS, who commanded her in the voyages she has made.

The paper read was a plain and somewhat dry specification of the construction of the vessel, which will, however, when printed *in extenso* in the minutes of proceedings, be extremely useful. The main dimensions of the barque *Josephine* are—Length, over all, 99 ft. 3 in.; extreme breadth, 24 ft. 6 in.; depth of hold, 9 ft. 9 in.; register tonnage, 168 tons; by old measurement, 221 tons. She was of a peculiar build, differing from almost any other merchant-ship, being intended for service in the Mexican trade, and calculated to cross the bar of Tampico, and other impediments. She was entirely of iron, even to the bulwarks; and as she lay low in the water, drawing 9 ft. aft, and 8 ft. 8 in. forward, her ports were hung on hinges forward, so that they should act as valves, and allow the water to escape from the deck, and yet shut of themselves when she heeled over deep on her side. Her general rate of sailing was from 11½ to 12 knots per hour; she was very buoyant and very dry, rising well to the sea. There was great capacity for stowing the cargo, owing to the absence of large projecting timbers. She was somewhat damp forward and aft, but was very dry in the main hold. There was not found to be any difference in the health of the crew from that of wooden vessels; she was a little cooler than other ships, owing to her being so deep in the water, and the thin material did not retain the heat like wood.

Iron ships have generally been found to get very foul: the *Josephine* was, however, paid with various compositions as experiments. That which succeeded best was—1 barrel of varnish, 2¼ cwts. of best tallow, 40 lb. black lead, 7 lb. brimstone, and 70 lb. arsenic. This being applied hot, the iron having been previously warmed and paid with boiled linseed oil, appeared to have prevented foulness, as after her voyages there was little weed or grass, and scarcely any barnacles; but very slight oxidation took place, and that only where the composition had been rubbed off.

They were as much annoyed by rats as in a timber ship, nor could they be destroyed by any of the means adopted. The principal feature of the paper was that which treated of the local attraction of the compass, which can scarcely be noticed in an abridged form. It appeared that the ship was on an even keel, and perfectly upright, the compass acted correctly; but in proportion to the listing over, so was the derangement of the magnet, the local attraction being changed by the side frames and deck-beams falling into new positions. This caused great variation in the ship's course, and it led to a conjecture whether this may not have been the cause of the loss of the *Great Britain*—as if her compasses were acted upon as much as those of the *Josephine*, a deviation of 6½ miles from her course might easily have occurred. Capt. Masters suggested the hanging the binnacles complete in gimbles like the compass, in order to their always remaining vertical, and also in adjusting the compasses that they should be tried in every position, a table of variation being made out for every degree of listing over. The paper was illustrated by drawings of the vessel and of her rigging, which possessed peculiarities, and also by several tables for the correction of the compasses.

June 8.—The following papers were read:—"*On the Expansive Action of Steam.*" By Mr. J. M. HEPPEL, Grad. Inst. C.E.

The object of the paper was to deduce a more exact formula than those now in use for the dynamical effect developed by steam in expanding from one pressure to another. The usual method of computing this effect neglects the influence of the variation of temperature, which always accompanies change of density, and which has been shown to modify considerably the corresponding pressure. M. de Pambour, however, has, by combining Guy Lussac's formula for the relation between temperature and density under uniform pressure, with that of Boyle for the relation between density and pressure under uniform temperature, deduced a formula containing the density, pressure, and temperature, from which any two being given, the third may be deduced.

What was further done in Mr. Heppel's paper, was to combine this formula with one by Mr. Scott Russell, expressing the relation between the pressure and temperature, and by this means to eliminate the latter, and obtain a formula containing only the pressure and density. From this formula another was easily obtained, showing the total dynamical action developed during expansion from one pressure to another, and the results were given in a tabular form, exhibiting—

1. The pressure in lbs. per square inch.
2. The relative volume, or ratio of the volume of steam, to that of the water which produced it.
3. The dynamical effect before expansion, or the number of lbs. raised one inch by the evaporation of each cubic inch of water.
4. The dynamical effect during expansion, or the number of lbs. raised one inch by the steam produced from one cubic inch of water in expanding from a pressure of 100 lb. per square inch to the particular corresponding pressure.

The dynamical effect in expanding from any one pressure to any other, must be clearly expressed by the difference of the corresponding numbers in this column.

Part of the remainder of the paper was devoted to showing, that whilst the performance of engines could not possibly be expected to exceed the results ascertained as above, it should not fall far short of them in the case of engines of good construction. In conclusion, a simple method was suggested of ascertaining the magnitude of all the forces in action during the working of the Cornish engine, independently of the indicator.

In the course of the paper, the fallacy of the theory of what had been termed the "percussive action" of steam was ably exposed; and although, from the paper being full of mathematical formula, it was not well adapted for being read at a public meeting, it evidently possessed great merit as an investigation of an important subject.

"*On the Expansive Action of Steam.*" By Mr. TATE, mathematical master of the Training College, Battersea.

The object of this paper was to demonstrate and apply a formula some time since discovered by the author, expressing the law of the expansion of steam, and at the same time to establish certain general equations relative to the work of steam, applicable to all formulæ professing to give the law of volume and pressure. It also examined and corrected Pole's formula, which, although a decided improvement upon Pambour's, was stated to be not sufficiently accurate for pressures above 70 lb., or below 16 lb.

M. PIARGET exhibited in the library, after the meeting, specimens of his improvements in producing ornamental metal surfaces, formed by the deposition of metals during the electrotype process, which is conducted in a peculiar manner, with mixtures adapted to the effect desired to be attained. The form also of the bath is peculiar, and when the plate is taken out of it, and off the model, it exhibits a burnished polish, or a dead appearance, according to the preparation used. The metal thus produced is stated to be of a much better description than metals which have not undergone such process, as it is more flexible, and is capable of withstanding the action of heat without destroying the form or the copper, and the surface will not tarnish when exposed to the air. Portions of any pattern can also be silvered by a similar process; and the general expense is about one-third of that of engraving or chasing, while the boldest or most minute patterns can be equally well produced.

June 15.—"*On the Law which Governs the Discharge of Elastic Fluids under Pressure, through short Tubes and Orifices.*" By W. FROUDE, M. Inst. C.E.

The law proposed was a modification of that which has been usually assumed—viz.: a simple application of that which holds good with respect to non-elastic fluids; this law is, generally, that the velocity of issue is directly as the square root of the pressure, and inversely as the square root of the density; but this law neglects wholly the reaction that must arise from the expansion necessarily taking place in the course of issue. The nature of the action was illustrated by the following example:—If a balance be supposed, with an equal weight in each scale, one of the weights being a spiral spring, like that of a spring balance compressed lengthwise with its axis vertical, and held in a state of compression by a cord. Now let the cord be suddenly reversed, so that the spring is enabled to extend itself vertically; the scale in which it stands will obviously be depressed, the spring reacting on it as it expands upwards, and continuing to press till wholly relaxed; or if the scale in which it stands were ascending by a preponderance given to the other scale, the rate of ascent would be in the same way retarded. The amount of the retardation would depend on the strength and the weight of the spring, and on the length to which it would extend itself when released. Now in the discharge of an elastic fluid, there is an action, strictly analogous, operating continuously, however, instead of *per saltum*, the strength and weight of the spring being represented by the elasticity and density of the fluid, and the length to which it would extend itself by the degree of expansion, in the course of issue. The reduction in quantity of discharge, due to the action, was to be measured by the velocity imparted by expansion, to each particle of the elastic fluid in course of issue, the velocity of each particle after expansion, would be its velocity before expansion, multiplied into the rate of expansion, and the primary force must be subdivided in generating each additional unit of velocity, so that the portion applicable to the generation of velocity before expansion, would be the whole force divided by the rate of expansion; thus, the velocity before expansion would be divided by the square root of that rate. For instance, an elastic fluid expanding four times in course of issue, would be discharged with only half the velocity of a non-elastic fluid, under the same circumstances of pressure and density. This modification was shown to fulfil the general dynamical law "that a given force, acting for a given time, will produce a given momentum, whatever be the weight of the mass acted upon." This seemed to be the essence of the law for non-elastic fluids, but it was disregarded by the unmodified application of that law to elastic fluids, in which there would be a great accession of velocity, of particles issuing under a given pressure, without any reduction of quantity discharged in a given time; if, however, the quantity be reduced as proposed, in the ratio of the square foot of the density, and the velocity be accelerated in the same ratio—the final momentum would be the true equivalent of the pressure. This, in its practical application, explained what was inexplicable by the ordinary theory.

The difficulty experienced from the back pressure of the waste steam in locomotive engines was exhibited, showing, that at 60 miles per hour, this would be at the least equivalent to 8 lb. per inch throughout the stroke, thus showing a loss of nearly 50 h.p. As applied to the case of air, discharged into an exhausted receiver, the result was highly curious. The rate of discharge, instead of increasing throughout as the degree of vacuum was increased, would be maximum at 15 inches of vacuum, although nearly uniform for many inches above and below that point; it would, however, progressively decrease above that point, because the expansion would increase in a higher ratio than the pressure, and ultimately, at the point of perfect vacuum, it would be at a minimum (indeed stationary, were air perfectly elastic), because at that point the expansion would be infinite, but the pressure only finite—viz.: 30 inches of mercury. Experiments made, by permission of Mr. Brunel, with the South Devon Railway atmospheric apparatus, confirmed the theory. The line traced by an indicator apparatus was shown to accord very closely with one traced by this theory, whilst it was widely at variance with the result of the ordinary theory.

[We must caution our readers against placing any confidence in the new law of the motion of elastic fluids, enunciated by Mr. Froude, which seems to us to be directly opposed to the fundamental laws of dynamics. If we suppose any number of particles acted on by *external* impressed moving forces, all in the same direction, the motion of the centre of gravity of the particles in that direction will be the same as the motion of the centre of gravity of a solid body of which the mass is equal to the sum of the masses of all the particles, and the moving force the sum of the moving forces acting on all the particles; and this law is true whatever be the nature of the connection between the particles or the mutual internal forces which they exert on each other. In the case of the motion of particles of fluid from an orifice—if the pressure at the orifice is constant, we confess we can see no reason why the quantity discharged in a given time should not be the same, whether the fluid be elastic or not—the question of elasticity or non-elasticity involving merely the internal or molecular connection of the discharged particles. We wish, instead of the brief and not very intelligible abstract inserted above, we had been favoured with Mr. Froude's unabridged analysis. If his views be correctly reported, it seems to us that he has confounded mass with volume; at all events, his results lead to an evident absurdity—viz., that if air were perfectly elastic (as indeed it is *very nearly*), and the vacuum in an air-pump were perfect, on opening the cock of the receiver no air would flow in. We think that if Mr. Froude repeats his experiments with a well constructed air-pump, he will be convinced that he is mistaken. Let him take an exhausted receiver, with a mercurial gauge, and having opened the cock, note the times of the mercury rising from 0 to 5 inches, 5 to 10 inches, 10 to 15 inches, respectively; —why our ear at once detects the absurdity. Who has not noticed how the hissing of the air, as it rushes through a small orifice into a vacuum, changes from a shrill to a hoarse note? There is no doubt that the law of theory is not fulfilled in practice, but that is owing to the friction—or rather resistance—arising from the particles of air striking, with enormous velocity, against the inequalities of the small tube. Neither is it possible—at least in the present state of analysis—to estimate exactly the pressure at the orifice. But the same difficulty holds in the case of inelastic fluids,—for the motion of which, we refer the reader to a paper in the Journal for April; one or two errors which escaped us at the time, in the proof, will be found corrected in the Number for June. For the "back pressure," we recommend our readers to turn to the Count de Pambour's valuable work on the steam engine.—EDITOR.]

June 22.—"*An Account of the Plans that have been Proposed for Connecting the Atlantic and Pacific Oceans by a Navigable Canal.*" By Mr. JOSEPH GLYNN, M. Inst. C. E.

The author took a review of these projects from the time of Cortez, who proposed to cross the Isthmus of Tehuantepec by joining the waters of the River Coatzoccoalers, which flows into the Gulf of Mexico, with those of the River Chicapa, flowing into the Pacific, by the Bay of Tehuantepec; a plan which has lately been revived by Don José de Garay, who, with the assistance of Signor Moro, surveyed the country from sea to sea, and showed that the chain of mountain is there broken for about 35 miles, giving place to an elevated plain or table land, called the Mesa de Tarifa, where both these rivers originate, and where their junction could be easily effected. The objections to this plan are, the length of the river navigation, about 200 miles, and the ascent of the stream to the Mesa de Tarifa, about 200 metres, or 656 feet above the ocean. The survey was made under the patronage of the Mexican President, General Santa Anna, who professed to grant many important privileges to the promoters. The Isthmus of Nicaragua was next examined, and after that the course of the River St. John to the lake, which is a little more than 15 miles distant from the Pacific Ocean, and about 130 feet above its level. The distances and the levels were accurately taken by Mr. Bailey, an officer in the Royal Marines, by desire of General Marazon, President of the Central American Republic. The ridge of hills intervening between the lake and the ocean, and the uncertainty of the waters in the River St. John, alternately swollen by the rains, or dried up by the heat of a tropical sun, the volcanic character of the country, and the unhealthy nature of the climate on this river, from which Lord Nelson's expedition suffered so much, render the execution of such an undertaking at this place very improbable. The Isthmus of Panama presents fewer obstacles than any other point—the distance from sea to sea is only about 39 miles—and the country is traversed for nearly the whole width by the great river of Chagres and its tributaries, which are interlaced, as it were, with the streams flowing to the Pacific. The chain of mountains here sinks into extensive savannahs and forests, with a few detached and isolated hills, and small elevations, seldom exceeding 500 feet in height. The country was surveyed in 1828, at the instance of General Bolivar, by Mr. Lloyd, an English officer, who also took the levels, and determined the difference between the two oceans to be 3½ ft. (3·52), the waters of the Pacific being the highest. Mr. Lloyd's valuable papers, deposited with the Royal Society, and the Royal Geographical Society, were exhibited to illustrate the paper. A survey of the River Chagres was also made by order of the Admiralty, during which Captain Foster, of her Majesty's ship *Chanticleer*, lost his life. The maps, plans, sections, and other valuable information deposited with these societies, seem to have created but little interest in England; but they have been diligently examined, and extracts and copies taken by foreigners, who have had free access to them, especially by the French; and M. Guizot lately sent M. Napoleon Garella, as engineer-in-chief, with a numerous staff of assistants, to make a further survey, and ascertain the practicability of making a canal. This survey has fully confirmed that of Mr. Lloyd, and proves that there are no obstacles which engineers and contractors of the present day could not encounter and overcome without much difficulty or expense; the difficulties being more of a political character, and to be dealt with by statesmen rather than by engineers.

The meeting was very fully attended, and an interesting discussion ensued, in which his Royal Highness Prince Louis Napoleon took an active part. He had evidently studied the subject carefully on the spot, and traced a line between the lakes Nicaragua and Leon, which he recommended as preferable on account of the local facilities, the salubrity of the climate, the already populated character of the country, and the advantages of the two lakes, which, at small expense, may be converted into harbours, accessible at all times for vessels of heavy tonnage. The plans proposed by his Royal Highness appeared to meet the views of the meeting, as far as a ship canal was concerned; but it was agreed that for quick transit by railway, the lines traced by Mr. Lloyd over the Isthmus of Panama were to be preferred.

Conversazioné.—The President, Sir John Rennie, gave his two conversazionés on May 29th and June 5th. The latter of these was one of the best conversazionés of the season, forming a grand union of the men most eminent in science, literature, and art. Additional rooms were thrown open in Sir John Rennie's mansion, and the personal attention of himself and Mr. Charles Manby, the Secretary to the Institution, to the hospitable entertainment of the guests, made the meetings particularly pleasing. The leading feature in the model-rooms was a grand collection, illustrative of the progress of ship-building, from the time of the Pett's to the last productions of the Surveyor-General of the Navy. Next to them came a series, showing what has been done in electric telegraphs and clocks. A mass of electric telegraph lines gave singular evidence of the extension of the system, which has now become a recognised branch of public service. It is a curious sign of the age, to notice the *Times*, in a late number, complain of the mismanagement of the Rugby telegraph, by which they were deprived of their accustomed racing news. The visitors were so numerous that we may readily be excused for missing many of the most prominent. The Grand Duke Constantine of Russia, being unable to attend in the evening, went with his suite to a private view of the models.

Count D'Orsay contributed some statuettes and busts of the Emperor of Russia, Daniel O'Connell, the Duke of Wellington, &c., which were deservedly much admired. Paintings and sketches by Landseer, Oliver, Buss, Wood, Scanlan, Digby, Wyatt, Boxall, and Ward; enamel paintings, by Bone; chalk drawings, from Mr. Fuller; and some beautiful sketches, from Messrs. Ackerman's collection, were profusely scattered throughout the rooms. Taylor, Williams, and Jordan, had some excellent specimens of machine carvings; and Mr. Rogers some delicate examples of hand carving.

A series of models from the Admiralty exhibited the construction of a 50-gun ship at various epochs. Other models illustrated the most approved forms of bows, sterns, and midship section; and the general lines of the vessels composing the experimental squadron were contrasted by a series of uniform models. The wave principle was illustrated by models from Mr. Scott Russell and Dr. Phipps; and the progress of the steam navy was exemplified by models of vessels and engines, constructed by Messrs. Rennie, Maudslay, and others; with screw propellers by G. Rennie, Woodcroft, Hays, and Maudslay. Models of Brunel's block machinery, and Hurwood's patent scuttle, were appropriately introduced.

All the various systems of electrical telegraphs were represented, and were at work in the apartments:—Bain's electric clock—Nott and Gamble's single-wire telegraph—the Electric Telegraph Company's system, as used at the Admiralty—Brett and Little's apparatus, and Brett's writing telegraph, in which, by depressing a series of keys, corresponding letters are brought into contact with a continuous strip of paper, and the communication is printed at any number of miles distant.

Mr. Cowper contributed a series of models of the old French and other telegraphs, in order to form a contrast with the present instantaneous methods of communication.

There was a series of models of bridges of all kinds, amongst which we remarked one of corrugated cast iron, erected by Mr. Barlow on the Tunbridge Railway.

The wrought-iron tube bridge, by Mr. R. Stephenson, at Conway, beautifully shown, on various scales, by Salter's elegant card-board models.

A cast-iron girder bridge, by Mr. Borthwick, of the same construction as that over the Dee, at Chester.

The drops for loading coal vessels at the Bute Dock, Cardiff, by Mr. Highton, appeared to be an ingenious modification of the system used in the north.

Stephenson's long boiler locomotive, Bessemer's axles, Dunn's turntables, Stevens's railway signals, and Clarke and Varley's new atmospheric railway tube, formed an interesting series of railway models.

Cochrane's machine for sawing out carved timbers of all forms, without waste, was worked, and was universally admired. It was stated that these efficient machines were now being introduced into the royal dockyards.

Little's new printing machine, by which the number of sheets now dispatched, great as the quantity seems, can be doubled, was also at work, and excited much attention.

A curious clock, made by Tompion, in 1670, and presented by Charles I. to the Duchess of Cleveland, was exhibited by Mr. Vulliamy.

M. Praget contributed some extraordinary specimens of gold electro-deposit for ornamental work for clock cases, &c. It appeared from the statements that this introduction would make a great diminution in the price of this kind of work.

A collection of fossils, from the Oxford clay, at Trowbridge, made by Dr. Mantell, during the excavations on the line of the Wilts, Somerset, and Weymouth Railway, appeared to excite attention among the geologists—as did two casts of impressions of the feet of some unknown species of animal, found in the new red sandstone in the United States, and recently transmitted to Dr. Mantell.

A revolving disc pendulum, by Mr. Fronde, for rendering uniform the circular revolution, under considerable variation of the maintaining power.

Otis' American Excavator, which was worked on the Eastern Counties Railway, by Mr. Hyde, and that of Messrs. Barber, Brothers, invented by Colonel Hamilton, and now in construction for dredging the port of Toulon, were placed with Prideaux's Excavator.

A model of the Somerset-bridge, of 110 feet span, by Mr. Brunel, on the line of the Bristol and Exeter Railway, an example of the strength and simplicity that may be attained by well-constructed trussed timber bridges.

Fuller and De Berque's application of thick rings of vulcanised India rubber, alternating with metal discs, to form buffer springs for railway carriages.

Davison's system of cleansing casks, as used at Truman and Hanbury's, and other breweries.

SOCIETY OF ARTS, LONDON.

At the Annual Meeting, which took place on Thursday, June 10, in their Great Room in the Adelphi,—H.R.H. Prince Albert, as President of the Society, filling the chair. His Royal Highness congratulated the Society on its increasing prosperity and usefulness; and proceeded to confer the honours which had been awarded to authors of important works or inventions in arts, mechanics, and manufactures submitted to the Society during the past year—and many of them exhibited at their late Exposition. The list of medals, &c. awarded on the occasion is as follows:—

The GOLD MEDAL to Messrs. Davidson and Symington, for their method of applying Currents of Heated Air to Seasoning Timber and to the various Manufactures—Messrs. H. Minton and Co., for the Models of a Jug and Loving Cup—Mr. Thomas Drayton, for his new process of Silvering Glass with pure Silver—and John Everett Millais, for his Original Composition in Oil.

The GOLD ISIS MEDAL, to Messrs. Richardson and Co., for their specimen of Enamelled Colours on Glass—Thomas Brown Jordan, for his Machine for Carving Wood, Stone, &c. for ornamental and decorative purposes—Mr. Henry Grainger, for the best specimen of White Earthenware—Messrs. H. Minton and Co., for the best specimen of White China—The same, for the best specimen of Deep Blue Colour on China—and the same, for the best specimen of Green Colour on Porcelain.

The Large SILVER MEDAL and 10*l*. 10*s*., to Messrs. D. Pearce and C. Worrall, for their design and model of a Lamp Pillar—Mr. Charles Meigh, for a model of a Mug ornamented in relief—and M. F. Abate, for a means of Preventing the Emission of Noxious Vapours from Sewers. The same Medal and 5*l*. 5*s*., to Mr. John Strudwick, for his design for a Roller Window Blind—Mr. Daniel Pearce, for his design for Printing on China—Mr. John Philip, for his design for an Earthenware Mug ornamented in relief—Mr. Bedlake, for his design for a Geometrical Stamped Drugget—and Mr. J. Austin, for an Original Composition, and specimen of Stained Glass. The same Medal and 3*l*. to Mr. G. Inman, for his Compass Plan. The same Medal, to Mr. Horne, for his Block Printing in Distemper—Mr. Edward Keys, for his model of a Mug ornamented in relief—Captain Carter for his method of Suspending a Knapsack—Mr. Fuller, for the application of Vulcanised India Rubber to Railway Buffer Springs—Mr. M'Sweny, for his improved double cone barrel Steering Wheel—Mr. C. J. Varley, for an Apparatus for facilitating the use of large Gregorian Telescopes—Mr. R. Day, jun., for his Model in Plaster of the Martyrs' Cross, Oxford—Mr. W. Ford, for his Original Model of a Figure of Nebuchadnezzar—Mr. C. S. Kelsey, for his Original Figure of a Greek Youth—Mr. E. J. Physic, for his reduced Model of a Figure of Mercury—Mr. Westerburgh, for his Portable Level—Mr. J. Walker for his Model of a Sewer Trap—Mr. Chadley, for his plan for Preventing the Emission of Noxious Vapours from Sewers—Master H. Bursill, for a Cast from an Original Model of the Figure of Hercules—and Master Alexander Stanesby, for a Chalk Drawing of Apollo from the round.

The SILVER ISIS MEDAL and HONORARY TESTIMONIAL, to Mr. W. Wood, for his Tuphlograph for the use of the Blind. The same Medal and 1*l.* 1s., to Mr. G. West, for his Microscopic Drawing of the Spine of the Echinus. The same Medal, to Mr. J. Bolton, for an Instrument for facilitating the Cutting of Screws—Miss Susan Durant, for an Original Bust in Plaster, being a Portrait—Mr. C. Worrall, for a Model in Plaster of a Candelabrum—Mr. C. Fox, for an Original Composition in Plaster—Mr. C. Hodgetts, for an Original Chalk Drawing of the Gladiator—Mr. J. G. George, for a Chalk Drawing of the Gladiator—Mr. Arthur O'Connor, for a Chalk Drawing of the Head of of Jupiter—Miss Mary Elizabeth Dear, for a Portrait in Chalk and other Drawings—Mr. H. Souns, for a Design executed in Metal of the Head of a Greek Warrior—Miss Jane Campbell Bell, for a Chalk Drawing of a Head—Mr. F. Sands, for an Oil Painting of Birds from Nature—Mr. E. Hughes, for a Chalk Drawing of the Statue of Mars—and Mr. F. Wright, for a Clock Case carved in wood. The Silver Palette, to Master James Webb, for a Sepia Drawing of a Tree from Nature. Honorary Testimonial and 3*l.* to Mr. Willett, for an Apparatus for facilitating the Collection of Liquid Manure. Honorary Testimonial, to Mr. Thomas Lambert, for a Flexible Diaphragm Water Valve—Mr. G. P. Bayley, for his Brush for Tubular Boilers—Mr. W. Milton, for an improved Angular Drill Stock—and Mr. T. Restell, for his Compensation Pendulum.

In addition to the foregoing premiums, various sums of money, amounting together to 45 guineas, have been awarded to the authors of works of merit in Art as connected with manufactures.

THE DECORATIONS OF COVENT GARDEN THEATRE.

Mr. LAUGHER read a paper at the Decorative Art Society *on the Decorations of Covent Garden Theatre*, 1847, considered in their relation to art. Alluding to the practical difficulties to be overcome in so brief a period, he said, that he was disposed to attribute some of the defects in the design to the necessity of using such available embellishments as the experience of the architect enabled him to collect *instanter;* and while admitting that much energy and some discrimination might be detected in some of the operations, he contended that the selection of an ornamental material in which the architect is avowedly interested, and its unskilful application, were equally remarkable. The material thus alluded to is called cannabic; and was described as being composed of the refuse part of flax, held together by a bituminous matter, and pressed in thin sheets into intaglio moulds, producing thereby a *basso-relievo* surface at rather less expense, and of greater lightness, than papier mâché and similar substances. The author considered this material a useful auxiliary in decoration; but in the present case, the distance at which it is placed from the point of view, together with injudicious colouring and an excess of burnished gilding, cancel the interest which under favourable circumstances accompanies its adoption. Mr. Laugher complained of the gloomy and heavy tone of red and shadow pervading the boxes:—the divisions being covered with crimson and marone figured paper, with a crimson carpet on the floor, crimson curtains and valances; while the light impingeing over a smoothly stuffed cushion in front covered with crimson silk, diffuses a red glare by no means favourable to the appreciation of colour elsewhere. The arrangement of the curtains and valances was said to be meagre; and it was assumed that the whole had been intended to offer a quiet effect, with a reliance on the value of the silk for imparting respectability. The grounds on which crimson had probably been selected for these purposes were discussed. If as a background to a picturesque development of the audience, it was said that it totally failed—and if with reference to the effect of the general interior, the result was to be condemned for the objectionable and inartistic effect of the horizontal strips in white and heavy-toned red in harsh and forcible contrast, placed moreover without apparent vertical support. The carved fronts to the boxes were not considered equal in respect of form to those at the St. James's Theatre; and the general effect of colour upon them was described as pallid and faint—which an excess of *burnished* gilding does nothing to relieve. It was argued that gilding ought to be burnished only in a very slight proportion when placed on a white or a light coloured ground; and that the burnishing had in this case completely confused the delicate *basso-relievo* forms of ornament. The ceiling, it was observed, offers an agreeable repose to the eye in the circular range of graduated green with the full-toned browns prevailing in the marginal decorations. The general effect of the colouring throughout the embellishments is influenced in a remarkable manner by the crimson boxes in which the spectator is placed; and this, it was argued, constitutes the key-note to which other parts offer but little accordance. It was suggested that a charming effect might be obtained by the application of different colours for the curtains of the respective tiers—also that the divisions in the boxes ought to be of a neutral colour. The character, treatment, and propriety of selection in various details of the embellishments upon the box fronts were described and commented upon. It was said that forms of ornament prevailing at almost every period had been applied:—ancient Greek, Roman, Renaissance, Louis XIV., Louis XVI., and modern French combination, had each assisted to confuse and debase, in the motley arrangement, the attributes whose aspects they wore; while the ceiling itself, which it was stated is almost the only portion partaking of artistic manipulations, owes its merits to examples of Le Brun. The introduction thereon of ropes and masks in *basso-relievo*, and meretricious glitter of gilding, whereby the allegoric subjects appear in abeyance, were considered to mark the loss of skill between the artists of that and those of the present period.

[We do not by any means concur with Mr. Laugher in his sweeping conclusions. We cannot see how the lining of the box can serve as the key-note to the other decorations, and it has never produced that effect on us. We likewise differ from him *in toto* as to the want of effect of the crimson as a background to the audience, for we agree with those who hold that it admirably sets off the dresses and appearance of the company, as indeed on theoretical grounds it might naturally be expected to do. We suspect Mr. Laugher has seen the house when there was no audience in it. We are glad, however, to acknowledge in Mr. Laugher's essay a praiseworthy endeavour to raise a higher standard of criticism.—EDITOR.]

THE STEAM JET FOR VENTILATING.

Professor FARADAY, in a former lecture delivered at the Royal Institution "*On Mr. Barry's method of warming and ventilating the new House of Lords*", mentioned that a part of the means employed for securing a current of air sufficiently abundant to insure the required object was the use of a jet of high-pressure steam in the ventilating shaft of that building. At a recent meeting Mr. Faraday explained the physical conditions of such a steam-jet, and the relations of the vapour discharged from it to the surrounding air.

More than forty years ago, Dr. Young (Nat. Phil., vol. ii., p. 534) had shown that wherever any elastic fluid was forced from a jet with but small velocity, the steam proceeded for some inches without observable dilatation, and then diverged into a cone; but that when the pressure on this vapour was increased, the apex of the cone approached the orifice of the jet; but whatever might be the amount of this pressure, the form of the cone continued the same. Mr. Faraday proceeded to notice the lines of motion of the particles constituting this cone of vapour. The rings of smoke produced by the combustion of bubbles of phosphuretted hydrogen on the surface of water were exhibited. The revolution of each of these hollow rings on the axis of the cylinder which forms it was pointed out, as was their gradual expansion when rising into the air: and it was shown that each of these enlarging rings might be viewed as a magnified element of the cone of steam issuing from the jet. In the same class of effects Mr. Faraday placed the rotating clouds of smoke which are seen issuing from the chimneys of steam-boats, &c. The force with which the particles of the air surrounding the cone of steam produced by a powerful jet were drawn towards it, were shown by various striking experiments. Hollow balls of 1 and 2 inches diameter were seen drawn into the cone, and sustained floating in the line of its axis, even when, by an arrangement of the apparatus, this axis was brought 35° out of the perpendicular. An upright glass tube, 18 inches long and 1 inch diameter, having one extremity plunged into water and the other end drawn into a capillary jet was visibly exhausted of its contained air (the water being drawn up from the lower end of the tube) when the capillary jet was placed within the in-draught of air occasioned by the cone of steam. In closing this part of his subject, Mr. Faraday explained the use which has been made of a cylindrical or conical jacket to include this steam-cone, and thus to increase the draught-power of the jet. In the arrangement adopted by Mr. Barry for ventilating the House of Lords, this jacket is the ventilating-shaft itself; so that there can be no room for the entrance of air to form a downward current in the shaft. This mode of moving air has been adopted in lead-works and other manufactories, for the purpose of washing and condensing the smoke where noxious fumes are generated in the processes. Noticing the coolness of the high-pressure steam, even near the orifice of the jet, as being due to the quantity of cold air rushing towards it and diminishing its temperature, Mr. Faraday connected with this and the other phenomena the experiment of M. Clement Désormes—who showed that when steam, under high pressure, is allowed to escape from an orifice pierced in a plate, and a flat disc is brought close to this plate, the plate and disc are made to adhere together. In this case, the elastic force of the steam issuing from the jet, and which tends to separate the plate and disc, diminishes rapidly in its course from the centre to the edges of the disc; at the same time, the radial currents by their in-draught, as before illustrated, bring the two plates together with a power which is so much greater than the former that the surfaces adhere. Mr. Faraday finished by noticing the danger of conical safety-valves in high-pressure boilers, when the lateral expansion of the conical surface is large in proportion to the sectional area of the steam passage.

TIRES OF RAILWAY WHEELS.

The following remarks have been communicated by a correspondent ("X. Y. Z."), to the *Railway Record:*—"It was given in evidence, at an inquest recently held to decide upon the fatal results of an accident which occurred on the Great Western Railway, that the fracture of the steel tire of the driving-wheels of some of their locomotives was by no means an unusual occurrence, and that even those tires sometimes snapped when the engines were not running. The dreadful effects of the accident in question make it evident that nothing should be omitted by which risk may possibly be mitigated; and to this end, among, probably, many better suggestions, I beg to offer the following, both as respects the cause and its removal.

"These steel tires are dovetailed into the iron wheel; and being let in hot, it appears to be assumed that the sledge hammers of the forgers will cause the two metals—steel and iron—to become properly welded together. Now this I venture to dispute; on the contrary, I am convinced nothing like a real cementation of the two metals will be effected. If this assumption be correct, it necessarily follows that the iron felloes of the wheel will be surrounded by a distinct steel hoop. Now, the transverse section and body of hoop is very small, compared with that of the felloes, or iron rim, of the wheel—consequently, under the enormous pressure of a Great Western locomotive, the steel hoop will have a tendency to *roll out* longitudinally more than the iron rim of the wheel; and, so rolling out or stretching, it must either fracture the felloes, or the iron rim itself, if it is let into its dovetailed bed very tight; or it must become somewhat larger in diameter than the felloes of the wheels. If this latter be the result, we know that the wheel and the steel tire cannot, without a jerking back of the tire, make the same number of revolutions in any given distance. A tire so enlarged, on an iron wheel, will, when the wheel is in revolution with a heavy load upon it, be rolled down tight into its bed at all points behind that of its contact with the rail; and, at all points before that, it will be thrown partly up and forward out of its bed, by so much as it is larger in diameter than the felloes of the wheel. But when, from any cause—such as an increase of speed, or at some portion of its bed where the steel rim fits tighter —this kind of slipping of the larger outer rim on the smaller inner one, can no longer be maintained, the outer, that is the steel rim, must snap, and its fractured pieces frequently fly off with great force. But it is stated that these tires sometimes snap when the engine is not in motion. Here the laws of expansion and contraction, probably, come into action. Supposing a steel tire not to have been rolled out, as previously assumed, in running; then, when the engine comes to a state of rest, the wheel will begin to discharge into the atmosphere the extra amount of heat it has acquired during its rapid journey; and, though the contractive forces of iron and steel are, in like conditions, nearly the same, yet, the tire being the outside, will cool faster, and contract at first more than the body of the wheel; and hence it will be likely enough to snap, particularly when the hardness of the steel is considered. The converse of all this even might account for the flying off of those tires when running, without supposing there were any rolling out of the metal under the enormous load of the engine, with all its *hammering* on the rails. Now, if the cementation of the steel tire and the iron felloes of the wheel were perfect, the risk of all such accidents would seem to be obviated; and this occasions me to mention, that I some time back observed that a patent had been taken out by a Sheffield gentleman—I think of the name of Sanderson—for welding a steel plate, of sufficient thickness, on an iron bloom, and then rolling out into bars. In fact, it seemed to me that this was a plan for plating iron with steel, precisely on a similar method with that of plating copper with silver, as long practised in the well-known Sheffield plated ware. I have not been in the way of learning whether this patent has been successfully worked out; but it appears to me it might be well worth the while of any railway company using steel tires to inquire."

ARMY AND NAVY CLUB-HOUSE.

Table of Dimensions of Coffee-Room, &c., in some of the Designs.

No.	Architect.	Coffee-Room.	Area in Sq. Feet	Morning-Room.	Area in Sq. Feet	Drawing-Room.	Area in Sq. Feet
		ft. ft.		ft. ft.		ft. ft.	
28[1]	Tattersall	68 by 21	1428	55 by 24	1320	55 by 21	1155
55[2]	Fowler and Fisk	100—32	3200	56—33	1848	101—29*	2953
1		56—25 6	1428	46—22	1012	—	—
3		54—29 6	1543	42—29	1218	54—29 6	1593
12		80—27	2160	56—28	1568	56—25	1400
13		97—23	2231	56—28	1568	47—23	1081
14		64—30 6	1952	30 6—30 6	930	—	—
15	Fiddian	98—30	2940	44—25	1100	98—30	2940
18		42—32	1344	53—32	1196	53—32	1696
20		75—29	2175	58—29	1682	—	—
23	Salvin	85—30	2550	58—30	1740	58—30	1740
33		85—27	1685	58—21	1218	58—21	1218
38	Lamb	90—23	2070	98—21	2058	98—21	2058
39		80—31	2480	88—26 6	2332	66—26 6	1716
40	Johnson	70—30	2100	57—27	1539	57—26	1482
44	Owen Jones	65—39	2535	39—30	1080	65—39	2555
46	Parnell & Smith	70—34	2580	52—24	1248	55—30	1650
49	Granville	85—28 6	2462	58—28 6	1653	58—28 6	1653
50	Fripp	80—31	2480	48—24 6	1176	80—31	2480
53		62—29 6	1829	55—29 6	1620	—	—
57	Alexander	81—32	2592	42—31	1302	—	—
58		84—30	2520	56—26 6	1484	68—30	2040
67		93—27	2511	55—27 3	1499	55—27 3	1499
69	Papworth	80—40	3200	56—28	1568	56—28	1568
	Travellers' ..	68—24 6	1066	43 6—24 6	1065	39—23 9	900
	Reform	105—27	3105	58—28	1624	115—27	3105
	Conservative ..	80—28 6	2280	92—26 6	2438	92—26 6	2438

* Including Library.

ARMY AND NAVY CLUB DESIGNS.

Dear Sir,—On the part of my brother and myself, I beg to say that we observe in your valuable periodical, at page 174 of the last number, that we are held up, *ex cathedra*, as being guilty of perpetrating an untruth in the design for the Army and Navy Club-house, exhibiting by us in the gallery of the Royal Academy. As we took the trouble of making a drawing of Winchester House, for the purpose of regulating our own design, and also the liberty of sending to the secretary and committee that drawing, for the purpose of affording a test of the correctness of the designs submitted; and knowing, as we do, that the perspective of our drawing is correct, for it is our own handiwork, I beg of your justice to make this exculpation as public as the odium cast by your reviewer upon, dear Sir,

Your obedient servant,

John W. Papworth.

10, *Caroline-street, Bedford-square, 18th June*, 1847.

⁂ I write this because, in a perspective view, such an error or liberty, as the case may be, is hardly, if at all, justifiable.

NOTES OF THE MONTH.

Avignon and Marseilles Railway.—A serious disaster has occurred on the new line of railway between Avignon and Marseilles, which was just ready to be opened. The viaduct which carried the railway over the river Neurthe, one of the principal works of art upon the line, has fallen. The particulars of this event had not reached Paris, but it appears that no lives have been lost. The damage to the company will amount to from two to three millions of francs.

Crimple Viaduct.—This magnificent viaduct will, when completed, form one of the most wonderful of the achievements of science in railway construction in the kingdom. Its massy towering piers are now all reared, and its lofty expansive arches, stretching their wide concavities across the deep glen, will shortly be brought to a close. Those of our readers who may be unacquainted with this structure, may feel somewhat interested by a brief description of its situation, and an accurate admeasurement of its gigantic form. Its situation is about a mile to the south-east of Harrogate; it is intended to convey the Harrogate and Church Fenton line of railway across the Crimple Valley. The viaduct consists of 31 arches, each of 52 ft. span, and the loftiest are 130 ft. in height. The piers on which they rest, 32 in number, are about 20 ft. each in thickness at the base, and are composed of immense blocks of hard granite. The top of each pier, immediately beneath the springer, is 8 ft., and the quoins 4 ft. in thickness. The abutments are thickly flanked, and joined by lofty embankments. The line at the south end is carried through a long deep tunnel; while at the opposite extremity it proceeds along a deep rocky cutting. The whole length of the masonry is about 1856 ft. Between the first and second buttresses at the south end runs the line of the Leeds and Thirsk Railway, which is carried along the mountain side a considerable distance, and afterwards thrown across the vale by another viaduct, which, however, appears very diminutive compared with the one described above. The part of the valley over which the monster viaduct is thrown, is a beautiful and romantic little defile between two high rocky mountains, whose steep and rugged sides are covered with a profusion of heath, brushwood, and other kinds of vegetable life, indigenious to the mountain soil.—*Harrogate Herald.*

The Exhibition of Oil Paintings at Westminster Hall, must be looked upon as satisfactory on the whole, while the awards of the Commissioners can scarcely be impugned. The works are 120 in number. The 500*l.* prizes are given to Mr. Armitage, for his Battle of Meanee, a most spirited work; to Mr. F. R. Pickersgill, for the Burial of Harold; and to Mr. G. F. Watts, for his Sketch of Alfred inciting the English to meet the Danes at Sea. The 300*l.* prizes are given to Messrs. John Cross, P. F. Poole, and J. Noel Paten. The 200*l.* prizes to Messrs. J. E. Lauder, Charles Lucy, and J. C. Horsley. Among the remaining meritorious works are those of Mr. S. Gambardella, Mr. Wm. Cave Thomas, Mr. Salter, Mr. Crowley, and Mr. Brunning. The great defect is in the choice of subjects, showing the want of liberal education on the part of the artists It was not so in the middle ages; but now the artist thinks he need only study with his pencil, that he can learn enough by his own observations, without having recourse to the observations of others. The partisans of "art-cultus" and artistic neology had better look to this.

The Opening of Hartlepool West Harbour and Docks, situate near the village of Stranton, about a mile and a half to the south of Hartlepool, close upon the sea-shore, has taken place. The dock comprises an area of about eight acres of water, and has substantially-built quay walls on every side, and in cases of danger is calculated to afford a convenient place of shelter and security for a large number of vessels. The harbour comprises about fourteen acres of water, and is enclosed by two bold piers jutting into the sea, the whole built in the most solid and substantial manner. Vessels can always be afloat in the dock with twenty-three feet of water, if required. A graving dock has also been commenced.

OBITUARY.—We have to record the death of Mr. John Buonarotti Papworth, late Vice-President of the Royal Institute of British Architects, which occurred on Wednesday, the 16th ult., at his residence, Park End, St. Neot's, whither he had retired from London, after more than fifty years of professional practice. Early in life, his excellent judgment and a kind heart acquired for him the intimacy of the leading artists, and also the confidence of many wealthy amateurs as to the direction of their patronage, and as to the decoration of their mansions; in this course he originated and accomplished the adoption of the tasteful style of modern furniture, from which cause he was selected by government to carry out the foundation of the School of Design at Somerset House. His works on garden and rural architecture, very favourably received by the public, were the results of his experience in landscape gardening, which he joined as a profession with his other art. Amongst the clients to whom he owed an extremely varied practice, he numbered several of the late branches of the royal family, especially the Princess Charlotte, and also the present King of Würtemberg, from whom he, having designed the Palace and English Park at Kaunstadt, received the appointment of architect to his Majesty. His son will have the satisfaction of remembering how highly Mr. Papworth was respected, not only by his private friends and by his clients, but by those severer judges, the members of his own profession, to whose splendid token of their esteem we gave publicity at the beginning of the year.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM MAY 22, TO JUNE 24, 1847.

Six Months allowed for Enrolment, unless otherwise expressed.

Henry John Nicoll, of 114, Regent-street, Middlesex, tailor, for "Improvements in garments, and in pockets, bags, and other receptacles."—Sealed May 22.

Sydney Smith, of the county of the town of Nottingham, engineer, for "a certain improved apparatus for determining the pressure of steam in boilers, and regulating the dampers of a furnace."—May 22.

William Bridges Adams, of Old Ford, in the county of Middlesex, engineer, and Robert Richardson, late of Manningtree, in the county of Essex, but now of Hadleigh, in the county of Suffolk, for "certain Improvements in the construction of railways, and of engines and carriages used thereon, and also in transport and storage arrangements for the conveyance, management, and preservation of perishable articles."—May 22.

Moses Poole, of London, gentleman, for "Improvements in the construction of pneumatic springs and presses." (A communication.)—May 22.

Jean Marie Fourmentin, of New Bridge-street, Blackfriars, gentleman, for "Improvements in the manufacture of carbonate of lead."—May 22.

William Edward Newton, of Chancery-lane, Middlesex, civil engineer, for "a new or improved instrument or apparatus for making or manufacturing capsules for enclosing medicines, preparations, or other liquid or solid preparations." (A communication.)—May 22.

John Aitken, of Russell-street, Bermondsey, leather dresser, for "Improvements in steam-engines or atmospheric engines, in distilling and pumping water."—May 22.

William Dyne, of Rochester-terrace, Stoke Newington, Middlesex, corn merchant, and Morys Haggar, of Church-street, Stoke Newington, for "certain Improved apparatus for protecting life and property in cases of shipwreck."—May 22.

Charles Chinnock, of 52, Regent's Quadrant, Middlesex, for "Improvements in regulating motion, and controlling friction in the joints and other parts of furniture, machinery, and carriages."—May 22.

Henry La Lievre, of Cleveland-street, Mile-end, Middlesex, for "Improvements in dyeing and stretching silk, and in finishing plush."—May 24.

Pierre Armand Le Comte de Fontainemoreau, of 4, South-street, Finsbury, London, for "certain Improvements in the machinery for cutting wood, and in laying and uniting veneers." (A communication.)—May 25.

Christian Schiele, late of Frankfort on the Maine, but now of Manchester, for "certain Improvements in machinery or apparatus for condensing steam, which said improvements are also applicable to other similar purposes."—May 27.

Alexander Allan, of Crewe, in the county of Chester, engineer, for "certain Improvements in turn tables, to be employed on, or in connection with railways, part or parts of which said improvements are also applicable to the construction of tubular boilers."—May 27.

Henry Gilbert, of Marina, St. Leonards, surgeon, for "Improvements in apparatus for holding sacks to facilitate the filling them with corn or other material."—May 27.

Henry McEvoy, of Hall-street Works, Birmingham, machinist, for "Improvements in the manufacture of, and in the packing hooks and eyes."—May 27.

Benjamin Thorneycroft, of Wolverhampton, iron master, for "Improvements in the manufacture of rails for railroads."—May 27.

James Johnstone, of Willow Park, Greenock, Esq., for "certain Improvements in the manufacture of sugar."—May 27.

James Blewitt, of Llantarnam Abbey, Newport, in the county of Monmouth, Esq., for "Improvements in the manufacture of malleable iron."—May 27.

Archibald Brooman, of Fleet-street, for "certain Improvements in the processes and machinery employed in scouring and bleaching." (A communication.)—May 27.

Alfred Stevens, of 2, Queen's Terrace, Saint John's Wood, Middlesex, chemist, for "a new or Improved preparation or preparations of certain substances for making various glutinous compounds."—May 29.

Francis Bernard Bekaert, of Rue Royale, Exterieure, Brussels, in the kingdom of Belgium, for "a method of increasing the quantity of cream procured from milk, and preserving milk."—May 29.

William Horne, of Long-acre, Middlesex, coach-maker, George Beadon, of Battersea Fields, Surrey, and Andrew Smith, of Millwall, Middlesex, engineer, for "Improvements in wheel carriages."—June 3.

Josiah George Jennings, of Great Charlotte-street, Blackfriars, for "Improvements in water-closets, and in making joints and connections of pipes."—June 3.

Christopher Nickels, of York-road, Surrey, gentleman, for "Improvement in the manufacture of woven fabrics, and in giving elasticity to certain articles of fabrics."—June 3.

John Hill, of Hulme, near Manchester, machine maker, for "Improvements in looms for weaving certain kinds of cloth."—June 3.

Thomas Woodbridge, of No. 10, Osborne-street, Whitechapel, Middlesex, corn-dealer, for "a certain Improvement or certain improvements in steam engines."—June 3.

Samuel Benjamin Edward Berger, of Abchurch-lane, in the city of London, merchant, for "certain Improvements in the construction of railway carriages."—June 3.

George Taylor, of Holbeck, near Leeds, mechanic, for "Improvements in the construction of engines and carriages to be used on railways."—June 3.

Richard Clark, of 447, West Strand, lamp manufacturer, for "certain Improvements in the production of artificial light, and in burners, lamps, and candlesticks."—June 3.

Samuel Ellen, of Grange-road, Bermondsey, gentleman, for "Improvements in the manufacture of losh hide leather and other oiled leathers."—June 8.

Charles Larrard, of Leicester, machinist, for "Improvements in machinery for cutting wood for the manufacture of bobbins and other articles."—June 8.

Henry Cox, of No. 2, Chappel-place, Battersea Fields, Surrey, for "Improvements in the preserving and preparing of wood, bricks, tiles, and other substances."—June 10.

Bondy Azulay, of Rotherhithe, in the county of Surrey, printer, and Abraham Solomons, of the city of London, merchant, for "certain Improvements in the manufacture of charcoal and other fuel."—June 10.

William Darling, of Glasgow, Scotland, iron-founder, for "Improvements in moulding, and in the manufacture of certain articles of cast iron."—June 10.

William Beckett Johnson, of Manchester, engineer, for "certain Improvements in the construction of locomotive engines, to be used upon rail or other ways, which improvements are also applicable to carriages used upon railways."—June 12.

James Johnson, of Bradley, in the county of Stafford, iron founder and boiler maker, for "Improvements in the manufacture of rivets, railway, or other pins, bolts, nuts, and spikes."—June 12.

John Mercer, of Oakenshaw, and John Greenwood, of Church, both in the county of Lancaster, chemists, for "Improvements in certain substances applicable to the manufacture, scouring, and washing wool and woollen fabrics and other substances."—June 12.

George Edmund Donisthorpe, of Leeds, in the county of York, manufacturer, for "Improvements in weaving and spinning wool and flax, and in treating wool previous to spinning, and heckling flax."—June 12.

Joseph Wilcock, of Barnsby, in the county of York, gentleman, for "certain Improvements in the ventilation of mines."—June 12.

James Richards, of New York, engineer, for "Improvements in constructing pistons."—June 12.

Francis Bowers Stevens, of Hoboken, in the county of Hudson, in the State of New Jersey, in the United States of America, engineer, for "Improvements in applying means and apparatus to ships and vessels, to improve their speed."—June 12.

John Lane, of Oriel-street, Liverpool, brewer, for "Improvements in railway carriages and engines."—June 15.

Richard Roberts, of Manchester, engineer, for "Improvements in machinery for preparing and spinning cotton, and other fibrous substances."—June 15.

James Timmins Chance, of Handsworth, in the county of Stafford, glass manufacturer, for "Improvements in the manufacture of glass." (A communication.)—June 15.

John Lane Higgins, of Oxford-street, Middlesex, Esq., for "Improvements in the construction of winches and windlasses."—June 15.

Frederick Theodore Philippe, of Bellfield Hall, in the county of Lancaster, calico printer, for "certain Improvements in machinery or apparatus for stretching, drying, and finishing woven fabrics."—June 15.

Alexander Symons, of London-street, Fenchurch-street, merchant, for "Improvements in railway carriages in preventing accidents on railways, and ascertaining the speed of carriages."—June 15.

James Houghton, of Oldham, in the county of Lancaster, for "certain Improvements in machinery or apparatus, to be used in the preparation and spinning of cotton, wool, and other fibrous substances."—June 15.

Henry Pooley, of Liverpool, iron founder, for "certain Improvements in weighing machines."—June 16.

James Hill, of Staley Bridge, in the county of Chester, cotton spinner, for "Improvements in or applicable to certain machines for preparing, spinning, and doubling cotton, wool, and other fibrous substances."—June 19.

Samuel Keeling, of Hanley, in the county of Stafford, for "an Improved method of making candlesticks."—June 19.

James Murdock, of 7, Staple Inn, Middlesex, patent agent, for "an Improved mode of manufacturing woven goods figured on both sides."—June 19.

Francois Henri Bickes, of Mayence, on the Rhine, gentleman, and Meyer Henry, of Colonial Chambers, Crutched Friars, merchant, for "certain Improvements in rearing, manuring, or preparing corn, seeds, plants, and trees, and in fertilising land."—June 19.

William Vickers, of Sheffield, steel manufacturer, for "Improvements in the manufacturer of iron."—June 19.

Thomas Russell Crampton, of Adam-street, Adelphi, engineer, for "Improvements in locomotive engines."—June 19.

James Robertson, of Great Howard street, Liverpool, for "Improvements in the manufacture of casks and other wooden vessels, and in machinery for cutting wood for that and other purposes."—June 19.

John Macintosh, of Bedford-square, Middlesex, for "Improvements in engines to be worked by steam or other suitable fluid, and improvements in propelling carriages and vessels."—June 22.

James Soutter and William Frederick Hammond, of the Spread Eagle Works, Limehouse, engineers, for "certain Improvements in the steam engine, and in machinery for propelling."—June 22.

John Obadiah Newell Rutter, of Brighton, gas engineer, for "certain Improved methods of, or apparatus for conveying intelligence."—June 22.

Henry Mapple, William Brown, and James Lodge Mapple, of Childs Hill, Hendon, for "Improvements in communicating intelligence by means of electricity, and in apparatus relating thereto, part of which improvements are also applicable to other like purposes."—June 23.

John Richard Watson, of Pentonville, Middlesex, gentleman, for "an Improved instrument for registering angles at sea."—June 24.

ERRATA.—In the last number of the Journal, in our review of Mr. Hann's "Treatise on the Steam Engine," page 195, for

$$x = \rho\,(1 - \cos\phi) + \frac{r}{2}\cos\theta, \qquad \text{read}$$

$$x = \rho\,(1 - \cos\phi) + r\,(1 - \frac{1}{2}\cos\theta).$$

OBITUARY.—We have to record the de
worth, late Vice-President of the Roy
which occurred on Wednesday, the 16t
St. Neot's, whither he had retired from
of professional practice. Early in life
heart acquired for him the intimacy
confidence of many wealthy amateurs
and as to the decoration of their man
accomplished the adoption of the ta
which cause he was selected by go
the School of Design at Somerset I
architecture, very favourably recei
his experience in landscape gard
with his other art. Amongst the
varied practice, he numbered s
family, especially the Princess
Würtemberg, from whom he,
Park at Kannstadt, received
His son will have the satisfact
worth was respected, not onl
but by those severer judges,
splendid token of their este
year.

LIST

GRANTED IN EN

Six Months allow

Henry John Nicoll, of
garments, and in pockets,

Sydney Smith, of the co
proved apparatus for det
dampers of a furnace."—

William Bridges Ada
Richardson, late of Ma
county of Suffolk, for "
gines and carriages us
conveyance, managem

Moses Poole, of Lo
matic springs and pr

Jean Marie Fourn
ments in the manu

William Edward
Improved instrum
medicines, prepar
May 22.

John Aitken,
steam-engines or

William Dyne
Morys Haggar,
protecting life

Charles Chi
lating motion,
and carriages

Henry Le
ing and stre

Pierre Ar
"certain I
veneers."

Christi
Improve
are also

Alexa
ments I
which
May 2

He
holdi

H
the

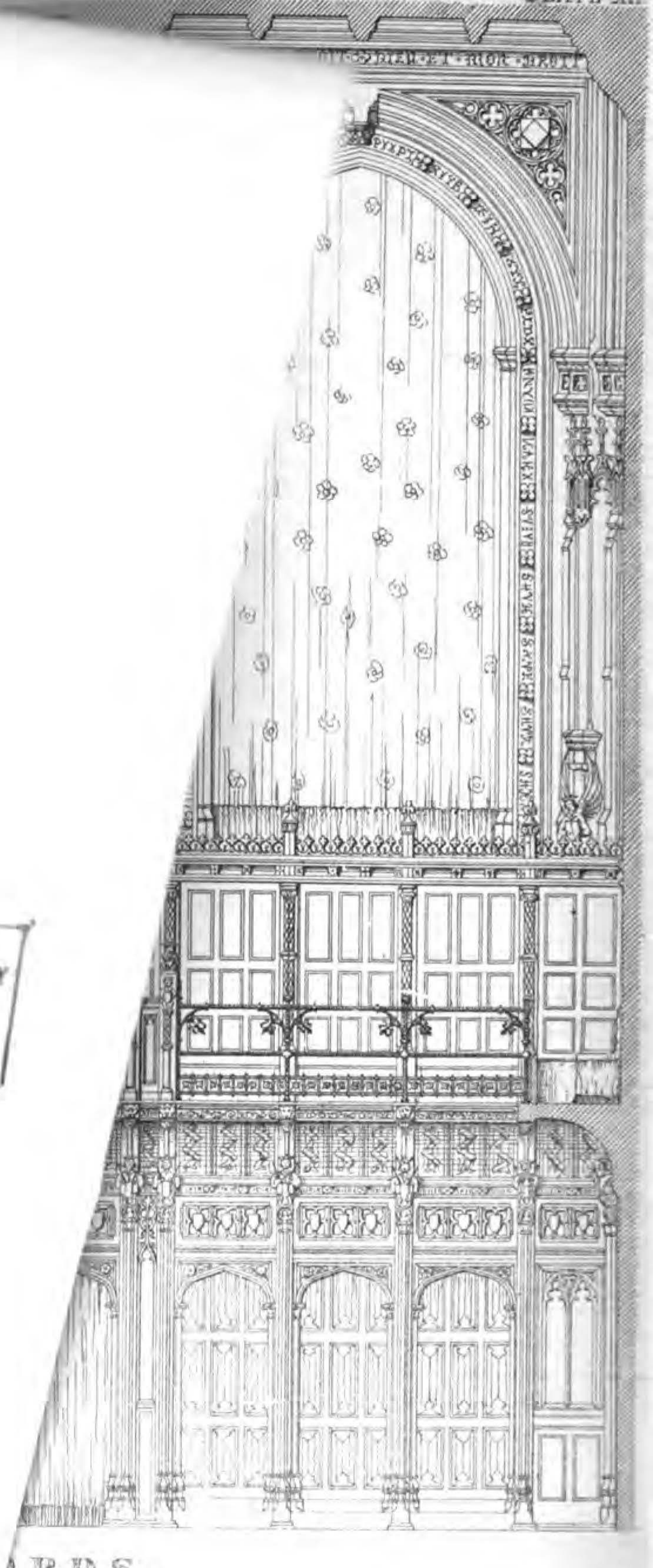
F
m

m

"

n

PLATE XII



RDS.

10 20 Feet

THE NEW PALACE AT WESTMINSTER.

(With an Engraving of the House of Lords, Plate XII.)

CHARLES BARRY, ESQ., ARCHITECT.

We this month, agreeably to our promise, give a second view of the interior of the House of Lords; it is a transverse section, or view of the north end, showing the Reporters and Strangers' Gallery. The archway under the centre of the gallery is the principal entrance to the House, and the side arches enclose two small waiting rooms or lobbies. The arches above the Gallery, and the centre one below, are filled in with cloth curtains. The front of the Galleries and the enclosure to the Lobbies below are of wainscot, and the arches above of stone. The faces of the spandrels and ribs are elaborately gilt, similar to the side elevation. The Plate is drawn to the same scale as the one in last month's Journal.

The following is Mr. Barry's report of the state of the works on June 30, 1847:—

The carcase works of the portion of the building towards New Palace Yard are entirely completed.

The Victoria Tower is about 90 feet high; the carving of the stone groin within it is completed, and the scaffolding is removed.

The Clock Tower is also about 90 feet high. Framed scaffolding and hoisting apparatus have been prepared, and are now being fixed for the upper portions of those towers, which are not yet contracted for.

The stone groin over the Central Hall is now being turned, and is far advanced to completion.

St. Stephen's Hall is in part carried up to its full height for the roof, and the remainder is, upon an average, within about 10 feet of the same level. St. Stephen's Porch and the western entrance of the building is carried up to the height of about 30 feet above the ground.

The Commons' public lobby, and the central masses of the building above the corridors and public staircase, are, upon an average, within about 10 feet of their full height.

The House of Commons' ceiling, beams, and bracketting, and the stone screens at the north and south ends of the house, are completed. The fittings and finishings of the house are not yet ordered, as no decision is yet come to respecting Dr. Reid's plans for warming and ventilating this portion of the building.

The House of Lords, the royal ante-chamber, and the house or public lobby, with all their warming and ventilating arrangements and apparatus, are (with the exception of a portion of the stained glass, the fresco paintings, statues, and other works of art) completed; and those portions of the building were occupied for the first time immediately after the Easter recess of the present year.

The fittings of the old House of Lords were removed during the Easter recess, the house converted into a gallery of approach from the House of Commons, and other communications made between the temporary and the new buildings.

The fittings and finishings of the libraries and refreshment rooms are near completion. A considerable extent of joiners' work in ceilings is prepared: much of it is fixed, and other finishings are executed in other portions of the building.

Ten new committee rooms in the river front have been temporarily fitted up for use since Easter.

There are at present 1,276 men engaged upon the works of the New Palace, of whom 708 are employed at the building, 147 at the quarries, 228 at the government works at Thames-bank upon the joiners' fittings and wood carvings, and 193 upon miscellaneous works both at the building and elsewhere.

A Builders' Benevolent Institution is about being established for the relief of decayed masters in the building business, and also for the relief of workmen in the employ of a subscriber, who may meet with an accident; it is also proposed to establish Alms-houses when an adequate sum can be raised.

CANDIDUS'S NOTE-BOOK.
FASCICULUS LXII.

"I must have liberty
Withal, as large a charter as the winds,
To blow on whom I please."

I. "Why work we not as our forefathers wrought," is a question that was put by Mr. Scott as the motto to his design for the Army and Navy Clubhouse. No doubt it is one which he considers unanswerable; yet the design itself furnished a tolerably conclusive reply, as did likewise one or two others which appeared in similar architectural masquerade, having assumed the costume of mediævalism. Clubs and Club-houses, however, are institutions belonging exclusively to modern civilisation and refinement. In former times, there was nothing whatever analogous to them, unless it were convents,—cœnobitism, or living in common, and the exclusion of the society of the other sex, being one great characteristic of both. Yet there all resemblance ends; modern cœnobitism being of quite a different stamp from that which was in vogue among our "forefathers." Everything has been metamorphosed—either greatly reformed or else grossly perverted. The Coffee-room has taken place of the Refectory, and the epicurean *carte* has put the meagre days of the "good olden times" to flight. Are the latter, then, to be now restored?—or are we to return to mediævalism only by halves? If we are to be archaic in our buildings, why not also in our dress, in our speech, in our amusements? Why do we not dine as our forefathers dined? And we might go on adding question of the kind to question, till we asked: why are we not our veritable forefathers themselves?—Sentimental *archæomania* is one of the fashions of the day, and one whose very extravagance will sooner or later bring it into contempt, when it will be put on the same shelf with bibliomania and other exploded follies. Like bibliomania itself, archæomania is—although it does not absolutely exclude them—quite independent of any knowledge of, or taste for, the intrinsic æsthetic value of the class of productions it concerns itself with. The one prides itself upon estimating buildings as the other does books—by merely extrinsic circumstances, instead of judging of them by their architectural or literary worth. The building may be rubbish, the book may be—rubbish also; but if the one can be proved to be of the date of the Conquest, the other be a black-letter edition—perhaps an unique copy in the original binding—your archæomaniac and your bibliomaniac fall into ecstasies,—that is, provided there be anybody present to witness them, such raptures being themselves far too valuable to be acted in private. Your archæomaniac will, perhaps, be able to tell you the date of every part of a cathedral, and the names of all the respective bishops or other founders, together with many other, no doubt, highly *curious*, yet altogether extrinsic, matters; but ask him for a critical elucidation of individual and aggregate beauties, and he stares at you with contempt, if not with horror—probably the latter, for he feels very uncomfortable in your company. You seem to expect something like reasoning *now* from him; while he demands the unquestioning admiration of implicit faith from you.—Go to! you are a heretic!

II. Among the designs for the same building, namely, the Army and Navy Club-house, was another Gothic one that was an absolute bargain; for, although it showed a lofty structure, bristling with pinnacles, and crowded with canopied niches and their statues, and the whole was to be executed in real stone, the estimate was neither more nor less than the exact £30,000; which rigourously prescribed sum was *conscientiously* adhered to by nearly every one of the competitors, notwithstanding the prodigious difference of the designs themselves, in regard to a great variety of circumstances affecting cost. But, alas! even such tempting bargain as the design alluded to, did not tempt the gentlemen of the Army and Navy Club. Perhaps they rather looked at that and the other Gothic designs with *con*-tempt, as silly *at*-tempts to make them make monkeys of themselves, by aping the architure of monkery and monkish times. Let us not mock "our forefathers," by substituting mere mummery for art.

III. We have outgrown mediæval architecture. It is a garb which, besides that it ill accords with the rest of our social costume, would require to be enlarged—to be both greatly lengthened and widened, in order to fit it to the present stature of civilization. It may become the church well enough, as being of the true clerical cut and "cloth." But for ordinary purposes, and all sorts of purposes,—that is not to be thought of seriously. Nevertheless, it is stated that the Carlsruhe Theatre, which was lately burnt down, is to be rebuilt in the Gothic style—at least, some such idea is entertained, and Heideloff has been specially invited to furnish designs in that style. Still, complimentary as this looks to Gothic architecture, it may fairly be questioned whether the compliment will not be resented rather as an insult, by the staunch advocates for medievalism. To apply such a style to a theatre will be deemed by them little less than a downright profanation of it. One inevitable scandal will be, that Precedent must be rudely shoved aside, there being no precedent whatever for any *profane* structure of the kind in all the remains of the middle ages. Innovations, and very extensive ones, there must be, in order to accommodate the building to its express purpose. The idea is not, indeed, quite new to the Germans, a private court theatre having been built some few years ago, by Ottmer, in a sort of Gothic—but of such sort, as would certainly scandalise our Pugins and our Willises. Whether Heideloff will acquit himself of the difficult task imposed upon him, much more satisfactorily, may be doubted, since the very fact which is alleged as peculiarly qualifying him for it, must in a great measure disqualify him also; because if he has all along devoted himself exclusively to the study of Gothic architecture and art, he must come quite unprepared to such a very special subject as a theatre, which is, moreover, one that demands ability of a particular kind. His designs for Gothic furniture do not promise much for his power of invention—that species of invention which consists in re-combining forms and details into novel applications of them, and adding others to them where necessary, conceived in the same spirit and treated with the same gusto.

IV. Although in his lately published lecture on the "Education and Character of the Architect," Professor Donaldson earnestly recommends the study of biography, and especially *commends* Milizia's "Lives," he seems to think that no farther dose of biography is now wanted. At least, he has expressed no desire to see some one undertake a continuation of that work, bringing it down to the present time. Such a continuation of it ought to be fully as interesting as Milizia's work, which, to say the truth, hardly pretends to be a readable book, though useful enough as one of mere reference. To say the truth again, there is very little that answers to the idea of biography in it, most of the lives being very jejune notices of the individuals themselves, with a dry enumeration of their principal buildings. The subjects of such biography have since then greatly accumulated, although it must be confessed that materials for them are in many instances very scanty, owing to their not having been collected while they were within reach. Still there is very much lying scattered about, which requires only to be searched out and put together. It will, perhaps, be said that in the two last generations of architects who have gone off the stage, there were few who distinguished themselves either by great works or great talent. Still, there were many of celebrity, whether that celebrity was merited or not, and several of great ability also,—persons quite as worthy of a niche in biography, as are a very great many of those recorded, and merely recorded, by Milizia. It is in one respect all the better if there are comparatively few to be spoken of, because in that case there is room for biographical narrative and critical remark. Something more attractive and instructive also than such mere *skeletons*, as many of the notices in Milizia are, is highly desirable;—something sufficiently readable to impress itself on the memory;—something analogous in plan to "Johnson's Lives of the Poets." Properly written, the biographies of architects, or indeed any artists, might be made to comprise a great deal of valuable preceptive comment, illustrating and illustrated by the buildings themselves that are spoken of; and even where they must be spoken of with censure, art and good taste are benefitted by the exposure of mistakes and errors. It is almost as necessary to know what we ought to avoid as what we ought to imitate; otherwise we have only one-half of the experience necessary for our guidance, and are in danger of running aground on the very same shoals that others have been wrecked upon, merely because the mistaken, not to say dishonest, lenity of biography and criticism has not pointedly marked out for our warning, those concealed dangers.

V. Not long ago a volume made its appearance, which promised beforehand to be an unusually complete piece of architectural biography, the whole of it being devoted to the life of James Gandon. As the subject of it could possess no interest for the general public, it was almost to be taken for granted that it would contain a great deal that would be particularly interesting to architectural readers. Instead of which, it has no interest at all for any one: as a biography it is a nullity, there being nothing in the history of the man himself but what might have been related in a couple of pages. His was not a life replete with incident like that of Benvenuto Cellini; neither is it made a vehicle for bringing us acquainted, except here and there merely nominally, with other individuals who were of particular note. The anecdotes with which the book is eked out, are all of the most trivial description; and the notices of contemporary artists—nearly all of them, by the by, painters—are as dull as they are meagre, or rather are so meagre as to be almost of necessity very dry and dull also. The only one of whom we are allowed to obtain more than a mere glimpse, is Paul Sandby, who exhibits himself as a humourist, in which character he prepossesses us not a little in his favour in one or two very lively and playful letters—the only *bonne bouche* in the volume. As to Gandon himself, he might just as well have been any thing else—a builder or contractor, for instance—as what he was; and the book might still have been just what it is now. That he was an architect seems to have been all but entirely forgotten by his biographer. Though he did not erect many structures, those which he did were important ones; accordingly they ought to have been made the subject of full description and discussion: or if his works do not deserve it, but are as uninteresting as his own life, why should his biography have been attempted at all? At any rate, one work there is of his which would have afforded ample matter for notice, namely, the two supplementary volumes to the "Vitruvius Britannicus," for upon them might very properly have been founded a review of the state of architecture in this country during the period they illustrate. As it is, the "Life" of Gandon fully verifies the proverb, that "God sends meat and the devil sends cooks."

VI. Allan Cunningham's "Lives of British Architects," are just what they were intended, a few popular and pleasingly written biographies of the kind, derived from accessible sources, interspersed with superficial, and some of them erroneous, remarks, that may pass for very respectable second-hand criticism. With him, Vanbrugh the architect is eclipsed by Vanbrugh the dramatist. Allan contented himself with what he could find at hand and shaped-out for him, without looking about for more *raw material*. James Wyatt is excluded, although he was most undeniably of extraordinary vogue in his time, and also in some measure makes epoch in his profession by having been one of the first to practise revived Gothic architecture to any extent. Notwithstanding, too, that he himself was a Scotchman, and not deficient in nationality, Allan gave us no biography either of Sir William Bruce, or Robert Adam;—and the omission of the latter is remarkable enough.

VII. If we turn to the continent, we shall there discover many important names that are now become available for architectural biography,—such for instance as Percier, Cagnola, Piermarini, Schinkel, and quite recently, Friedrich Gärtner. Of these, with the exception of the last, various memoirs, and some of them of considerable length, and critical as well as biographical, are to be met with in foreign publications; as are likewise those of a great many other French, Italian, and German architects. Most of them are quite as "well written" as Milizia's "Lives;" some of them incomparably better. As to Mrs. Cresy's translation of the latter, it is charitable to suppose that she was learning Italian at the time, and turned the book into English, for there are passages in it of which it is impossible to discover the meaning at all without referring to the original. Milizia required not a lady translator, but one thoroughly conversant with architecture, and capable of officiating as his annotator also.

HISTORY OF ARCHITECTURE IN GREAT BRITAIN.

A Brief Sketch or Epitome of the Rise and Progress of Architecture in Great Britain. By James Elmes.

"Epitomes are helpful to the memory, and of good private use."
Sir Henry Wotton.

(Continued from page 210.)

The great epoch of modern architecture in England is that of Wren, and was created by the fire that reduced the city of London to a mass of ruins. Wren was fortunate in falling upon such an opportunity, and London was fortunate in finding such an able rebuilder as Wren, who was a singular combination of the greatest powers of the human mind. He was a scholar, a poet, an artist, an astronomer, a mathematician, an engineer, an architect, and a profound philosopher. Nothing was too difficult for his aspiring and powerful mind. He was born when Charles I. was in the zenith of his power, having then sat on the throne of Great Britain, as its second monarch, about seven years. How that monarch patronised architecture and the other arts of design is before recorded. Wren began his public career at a very early age; but, unlike the generality of precocious youths, retained his intellect unimpaired and his body vigorous to a Nestorian age.

He left Westminster school and was entered a gentleman commoner of Wadham College, Oxford, at the early age of fourteen. Although so young, he obtained the notice and friendship of the greatest men then resident in that university. The great mathematician, Oughtred, then a Fellow of Wadham, records his talents in his "Clavis Mathematicus," and Dr. John Wilkins, the then warden of his college, introduced him as a prodigy of science, to the Elector Palatine Prince Charles, who was on a visit to that distinguished seat and seminary of learning. He had previously known this illustrious Prince when on a visit to his father's house, the Deanery at Windsor, and took this opportunity of presenting some scientific inventions by the desire of Dr. Wilkins, and recorded them in a letter* to His Serene Highness. As a scholar, he was commanded by Sir Charles Scarborough to translate Oughtred's "Geometrical Dialling" into Latin, for the use of the learned men of Europe; and this when he was only in his 15th year. In the same year he invented and received a patent for an instrument for writing with two pens; and it is recorded as a singular coincidence that Sir William Petty, the founder of the noble family of Lansdowne, invented a similar machine in France, and obtained a patent in England in the same year with his youthful cotemporary. He was at the same period engaged by Dr. Sir Charles Scarborough as his demonstrating assistant in his lectures on anatomy, of which appointment he was so proud, that he communicated it to his father in a letter of elegant Latin. He also signalised himself as an astronomer, a scholar, and a poet, by a series of Latin metrical stanzas, proposing a reformation of the ancient fables of the signs of the zodiac; an algebraical treatise on the Julian period; and a Latin treatise on spherical trigonometry.

Few men of any time have exhibited a more expansive mind than Wren: like Michael Angelo, nothing seemed too great, too difficult, or too minute for its investigation. At one time sweeping the heavens with "Galileo's tube," tracing the motions of planets and comets through empyreal space; at another seeking the properties of insects and animalculæ with the microscopic lens; occupied in his study by storing his vast mind by the treasures of ancient lore; giving to the learned his discourses in Latin, worthy of the Augustan age; improving machinery for tillage, the mensuration of time, registration of changes in the atmosphere, and other useful projects. In fact, his mind was never unemployed; he studied, as Horace directs, by day and by night, and of no man could it be more truly said, *nulla dies sine linea.*

Whilst Wren was pursuing his course of studies and inventions with indefatigable industry, giving to the world useful discoveries at an age when others were studying their elements, a circumstance occurred that gave a powerful direction to Wren's mind. In 1648, Wren's 16th year, Pope Innocent X. announced to the world, that St. Peters, the great cathedral of Catholic Europe, was then completed, under the superintendence of the illustrious Bernini. This great event was the engrossing topic of the day, and induced Wren, among others, to the examination of its claims to celebrity, by comparing it with the great works of the ancients and their architectural law-giver, Vitruvius, which was then a sealed book but to the learned. This new study enabled Wren, in after days, to complete our Protestant cathedral of St. Paul by himself, whilst that of St. Peter's occupied the talents of twenty architects, from Bramante to Bernini, including Raffaelle and the mighty Buonarotti, who raised, as he had promised, the Pantheon into the air. Nineteen popes, from Julius II. to Innocent X., aided by forced contributions from the whole Christian world, raised the one: a single people, in three short reigns, by one architect, a single diocesan Protestant bishop, from no funds but those voluntarily given by the people, accomplished the other.

Wren's society and advice was sought by all the illustrious in birth and mind. His reputation was not merely British, it was European. At one time, he is sought by Helvicus to illustrate his chronological tables by an algebraical calculation of the Julian period; at another, invited by the illustrious Boyle to examine the hypothesis of Des Cartes on the pressure of the atmosphere, which indisputably gives to Wren the invention of the barometer; again, Dr. Willis desires his assistance in dissecting and preparing a treatise on the anatomy of the brain. Immersed in the numerous engagements consequent on being elected Fellow of All Souls, Oxford, and the preparation of an inaugural discourse on being appointed professor of astronomy in Gresham College, he found time to solve Pascal's problem, and to propound another, originally proposed by Kepler, and privately answered by himself, and was the only solution ever given to it. Hundreds of such instances, in every branch of science, occur in his biography, from an investigation into the motions of the satellites of Jupiter, and as Savillian professor in Oxford to report on the constellation Taurus, to an earnest solicitation of his friend John Evelyn,* on the education of his son, to which Wren applied himself with as much sincerity and zeal as he did to the questions of the most learned in Europe, and to the king's command to make a globe of the moon. Sought for both in Oxford and in London, his presence at one causing regrets for his absence at another; filling with unexampled earnestness and zeal the astronomical chairs of the university and the metropolis, descanting to them upon the starry heavens, and entertaining the members of the newly-formed Royal Society by microscopical disquisitions upon the smallest insects, and with ever-recurring novelties in mechanics, he still found time to cultivate the arts of design, and the still more abstruse science of chemistry, which he studied with other learned cotemporaries under the celebrated Rosicrucian philosopher, Peter Sthael, of Strasburgh, who was invited to Oxford and courteously entertained by the illustrious Robert Boyle, one of the closest and perhaps the most distinguished of Wren's friends.

At this period of Wren's life, his 28th year, which was marked by the restoration of monarchy in the person of the profligate and ungrateful Charles II., 1660, whilst he was filling the rich storehouse of his mind from every available source, had it been directed to any distinct object, whether in literature, philosophy, science, or art, he would have been eminent in either. From the circumstance of there being at that time no architect in England, but the neglected and almost forgotten Inigo Jones, he was consulted as a man of general knowledge upon all the little architectural projects of the day. Had Cromwell been a patron of the liberal arts, Wren, most likely, would have been his architect and surveyor-general, for it is related that Mr. Claypole, who married Oliver Cromwell's favourite daughter, who had more influence over her father than any other human being, was well acquainted with Wren. Claypole, who was a mild, retiring man, fond of mathematics and the studies of the closet, had a great love for the society of the youthful philosopher, and frequently introduced him to his own domestic circle, where the stern Protector occasionally paid visits to indulge in converse with his favourite daughter. It happened at one of these visits that Cromwell came into the room as they sat at dinner, and without any ceremony, as was his usual way in his own family, he took his place. After a little time, fixing his eyes on Mr. Wren, he said, "Your uncle has been long confined in the Tower." "He has been so, sir," replied Wren; "but he bears his afflictions with great patience and resignation."

Cromwell—"He may come out if he will."

Wren—"Will your highness permit me to tell him this from your own mouth?"

Cromwell—"Yes, you may."

As soon as Wren could retire with propriety, he hastened with no little joy to the Tower, and informed his uncle of all the particulars of this interview with Cromwell. After which the bishop replied, with warm indignation, that it was not the first time he had received the like intimation from that miscreant; but he disdained the terms proposed for his enlargement, which were a mean acknowledgment of his favour, and an abject submission to his detestable tyranny; that he was determined to tarry the Lord's leisure, and owe his deliverance, which was not far off, to him only.

That Cromwell did patronise Wren is clear, from a letter written by the latter to his friend, Dr. John Wilkins, wherein he states that his diplographic instrument, for which he had recently received a patent, had been "commended to the then great, now greatest person in the nation," (Oliver Cromwell.)

In 1661, Wren may be said to have commenced his architectural career, and to have fixed upon his future profession. He had completed his academical honours by receiving from his university the well-won degree of doctor of civil law. The king (Charles II.), who had acquired, both from his father and his sojourn abroad, a great love for the arts, finding on his return to the throne of his ancestors, how much the royal palaces, the cathedral of St. Paul, and other sacred edifices, had been dilapidated and desecrated by the military hordes of the Commonwealth, had determined on their restoration. Sir John Denham, author of "Cowper's Hill," who is more renowned for his poetry and polite learning than for any knowledge of architecture, had been appointed, in reversion, to the office of surveyor-general of his majesty's works, in reward for his loyal services, to which he had now nominally succeeded by the death of Inigo Jones during the interregnum. The fame of Wren had reached the ears of the king, who propos-

* Elmes' Life of Wren, Appendix No. 2.

* Author of the well-known Parallel of Architecture.

its illustrious architect, whom the *Quarterly Review** calls "the pride and honour of English art," to the rank of an equally bold and original imitator, as Milton is of Homer and of Virgil; exhibiting in all its parts the most indubitable marks of real genius—"that quality, without which," says Dr. Johnson, "judgment is cold, and knowledge is inert; that energy, which collects, combines, amplifies, and animates."

* For October, 1822.

(To be continued.)

GLANCE AT SOME OF THE ATTRIBUTES OF ARCHITECTURE.

By Frederick Lush.

No. II.

"Greek art had her infancy, but the Graces rocked the cradle, and Love taught her to speak."—Fuseli.

Simplicity, &c.—We cannot arrive at conclusions respecting the first principles of art, without making the human mind, as being the source of all beauty, the groundwork of our investigations. All the qualities that contribute, or are essential, to artistic beauty, will be found to make up the requirements of a perfect mind; and among these qualities, that which bears a very striking analogy to it, is simplicity.

Simplicity and unity of composition may be compared to that power of generalization which selects from dissimilar objects, parts of a like nature or property, and then includes them under one genus or kind. It was a principle of the Greeks, which was founded on the idea they formed of perfect nature, "to combine into one grand expression of feeling a whole series of ideas, and by excluding everything heterogeneous, to combine all homogeneous elements into a perfect and harmonious unity" (Schlegel*.) Amidst, therefore, the many and varied elements of an art, whose grand object is to make a strong impression on the senses, no matter that is irrelevant must be allowed—nothing that would produce confusion; so that the eye may repose upon it without the least distraction: the various ingredients being so balanced and regulated, that not one of them shall act prejudicially to the rest by any undue proportion; but that each combine, to the utmost of its power, in such perfect unison and co-operation, as to conduce towards but one end, and announce in its effect the one great controlling mind that directed and presided over it. This is so necessary, that even where the style of architecture is elaborate and intricate, it must still preserve a marked unity and consistency of purpose, for without it we may not be enabled to see and embrace clearly the complication and web of the whole. In simplicity, a degree of variety and contrast must be joined to it, lest it should be too monotonous and betray a poverty of imagination; variety also, uncomposed and without some simplicity and consistency in its parts, would withdraw the attention from it on account of the appearance of confusion.

Those ancient temples, which in their plan and general forms were parallelograms, and offered a most striking similarity and uniformity of parts, suggested to the spectator ideas of infinity, nothwithstanding their extreme regularity. But the gratification which the mind receives from objects, depends upon the nature of the exercise they afford to the visual faculty; and circular forms, in consequence of bringing all the muscles that move the eye into play, causing an equable share of labour, are found to yield more delightful sensations than those produced by objects bounded only by straight lines. Now, a knowledge of the effect of geometrical figures was known to the Greeks; and we have a fine instance of their appreciation of the circle, in the Choragic monument of Lysicrates. In this rotund temple, as in many others, we may notice that the figures in succession in the bas-reliefs on the frieze, seem to the eye to have no limitation, but as it advances and one portion appears, another disappears; so that although the whole is most simple and uniform in itself, and may be easily embraced at a glance, yet at the same time it seems endless and infinite. This beautiful idea was imitated by the Romans, but its elegance and grace was lost in vastness of dimensions; for grandeur emanated from them as beauty did from the Greeks, and proofs of their masterly control over the arch and vault, which they were ever ambitious to display, remain to us in their Aqueducts, in their Pantheon, and Castle of St. Angelo. So the classical mind of Bramante, soaring and expanding itself in the contemplation of circles, in conceiving a design for St. Peter's, suggested "for the naves, an adaptation of the arrangement of the great arches in the ancient edifice called the Temple of Peace; and for the conjunction of the four naves, the construction and form of the Pantheon:" thus uniting and harmonizing in one stupendous structure the proportions of two of the grandest edifices of antiquity.

* Lectures on Dramatic Art and Literature.

Simplicity is the leading characteristic of Grecian architecture. The form of their temples was the simplest, although in its details the most elegant, and in its dimensions the grandest, that could be conceived—gracing the sites on which they were erected; for there seemed to exist among the architects a sort of anxiety lest they should in the smallest degree disfigure nature. The orators and philosophers of the day beheld in them the image and reflection of sincerity and truth; and the aspiring columns, no less than the graceful superstructure, were channels for conducting minds habitually soaring, to the contemplation of supernatural beauty. At the glorious epoch of the Parthenon, the porticoes being the favourite places of resort, a building would scarcely have been tolerated that was not stamped with that calm repose, that dignified simplicity, which most assimilated with the feelings of the Athenians. Hence the sedate grandeur of expression which breathed from their walls, which led the thoughts upward, and was eloquent not only with the authoritative voice of the senate, but with the stern wisdom yet mild tranquility of the deity to whom it was consecrated. The presiding goddess of Athens was the muse that aided them, the fount whence they drew their inspiration.

The Greeks prided themselves upon the invention and perfection of their columns, and since they made them perform such an important part in their edifices, they took care to set off their contours and proportions to the best possible advantage. With what success they did so, we have proofs in the impressions conveyed to us by some of the porticoes of their temples—as that of Minerva, where the utmost relief and effect are given to these features, by the majestic shade which is flung into its intercolumniations. Here, it may be remarked, the chiar'oscuro is not broken up and minute, but the light and shade of the structure presents broad and simple masses.

The most cherished objects which the sculptor could commemorate on their temples were the deeds of conquerors and heroes; but then there was demanded on his part a high command of talent, that such things should be worthily represented; and that, by a scientific and beautiful execution, by force of expression and simplicity of character, they should be at the same time a powerful auxiliary to the architecture. Viewing sculpture in the days of Phidias, we cannot but be struck with its admirable harmony to the grand and simple character of the temple. The high embellishment and importance which it received from the introduction of sculpture, is particularly observable at that epoch; and it is only by an attentive examination of the bold and decided execution of the ancient relievi, so adapted in their effects of chiar'oscuro to their elevated positions, that we can appreciate the excellency of the principles which regulated their introduction into the buildings—principles often inculcated and taught by the philosophers, and founded on a profound knowledge of optics and perspective.

In the materials and means employed, as well as in the forms they selected, we see how wisely they sought and secured simplicity; they adopted just so much as the peculiar nature of circumstances prompted, and no more; they produced the greatest strength with the fewest materials—the greatest effect with the simplest means; they brought out the most beautiful features into the strongest relief; they mingled the *utile cum dulci;* the elongation of lines and the relation of spaces satisfied the mathematician,—the delicacy of the curve delighted the poet; the uniformity and succession of parts, the huge masses of the surfaces, the long unbroken continuation of the members, all tended to produce sublimity and breadth of manner; the ornamental portions softened the aspect, and prevented too great a degree of austerity: yet, in the sculpture there was no artificial refinement,* no laborious minuteness, but it contributed to the stateliness of the pile; and even when the Greeks thought it necessary, under their glowing sky, to heighten the effect of the whole by the addi-

* The Elgin Marbles.

tion of pigments, still its moral grandeur rose paramount to all the brilliancy of colour. Owing to the searching and penetrating light which shon around it, anything that was defective would be immediately manifest—the beauties more strongly developed; so the utmost ingenuity of the artist was taxed to combine greatness with caution, effectiveness with economy: if the colouring, for instance, were over-warm and not judiciously applied, a glaring contrast might be produced; equal care was necessary, also, lest it should be too cold, amidst the variegated and luxuriant scenery by which it was surrounded. On the same principle, nothing unnecessary or superfluous was to obtrude itself in the ornamental portions;—what took the lead in these were the sculptured figures, that represented various actions, and gave the most animation to the marble—on the execution and arrangement of which, mature consideration was to be bestowed, a conspicuous situation being given to the principal: to conclude all, the building, by its pyramidal termination, was brought to an exquisite climax.

This supremacy of grandeur over the desire for the exhibition of ornament—this mastery of simplicity over every inferior feeling, convinces us of the high taste and refinement of the Greeks. They attempted, but indeed were able, to achieve the sublime. They knew that art could only possess the efficient cause of the sublime, in proportion to the manifestation of skill and manly energy. They knew that a departure from simplicity would be a fatal blow to art: and hence it was that the legislature watched ever its interests, and Pericles enforced upon the artists the necessity of preserving in all their works a settled simplicity, as the principal source of grandeur. And there is in simplicity of architecture, especially in that so deservedly called "Classic," an attraction which calls forth a dignified calmness, yet a tenderness of soul, and steals upon its sympathies as does the pure and unsophiscated nature of a beautiful child. Hence the dominion of the architecture of the Greeks over our feelings—for the evidence of what is truly good or beautiful, is recognised by the soul as something most congenial to it; and that unity of design, that conformity of character, in Grecian architecture, corresponds in its nature to that of a well-regulated mind—to the healthy balance and proportionate development of all the powers that constitute a perfect nature. Architectural works that bear not this stamp cannot satisfy. Such are those where we see the imagination has gained an entire ascendancy over reason, and where an overweening fondness for a redundancy of ornament has been indulged in at the expense and sacrifice of simplicity.

THE BRITISH MUSEUM.

No. I.

The opening of the new hall of the British Museum is a fitting time for beginning a set of papers on its contents in this Journal, in which we have very often given notices relating to it. The collections in the British Museum are more the result of the exertions of the public than of the government, and unless the exertions of the government be kept up by the voice of the public they will be slackened. Great as is what has been already done, yet measured by what is wanted and what is to be done, it is but little. As the public get a better knowledge of the Museum, and make a better use of it, so they prepare themselves for the requirement of something more. We fear, however, that the worth of the Museum is not yet so fully felt as it ought to be; while we cannot but say, that even in its most trifling uses its worth is great.

By some, the Museum is looked upon as a great plaything or playhouse for the people. Be it so; we should be willing to take the matter op that footing, for it is no mean thing to furnish pastime for a people. Among the chief duties of a government, are to provide for the amusement of the people; and if men who are hard-worked in their several callings, can have a day's pleasure in a Museum, and can have given to them new thoughts, which shall fill their minds in many days of toil, this is a great thing. Discontent is one of the greatest evils which any government has to withstand, even where bodily evil, hunger, and want are not felt. The gloomy sway of the Independents broke down mostly from this cause; and the people hastily changed a good government for a bad one at the Restoration, because they were deadened and disheartened by the want of their accustomed pleasures. The playhouse, the bear-garden, and the fair were closed, the fiddler and the ballad-singer were put down, holidays were forbidden, and although plenty reigned at home, and glory crowned our arms abroad, the people were sullen and unhappy. In times of want, workmen are ever open to be led astray by mob orators and agitators, to whom, when in full work, they will not listen. As it is with one, so it is with many; when the mind is heavy and the heart faints, the man himself gives way to a trifling sorrow, and sinks from bad to worse; whereas, were he but upheld, he would overcome every hardship. More or less, the same thing is to be seen at all times, and we feel sure that we are always doing good when we are yielding pleasure to the old or to the young. Happy feelings are the mainspring of good deeds.

As it has been acknowledged by the greatest statesmen, that it is desirable to find pastime for the people, so it should be given usefully. The bloody shows of gladiators, or the beastly games of the bear-garden or the prize-ring, will give pleasure to those who are called enlightened Romans or enlightened Englishmen; the gambling cock or quail fight or horse race may prove still more enticing, but no one good feeling is awakened or strengthened, and no bad one weakened or quelled. The love of the good, the true, the great, and the beautiful is that which should always be kept before the people, from their childhood to their death, in all outward forms and shapes. It should never be thought that education is the time of schooling in boyhood, but it should be remembered that in its rightful meaning of "bringing up" a man, it is being carried on at all times, in all places, and by all means. The eye, the ear, the touch, the taste, the smell are always on the watch learning something,—and if not good, they are learning evil. Thus habits, which cannot be shaken or undone, are shaped slowly and unknown, and fetters are welded which chain the mind in the doing of good or evil. If mankind are to be thoughtful and careful in their deeds and thoughts, it is becoming that in everything we should keep sight of goodness, of truth, of beauty, and of greatness, for the Almighty maker of all has done this in everything, from the smallest being, hardly seen by Ehrenberg under the most powerful microscope, to the great bulk of the mastodon or the most dreaded beast which ever walked the earth. If mankind are not to be taught to think, at least, we should take all means of giving them right habits.

Whatever may be the feeling as to the forms of worship to be taught in common schools, however much quarrelling and bickering there may be about these—whereby the children of England run the chance of losing their schooling altogether—there can only be one feeling as to the right and duty of the government to look after the public bringing up of the people, by training them to proper thoughts, wherever there may be the means of doing so. No one, we believe, has ever thought otherwise than that the great mind of the Greeks, their love of freedom and of learning, was kept up as much by their care for the beautiful in their buildings and public works, as by any other means. Those lovely temples, those carvings which have never yet been outdone; those shapes, which seem already to have a soul, and want only breath to live, were but the outward showing of what the minds of the people held within, of those great feelings of which even the lowest Athenian slave must have had his share.

If we are to have great public buildings and great architects, we must have an enlightened people, a people who love art for its own sake. In Athens, lowly as were the dwellings, every public building was beautiful, and was so because no other dare be opened to them. Public buildings are always those which are the best for showing the skill and cunning of the builder, where there is the most money to be laid out, the best place to be had, and the most care to be taken in keeping up what is once built. In London, not to say in England, so far from our public buildings being always handsome, they are often far from it; and what a single rich man would not bear nor lay out his wealth upon, many thousands of the people are made to bear. It is a mere chance whether Wren or Dance be the architect, whether he be Barry or Soane. We should never see workhouses set up for public buildings, and barns for churches, if the people were brought up to think rightly. The taste of a people may wander upon matters of detail or of style, but it is always right as to what is great or beautiful. York Minster, St. Paul's, and Westminster Palace will always be liked by the people, although they may never be able to give a reason for their liking.

It is acknowledged that we have made a great step in weaning the people from cockpits, bear-gardens, and prize-fights, that we have lessened their love for low and bloody sports,—and we feel a kind of pride that we have done so much. We may be no less proud that we have given them a greater love of gardens, paintings, and museums, which, while we look upon only as a harmless change, must indeed work greatly upon the minds of the people. The lessening of drunkenness and idleness, the milder bearing of the people, the falling off of street fights, the greater cleanliness and neatness, if they lead to better health, are of still greater worth, as they lead to better minds. If we teach a workman to like the museum better than the alehouse, we teach him something more; by awakening his thoughts as to what is only rare, we awaken his mind in his own calling, and the thinking workman must be a better workman than the unthinking workman. There are, however, many callings in which the workman has to deal with shape and colour, and if his thoughts are in any way trained to see and feel what is beautiful, he has earned something which to him is of the highest worth.

That the people of England are not brought up to have a right feeling of the beautiful and great in works of art, is seen painfully, not only in our public buildings and in our shows of paintings, but also in our workshops. Whenever this has been looked into, there has been but one answer by men of skill and knowledge, whether English or foreigners, and that is—that the English people and English workmen have less taste than those abroad. This is the pain whereby carelessness of a natural and moral law is made known, and those who judge by the purse are punished in the purse. The price we pay for foreign silks, satins, ribbands, lace, clocks, watches, castings, jewellery, paper-hangings, made flowers, and other wares bought of the French, Flemings, Swiss, Italians, and Prussians is so great, as to be a wonder to those who reckon it up, and bethink themselves that England is the great loom and workshop for the world, the heart of trade, and the mistress of every craft whereby wealth can be made. We pay down in hard money a heavy fine for our want of learning; but this is not the only loss to which we are open, for we further lose the supply of foreign markets, which, if we tried in the right way, we could master, as we do all things that we once try. This is a money reason, and a weighty one for a love of art.

We cannot foster the love of the beautiful and great in art, without fostering the love of the true and the good. It does not follow that a painting, a carving, or a building shall be all truth and nothing more, but there must be something which shall strike the mind as true; and though with this it will take in much which is untrue or false, yet without some truth is mixed up, it will not take in any share of untruth. In a building, this seeming of truth may belong to the look, as, if a prison were built as a playhouse it would not be liked, neither would a playhouse if built as a church; so, too, if a building were so made, that it seemed unsteady or toppling, there would be a want of truth about it which would strike any man. In a play or in a painting, it is acknowledged that there should be this truthfulness, which when once given in the leading parts, the looker-on is willing to take the stage or the canvas as the real scene of the events, and to overlook the want of solidity in the colours, or the smallness of the drawing—nay, to go in despite of his own knowledge that the player is Jack Robinson, and believe him to be Alexander or Henry the Fifth. It is, perhaps, a failing of mankind, that a small share of truth is often enough for them, and that having that, they do not look further; but as in works of art they are trained to look for the true, so is the love of truth upheld; and the eyes of the looker-on being opened, and his mind awakened, it cannot be otherwise than that he should get a greater love of truth, and that it should follow him in his life.

The truthful in art is its groundwork, and carelessness as to this is a besetting sin of our artists, and therefore they do not carry the people along with them. The painter makes a show of bright colour, and thinks he does enough; the architect puts in good stone and good mortar, and then prides himself that he has done all. "*To kalon kai to prepon*,"—the handsome and the fitting—was the good rule of the Greeks in art; so likewise did they say "good and beautiful"—and, indeed, in a few words, they teach the whole sum of art. With a better trained people, we should have better drilled artists, for these latter would no longer dare to set themselves against all right laws, and waste their own powers and our means. The new school of art must be made from without, and not from within; it must, as with the Greeks, not depend upon the few of the artists, but upon the firm will of the many. Although Pericles took the lead, the Athenians never forsook the path in which he had led them, and the whole commonwealth took its way onward. On the other hand, single lovers of the arts die, and the arts die with them. The wealth of the Philips gifted Spain with paintings, but not with painters; Charles the First died before he had awakened a love for art in England; but if Lewis of Bavaria dies, the school of Munich will live in despite of churlish followers. Lewis has not merely bought paintings, but he has raised up a school of artists, who are already sought throughout Europe.

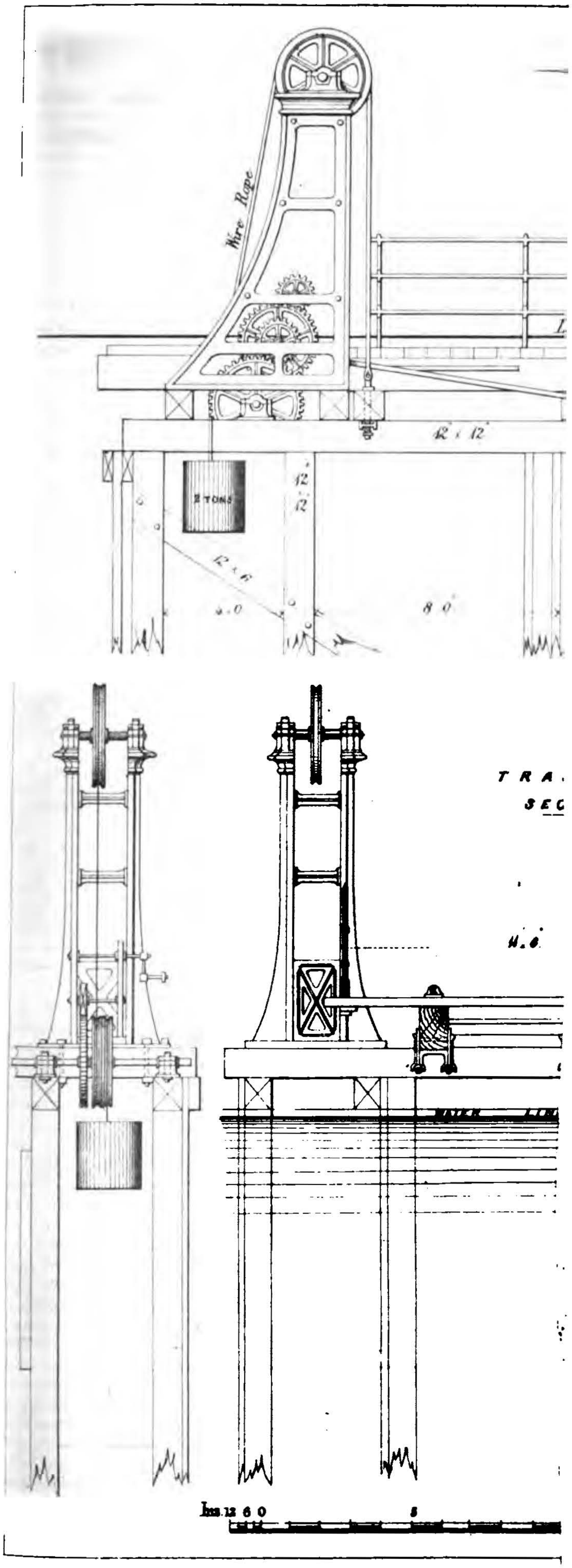
Where the love of the beautiful is strengthened, the mind likewise is strengthened, for it takes a healthy action instead of an unhealthy one. Discontent is one of the worst signs of a low state of being, as is seen in Ireland, where what is good and useful is altogether lost sight of in brooding over fanciful ills. A healthy mind is ever ready to draw the most good from everything: an unhealthy one to draw the most evil. So in criticism this may be seen; while the older, higher, and better taught critic is ready to find whatever is good, the younger and worse trained critic thinks he does best if he can hit upon a blot—which moreover he is sure to be able to do in any one of man's works. These must always be faulty from their very beginning: we know this, and it needs small skill to show it; but every one is not well enough trained to find a beauty and to feel it. How often is it found that an old and great painter will find a beauty in the work of a younger man, for which the brethren of the latter give him no praise, but the rather run him down for his faults. The greater our knowledge, the greater our pleasures; it is not, as is thought by some, that the round of our pleasures is hemmed in by our greater knowledge, but that the more we know, the better our feelings are trained, the greater love do we get for what is good and right, and the less we care for what is bad and wrong.

The kind of schooling which has been most used by enlightened people in olden times and in new times, has been such as to open the minds of youth to the great principles we have named. The teaching of Homer among the Greeks and Romans, and of the Classics among ourselves, better answers to a liberal, free, and easy way of training, than does the drier way of mathematical study, which there are many people who now uphold. In schooling, what is taught is less to be looked at than how the mind is trained, for the man of hereafter will not be made by a faultless knowledge of English grammar or an exact and correct way of reckoning, but by those powers of mind which will enable him to do his part among his fellow men. Public training should be in agreement with that of the schools—the man should be able to follow up what he began as a child; or if, as a child, his training has been careless, there is the more need that it should afterwards be in a right way.

We have thought it right to stand up for the British Museum, as a school for the people, inasmuch as the matter is little understood, and many able men are very careless about what so far from being a trifle is a thing of very great earnest. In whatever light we look at the matter, if we choose to think, we are always brought back to the same point—that the public training of the people in the right way is of the highest need, and that a museum, well laid out, is among the best schools and best means of doing this. Indeed, we have no fear in saying that every pound laid out in the British Museum has been already brought back by what we have earned in our workshops, to say nothing of the very great good which is done to the minds of its hundreds of thousands of yearly visitors.

It is pleasing to see that the part of the Museum given to olden art is now large and well provided; but it is not laid out as if those at the head of it had a clear sight of what it ought to be. To gather bit by bit works of art here and there, is not enough for any end of public teaching. The more the Museum is made useful, the more its worth will be felt, and the more will be done to make it greater and better. Although the Museum holds the works of many people, it neither gives any full view of the works of one people, nor of the way in which art has grown and been followed up. It is wanting as a whole, and the feeling made is that it is a gathering of bits of wreck, worthless to their former owners, and of which the now owners do not know how to make use. This is not to be said of all to the same length; but it is to be said, more or less.

Although the Greek rooms hold the Phigaleian and Elgin marbles, and have many later works of worth, they give, even to the scholar, but a small knowledge of what Greece and Greek art are; they rather want the book to help them out, instead of helping the book out. There is an earnest, it is true, of the will to do and of what may be done; but we want a great deal more. When a working man has seen all the marbles of the Parthenon, he has no better thought of the Greeks than he had before. The Egyptian rooms, which are much better off, will teach him much more as to the Egyptians. The letting in of some casts from the Parthenon, of the casts from the Egina marbles, and of the models of the Parthenon, have opened the way for more. We would have the Greek rooms laid out with casts from other museums of the works which are missing here; there should be models of such temples as can safely be laid down; likewise models of tombs. In the Greek rooms we would place the vases, bronzes, and coins. Why these are put away we do not understand.



, on the
it is con-
ich carry
of whole

r single
and pass
d to six
ed on to
en it is

tform is

Von L.

mstadt :

aissance
London :

rials for
g it to-
l, which
r by the
the case
itecture
nd other
occupied
, and by
seem to
buildings
g them-
n to be
being all
nothing
lves the
ne-eyed

gard to
ve been
tance—
een; or
be sup-
tention.
orth of
, on the
chapter
is said:
lings of
n raised
ia, &c.,
e Great
its the
On this
." This
which

ument at
architec-

of th
bear
and
they
bett
thou
and
worl
to d
to s
is of
Th
the l
publ
Wh
of sl
the
abro
law
the
cloc
othe
sian
ther
the
mad
ing
lose
coul
son
W
fost
pai
the
wit
tru
this
a pl
chu
top
ma
this
is w
and
dra
Jac
is,
eno
wor
uph
aw
of t
T
bes
alon
ae
prid
ham
like
they
hav
ther
mes
wit
arti
lead
the
love
Phi
Pir
of l
foll
a sc

Models would show the great buildings of the Greeks, from which would be seen the originals, which have been so much followed in late times. To the lower classes of builders, to masons, and to workmen, this would be of much use. We are sure that the model of the Parthenon has already done a great deal of good in showing to the people how a public building of this kind was treated at Athens. The peristyle, and the marble carvings, go far beyond what we are here pleased to call Greek architecture. With a better knowledge, of such things we should not be waylaid with brick barns stuck on to a small portico, or with porticos, so called by their makers, from being made with a few naked columns which but for the capitals dare not be called Greek or anything else. If the growth of Greek building in England be desirable, nothing is more likely to further it than a knowledge of it in its best shape.

The bronzes and a few more casts would enable us to follow Greek art from its beginning, and this is most useful. In the Eginetan marbles we have rude and grim drawings of men; in the Phidian we have gods in the shape of men. We can see how art began, and how far nature truthfully followed will lead us. The Greek carver learned from the living man, the carver of this day from a cast, the pattern drawer or bronze founder is taught in a school of design from a drawing of a cast, in which life has been so wiredrawn that it has fluttered away. Going into the Egyptian room we find in the best figures a careful anatomy in parts, but that the carvers, having stopped in that path in which the Greeks went on, never reached the power of the latter.

The works of the failing time of art teach likewise, and we can track the footsteps of failure from their first faint marking. When the carver set up the great works of old as his model he began to waver, and though he might bring forth a great work, yet he led those who followed him off the right track; so that in the end nature was forgotten. Whatever may be said, the living form is our nearest and surest inspiration, it gives us a nearer insight into the workings of the divine power, and we cannot therefore in art get better teaching.

The vases, showing how in the household, and in those things most brittle and most worthless, the principles of art were followed by the Greeks, should stand in the neighbourhood of the lasting remains of the Parthenon. It is by seeing the Greeks in small things as well as in great, that we are led to acknowledge the depth of their feeling for art and learning, upheld at a time when the printing machine was not, before the telegraph overcame time, or the railway lessened space. The schooling of the wealthiest Athenian was behind that given to a foundling in an English workhouse; but how much is England behind what Athens was in art!

The coins, which are now hidden, and about which it may be said no one knows anything, should be drawn forth. They will be as safe under the public watch, as where they now are.

The Egyptian rooms, and even the Etruscan, are in a better state than the Greek, and we have therefore not so much to say about them; but in the Egyptian rooms, models might well be placed of the pyramids, temples, obelisks, tombs, sphinxes, and great works. Now, we only see the little works of the Egyptians, their skill in handicraft; but we should have some knowledge of those great works, which have been the wonder of so many ages.

The Roman rooms give us a very poor knowledge of a people who, by their writings, are better known to us, and who have this claim—that they peopled this island before us, and that our English forefathers fought with them. A very great deal must be done before the Roman rooms will be what they ought. Among other wants we may name copies of the frescoes from Pompeii.

The Welsh or British antiquities should be put in order, so as to show us the state of the savages who filled the island before the English overcame them. The few models of cromlechs were a useful addition, but all such things should be modelled, and the works of the Irish and of the Welsh in Gaul should be shown.

The English antiquities cannot begin with any works of our forefathers in Scotland, but a collection should be formed which should include tombs, brasses, armour, weapons, coins, seals, models of buildings, books, paintings, and whatever are called mediæval antiquities.

RAILWAY LIFT BRIDGE.

(With an Engraving, Plate XIII.)

J. U. Rastrick, Esq., Engineer.

This Bridge is in course of construction over the Surrey Canal, on the Brighton branch railway from New Cross to the river Thames; it is constructed of timber, consisting of four inverted trussed girders, which carry the rails, the ends of the girders bear upon sills supported by piling of whole timbers, 12 x 12 inches.

The platform is lifted bodily by six wire ropes, which pass over single grooved pulleys, supported by iron standards, and then descend and pass round doubly-grooved pulleys; the ends of the ropes are attached to six iron balance-weights, of two tons each. The lower pulleys are keyed on to iron shafts, which are turned by the wheel gear at the end, when it is desired to raise the Bridge.

The clear water-way is 21 feet, and the head-way, when the platform is lifted, 12 feet; the platform is 31 feet long by 23 feet wide.

GERMAN ARCHITECTURAL WORKS.

1. *Beiträge zur Kenntniss der Backstein-Architectur Italiens.* Von L. Runge. Berlin: Heymann. London: Franz Thimm.

2. *Die Bauwerke in der Lombardei.* Von Friedrich Osten. Darmstadt: Leske. London: Franz Thimm.

3. *Kunstwerke und Geräthschaften des Mittelalters und der Renaissance* Von E. Becker und J. von Hefner. Frankfurt: Schmerber. London: Franz Thimm.

We may put these three publications together as affording materials for considerably enlarging the sphere of architectural study, and directing it towards edifices and works of art belonging to the mediæval period, which have hitherto been scarcely noticed, much less been illustrated, either by the pencil or by historical comment and description. This is especially the case with regard to the first work on the list, viz.: Runge's "Brick Architecture of Italy," though some of the examples are from Bologna, Ferrara, and other places usually visited by travellers, artists, and students. Yet, pre-occupied by the fame of the remains of classical architecture on the one hand, and by that of the modern standards of the art on the other, such visitors seem to have no eyes except for the Pantheon and St. Peter's, and for the buildings of Sansovino, Palladio, and other accredited masters. Surrendering themselves up entirely to their "Guide-book," they suffer their attention to be absorbed by, and their inquiry limited to, its directions. Next to seeing all that is there pointed out, it seems to be with them a merit to see nothing else—to search for nothing further. They do not even give themselves the chance of stumbling upon anything which their purblind and one-eyed "Guide" is unable to discern for them.

Even Woods himself is exceedingly unsatisfactory indeed in regard to some of the places and buildings he visited, for his visits seem to have been made *en courier*, and his notices of them—Ferrara and Faenza, for instance—are more provokingly tantalizing than complete silence would have been; or if they do not tantalize, it is because they mislead, by leaving it to be supposed that they really contain nothing at all worth an architect's attention. He does not even so much as hint at Brick Architecture in the North of Italy as constituting a peculiar style of ornamentation. Something, on the contrary, although in itself but very little, may be found in the 29th chapter of Hope's "Historical Essay of Architecture," in a note to which it is said: "In the plains of Lombardy, where stone is rare, clay has in buildings of importance, been *moulded* into forms so exquisite as to have been raised into a material of value and dignity. In the ancient churches of Pavia, &c., it presents itself in all the delicate tracery of the middle ages; in the Great Hospital,* Campo Santo, and Castiglione Palace, at Milan, it exhibits the arabesque, medallions, and scroll-work of the cinque-cento style. On this side the Alps, clay has never received forms quite so elaborate, &c. &c." This alone sufficiently recommends, or ought to recommend, Runge's work, which

* Most strange to say, Woods dismisses this extraordinary architectural monument at once, by merely assuring us that "it possesses little interest as an object of architecture"!!—although it is an edifice of most singular character.

as far as we are aware, is the first publication that presents us with specimens of brickwork as it was formerly practised in Italy.

Did we previously doubt it, we should be convinced by these examples that brickwork, combined with moulded bricks and terra-cotta ornaments, is susceptible of a high degree of embellishment, and readily affords great diversity of combinations. But we are prejudiced against it by the slovenly coarseness of our modern bricks, which are only used for ordinary buildings, or else intended to be concealed by ashlar facing. Thanks to acts of parliament, which have prescribed their size and shape, ours are, as Hope observes, the coarsest and most unsightly bricks used in any country; yet why parliament should interfere with the fashion of bricks, more than with any other fashion, it puzzles us to make out. Such interference has certainly been so mischievous, that unless the interest now affected for the advancement of art be all make-believe and sham, such injurious restrictions ought at once to be repealed.

The frontispiece, or engraved title-page, of Runge's work exhibits the portal of the church of Sta. Caterina at Bologna, a composition of such remarkable elegance and delicacy, that it is astonishing it should have escaped the notice of those who professedly go in quest of architectural studies. The next plate gives us two admirably profiled cornices at Ferrara and Faenza, also the part of a window and highly enriched string-course from a house at the latter place; somewhat similar decoration to which, we are informed by the author, has been adopted in the restoration of the Klosterkirche at Berlin. A house at Bologna has furnished the subject of the two following plates, and although it cannot be affirmed that the building itself is by any means a model, the windows and some of the other details afford valuable hints. It is to be regretted, however, that the principal cornicione and its friese are not shown at large like some of the other parts, for if we may judge by what can be made out in the perspective view of the building, they are of particularly rich and elaborate design. The other plates show a variety of other cornices, wherein the mere arrangement of bricks of nearly the usual shape is made to produce very bold and effective mouldings for such purpose. Hardly need we add that Runge's work deserves to meet with extensive encouragement in this country, as one of real practical utility, and calculated to improve the character of brick buildings.

Osten's work, on the contrary, is more of an archæological and historical nature, in which respect it is a highly welcome contribution to the history of architecture in Lombardy and the North of Italy, from the 7th to the 14th century. It promises to go far towards filling up what is now an hiatus in the architect's library,—towards serving as a bridge across the chasm which separates the classic from the mediæval period of the art. Lombardic architecture has of late years obtained attention; yet, owing to the want of adequate notices and illustrations, those who have spoken of it have not been able to enter into the subject so fully as they otherwise might and would have done. We do not know whether Osten intends to give only unedited monuments, but even should any that have been before represented be here introduced, they will be more satisfactorily explained than hitherto. The principal monuments contained in the two first *Lieferungen* of the work are the cathedral of S. Evasio, at Casale, Monteferrato; the baptistery of S. Pietro, at Asti, and the church of S. Andrea, at Vercelli, of none of which is any mention at all made by either Seroux d'Agincourt, or Wiebeking, Hope, or Woods. Both the churches are interesting, that at Vercelli more especially, it being, we are told, the work of an *English* architect, named Brigintbe —at least one whom the founder, Cardinal Guala Bicchieri, brought over from England, where that prelate had resided for several years. The edifice is further remarkable for having been completed within the short space of about two years, it being begun in 1219, and finished, together with the buildings of the adjoining convent, in 1222. It is accordingly uniform in idea, though it at the same time exhibits the combination of two different styles, for while the exterior is decidedly Lombardic, and the windows are very small semicircular-headed openings, the pillars, arches, and vaulting of the nave are expressly in the Pointed style, and some of the arches are unusually acute. The general dimensions of the plan are about 223 by 108 English feet, and 131 across the transept. The other church, viz.: that at Casale, which was begun in 741, by King Liutprond, and consecrated as a cathedral in 1107, by Pope Paschal II., forms externally a parallelogram of 170 feet by 104; but although the external form is so simple, the internal plan is very remarkable, the church itself, notwithstanding its moderate dimensions, being divided into five compartments or aisles, and preceded by an atrium or Galilee; of which latter two sections are given, but not even one, unluckily, of the body of the church itself. The baptistery at Asti is a polygon of 24 sides—accordingly may be classed with rotundas. It is 53 feet in its external, and 46 in its internal, diameter, and 40 high to the summit in the centre of the plan; although to the edge of the sloping *lean-to* roof over the surrounding aisle, or whatever else it may be called, the height is only 17 feet. Strikingly piquant, the architectural character of the structure arises almost entirely out of plan, and its consecutive forms, independently of, and in this instance quite without, decoration; wherefore, were *naive* a term current among architects, we should apply it to this building as a very appropriate epithet for it,—one that goes far towards expressing a prominent æsthetic quality in it. The edifice itself, indeed, belongs to a class now extinct; nevertheless, ideas available for other purposes than the original one, may be derived from it. Were our architects occasionally to turn to such studies as this example at Asti, and the Abbot's Barn at Glastonbury, they would not give us such fantastic monstrosities as they now frequently do when called upon to design buildings for industrial or economical purposes, for which a mediæval style is desiderated.

The third publication on our list, is of quite a different character from the other two, it being devoted to specimens of furniture and articles of *virtù*, both of the middle-age period, and that of the Cinque-cento and Renaissance. Most tastefully executed both as to drawing and colouring, it will form a very suitable companion work to H. Shaw's "Encyclopædia of Ornament," with which it agrees also in size,—at least the difference of size is so very slight, that the two books may stand beside each other on the same shelf. To many of our readers this, we presume, will be sufficient information as to the general nature and character of this collection of "Kunstwerke." Having as yet only the first *heft* or part before us, we cannot say which class of subjects will predominate, but the specimens themselves, selected from public and private collections at Vienna, Berlin, Dresden, Gotha, Cassel, Darmstadt, and other places in Germany, will be new to this country, and will extend our acquaintance with mediæval art and taste. That the latter reproaches the taste of our modern fashionable pseudo-mediævalism in furniture, is tolerably evident from an oak cabinet here represented, which unites extreme simplicity of general form with elaborate ornamental design. If we compare this with modern productions calling themselves designs for "Gothic furniture"—and we may mention those of Heideloff, both because he is a German artist of considerable repute, and because some of them have been not only shown, but extolled in the Art-Union,—the latter appear truly coarse and barbarous extravagancies, devoid of a single principle of either design or composition. To say the truth, some of Herr Heideloff's chairs are so preposterously absurd, that their clumsiness, inconvenience, and uncomfortableness, if not their ugliness, must deter any one from adopting them. Neither do we say that even such a specimen of furniture as the cabinet above-mentioned, is now suitable as an express model for us; for even the choicest and most genuine reliques of the kind require considerable modification, and ought to be regarded not as patterns, but as *studies*; and as a collection of such studies, these "Kuntswerke und Geräthschaften" promise to become a most valuable addition to the information we already possess—too scanty, perhaps, in itself—relative to "*industrial art*" during the middle ages.

OF LOGARITHMS.

By Oliver Byrne.

Sir—Having known for years the readiness with which you publish any thing interesting in art or science, even when it is not in strict accordance with the avowed objects of your excellent Journal, I take the liberty of sending you a few remarks on the construction of logarithms. Indeed, I know of no other periodical open to mathematical communications, particularly when the subjects require woodcuts to illustrate, or symbolical language to investigate.

Logarithms is as powerful an agent in calculation as steam is in mechanics; with this truth before us, it is strange that few know their proper use or how they are computed,—and fewer still, from the great labour attending the operations by any known method, attempt the calculation of these very important numbers. Since the days of Napier and Briggs, logarithmotechny, in a practical point of view, has received but little improvement, while logarithmic formulæ have been cultivated with great success, and advantageously employed to abridge many analytical inquiries in different parts of mathematics. However, it is also true, that some analysts have bestowed much time and labour in search of a simple and direct mode of calculating logarithms, and though wholly unsuccessful, or very nearly so, as respects the ostensible object of the inquiry, they have been rewarded by the discovery of those interesting and momentous formulæ which constitute what is at present termed "the Theory of Logarithms." It is also worthy of remark, that Briggs, Halley, Sharp, Vlacq, and others, who brought the doctrine of logarithms to perfection, were not averse to arithmetical calculations; but our modern mathematicians depend by far too much on purely algebraical expressions, foreign translations, and mere hocus pocus operations on operatical symbols.

In an inquiry on logarithms, it is usual to put N = any given number, a = the base of any system, and M = the *modulus* of the system. Substituting $1+n$ for N, &c., we have

$\log.(1+n) = M(n-\frac{1}{2}n^2+\frac{1}{3}n^3-\frac{1}{4}n^4+\frac{1}{5}n^5-$, &c., for the fundamental expression, from which several other formulæ are derived, hitherto used in the computation of logarithms. But the above series is only useful when n is a very small fraction; while the majority of those deduced from it, are only available in the process of determining logarithms from the combinations of others. The value of M, in the above series, cost Mr. Briggs 54 successive extractions of the square root, and 54 multiplications; and although many ingenious contrivances have been devised to abridge the labour of these extractions, the process is at best very tedious.

Lagrange converted the above series into

$$\log. m = rM\left\{(m^{\frac{1}{r}}-1) - \frac{(m^{\frac{1}{r}}-1)^2}{2} + \frac{(m^{\frac{1}{r}}-1)^3}{3} - \&c.\right\}$$

by substituting $m^{\frac{1}{r}}$ for $1+n$; r being entirely arbitrary. This formula can be rendered as convergent as we please, and therefore the value of r can be so assumed, that the logarithm of any number, m, can be determined to a limited extent, by using only the first term of the series, viz. from the equation—

$$\log. m = rM(m^{\frac{1}{r}} - 1).$$

This method, undoubtedly, is always applicable to the direct computation of a logarithm; yet it is the same in effect as that proposed by Briggs, and is equally laborious, on account of the great number of extractions generally required.

It is, perhaps, unnecessary to dwell at any great length on the difficulties attending the computation of logarithms by a direct process, independently of other logarithms; however, we cannot conclude these remarks without giving a remarkable expression, deduced by Professor Wallace, of Edinburgh. The form is this—

$$\log. x = \frac{b^{\frac{z}{n}}}{x^{\frac{1}{n}}} \cdot \frac{n(x^{\frac{1}{n}}-1)}{m(b^{\frac{1}{n}}-1)};$$

in which m and n are any numbers chosen at pleasure; z, always some value between 0 and 1; and b, the given base of the system. This expression leaves the base unrestricted, involves no infinite quantity, and is said by some to be "of great analytical elegance;"—yet, it is purely algebraical, and as to its practical utility in the actual determination of a logarithm, it is just as much use as any other intelligible hieroglyphics.

Perhaps you will allow me to state a fact, which you have tested*—*i. e.* that I have discovered a method by which the logarithm of any number, to almost any extent, may be calculated, independently of other logarithms, in a few minutes. Mathematicians and the curious will, I have no doubt, be obliged to you for publishing the following results. It is well known that when the diameter of a circle is *one*, the circumference is

3·14159265358979323846264338327950288419716939937511,

to 50 places of decimals. Now, I find the logarithm of this number to be

·49714987269413385435126828829089887365167832438044, which is true to 50 places. For the information of the general reader, it may be necessary to mention, that the logarithm of a number consisting of so many places of figures, has not been before computed to anything near this extent; for, by any of the known methods, such a calculation is almost impossible. From the above result, the logarithm of the area of a circle, when the diameter is *unity*, may be readily deduced, and is found to be

$\bar{1}$·89508988136617146392379049884191282011529856145642; correct to the last figure.

* [We have witnessed Mr. Byrne's facility in calculating logarithms without the use of any book. It is highly desirable that his system of calculation should be revealed to the public.]—Ed. C. E. & A. Journal.

With equal facility, we obtain the logarithm of the contents of a sphere, when the diameter is *unity*, to be

$\bar{1}$·71899862231049022184250149021129053768335957872764.

M = ·43429448190325182765112891891660508229439700580366 66.

July, 1847. OLIVER BYRNE.

WARNER'S LONG RANGE.

For the following calculations of the dimensions of the balloons which would be required for the purposes of Mr. Warner's Long Range, we are indebted to the courtesy of SIR HOWARD DOUGLAS, whose scientific researches have so greatly tended to disabuse the public mind of errors respecting the resuscitation of an old project for aeronautic warfare.

It has been already explained that Mr. Warner's apparatus consists of a balloon, from which, when it has attained a proper altitude and position, heavy shot or shells are to be let fall, being detached from the car by self-acting mechanism: these missiles derive their destructive effects from the velocity acquired by the action of gravity during their descent, or from the disruptive force of an explosive composition contained in them.

First of all, let it be required to determine the greatest possible velocity which the shots will acquire.

Falling bodies are acted on by two vertical forces during their descent—the accelerating force of gravity, and the retarding force of the resistance of the air. The former of these forces is constant at all velocities; the latter increases very rapidly with the velocity, and may be assumed to vary as the square of it. Consequently, the resistance to the progress of the balls becomes greater and greater, till at last it just counterbalances the action of gravity: in this stage of the descent, the velocity is said to have acquired its "terminal value," beyond which further acceleration is impossible. When once, therefore, a falling body has acquired its terminal velocity, it is no longer accelerated, but continues its descent with precisely the same uniform velocity (unless new forces are brought into operation), till it reach the earth.

Now it appears from numerous experiments, that the terminal velocity of a 12 lb. shot, filled with lead, (that is, the greatest vertical velocity which the shot can acquire by descent) is 419·6 feet in a second: and to acquire such a velocity the ball must fall from a height of not less than 2749·2 feet. These results may be safely relied on, as they express the mean of a vast number of experiments. The terminal velocities of solid shot of various sizes differ considerably. As the solid contents of spheres vary as the cubes of their radii, and their surfaces only as the squares of their radii, it follows that the larger the shot the heavier will it be in proportion to the surface exposed to the air's resistance, and therefore the greater will be the terminal velocity For shells filled with an explosive composition the terminal velocity is less than for solid shells of equal size, the former being lighter in proportion to the surface exposed to the resistance of the air.

If the resistance be taken to vary as the surface and the square of the velocity conjointly (the surface varying as the square, and the weight as the cube, of the radius), it may be easily shown that the terminal velocity varies as the root of the radius. Hence, $v = 178\sqrt{d}$ is a general expression for the terminal velocity of a ball of d diameter, the constant 178 being determined by numerous experiments.

The doctrine of terminal velocities is beautifully illustrated in the descent of the parachute, which, after it has attained a certain velocity, will, if properly constructed, continue to descend uniformly, without any further acceleration. Another admirable illustration is afforded by falling rain, which, unless retarded by the air, would be so much accelerated as to destroy vegetation.

The idea of defence of fortified places by "vertical fire"—that is, by shot discharged so as to fall nearly vertically on the heads of the besiegers—was promulgated by the celebrated mathematician, M. Carnot, who, however, totally overlooked the resistance of the air, and supposed the shot to describe parabolas. In a Reply* to his theories, it was shown theoretically, that the retardation of shot descending vertically would render them all but inoperative; and the theory was confirmed by actual experiments, undertaken by the author for the especial purpose of testing its accuracy. The following extract details the nature and results of these experiments:—

* "Observations on the motives, errors, and tendency of M. Carnot's principles of defence, showing the defects of his new system of fortification, and of the alterations he has proposed with a view to improve the defence of existing places. By Colonel Sir Howard Douglas, Bart., K.S.C. C.B. F.R.S., Inspector-General of the Royal Military College. London: printed for T. Egerton, bookseller to the Ordnance, Military Library Whitehall. 1819."

"A cohöorn mortar was placed 100 yards from six new deal targets laid on the ground, and two new wadmill tilts spread out near them, to estimate by the impression made on them the force with which the balls would fall.

The first round was with the usual tin case, containing 33 four ounce-balls, with a charge of one ounce of powder, elevation 45°. The case went bodily about 130 yards without breaking.

Loose balls were then put in over a wooden bottom. After a number of rounds with the above charge and elevation, with different numbers of four-ounce balls, it was ascertained that the cohöorn would throw 42 of them 100 yards, and that the spread was, on an average, about 10 or 12 yards. It was not very easy to hit the targets and cloths, although they covered a surface of 774 square feet; but, in one instance, 22 balls left their mark. The indentation on the surface of the deal was so small that it could not well be measured—it certainly was not more than $\frac{1}{10}$ of an inch deep. A ball thrown with force from the hand appeared to make an equal impression. Those which struck the wadmill tilt did not penetrate, but merely indented the ground underneath. The penetration of the balls into the ground (which was of the softest nature of meadow) was, on an average, 2 inches; but the balls thrown by hand did not penetrate so far.

The mortar was then elevated to 75°, and with two ounces of powder and 42 balls made nearly the range as before; but the spread was increased to about 40 yards, so that it was difficult to hit the surface aimed at. Several balls did, however, at length fall on the targets and wadmill tilts. The impression on the former was something increased, but still so trifling as hardly to be measured; the balls did not go through the cloth, and the penetration on the meadow was only increased to about three inches."

Secondly, to determine the dimensions of the balloons necessary to raise the weights proposed by Mr. Warner.

By a well-known principle of pneumatics, the weight of the balloon and its appendages, when floating in the air in equilibrium, is equal to the weight of the air displaced. Now the density of hydrogen gas when prepared in large quantities for the purpose of inflation is about ·2, or a cubic foot weighs ·2 oz. In order to ascertain the density of the air, the diminution of barometric pressure due to the altitude must be taken into account; and if the balloon be supposed to have attained the average altitude of 2500 feet, the density of the air may be taken at 1·09, or a cubic foot of air weighs 1·09 oz.

Assume the balloon to be spherical, and call its radius r. Its solid content $= \frac{4}{3}\pi r^3 = 4{\cdot}1887 \times r^3$.

The weight of that volume of gas $= {\cdot}2 \times 4{\cdot}1887 \times r^3$.

The weight of that volume of air $= 1{\cdot}09 \times 4{\cdot}1887 \times r^3$.

The weight of 100 shells of 500 lb. each = 800,000 oz.

The weight of silk, netting, car, &c., taken for an approximate determination of the size of the balloon, = 73,931 oz.

Now, as has been stated, the total weight raised is the same as that of a volume of air equal to the capacity of the balloon, &c. Hence, neglecting the space occupied by the car and appendages, we have the equation

$$1{\cdot}09 \times 4{\cdot}1887\, r^3 = {\cdot}2 \times 4{\cdot}1887\, r^3 + 800{,}000 + 73{,}931.$$

Whence may be obtained the following results:—

$$4{\cdot}1887\, r^3 = 981{,}945 \text{ (volume)}$$
$$r = \quad 61{\cdot}602 \text{ (radius)}$$
$$4\pi r^2 = 47{,}686 \text{ (surface)}$$

In other words, the capacity of the balloon and the quantity of gas which would be required to inflate it would be nearly *one million cubic feet*, the quantity of silk required in its construction would be *forty-eight thousand square feet*, and its diameter (double the radius) *one hundred and twenty-three feet*.

If instead of ascertaining the dimensions of the balloon at an altitude of 2500 feet, its dimensions necessary for raising the given weight just off the ground be calculated, the results will not be materially altered. In this case, the density of the air must be taken at 1·2 (instead of 1·09), and the diameter of the balloon will be found to be 119 feet instead of 123 feet. The following table shows the dimensions of the balloon necessary for sustaining the several specified loads, and the cost of the silk required in its construction.

Number and weight of shells or shot.	Required diameter of balloon in feet	Cubic feet of gas content.	Surface of balloon in square yards.	Quantity of material, yard wide.*	Cost of silk alone.
No. Weight.					£
20 of 25 lb. / 50 of 10 lb.	33·0	18,816	380	570	300
40 of 25 lb. / 100 of 10 lb.	40·4	33,510	569	854	455
60 of 25 lb. ..	45·8	50,893	731	1097	584
80 of 25 lb. ..	50·1	65,440	876	1314	700
100 of 25 lb. ..	53·1	77,951	1010	1515	812
100 of 500 lb...	123	974,349	5298	7947	3,200

* The silk of which balloons are made is of the best quality, and only 24 inches wide so that a corresponding increase must be made.

WICKET-GATE FOR CANAL LOCKS.

Invented by F. C. Lowthorp, Esq., C.E., *of Pennsylvania, United States*. (Reported in the *Franklin Journal*.)

The object of the apparatus is to draw water rapidly from a higher level to a lower; for example, to fill or empty lock chambers, or to draw off a canal level, mill race, or reservoir of any kind. It is effected by an ingenious application of hydrostatic pressure. In the effluent sluice is placed a gate, or wicket, with two leaves at right angles to each other, having a cross-section like the letter L, one leaf being longer than the other. This gate works upon pivots, or a hinge, at the angle of intersection of the two leaves, and at one side of the sluice. The shorter leaf of the gate is of proper dimensions to close the sluice when the flow of water is not required. This leaf is kept shut by the pressure of the head of water, which produces no effect upon the longer leaf so long as it is admitted freely to both sides of it.

When the sluice is to be opened, the water is drawn from one side of the longer leaf, and immediately the pressure upon the other side preponderates against the shorter leaf, and forces it open. The opposite effect is produced by admitting the water to both sides of the longer leaf, when the pressure upon the shorter leaf again close s the sluice. These alternate effects are produced by two small turning wickets at right angles to each other and coupled together, which are moved simultaneously by a single lever.

The time and effort required to manœuvre the small wickets will certainly not be greater than is necessary to work one of the simple turning wickets generally used in lock-gates, while the quantity of water discharged by the sluice will, with the above proportions, be about four-fold, and may, by a variation of the relative dimensions of the parts, be even greatly increased.

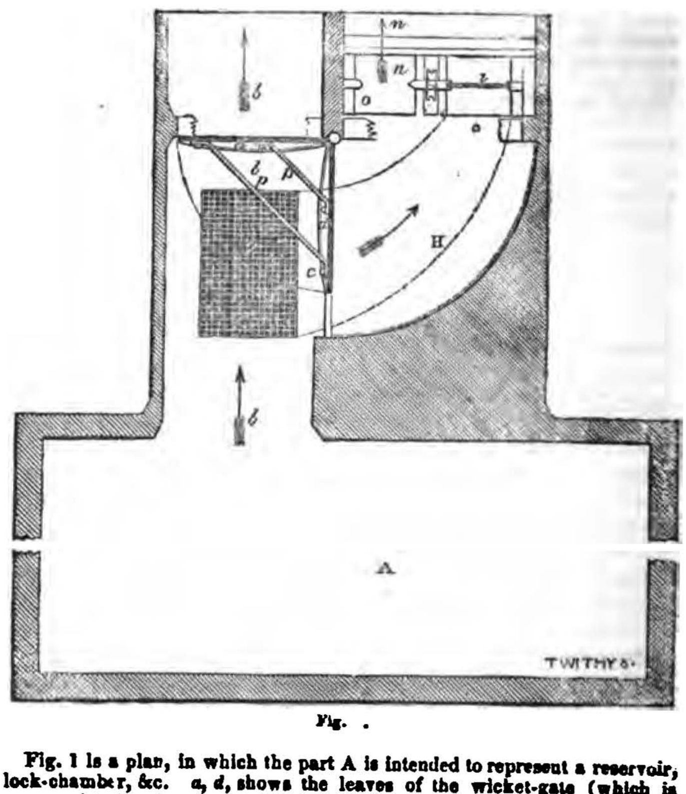


Fig. .

Fig. 1 is a plan, in which the part A is intended to represent a reservoir, lock-chamber, &c. *a*, *d*, shows the leaves of the wicket-gate (which is supposed to be placed in the side wall of a lock), both of which are secured to the shaft *s*, and are connected by means of the rods, or bars, *p p*. H is a recess or chamber, into which the leaf *d* moves in opening the leaf or gate *a*. *i*, *o*, are small valve gates (so connected or coupled, that both may be turned at the same time, the one opening, and the other shutting), used for emptying and filling the chamber H, and may be worked as shown in the plan and sectional views (figs. 1, 2, 3), or otherwise. *c c* is a channel or pipe, communicating with the water in the lock-chamber or reservoir A, and the chamber H, through the valve-gate *i*. *g* is a grating intended to prevent the channel *c c* from becoming obstructed. *n n* is a channel or pipe, communicating with the chamber H, and the lower level, through the valve-gate *o*. *m* is a man-hole in the leaf *d*, for the purpose of getting at the small valve-gates *i*, *o*, for repairs and other purposes. *b b b*, shows the water-way communicating with the revervoir and the level below.

Fig. 2 is a longitudinal section of the plan, represented in fig. 1.

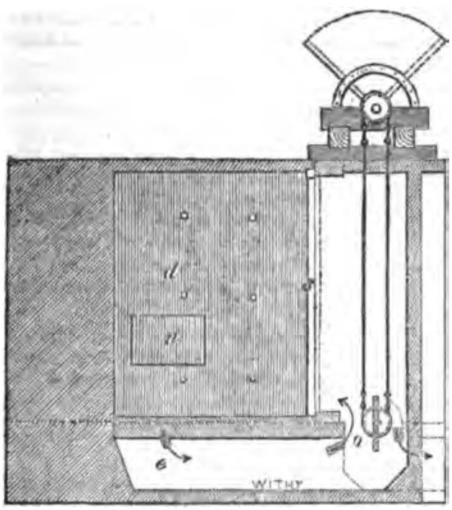


Fig. 2.

Fig. 3 is a cross section of the same.

The plan represents the wicket-gate as closed, and the lock, as well as the chamber H, full of water. When it is desired to empty the *lock*, the valve-gate *o*, communicating with the lower level, through the channel *n n*, is opened; at the same time, the valve-gate *i* (which is connected with the same), communicating with the lock-chamber, through the pipe *c c*, is closed; the water is thus discharged from the chamber H, and the pressure of the water acting on the larger leaf *d*, forces the gate or smaller leaf *a* open. The water contained in the lock-chamber is then discharged through the passage *b b b*.

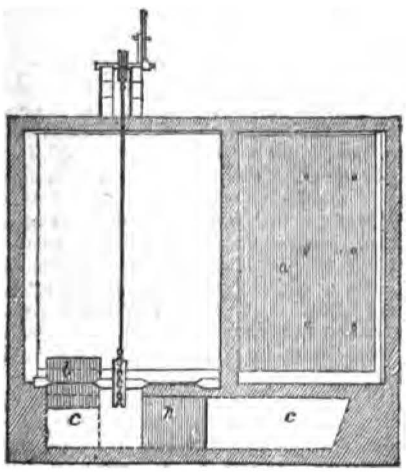


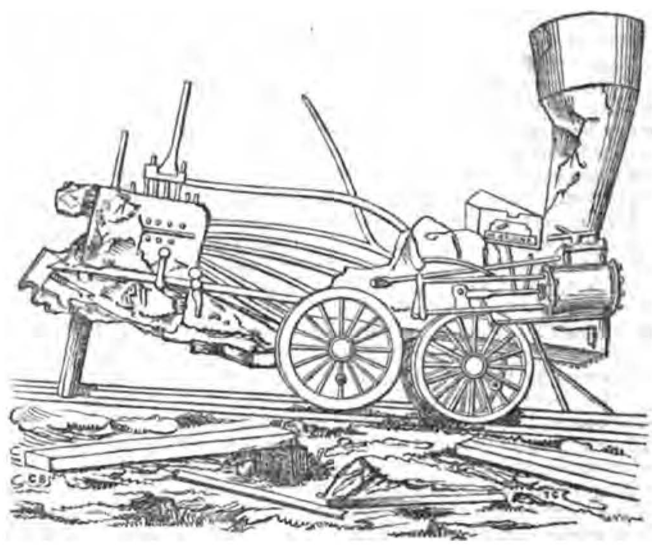
Fig. 3.

The inventor does not propose to confine himself to the precise mode of construction shown in the plan, but purposes availing himself of different modes of construction to suit different localities where gates for discharging water are used; the principle remaining the same, which consists in alternately applying and relieving the pressure from one side of the larger leaf (arm, or paddle) of a wicket-gate, thereby causing it to turn one way or the other, so as to force the other leaf of the gate open or shut, as may be desired; both leaves of the (valve-gate, or) wicket-gate being secured to, and made to turn on, or with, the same shaft, or axis; the shaft being placed in a vertical, horizontal, or in any other position desired.

EXPLOSION OF A LOCOMOTIVE ENGINE IN THE UNITED STATES.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred the examination into the causes of the explosion of the locomotive engine "Neversink," upon the Reading railroad, United States, on the evening of the 14th January last, report:—

That they have collected all the evidence bearing upon the subject which they could obtain, and have visited Reading for the purpose of examining the wreck of the engine; and they desire in this place to return their acknowledgments to the officers of the Reading Railroad Company, and especially to Mr. G. A. Nicolls, the superintendent, for their very great courtesy and kindness to the committee, in facilitating in every possible manner, their examinations, and putting them in possession of all information having a bearing upon the object of their research. The following is the result of their inquiries:—



The engine Neversink was originally built by Baldwin, and sent upon the road in April 1836. It then weighed 10½ tons, and had six wheels, two of which were drivers. The engine was thoroughly renewed and rebuilt by the Reading Railroad Company at their Reading depôt, in April 1846, and was changed to an engine of 19 tons, on six wheels, all connected drivers.

In rebuilding it, four plates in length at the fire-box end of the cylindrical part of the boiler were retained, and 1½ sheets in length were added at the front end of the boiler. The new iron was five-sixteenths of an inch in thickness, the old one-fourth of an inch.

The vertical part of the boiler was 51 inches in diameter; the fire-box was 39 inches long, 37 inches wide, and 44 inches high; the crown was stayed with wrought iron bridge bars, and was so strong that it received no damage from the explosion. The horizontal portion of the boiler was 41½ inches in diameter, and 11 ft. 6 in. in length between the tube-sheets. The smoke-box was 2 ft. 3 in. inches in depth; making a total length of boiler of 18 feet. There were 128 wrought iron tubes, two inches in internal diameter and one-eighth of an inch thick in the wall; they had copper ends at the fire-box tube sheets.

There was but one safety-valve, 2½ inches in diameter, placed upon the dome; there were four gauge-cocks, the lower one of which was 8 inches above the crown-sheet, and the upper one about 14 inches above the lower. The highest tube was 1½ inches below the crown of the fire-box, and 11½ inches below the top of the cylindrical part of the boiler. The fire surface, reduced to fire-box surface, amounted to 309 square feet. The cylinders were 13½ inches by 20. The driving wheels 46 inches in diameter.

It was a favourite engine upon the road, and had run, previous to alteration, in April, 1846 . . 71,010 miles.

Afterwards	18,041
Total	89,051 miles.

Upon their examination, the committee found the horizontal part of the boiler almost completely destroyed. In this part of the boiler the explosion had manifestly originated, commencing in the older iron which remained in the hinder part of the boiler. The tubes were, for the most part, still fast in the tube-sheets, but they were bent outwards at their middle, like the staves of a barrel. The steam pipe, as it passed through the boiler, was *collapsed*, but not broken. The outer shell of the boiler had been torn into fragments, and the rents had extended to the vertical part, the upper portion of which had been entirely torn away, so as to expose the fire-box, which was sound, but slightly caved in on the sides. The cylinders were unharmed by the explosion, but had since been removed. The quality of the iron appeared to the committee to be uniformly good.

There was, therefore, nothing about the engine to indicate that the accident had occurred from defects in workmanship or material, nor, indeed, did the tremendous power which was indicated, seem consistent with the idea of an originally defective boiler.

The evaporative power of these heavy engines is necessarily very great. Mr. Nicolls assured the committee that the Neversink was capable of drawing a train of 88 cars, weighing, loaded, 7¼ tons each, (equal to 637 tons,) at a speed of 12 miles per hour, (1056 feet per minute.) Allowing the traction to be 7½ pounds per ton, (as experiments upon this road show it to be,) this is equivalent to 153 horse power—requiring an evaporation of 2·55 cubic feet of water per minute.

Now, by the peculiar construction of these engines, rendered necessary by the restricted space allowable for the boiler, when the water-level stood two inches above the lower cock, the steam was confined exclusively to the hemispherical dome above the fire-box, the cubic content of which is rather less than 24 cubic feet, (23·8565 cubic feet.) The cubic content of each cylinder (13·5×20) is 1·657 (1⅔) cubic feet, and, as two cylinders are drawn at once, the ratio of the cylindrical content is as 3·314 to 24, or more than one-eighth. When the water-level is at the upper gauge-cock, the steam room is nine cubic feet, and the ratio about one-third. Now, the most recent (and apparently the best) authority upon the high pressure engine declares, after nearly 30 years of practical experience, that "the steam space should be at a minimum 20 times as great as the space to be filled with steam in the cylinder. If it can be made greater, consistently with the other arrangements of the boiler, so much the better." This is, of course, inapplicable in locomotive engines.

The reason, therefore, that these engines will throw water from the safety-valve, and from the gauge-cocks, when the actual water-level is dangerously low—and that, in the words of Mr. Kirk, they are ticklish in carrying their water, must be evident. The foaming in one of these engines must be incessant, and the danger of priming very great. The gauge-cocks, which, under the most favourable circumstances, are but indifferent indicators of the water-level, become, in this case, useless, and the engine driver must rely upon his experience of the engine and trust to incessant watchfulness alone, if he would avoid an accident.

A very remarkable fact about this explosion is, that the steam pipe passing through the upper part of the boiler, from the throttle valve to the cylinders, was *collapsed* and unbroken, as is well seen in the accompanying Daguerreotype portrait of the engine, taken after the explosion by Mr. David Monday, of Reading, and kindly lent by him to the committee. It is, indeed, possible that this may have been produced, during the explosion, by the sudden bending upwards of the tube, otherwise it would seem to indicate that the engine was throttled at the time of the explosion; an expedient which may have been resorted to for the purpose of avoiding the dampness of the steam, or to check the speed of the engine; but the fearful danger of which will be seen when it is considered that, if the steam was shut off but one-fourth, (the water being above the lower gauge-cock,) the pressure in the boiler would double itself in about one minute.

It seems useless to speculate upon the immediate cause of this terrible accident, since the death of all upon the engine has removed the direct testimony of the circumstances under which it occurred. However, it appears that the engine was under a very unusually heavy pressure of steam, and scarcely less certain that the safety valve was (accidently or otherwise) fastened down. Mr. Nicolls and Mr. Kirk both testify to the competency of the engine driver, who was in charge, and every one bears witness to his character for sobriety. That he may have been deceived as to the height of water in the boiler is possible from the character of the engine, although it is difficult to imagine how an experienced hand could have neglected the indications given by the increased pressure, as shown by the rapid running of the train and the sharpness of the exhaust.

Upon the whole, it appears probable to the committee that the explosion of the Neversink occurred in this way:—

That the engine was running under a heavy pressure of steam, and that, owing to the defective indications of the gauge-cocks, the water in the boilers was permitted to get below the upper tubes, which thus became unduly heated; that the rapidly increasing pressure (assisted, perhaps, by an injudicious partial closing of the throttle valve) caused the starting of one or more of the tubes from the forward tube-sheet, and this sudden relief of the pressure caused a foaming in the boiler, by which the water was thrown over the heated tubes, and being thus rapidly evaporated, caused an instantaneous increase of tension, which the additional openings were incompetent to relieve, and thus produced the rupture of the outer shell of the boiler. This, however, is intended only as a plausible suggestion, and by no means as a confident affirmation of the cause of the explosion.

But whatever hypothesis may be adopted to explain this unfortunate accident, its investigation has forcibly called the attention of the committee to several matters which they believe to be of sufficient practical importance to deserve the attention of the Institute.

First. The necessity of providing all steam engines with a second safety-valve, of large dimensions, regulated to the maximum pressure which the engine is intended to bear, and placed beyond the control of the engine-man. It is true that this will entail upon the owners the trouble of frequent examination to maintain the efficiency of such a valve, but this trouble will be more than compensated by the increased safety which will be procured by its use.

Secondly. The uncertainty of the ordinary gauge-cocks, as indicators of the water-level under the most favourable circumstances, and the deceptive character of their indications upon the modern locomotive engines, where the amount of work to be done and the restricted space which can be allowed to the boiler, necessarily confines the water and steam room, and renders the evaporation more tumultuous than in the larger boilers of stationary engines.

Thirdly. The committee would suggest the inquiry whether it is not feasible and advisable so to construct the locomotive engine that explosions, if they occur at all, shall take place in such a manner as to be less destructive to human life than they at present are. One of the great recommendations of the tubular boiler, when first introduced into use, was this very diminished liability to do injury, by allowing a tubular flue, of comparatively small size, to collapse, in place of the large cylinders, by which the boiler was at once emptied of its contents.

REVIEWS.

Earthwork Tables. By Charles K. Sibley, C.E., and William Rutherford, F.R.A.S. London: Longman and Co., 1847.

These tables are for the purpose of estimating the contents in cubic yards of the earthwork of railways: they are calculated, by the ordinary prismoidal formula, for a central width of 33 feet at slopes of 1, 1½, and 2, to 1; heights from 0 to 60 feet, at intervals of half-a-foot.

The advantages of the tables are, that there is no necessity for a second calculation, as at one glance the cubic contents of a chain in length are seen by merely looking for the corresponding heights of the respective ends of each chain's length in the table,—the heights of one end being given at the bottom of the table, and the other height on the side, and at the intersection of the two lines the cubic contents are given. Thus, for a cutting 5 chains in length, of the respective heights of

{ 0, 7½, 13, 11½, 3½, and 0, the contents are read off
{ 348, 1090, 1355, 756, 151:—total, 3700 cubic yards.

We believe these tables are the only ones that offer such a facility of calculation; consequently, we strongly recommend them to the Profession.

We must observe that there is another table, by which the contents for any other width, from 23 to 43 feet, may be found; for this purpose, it will be requisite to have two inspections, but no multiplication.

Architectural Maxims and Theorems, and Lecture on the Education and Character of the Architect. By Thomas Leverton Donaldson, M.I.R.A. London: John Weale, 1847.

Professor Donaldson has laid the ground-work for an excellent book; but in the present edition the Maxims are too concise, and are not carried out sufficiently to render them of much service to the student. Many of the Maxims require an explanation and a reasoning to prove that what is set forth is true. We feel assured that Mr. Donaldson, if he can devote the time to the work, will be enabled to enlarge it in such a manner as to make it a valuable work of reference, not only to the student, but also to the experienced architect.

With regard to the Lecture which is appended to the present work, we can only say, at the present time, that it is a good summary to a course of lectures, but there are some portions of it with which we cannot agree;—our reasons for differing must be deferred to another opportunity.

The Art of Sketching from Nature in Perspective Simplified by the Goniometricon. By George Earl, Principal of the School of Design, Peckham. London: G. W. Medes, 1847.

We gave a short account of this instrument in the Journal for December last (Vol. IX. p. 369). The object of the present work is to show how the instrument may be used; it is extremely simple, and is handled with great facility. It will be found of great service to the travelling student in taking sketches of buildings and other objects.

The Tradesman's Book of Ornamental Designs.—The second part of this work fully sustains its character for utility: the design for an iron gate is exceedingly good.

REGISTER OF NEW PATENTS.

RAILWAY AXLES AND SIGNALS.

Thomas Waterhouse, of Edgeley, near Stockport, cotton manufacturer, for "*mechanical Improvements applicable to railway engines and tenders, and to railway carriages of various kinds.*"—Granted March 10; Enrolled Sept. 10, 1847.

The object of the improvements is, firstly, to facilitate the passage of railway engines and carriages round curves, by allowing each wheel to move independently of its fellow. This is effected by forming one of each pair of wheels with a long nave equal to one-half the diameter of the wheel to which it is applied, which is bored to fit the axle, and to work against a shoulder on the same; it is to be kept in contact with the shoulder by a washer, secured to the axle, outside the nave by a key; the other wheel is fixed to the opposite end of the axle. Another method is to divide the axle at the centre into two parts, and fix bearings to the lower framing of the carriage, for the purpose of supporting the inner ends of the two parts of the axle; by which means the wheels are permitted to rotate independent of each other.

The second improvement is for an apparatus for sounding signals by means of compressed air; consisting of a force-pump for compressing air into a receiver beneath the carriage, from which it can be admitted, by the guard or attendant, into a railway whistle or other instrument for sounding signals.

DRESSING LACE AND FABRICS.

John Keely, Jun., of Nottingham, dyer and lace-dresser, for "*Improvements in dressing or finishing lace and other fabrics.*"—Granted December 14, 1846; Enrolled June 14, 1847.

This invention relates to a dressing for lace and other fabrics, which when made up, will not be liable to absorb moisture from the atmosphere, but will preserve their shape when exposed to heat or damp. 5 lb. of shellac is to be dissolved with 1 lb. of borax in 3 gallons of hot water, or the shellac may be dissolved by other alkalies, and in different proportions to the before-mentioned. The solution of shellac may be used alone, or, when thought desirable to give a greater degree of stiffness, it may be mixed with starch, gelatine, glue, or other stiffening material, dissolved by the ordinary methods, and then stirred into the solution of shellac while the latter is at a boiling heat: the quantity of stiffening material added will vary according to the stiffness required; the addition of 1 lb. of glue to a solution containing 1 lb. of shellac has been found to answer well. The solution is applied by dipping the fabric therein, or spreading it upon the fabric; the finishing is proceeded with in the ordinary manner.

GAS METERS.

Thomas Edge, of Great Peter-street, Westminster, for "*Improvements in the manufacture of gas-meters.*"—Granted Dec. 31, 1846; Enrolled June 30, 1847.

This invention relates, firstly, to the manufacturing of gas-meters of plates or sheets of iron, covered with a coating, first of tin, and then a coating of zinc, or with an alloy consisting of tin and other metals, to prevent or retard the destructive effects of the gas. The metals or alloys employed for this purpose are tin and zinc, as being found in practice to be the most desirable and efficient. Any known method for coating plate-iron with these or other metals may be employed. The inventor lays no claim generally to the coating or covering of plates or sheets of iron with zinc and tin, or with any alloy of metals, as these processes form no part of his invention when taken separately.

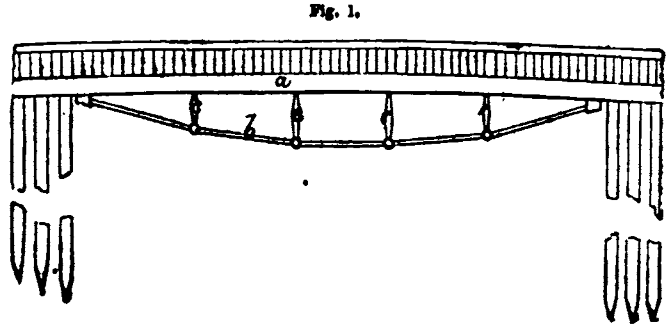
The second part of the invention is for forming the internal parts of the meter of the same or a similar kind of metal, so that no voltaic action may be induced between the several parts, by constructing them of an alloy of metals, as being most suitable, and which alloy is made to bear some analogy to the particular coating of the plates or sheets of iron of which the case is constructed; and, in order to preserve the solid parts, which are liable to be injuriously acted upon by the gas, or that come into contact with the water that becomes impregnated with the gas that passes through the meter, the inventor constructs them of an alloy of metals, consisting principally of zinc and tin, the proportions of which may be varied, or other metals may be added, for the purpose of hardening the alloy. For the above purposes, an alloy consisting of from 50 to 70 parts of zinc to from 30 to 50 parts of tin, will be found to answer the object required.

PIERS AND HARBOURS.

Peter Borrie, of the Crescent, Minories, City, engineer, for "*Improvements in the construction of piers and harbours.*" Granted Dec. 21, 1846; Enrolled June 21, 1847. (Reported in the *Patent Journal.*)

This invention relates, first, to the construction of piers, whereby the communication is maintained between the approach and the vessel, without the intervention of stairs, at all times of the tide. It consists of a combination of a permanent way, a floating pier, and a platform connecting the two, which is hinged at one end to the permanent way, and at the other rests on the barge or vessel, which rises and falls with the tide. For light traffic this erection is constructed almost entirely of wood; the permanent way, which in the drawing is represented as being curved, but which may be formed according to the nature of the approach, is supported on piles driven into the ground; the space between each set of piles leaving a clear water-

Fig. 1.



way. The roadway, which is of peculiar construction, is represented at fig. 1. Beams, *a*, are laid longitudinally and resting on the piles; at their extremities they are slightly curved upwards and strengthened by means of tension-bars, or chains, *b*; these chains are secured to a cast iron cap on each end of the beam, and support it at intermediate points by stretchers, *c*, *c*, *c*, *c*. Now, it will be obvious that the tendency of weight placed on the centre of the arch will be to straighten and, consequently, lengthen the beam, thereby throwing the greater part of the strain on the chain *b*. The barge, or floating part of the pier, is placed between two buttresses formed of piles, one at either end, and by them is guided in its rise or fall with the tide; and it is generally preferable to place this barge parallel to the current, without regard to the position in which it is necessary to connect the roadway; this barge may be constructed of iron, with a wooden deck, or it may be wholly of wood; the inner side, on which the hinged platform rests, having a greater displacement of water to compensate for the weight thereof, and it is furnished with water-tight bulkheads for additional security and strength. The platform which connects the roadway with the floating barge, is constructed in a similar manner to the permanent roadway, being formed of longitudinal beams, strengthened by tension-rods and stretchers, as before described; one end of these beams is connected by a strong bolt, passing through the cast iron caps and corresponding knuckles, fixed to the piles which support the extreme end of the permanent way, and thus forming a hinge on which it rises and falls; these piles are strengthened sideways by means of struts, so as to enable the structure to resist the strain consequent thereon; the other end of the platform, which rests on the barge, is furnished with rollers, which traverse rails placed in a recess formed in the side thereof, so as to bring the surface of the platform on a level with the deck. The flooring of this structure is supported from the beams by joists which, with other transverse fastenings, connect the whole firmly together, and it is surmounted by a railing as in other similar erections. Piers intended for heavier traffic, he constructs in a manner very similar to the foregoing, but with the several parts of a proportionate strength; but in many cases, where the rise and fall of the tide is too great to admit of the whole of the inclination being thrown on one moveable platform, he, therefore, makes use of an intermediate floating barge, protected by buttresses; this arrangement avoids the necessity of having the platform of any extraordinary length, when any great height is to be attained. Instead, also, of the rollers at the end of the platform bearing directly on the floating barge, it rests on a frame which is supported by a strong shaft laid horizontally in the direction of its length; this admits of a rocking motion, and, consequently, prevents any strain from twisting or affecting the permanent pier, to which the other end is affixed. In piers constructed for every description of heavy goods, in place of supporting it on piles, it is erected on a base of solid masonry, supporting cast iron pillars, on the top of which the longitudinal beams are placed, and the whole is finished in a manner proportionably strong for the accommodation of wagons and other vehicles; the platform of this pier also rests on an apparatus, the same as before described, for the purpose of counteracting the rolling of the barge from the action of the waves. The floating-barge of this pier, supposing it to be erected where it will be subjected to the action of the sea, is constructed with open-ended tubes passing through from side to side, as also from the deck to the bottom; this not only materially strengthens the barge, but allows the sea to break through and thereby partially avoids its effect. Having described the nature of his invention as regards piers, he states that he is aware they have before been erected where the communication has been effected by means of a platform, rising and falling with the tide, but what he claims is the peculiar construction of low-water piers, adapted for all kinds of traffic, and for the accommodation of all classes of vessels in loading or delivering passengers or goods of all kinds, at any state of the tide, without the intervention of stairs between the fixed and floating piers, and which pier forms proper roadways for carriages, carts, wagons, or other vehicles, even of the heaviest description, coming to or going from such vessels lying alongside the floating-piers; and when such piers are to be adapted for ferrys, the floating-piers may be made of such a height that their decks will be level with the deck of the steamer or other vessel used for the ferry, so that any carriage or vehicle may drive down the pier, and on board such steamer or vessel, without disengaging the horses, and which piers are constructed in the peculiar manner herein shown. The second part of this invention relates to the construction of a floating breakwater, for the protection of shipping in harbours, bays, estuaries, or other inlets of the sea. Fig. 2, represents a transverse vertical section of this breakwater, and fig. 3, an elevation of the same; it consists of a cylindrical caisson *a*, of iron, which being rendered water-tight forms the buoyant part on which the whole structure is supported; *b*, *b*, *b*, is a frame-work made of iron, attached to the caisson; on this frame-work a number of planks, *c*, *c*, *c*, are fixed longitudinally, which as the sea breaks through renders it comparatively smooth on the inside. The caisson *a*, has a

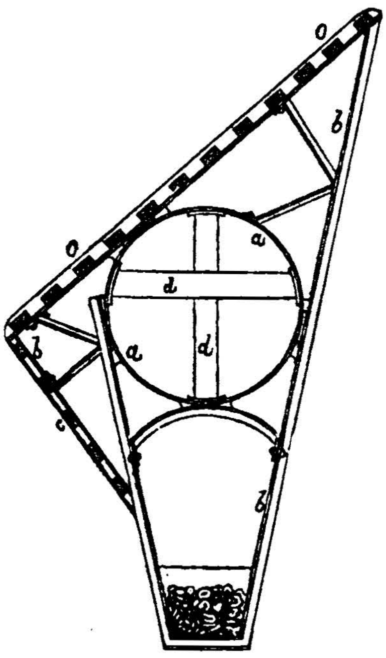


Fig. 2.

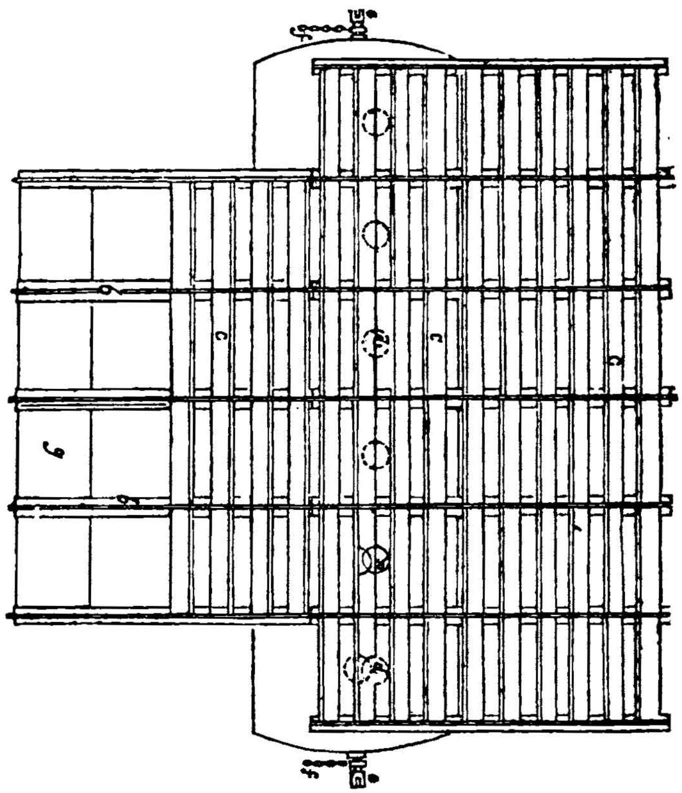
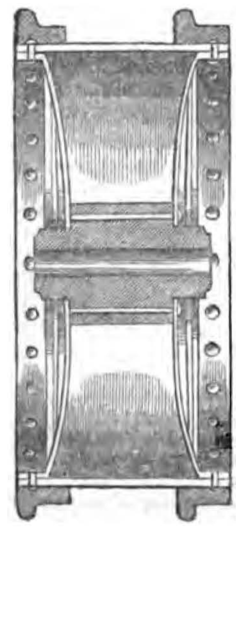


Fig. 3.

number of tubes, *d*, *d*, through it, both vertically and horizontally; these tubes allow the sea to break through, and consequently lessen the effect thereon, and likewise tend considerably to strengthen it; at the lower part of the frame-work a ballast-chamber is placed, which has the requisite quantity dropped through vertical tubes, *d*, *d*; several of these breakwaters may be connected together by the joints *e*, *e*, according to the entry of the harbour; the whole is secured by the chains *f*, *f*, to a suitable anchorage in the position most desirable for obtaining the desired effect. He does not claim the invention of floating breakwaters of iron, or other material; but what he claims is the forming of floating breakwaters in the peculiar manner represented in the drawing, and as hereinbefore described.

RAILWAY WHEELS AND BREAKS.

Henry Grafton, of Holborn-hill, engineer, for "*Improvements in railway wheels and apparatus connected with railway carriages.*"—Granted January 16; Enrolled July 16, 1847.



The improvements relate, firstly, to the formation of wheels for railway carriages, to adapt them for running on different gauges. The annexed engraving shows the construction of the wheel with two flanges or railway tyres. In place of spokes, the inventor proposes to have two dished plates formed of corrugated iron, which are made by pressing the plate in a mould; the centre to be rivetted to the nave and the outer rim to the tyre and a cylinder of sufficient width to receive the two tyres—the distance regulated according to the different gauges.

The second improvement is for a railway-break, consisting of a metal band placed between the two tyres, which by a lever is made to press upon the periphery of the wheel between the two flanges.

BARLOW ON ARCHES.

(Continued from page 215.)

(Remarks after the Reading of the Paper at the Institution of Civil Engineers:)

Mr. Cubitt, V.P., said he felt the propositions in the paper were so conclusive, that they scarcely afforded an opportunity for remark, much less for discussion. The great merit of the communication, and of the illustrations, was the adaptation to practice; in most of the treatises on arches, the theory alone was considered: Mr. Barlow had, however, very properly pointed out the possibility of constructing arches of certain forms and dimensions, strictly within the theoretical rules, so that they should stand well alone; but that when any pressure was imposed on them, they would fail. These were points of great importance, which should never be lost sight of by the engineer, and demanded not only great attention to the proportions of the structure, but also to the quality of the materials employed, the situation, the nature of the foundation and of the backing and numerous other considerations, in order to adapt the arch to the use for which it was intended.

Mr. Sopwith agreed in the value of the paper. He viewed it more particularly in its application to the construction of arches in mines, where solidity and permanence were of such importance, on account of the unequal pressure to which they were subjected.

Mr. Brunel had endeavoured, during the reading of the paper, and the remarks of the preceding speakers, to find some point whereon to found observations, but it was very difficult, as the author's practical experience appeared to have constantly directed his theoretical investigations. He thought, however, that the compressibility and elasticity of materials of construction had not been sufficiently insisted upon. This did not generally obtain enough consideration, yet it was of great importance to the stability of a structure; all materials, even to granite, possessed an amount of elasticity, and it did not suffice to have the line of pressure fall merely within the mass; it should be sufficiently within it to allow for any yielding from elasticity, without endangering the building.

Mr. Pellatt observed, that the valuable information might be rendered available in the construction of the vaults of furnaces, the duration of which was of great importance in the glass manufactory. It was desirable that the crown of the arch of a glass furnace should be so low as to keep the heat well down, and yet if it was too flat, it was soon destroyed by the impinging action of the flame, or else the expansion of the materials by the heat destroyed the equilibrium of the arch, and it fell. At present the practical judgment of the workman was alone depended upon for the proper form, and the consequence was, that although a well-built furnace arch might last 14 years, it might not last longer than 14 months.

Mr. Inman said that the ruins of ancient buildings would afford many striking lessons of the correctness of the principles laid down in the paper. Numerous examples of remains of arches standing without other support than the stones of which they were composed, might, he believed, be found, which could corroborate the views of the author, and he recommended such examples being sought for as illustrations.

Mr R. Stephenson wished to express his conviction of the useful character of the paper, which, he was convinced, would remove many difficulties hitherto felt in examining the subject by the process laid down by Professor Moseley, whose formulæ, though highly scientific, and no doubt very beautiful, were much too abstruse for the use of the practical man. Any thing which tended to elucidate these formulæ, and render the subject more popular, must be received with great interest by the civil engineer, whose labours would be materially facilitated by such clear adaptations of theory to practice. It would appear, that the principal novelty consisted, in describing by a simple process from two given, or assumed, points, a curve of equal horizontal thrust, falling within such points in the voussoirs, as should demonstrate the stability or instability of the structure. There could be no doubt of the value of such a process; but he would suggest to Mr. Barlow the desirableness of giving, in somewhat more precise and simple terms, the mathematical demonstration of that which must be universally admitted in practice. He would suggest whether Moseley's term of the "*line of pressure*," as contra distinguished to the "*line of resistance*," did not convey the meaning of the proposition better than the term "*curve of horizontal thrust*." It was accepted as perfectly true, that, as stated in the paper, the horizontal force at any part of the curve was opposed by a horizontal force of equal amount, exerted in an opposite direction, and that the horizontal force or thrust was equal throughout the curve, and hence the equilibrated arch; yet this had not been hitherto clearly and simply laid down, in such a manner as to be practically used.

Mr. Bidder accorded with Mr. Stephenson in his appreciation of the value of the paper, he had seldom heard one of greater utility, and he trusted so good an example would be followed in the Institution. The proposed mode of describing the curve or line of pressure, showed the impropriety of constructing brick arches in separate superposed rings; the line would in almost every instance, travel out of the ring in which it commenced, and in case of fracture, the rings would fail consecutively; but if the arch was well bonded together throughout its entire depth, the line, or curve, would be traced within it, and it would possess the requisite strength. All the best brick arches were now built in that manner with full bond. An arch had recently been so built by Messrs. Grissell and Peto over the River Lea, with a span of 87 feet, and a rise of 6 feet; the centres were struck within an unusually short time after the arch was keyed; but it stood perfectly, and with very little subsidence. He was tempted to consider an arch constructed of rectangular bricks set in a matrix of cement, as a bent trussed girder, the tension rods of which were represented by the abutments of the arch. Very flat arches, such as the Maidenhead Bridge, were examples of what he meant.

Mr. Brunel could not agree with Mr. Bidder's comparison, or what he might be permitted to term his amusing theory; on the contrary, he must contend that there was no analogy between the arch and a trussed girder. In the former the main force was pressure, in the latter the force exerted was tension; the abutments of the one had to resist a horizontal thrust, at a given angle, whilst the wing walls, under the other, had to support only a vertical pressure; any tendency towards horizontal thrust, which might have arisen from deflection of the beam or girder, was prevented by the tension rods which connected the opposite extremities. If an arch could be considered as a bent trussed girder, it must follow, that it would stand equally well whether the curve was upwards or downwards, which certainly did not accord with his notions of the properties of an arch.

Mr Bidder replied that his views were misapprehended; what he contended was, that a brick arch being formed of rectangular pieces, set in a matrix of cement, having great adhesive properties, upon which it in a great measure depended, it should be considered as a homogeneous mass, assuming the nature of a curved trussed girder, the resistance of the abutments acting as the tension rods of a girder. He must still contend for his position, and that the bridges of great span and small rise, erected by Mr. Brunel, were excellent examples of the construction he meant.

Mr. R. Stephenson considered that Mr. Bidder only meant to put forward the position for the sake of argument. It was certain, that the arch and the trussed girder, being supposed to be formed of the same materials, the former would be supported by the resistance of the abutments to compression, and the latter by the tension of the tie-rods; the adhesive properties of the materials not being in either case taken into consideration. The arch, *per se*, should always be considered as composed of separate masses, not set in a matrix; but combined in a certain form, the only adhesion being the friction of the surfaces. It would be desirable if Mr. Barlow would give a more perfect mathematical formula for describing the curve; the rule which he had given had too much the character of being empirical and of being made to fit given cases.

Mr. W. H. Barlow was unable to perceive any deficiency in his definition, or in the method by which he ascertained the curve. The line of thrust, as obtained by the construction given in the paper, was practically given in the models.—It was not a necessary condition of stability, that the line of pressure should intersect the surfaces of contact at right angles, it was sufficient that the direction of the pressure should meet the surfaces of contact, within the limiting angle of friction. The same condition was exemplified in a column; there the line of pressure was a vertical line, but the surfaces of contact of the stones might be inclined, without occasioning the upper part to slip, provided the inclination was within the angle of friction of the material employed.—Moseley's formulæ, although theoretically perfectly accurate, were too complicated, and involved too much mathematical knowledge for the general use of practical men.—A deep or thick arch contained more than one "line of pressure;" the line of pressure to be dealt with in practice was, in effect, the centre of a surface of pressure.

Mr. R. Stephenson said, that mathematicians always considered the line of pressure to be at right angles with the supporting surfaces or the abutments. It would appear, however, from Mr. Barlow's explanation, that instead of drawing a series of lines at right angles to the surfaces through given points, thus forming what might be termed the polygonal theory, he described a correct curve through the same given points. Mr. Stephenson could not understand how the voussoir could give a line differing from the line of force treated of by mathematicians.

Mr. Brunel said, the subject was one of great difficulty, as it embraced so many considerations; it might, however, he thought, be rendered simple, by considering an arch not as composed of separate voussoirs bound together by cement, thus involving other principles, but as a homogeneous, and, he might almost say, an elastic mass. If viewed in that light, the pressure would be found to extend more or less over the whole surface. The "centre line," or "neutral axis," might in such case receive the denomination of the "line of pressure." If this idea were followed up, there would be less difficulty in explaining the principles laid down by Mr. Barlow.

Mr. W. H. Barlow said, that Mr. Brunel's "line of neutral axis" expressed more nearly what he understood by the "line of pressure," and that line described by the impinging points of the curved surface of the voussoirs of the model. Mr. Barlow thought, that Mr. Bidder's experience, as to arches turned in one entire bond, being stronger than those composed of separate rings, bore out the deductions of the paper. The rings could not separately contain the curve of equal horizontal thrust; but when bonded they did so. An arch turned in separate rings depended too much on the adhesive strength of the cement or mortar.

Mr. Cubitt, V.P., said, it appeared to him that the whole question was contained in the proposition demonstrated by the model with curved voussoirs, where the points of contact, and consequently the curve of pressure, varied according to the spot where the pressure was imposed. In practice, this pointed out the necessity of adapting the form of the arch to the service it was intended to perform. For instance, if the roadway over an arch were level, and the pressure equal, the fracture would take place by depression of the haunches and the opening of the extrados of the crown; but if the roadway were curved, the pressure being thrown upon the crown, the crown would fall, and openings would occur at the extrados of the haunches. Different calculations must therefore be made for the different constructions.

Mr. G. Snell observed, that Mr. Barlow, in his geometric contruction of the line of resistance, assumed, that there were already two points found. Now two points in the line of resistance were determined, when the points of rupture were known; for, at the time when rupture was about to take place, when the arch was balancing between standing and falling, the line of resistance touched the extrados or intrados of the arch, at the points of rupture. One of these points of rupture was determined by the conditions of the question, the other might be determined by a geometric construction, founded on the principles set forth in Moseley's works, and which he had demonstrated in his lectures. The process was one of approximation, and he supposed three trials would be sufficient to determine the point of rupture, with perfect accuracy. The process would apply to all shapes of arches under pressure, in any direction, in any position, or of any amount; but Mr. Snell would at present confine himself to the simple case of an arch which was loaded equally on either side, and the voussoirs of which were equal each to each, on either side of the centre line. In such a case, the one point of rupture would be at the crown of the arch, which would be on the point of turning on one of its edges, at its extrados, if the arch was about to fail by the sinking of the crown; and at its intrados, if it was about to fail by the rising of the crown. In the first case, some stone at the haunches would be on the point of turning on its edge at the intrados. In the second case, some stone at the haunches would be on the point of turning on its edge at the extrados. He would confine himself to the first of these cases. Then, to find the point of rupture, choose some point C (fig. 1), which was considered to be near the point of rupture, and which, in this case was at the intrados; draw C D the joint of the voussoir. The arch being about to fail, by the turning of the key-stone on its edge at A, the resultant of all the forces, at that point, must touch the curve of the extrados at A; its direction was therefore horizontal, and was represented in position and direction by the line A e. The resultant of the weight of the mass A, B, C, D, was represented in position and direction, by a vertical line passing through the centre of gravity, G, such as G h. Now, the only forces acting on the point C (in this case) were the resultant of the forces at A, and the weight of the mass A, B, C, D, and these, being represented in position and direction respectively, by A e and G h, which intersected at the point m, the resultant of all the forces acted through m; it also acted at C, and therefore m C represented the resultant of all the forces acting at C. Now, as before stated, if C was the point of rupture, the line of resistance touched the curve of the intrados at C, therefore a tangent to the line of resistance at C was also a tangent to the intrados, and the resultant of all the forces, acting on any point in the line of resistance, was in the direction of a tangent to that line. Therefore, if C was the point of rupture, m C was a tangent to the line of resistance, and therefore m C was a tangent to the intrados, as in fig. 1. If C was not the point of rupture, but if the point of rupture was above C, m C would cut the intrados, as in fig. 2; but if the point of rupture was below C, m C would cut the intrados, as in fig. 3.

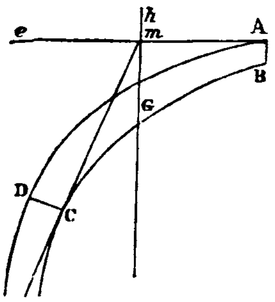


Fig. 1.

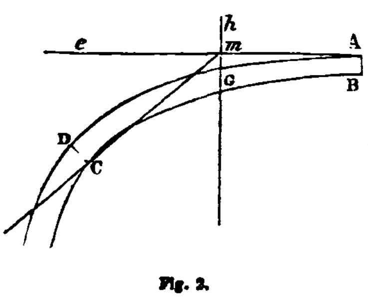


Fig. 2.

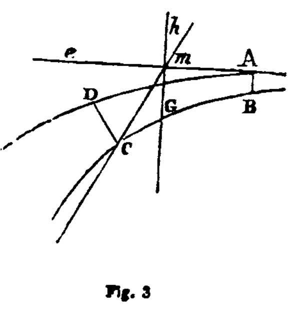


Fig. 3

Mr. H. W. Barlow said, he assumed two points in order to facilitate the investigation. As far as practical utility was concerned, the line of thrust might thus be obtained at one operation, instead of pursuing the laborious process necessary for determining the theoretic line of resistance; indeed, excepting for the most regular geometric forms of the arch, Moseley also adopted a tentative process. Moseley's line of resistance touched the intrados and extrados at the points of rupture. Now a practical eye could detect very closely which would be the point of rupture, and a curve of equal horizontal thrust drawn through these points, though it might not produce the line of resistance with mathematical accuracy, was sufficiently near it for all useful purposes. Moseley's theory was undoubtedly very perfect; in fact he was the only mathematician who had treated the subject consistently with its practical requirements. The difficulty in his mode of investigation was in those arches which did not partake of regular geometric forms, and in these cases Mr. Barlow's method would be found easy of application.

Mr. Brunel still thought, that Mr. Barlow had scarcely met the objections which had been raised. It was true that in practice some points might be assumed; but it was more satisfactory to have positive rules for finding these points, and assuring the mind as to the correctness of the basis of the proposition. In a very large arch, with a small rise, the line of pressure must be confined within very narrow limits, and in such a case a formula giving the points definitively was essential for inspiring confidence.

Mr. W. H. Barlow replied, that the limits which confined the line of resistance, depended on the thickness of the arch and not on the ratio of the rise to the span; the points of rupture in ordinary forms of arches were well known; they were at the extrados in the crown, and at the intrados in the haunches; there was, therefore, no difficulty in finding the line of resistance in these cases. If the mind was as perfectly impressed with the direction of the forces in arches, as in the case of columns, both could be built with equal security.

Mr. G. Snell stated, that in all cases of equal thickness of voussoirs throughout, Mr. Barlow's rules might apply; but if the thickness was less at the crown, as in the case of an arch with a keystone of limited depth, but of which the voussoirs increased towards the abutments until they came to an extreme length, he did not see where Mr. Barlow could assume his points in the line of resistance.

Mr. W. H. Barlow replied, that in reference to that particular form of arch, it was evident many curves of equal horizontal thrust would be drawn within the thickness, so that it was unnecessary to entertain the question; because, if any one curve of equal horizontal thrust was contained, it proved that the theoretical line of resistance was also contained. It would be observed, on referring to the paper and consulting the drawings and models, that the rules were general, and applied to every form of arch and archiform structure, loaded or unloaded, and whether of equal thickness or otherwise. The model, with the rectangular voussoirs leaning together at the apex, was selected as an extreme case. He wished to remove an impression, which might have been produced, by his stating that his mode of treating the subject of arches was not mathematical as that of Professor Moseley: he only alluded to the use of geometric construction instead of algebraic formulæ; the principle or theory was the same in both cases. The misapprehension as to assuming points in the curve, which Mr. Stephenson alluded to, as not having been sufficiently explained, arose from the modification which was necessary in applying theory to practice. If perfect hardness of materials and mathematical accuracy of workmanship were attainable, the pressure would be transmitted in the line of resistance, as laid down by Moseley, and described by Mr. Snell. On the other hand, if the materials were in the softest state in which it was possible for an arch to sustain itself, the pressure would be transmitted in that curve of equal horizontal thrust, which corresponded most nearly to a line drawn through the centre of the thickness of the arch; because in that state of the arch, the whole available surface of the voussoirs must be acting, to support the insistent pressure; practically, therefore, the pressure would be transmitted in a curve of equal horizontal thrust, somewhere between these two limits. Now, in the case of large brick arches, particularly when the centres were first struck, the state of the arch approached that which had been just mentioned, and it was for that reason he had stated in the paper, that in determining abutments for arches of large dimensions, the points p p' should be taken in the centre of the thickness of the arch, though the extreme limit of stability, if the materials were hard, would be when the points p p' were in the theoretical line of resistance. Assuming the points p p' to be in the centre of the thickness, and making the abutments accordingly, was in effect nothing more than providing abutments of such dimensions as should resist the thrust of the arch, when it was in the most disadvantageous state in which it was possible for it to exist. An arch constructed with abutments only just sufficient to contain the theoretical line of resistance, would possess the same degree of stability as a column placed so far out of perpendicular, that a vertical line drawn through its centre of gravity would just fall at the extremity of its base; but an arch, with abutments built so as to contain the curve of equal horizontal thrust, which accorded nearest to the centre line of its depth or thickness, would be under the same condition of stability as a column placed perfectly vertical.

CONSTRUCTION OF SEA WALLS.

Opinions of Engineers on the Construction of Sea Walls, referred to in Sir HOWARD DOUGLAS'S *Protest, given in last month's Journal.*

ANNEX (B).—SIR JOHN RENNIE *on the Mode of Construction of the proposed Harbour.*

With regard to the last important consideration, namely, the particular mode of construction, and the cost. Various plans may and have been proposed for this purpose, such as founding the substructure below low water in caissons, and raising a superstructure of perpendicular walls of masonry upon them, carrying out frame-works of timber or iron, and forming walls of masonry within them, filling the interior space between the walls with chalk or concrete; another plan consists in throwing down masses of chalk into the open sea, and covering them with stone of harder description. None of these, however, appear to me applicable to the purpose, particularly for the great outer mole or breakwater; the only similar examples where caissons have been employed, are the memorable cases of Cherbourg and Sheerness, where they signally failed. Wooden caissons and hollow circular towers, composed of brickwork, masonry, and timber combined, also wooden floating breakwaters, were proposed by General Bentham to be used in the construction of the breakwater at Plymouth, but after being fully discussed, these plans were abandoned as being inapplicable, and, looking to the particular circumstances of Plymouth Sound, the reasons given for the rejection of those plans were unanswerable. In such great and important works, where failure would be attended with most disastrous consequences, none but those means which are best recognised as certain of success should be adopted. This has been amply justified by the result of the mode adopted in the construction of the breakwater at Plymouth, which has completely succeeded in every respect, whether as regards design, construction, or economy, and I feel convinced that under those circumstances, no other system would have answered so well. Much has been said about the damage occasioned by storms disturbing the rubble; the fact is, storms form the principal agent in consolidating the rubble and save manual labour, and, to use the late Mr. Rennie's words, are the best workmen.

ANNEX (C).—MR. GEORGE RENNIE'S *Report on the Harbour in Dover Bay, and his Evidence.*

With respect to the form and construction of the proposed breakwater. Experience has proved the principles of Cherbourg, Plymouth, and Kingstown Breakwaters. The destruction of the cones at Cherbourg, and the failure of the brick masses at Sheerness, are sufficient arguments against the adoption of caissons, or other expedients.

If such a work as is now proposed be undertaken, it should be solidly and properly done. The magnitude of such a work would not justify the risk of a failure; and, without entering into the question of the comparative cost and efficiency of different systems, I have no hesitation in pronouncing in favour of sloping stone breakwaters, similar to that of Plymouth; assuming, therefore, the same profile or section for the proposed breakwater as that, from 1,800 to 2,000 square yards, and the same prices which that work has cost, the probable amount will be about £2,500,000; in consequence of there being no good materials in the vicinity, they must be brought from elsewhere.

Ques. You have spoken of the experience you have had in constructing breakwaters, and of the observations you have made upon existing breakwaters; you have studied fully also the theory upon which the construction of breakwaters depends with respect to the action of the sea?—*Ans.* I have.

You have said that you consider upright walls not so capable of resisting the action of the sea as sloping; do you form that opinion upon the well-known theorem of the action of fluids in motion upon planes in terms of their obliquity?—I do.

And that as the obliquity increases the effect upon the wall is diminished in a very high ratio?—It is.

Do not the advocates of the upright system predicate their theory upon the supposition that waves in the open deep sea have only an oscillatory motion, direct and indirect, but that they have no progressive motion; that they do not act with any propelling or percussive force upon an erection in the sea?—I believe they have that notion.

And that the only motion is a vertical?—Yes.

And that, consequently, the only effect that waves produce upon the wall is by their statical pressure, or weight?—I believe so. But in answer to that, some experiments have been recently made upon the horizontal action of waves upon flat surfaces by Mr. Alan Stevenson. Mr. Stevenson showed me an instrument when I was in Edinburgh in June last, which consisted of a flat plane of a foot space, stuck upon the end of a rod, just like a letter balance, placed vertically to the shock of the sea. It had a spring behind it, and, of course, when a wave struck it, it indicated by the pressure against the spring the force of the wave. The action of a wave moves horizontally, and when it strikes an object, it does it with the mass of the wave put in motion, multiplied by its velocity. Consequently, in order to repel that wave, we must have a mass which shall be such that its weight shall be capable of resisting the shock. It must be equal, both by its adhesion and weight, to overcome the shock of the wave.

Do not you think that so far from a sloping breakwater treating the force (as the advocates of the upright wall state) with which the water rushes up, it is the force with which the water does so rush up the plane, being thus permitted to expend and exhaust itself, which diminishes the effect in the horizontal direction upon the structure; and that if it were not so, as in the case of an upright breakwater, that force would act wholly like a ram upon the perpendicular wall, to overthrow it?—It would; if we compare it with the friction of water in waves, which I have found by experience to be something like a third of the pressing or horizontal force, I should think by the same reasoning that the force of waves would be diminished in the same proportion, only that the friction of those large stones is much greater. I should say that the force by the great angular inclination of those stones would be diminished in the ratio of one-half the momentum or impulse of the shock.

Is it not clear, then, that so far from waves having wholly an up and down motion upon the face of an erection in the sea, so far from their having no force in a horizontal direction, they do come in with propelling and percussive force, which does act horizontally against the erection, whatever it may be, with a force which varies according to the slope?—I am quite of that opinion, and it is further confirmed by the forms which beaches take.

The advocates of the upright breakwater do not dispute the hydraulic fundamental theory, that when fluids in motion act upon a plane, the force of the motion upon the plane diminishes in a high ratio in proportion to the angle of the plane, but they assert that this does not apply to the hydraulic construction which we are considering, because there is only an up and down motion. Do you or do you not consider that the construction of breakwaters, and their proper form, does depend upon that hydraulic theorem, and that it would not be safe to proceed to the construction of any breakwater upon the supposition that it is not governed by those laws, for that there is no horizontal motion, but only a vertical pressure?—I think so. I think that the advocates of perpendicular walls are quite wrong, with all due deference of course.

Do you think it is practicable, or would it not be exceedingly difficult to build an upright wall in the open sea, in seven fathoms water?—I think it would be almost impracticable in deep water; I should be very sorry to undertake such a thing.

Do you think, if undertaken, it would be safe to use any artificial or inferior materials, such as concrete or chalk, in any part of it?—I do not, decidedly.

Do you know any case in which an upright wall has been built in modern times in such deep water as that in which we propose to erect this breakwater?—I know the case of Sheerness, where the masses were sunk to form an upright quay wall.

Would not the erection of a breakwater, perfectly upright, in the open sea, in Dover Bay, in seven fathoms water, be an experimental measure?—It would.

Under all the circumstances of the case, confining yourself to the practical question, and especially considering the effect of failure, do you think in the natural roadstead and anchorage of Dover we should be justified in making such an experiment under such circumstances as these?—I do not. Of course I may be a partisan of a particular system, but I give you my unbiassed judgment.

ANNEX (D).—MR. WILLIAM CUBITT'S *Plan for the Construction of a Harbour of Refuge in Dover Bay.*

The most obvious mode of construction, and possibly after all the best, is that of depositing large masses of rough hard rubble stone in the sea, in the line of the intended work, in the same manner in which the harbour of Kingstown and the breakwater at Plymouth were constructed. The simplest is tumbling large stones into the sea, as Plymouth Breakwater and Kingstown Harbour Pier; another mode is building in water with large stones, by means of the diving-bell; another by building caissons, filling them up partially, and floating them into their berths, and sinking them, and completing afterwards, either in or about them.

On the whole, therefore, after a most careful consideration of the subject, my recommendation to their lordships is, to form the harbour at Dover Bay with piers or breakwaters, constructed by depositing the largest blocks of either granite, Portland cap stone, or limestone, or all of them as may be procurable together, with all the small stone that may be procurable together, with all the small stone that may arise in quarrying the rough blocks; and to form the breakwaters with circular heads at each of the entrances 300 feet in diameter, brought up from the bottom with solid facings of ashlar masonry by means of the diving-bell after the harbour is enclosed, as is now being done at Kingstown Harbour.

Ques. Will you have the goodness to state, after such strong expressions in favour of an upright wall, why you now recommend a long slope?—*Ans.* The reasons I stated, that if in constructing a wall in the sea 72 feet high, which is the height we calculated upon in deep water, we could be sure of all our premises, the thing could be done, and would be the most perfect. I also stated, I think I recollect, in that report the reason I went from that and recommended another plan was, because I wished to recommend that which was perfectly certain to be effected with no contingencies, and at a much more easily ascertained cost than a breakwater with upright faces, which I certainly deemed the most perfect if done, but the casualties and unknown circumstances attending which rendered it doubtful in some points, and the expense of which would be greater. That in a thing of so large and important consideration as this harbour is, where millions of money, to say the least of it, must be expended, to do anything effectual, in my opinion it is better to take that thing which we thoroughly understand and know, than to take a thing which is in the least degree experimental on such an immense scale.

You are, no doubt, aware of the tremendous disasters that attended the long slope at Plymouth during its progress of construction. With such facts as these before us, do you think the long slope can be safely adopted at Dover?—Quite so, and for very good reasons. It is not because a casualty happened from a great storm arising whilst the breakwater was building there, or because another happened afterwards, in which they took up 200,000 tons of stone, which is not a great quantity, that we are to conclude that the plan was not a good one. I believe that that breakwater was set about in an imperfect manner. The makers of Plymouth breakwater prided themselves upon taking all large stones for it, the breakwater consequently was too hollow, and when a heavy sea came it curled over the surface of the breakwater, covering it with the water, and the compression of the air inside drove up the stones. Now, if all the stuff that was raised in the quarries, large and small, had been put into that breakwater, I do not think that that quantity of stone would have tumbled out of it; and again, when a breakwater is fairly trimmed over, and trimmed into form, there is no difficulty in paving that with heavy stones on the edge, and giving it as perfect and smooth a face, after a little time, as can be, at any angle you please, so that no sea can break into it at all. It is because the thing is imperfectly done that it is not good. And with regard to casualties happening, I am sure I do not myself suppose, and I do not think any party in reason will suppose, that we can build an upright wall without having casualties; things will be tumbled head over heels, and we cannot work half the time, or sometimes a quarter of the time. We must have the benefit of experience in a great work of this kind; and, I think, there is not that experience for an upright breakwater yet to justify us in entering upon it to this extent in the first instance.

I will ask your attention to the different aspects of the two works, the Plymouth breakwater and that proposed at Dover. What will be the effect of its striking in that way upon those loose stones; will it throw them into the passage?—I would have none come out. But in completing the end of the rubble, if there were a thousand stones driven out they would be taken out, and it would be cleared out again in completing the ends with the diving-bell, exactly as they are now completing the walls of Kingstown harbour.

You are aware that at Plymouth the entrances of the breakwater are at each end, but at Dover the entrances must be directly through the slope?—Exactly so. So it is at Kingstown harbour; and though the seas there are not equal to those at Plymouth Sound, they are at times uncommonly heavy seas, and I have seen a perfectly clear passage in the seven or eight fathom water. There is no difficulty about that.

Without going into the question of the principle of the action of waves on upright faces or slopes, you think that to build an upright wall in Dover Bay in the open sea, in seven fathoms at low water, exposed to the action of currents and tides, would be altogether a very difficult undertaking?—Upon any plan whatever.

And having bestowed upon this important question all the science and all the attention which you have devoted to it, and with all your experience, you come at length to this practical conclusion, that upon the whole, after the most careful consideration of the subject, your recommendation would be to form the harbour at Dover Bay by depositing blocks or masses of stone, as shown in the plan which accompanies your report, using the largest blocks either of granite, Portland stone, or limestone, so as to form a section, having a long fore-slope?—I do; but I not only do that, I give a statement at the same time of the dimensions of the thing, the quantity measured, and show what addition it would make in the cost of the whole, and what saving might be made by using other materials in its construction.

Then you think that any attempt to erect an upright wall from the bottom in Dover Bay, at the depth of seven fathoms at low water, and to form that wall of blocks of concrete, or any other artificial material would partake very considerably of an experimental undertaking?—Quite so.

And that we should not be justified in recommending or approving anything which is of an experimental character for this national work?—I think there would be great danger in undertaking a work of that kind upon an experimental or new plan. We are not sufficiently experienced beforehand, having no previous knowledge. There are very weeks in the year in which it is at all comfortable, being off Dover one mile or two miles at sea. It is all blind work at the bottom of the sea. People may think that they can put those down with scaffoldings, but what is to be done at 72 feet deep, with a diving-bell, in the open sea, is very difficult to say.

Annex (E).—Mr. Alan Stevenson's *Answers to Questions proposed to him on the Mode of Construction.*

You are considered to have bestowed much study and observation, and to have great practical experience as to the action of waves on erections in the sea?—I have had considerable experience in the erection of works exposed to the action of the sea, in piers, light-houses, harbours, and beacons; and I believe I have enjoyed good opportunities, more especially at the Skerryvore Rocks, of observing the action of the waves.

All my experience, observation, and consideration, lead me to believe that a sloping face is better calculated to resist the action of the waves than a perpendicular one, and the force expended against the perpendicular plane seems by concentration to become more intense, for the seas rise to a greater height than those which strike a sloping face. Such an opinion is in accordance with the phenomena which characterise almost every part of the coast, where it is found that the angle of the shore varies with the force of the waves. I cannot imagine that the waves of the sea exert no percussive energy, when I observe their power in forcing forward a vessel which has neither wind nor tide to help her, or a vessel at anchor, an effect which I have felt in 12 and 18 fathoms water; or when I consider the height to which spray rises in deep water by striking a vessel at anchor.

That waves driven in by gales of wind are destitute of percussive effect I cannot conceive to be possible.

The force of the waves will be greatly diminished when they act obliquely on a sloping surface. From the effect of the slope to increase the surface of the wall opposed to a given perpendicular surface of the wave, the energy of the wave will necessarily be decreased in proportion as the impinging particles are spread over a greater surface. But the force of impact thus diminished in the ratio of the sine of the inclination of the surface to the direction of the fluid's motion, must, in order to estimate its tendency to displace the wall horizontally, be resolved, first, perpendicularly to the surface, and again in a horizontal direction, so as to be thus finally diminished in the ratio of the cube of the sine of the inclination of the surface of the wall to the direction of the wave. Experiments upon the action of fluids or surfaces confirm the view thus theoretically assumed.

I cannot perceive any material difference, in so far as the result is concerned, between the case of the breaking wave and that of an unbroken wave, except that I should expect more force in an unbroken wave which has not encountered an obstacle. Admitting that both have an onward movement (which I take to be the case with all waves which are acted on by the wind), it would appear to me that the direction of the force in a broken wave must be more diffused in different directions, and would thus seem to possess less of a "ram-like power."

What do you think of the theory which assumes that waves have no other action than statical pressure upon a perfectly upright wall, although it is admitted that waves in a broken or breaking state have a percussive force, which an upright plane is not so capable of resisting as a slope, according to the well-known hydraulic theorem to which I have adverted?—My opinion of that theory is that it is not sound, and I found my conclusion on observation, and on reasoning, which both conduct me to the same result.

How can the hydraulic action or percussion of the wave, in the direction of its motion, cease when it comes in contact with the wall, and become hydrostatic pressure, without acting by impact on the wall which stops that motion, and which consequently, if it stands, resists that impulse?—I see no reason, as stated in the last answer, for supposing that the purely vertical or undulatory movement, which the above theory ascribes to all unbroken waves, should not produce, in the process of its neutralization by a vertical wall, effects similar in kind to those produced by its neutralization by an inclined plane. In both cases the undulation is checked; and whether this is done by reflecting the vertical or undulatory motion in one direction or another, seems in no way to change the measure of the whole shock, which such a concussion and final extinction of the force seems to imply.

Are you aware of any case in which a perfectly upright wall has been built in the open sea, in a depth of seven or eight fathoms?—I never heard of any upright wall being built in any such depth as seven or eight fathoms.

Would not such a mode of construction, applied to Dover Bay, be essentially an experimental measure?—Certainly, so far as my experience goes.

What is your opinion of the difficulty, facility, or practicability of building an upright wall in the open sea in such a depth of water? and how should you proceed to execute such a work?—I should consider building an upright wall from the bottom in seven or eight fathoms in an open seaway, like that at Dover, as a work of the utmost difficulty, if not indeed wholly impracticable.

Are you prepared, as a practical and experienced engineer, to recommend that such an experimental mode of construction should be tried in such a place, on such a scale, at an enormous cost, and for such permanent national objects as those to which these proceedings relate?—So far from recommending the trial of such a work, I should humbly, but decidedly, dissuade the government from such an attempt, which I am sure would end in failure.

What, upon the whole then, is the mode of construction which you would propose for executing this great work, in the most certain, solid, and enduring manner?—Taking into account the forms of the natural shore, and the tendency of the foregoing views, I see nothing to warrant a departure, in any material degree, from the existing practice of engineers in the construction of breakwaters.

What is your opinion of the action of the wave upon a perpendicular wall, with a smooth surface in deep water?—I cannot conceive that the unbroken waves caused by wind have less percussive force than when they are broken and diffused; I must conclude that the sudden check of this force by a vertical barrier will produce a greater single effect than the gradual expenditure of force over a larger space caused by meeting the successive surfaces presented by a sloping wall. The tendency, therefore, appears to me to be towards a more certain and rapid destruction of the vertical barrier than of the sloping one. The destruction of the sloping breakwaters may either prove that the slopes were not sufficiently great, or that the materials composing them have been ill assembled, so as to cause vacuities between the stones, or, which is perhaps the most common cause of failure, the foundation of the glacis has not been laid at a low enough level, or, finally, that they have not been paved with stones of sufficient weight, nor united to each other with the care necessary to exclude the action of the water, which tends to remove this description of paving.

The analogy between the natural beach composed of loose materials and the face of a breakwater is not complete, because the materials with which a breakwater is to be paved may not only be larger than those which play about on a natural shore, but may have the additional advantage of being carefully assembled and united together. Again, it must be remarked that artificial works are exposed to greater risk from casualties than the natural beaches, from the following reasons: First, because the choice of their position is too often empirical in so far as their stability is concerned, and is primarily and sometimes almost solely determined, with reference to their fitness to produce an effect in stilling a basin or harbour, with only a secondary regard to the risks of injury which they may encounter. And, second, because, from motives of economy, such artificial works, so far from having slopes greater than those of the neighbouring beaches, are generally steeper, and, as before noticed, are too often deficient in solidity and in the careful protection of their surface by means of pitching.

From the general tenor of the answers you have given to Sir Howard Douglas's questions, you are of opinion that the unbroken wave has percussive force like the broken wave, and that, of the two, you consider the unbroken wave to have this force in a greater degree than the broken wave: will you be good enough to state how you account, therefore, for these facts on your theory?—I am of opinion that an unbroken wave has percussive force like a broken wave, and probably in a greater degree, because it has not sustained the same check or retardation. I believe that all waves, except the great tide wave, have an onward motion, because I know of no cause constantly in operation which is capable of producing waves but the wind, and this agent, it appears to me, must of necessity impress upon the waves some degree of onward motion. From all my experience I have invariably found that the sea broke gently and playfully on all the sloping walls, while it broke with a loud noise on the plumb walls, and raised the spray in some cases to the height of 30 feet and upwards. In striking against this perpendicular face the successive waves make a sound similar to that of a great gun at a distance, carrying sometimes with them large pieces of stone which, falling on a lighthouse roof, occasionally damage it; though at the distance of 240 yards from the face of the rock.

There is no analogy between the case of a pile which permits the sea to pass round it freely, and that of a continuous wall which checks its progress and opposes a long front of resistance. The mere circumstance of the in-shore piles being more injured than the outer ones, appears to me not very relevant to the subject under consideration.

As to the circumstance of the piles which were braced being more injured than those which were unbraced, this only proves that from the manner in which the braces were applied, they offered more resistance to the wave than was compensated for by the additional support derived from them. I have sufficiently shown that it is possible to explain the various circumstances adduced by Colonel Alderson on the view which I have taken of the percussive nature of all waves with which we have to do in the formation of breakwaters.

In my own mind I have no doubt that ocean waves are not purely oscillatory, but that all waves have an onward motion, and possess percussive force, and my humble conviction is, that the first attempt on a large scale to check the force of the waves in deep water, by means of a vertical wall, will prove a signal failure, and that a force will be developed by the collision of the wave with the wall, whose amount will be found to surpass anything which has hitherto been experienced on the face of a sloping breakwater.

I cannot look upon the works at Plymouth, Kingstown, and Cherbourg, each of which I have visited, as any longer merely experimental. Such works, may, on the whole, be considered as satisfactory as the nature of the circumstances will permit.

Do you think it impossible to construct a breakwater at Dover in such a manner, and by such methods, as would give it practically a monolithic character, and render it capable of resisting the force of the sea in the same manner as an upright cliff?—I have already expressed my belief that the waves have an onward motion, and that this motion would be continued until checked and thrown back by the action of the wall. The wall therefore must reverse the movement and annihilate the force on its onward course, and seems consequently obnoxious to sustain the final effort of the waves. I cannot see how in such a case any part of the water can be considered as at rest, and thus operating as a non-conductor of the force; and the facts alluded to in my former answers, which I have myself observed, as to the action of waves against cliffs, seem fully to corroborate my views.

Annex (F).—Mr. William Stuart, *Superintendent of the Plymouth Breakwater, on the Mode of Construction.*

I have been employed at the breakwater from the commencement of the work in 1811; but as superintendent only since 1839.

The slope, as left by the sea, from low water upwards, was about 5 feet horizontal to 1 foot perpendicular, and in some places rather more. Messrs. Chapman, Jessop, and Rennie (the late Mr. John Rennie), engineers, were called in to report; and it was thereupon determined, in April 1825, that a breakwater should be formed regularly from the level of low-water spring-tides, with a casing of rough squared blocks of granite and limestone, commencing on the exterior, or south slope, with a slope of 5 to 1, as the sea had left it; and on the inner, or north side, with a slope of 2 to 1.

What was the object of increasing the breadth at the top?—To add to the stability of the breakwater.

Do you attribute the damages you have stated in the years alluded to, to the form and shape of the breakwater, and to the want of filling up the interstices?—In the first gales I attributed the damages to the fact that we had not length enough of foreshore, or of extension to seaward.

Not slope enough?—Not slope enough.

What was the objection you had to the more upright slope?—I was convinced it could not stand; and my belief was afterwards confirmed by the actual failure of a solid part of the breakwater, which had been built on this plan, and also by the failure of a part of Statten Pier itself, which had never to encounter anything like so severe a test as the breakwater.

Do you think if the breakwater had been constructed in any other form, for instance, if it had been either wholly upright from the bottom of the sea, or upright from about low-water mark, that such a breakwater would have had power to resist the force of the sea which overturned that large portion of it which you have mentioned?—I think not.

Do you think that oblique planes of breakwaters, built in the sea, are better calculated to resist the force of the sea in the direction of motion than any upright work?—I do, decidedly.

Having said you prefer a sloping breakwater, as best able to resist the force of the sea, you further state, from your own experience, you think the long slope of 5 to 1 is that which is most likely to remain in a state of stability?—I do.

I would begin by throwing in stones and getting the whole up to low-water mark, letting them find their own base in the first instance, with rubble stone, large and small together, and then that would become a protection, and the sea would level down and you could then add to it again.

Was any part of it ever made upright?—Never.

So that the upright building was never tried?—Never.

Annex (G).—Mr. J. M. Rendel, *on the Mode of Construction, and Evidence.*

To construct a breakwater in seven fathoms water is, I apprehend, a very formidable undertaking, especially if any of the ingenious contrivances of caissons and machines of that kind are to be resorted to. I doubt very much, if a breakwater is to be constructed in seven fathoms water, whether the only safe plan would not be to deposit in the usual way from vessels (if it is a detached breakwater, or from a railway, if it is a breakwater connected with the shore, and the shore produces suitable materials), a mass of stone up to within, say, two or three feet of low water; and above that to construct perpendicular walls of the kind referred to in Col. Jones's letter of suggestions.

Considerable doubt being entertained as to the slopes, and particularly the sea-slope of a breakwater, as least likely to be damaged by the action of the waves, you are requested to state, on reading Col. Jones's paper upon this important subject, your opinion upon it?—I think Col. Jones would be very likely to fall into the same error in universally applying perpendicularly-sided breakwaters as other engineers have been of universally employing sloping ones. I think if the stones were thrown in and allowed to form their own slope, that slope being determined by the nature of the materials up to within two or three feet of low water, and then the breakwater raised upon that with perpendicular sides, it would be the most economical plan in most situations. I should be more disposed, if I had to build one in seven fathoms water, to adopt the plan I before referred to: suppose I had an unlimited command of materials, I should first of all begin to deposit those materials to form a rough mass up to within a moderate depth at low water, and then when I had brought my foundations up to that point at which the sea would begin to attack me, I should begin to attack the sea by building with a class of materials that would be its master. I think an upright wall in that case might be desirable.

In your evidence before the Commissioners last year on the difficulty of constructing works in seven fathoms of water, you deprecate the use of caissons, and expressed doubts whether a breakwater could be constructed in seven fathoms water by such means; do you retain that opinion?—I do.

You say you do not know of any instance in which a breakwater, with an upright face of the magnitude now contemplated, has been constructed in the open sea, in seven fathoms water?—I do not.

Then you say in another part, that if you had an unlimited command of materials, you would begin to deposit those materials so as to form a rough mass, with a slope up to about low-water mark, and upon that you would build a superstructure in the shape of an upright wall?—I should do so.

And you recommended this combination of the slope for the substructure with an upright wall for the superstructure?—I should so build if I had suitable materials at hand.

Are you still of that opinion?—I am.

You stated that if you had plenty of materials at your disposal you would be disposed to form the breakwater foundations below low-water mark with a slope, and above with an upright wall; was that as matter of economy or as matter of principle?—As matter of economy. It is quite a question of the cost. I have just finished a design for Holyhead Harbour; there, on account of the facility of getting rough masses of stone for the breakwaters, I have proposed to form them of rubble-stone up to low-water mark, with sloping sides.

If the execution of this work, with the brick blocks, were pressed on so rapidly as to render it necessary that those blocks should be made in remote places to be shipped or otherwise transported to Dover, would not a great part, if not the whole, of the economical advantage of using brick masses instead of stone disappear?—To a certain extent it would, but there is no county in England where brick earth more abounds than in Kent. In short, I am quite satisfied that you must have the material without bringing it by vessel; it must be brought by railway.

ON THE ACTION OF WAVES.

Annex (H).—Prof. Airy's *Answers to Questions proposed to him on the Action of Waves.*

Which form of structure is best adapted to resist the force of the waves, an upright wall or a breakwater with a slope similar to that at Plymouth?—In my judgment, an upright wall.

You have mentioned in a work which I have read with great attention and admiration, on the theory of waves, that the horizontal motion of the particles of water next the bottom, produced by waves in the sea, is found to extend to very great depths, and to occasion a sensible disturbance of stones and sand at the bottom, and that waves break over ridges or shoals, to the depth of 500 feet?—Yes; but in these instances the waves are very long.

Without entering on your theory of waves in the open deep sea, and confining my questions to your deductions from that theory, as to the practical effect of waves on erections in the sea, am I correct in saying you assume, that in deep water the motions of the particles are oscillatory, that the rising and falling of the surface of the sea depend on the horizontal movements taking place alternately in the same and contrary directions?—Yes.

That those displacements are represented by a periodical function, the sine or cosine of an angle depending on time?—Yes.

That this circular or elliptical movement of the particles is shown to take place only when a wave is transmitted along a channel of uniform breadth and depth?—Yes.

That as the depth of water becomes less, the waves become shorter?—Yes.

That their fronts become steeper?—Yes.

So that as they proceed into water of less depth, their faces become more and more perpendicular until they break?—Yes.

That waves in a broken state strike erections in the sea, in a manner to act powerfully and percussively, as hydraulic rams by their momentum?—Yes; when in a broken state they act percussively, not by the ordinary hydrostatic pressure.

Their mass and velocity give those waves that momentum or percussive force?—Yes.

For that reason, in the shallower parts of the proposed harbour, where the waves come into a depth at which, according to your theory, they would by breaking exert such a force upon the wall, you would recommend a sloping and not an upright wall?—I should. I think a sloping wall is best able to resist the action of the water in a broken state; and inasmuch as you cannot avoid the breaking of the waves, I should recommend a slope there; but in other parts, where you can avoid the breaking of the waves, I would have a perpendicular wall.

The waves become shorter and shorter as they advance, and, acquiring increasing tendency to break as they come into shallower water, their faces will be nearly vertical, in the state just preceding the broken state. Now, for the reason which you assign for thinking a sloping wall more capable of resisting the impact of a broken wave than an upright wall, do not you think that waves in heavy gales coming in with considerable velocity, and in that state, would act upon an upright wall with the percussive force due to their weight and velocity, and produce a more serious effect than if that impact were to act against a slope?—It will not strike at all. There will be a great swell up and down again; there will be nothing like horizontal motion.

The wave is proceeding?—It becomes a stationary wave; a combination of a direct and a reflected wave. It goes up and down again without breaking; it is merely an elevation of the surface. I have been in circumstances where I have had good opportunities of observing that practically, and I know that that is the case.

Then the modification you would propose is, that in the depth of water in which you think the wave would break, you would recommend a slope, and in the other part an upright face?—Yes.

In what depths, practically, would that be? I think you said the pilots can best answer that. You say that inasmuch as a wave does not break against an upright surface, it will exert no percussive force upon the wall?—No. It will exert the same sort of pressure that there is against a lock-gate; that is, a hydrostatic pressure.

Equal to the weight of a column of water, whose base is the surface pressed, and height the depth of the centre of gravity?—Yes.

On the Concave Face.—The construction would be exposed to less danger, if the section of the wall presented to the sea a hollow curve, like the base of the Eddystone lighthouse; but still there would be the breaking sea searching through every joint, and nothing can make square-stone masonry quite secure when it is exposed to this.

BRITISH ASSOCIATION.

The seventeenth meeting took place at Oxford on the 23rd June, when Sir Robert Inglis delivered an elaborate address, which we give in a condensed form.

Sir Robert Inglis's Address.

I begin with *Astronomy.*—The progress of astronomy during the past year has been distinguished by a discovery the most remarkable, perhaps, ever made as the result of pure intellect exercised *before* observation,—and determining *without* observation the existence and force of a planet; which existence and which force were subsequently verified *by* observation. It had previously been considered as the great trial and triumph of dynamical science to determine the disturbances caused by the mutual action of "the stars in their courses," even when their position and their orbits were fully known; but it has been reserved for these days to reverse the process, and to investigate from the discordance actually observed the existence and the place of the wondrous stranger which had been silently, since its creation, exerting this mysterious power. It was reserved for these days to track the path and to measure the force which the great Creator had given to this hitherto unknown orb among the myriads of the air.

I am aware that Lalande, more than fifty years ago, on two nights—which, if he had pursued the object then first discovered, would have been well distinguished from the rest of the year, and would have added new glory to his own name—did observe what is now fully ascertained to have been the planet Neptune; but though Uranus had just been added to those bright orbs which to mortal eyes for more than 2,000 years have been known to circle our sun, Lalande was observing before Piazzi, Olbers, and Harding had added Ceres, Pallas, Juno, and Vesta to that number, and before by those discoveries it was proved, not only that the planets round the sun had passed the mystic number of seven—since Herschel had confuted that ancient belief—but that others might also remain to reward the patient labours of other observers. He therefore distrusted his own eyes; and preferred to believe that he had been mistaken, rather than that the existence and force of a new planet had been reserved for the discovery of this latter age. What his eyes saw, but what his judgment failed to discriminate and apply, has since become a recognised fact in science.

I will not presume to measure the claims of the two illustrious names of Leverrier and Adams: of him, who, in midnight workings and watchings, discovered the truth in our own country, and of the hardly happier philosopher who was permitted and enabled to be the first, after equal workings and watchings, to proclaim the great reality which his science had prepared and assured him to expect. I will trust myself with only two observations: the one my earnest hope that the rivalry not merely of the illustrious Leverrier and of my illustrious countryman Adams, but of the two great nations which they represent, France and England, respectively, may always be confined to pursuits in which victory is without woe, and to studies which enlarge and elevate the mind, and which, if rightly directed, may produce alike glory to God and good to mankind: and the other, my equal hope, that for those (some of whom I trust may now hear me) who employ the same scientific training and the same laborious industry which have marked the researches of Leverrier and Adams, there may still remain similar triumphs in the yet unpenetrated regions of space; and that—unlike the greater son of a great father—they may not have to mourn that there are no more worlds to be conquered.

It is a remarkable fact that the seeing of the planet Neptune was effected as suddenly at Berlin by means of one of the star-maps which has proceeded from an association of astronomers chiefly Germans; such maps forming in themselves a sufficient illustration of the value of such Associations as our own, by which the labour and the expense—too great, perhaps, for any one individual—are supplied by the combined exertions of many kindred followers of science.

It is another result of the circulation of these star-maps, that a new visitor, a comet, can hardly be within the range of a telescope for a few hours without his presence being discovered and announced through Europe. Those comets which have been of larger apparent dimensions, or which have continued longer within view, have, in consequence, for more than 2,000 years been observed with more or less accuracy; their orbits have been calculated; and the return of some has been determined with a precision which in past ages exercised the wonder of nations;—but now, improved maps of the heavens, and improved instruments by which the strangers who pass along those heavens are observed, carry knowledge where conjecture lately dared not to penetrate. It is not that more comets exist, as has sometimes been said, but more are observed.

Lord Rosse's Telescope.

An Englishman—a subject of this United Kingdom—cannot refer to the enlarged means of astronomical observation enjoyed by the present age without some allusion to the noble Earl, Lord Rosse, and his most wonderful telescope. Its actual operations have been for a time suspended by a cause not less honourable to Lord Rosse in another character. They have been retarded, so far as he himself is concerned, by the more immediate duties, which, as a magistrate, and as a landowner, he owed to his neighbours, his tenantry, and his country, during the late awful visitation which has afflicted Ireland.

Star Catalogues.

The Catalogues of Lacaille and of the Histoire Céleste are now before the world; and with the Catalogue of our Association constitute a series of most important gifts conferred on astronomy.

Lunar Theory.

The Astronomer Royal has done me the honour and the kindness, by a paper which I have just received from him, to make me the vehicle of communicating his wisdom to you on a most important and interesting discovery of the past year:—

"In the lunar theory a very important step has been made in the course of the past year. When, near the beginning of the present century, a considerable number of the Greenwich lunar observations were reduced by Bürg for the purpose of obtaining elements for the construction of his Lunar Tables, and generally for the comparison of the moon's observed place with Laplace's theory, it was found impossible to reconcile the theoretical with the observed places except by the assumption that some slowly varying error affected the epoch of the moon's mean longitude. From the nature of the process by which the errors of the elements are found, the conclusion upon the existence of this peculiar error is less subject to doubt than that upon any other error. So certain did it appear, that Laplace devoted to it one entire chapter in the *Mécanique Céleste*, with the title 'On an inequality of long period by which the moon's mean motion appears to be affected.' Guided by the general analogy of terms producing inequalities of long period, he suggested as its probable cause an inequality whose argument depends upon a complicated combination of the longitude of the earth's perihelion, the longitude of the moon's perigee, the longitude of the moon's node, and the moon's angular distance from the sun. But he made no attempt to calculate its theoretical effect. He also suggested an inequality depending on a possible difference in the northern and southern hemispheres of the earth. Many years elapsed before these suggested theoretical inequalities were carefully examined by physical astronomers. At length the introduction of new methods enabled Poisson and Lubbock successfully to enter upon the investigation of the theoretical values; and they proved that inequalities depending on the arguments suggested by Laplace could not have sensible values. The theory was now left in greater doubt than ever; and suspicion fell even on the accuracy of the reductions of the observations.

"A few years since, as is well known to members of the British Association, the British Government, at the representation of the Association, sanctioned the complete reduction, on an uniform plan, of all the observations of the moon made at the Royal Observatory of Greenwich since the year 1750: and the immediate superintendence of this work was undertaken by the Astronomer Royal. The reductions are now printing in all necessary detail; and the press-work is at this time very far advanced. In the last summer the corrections of the elements of the moon's orbit were generally obtained; and the errors of epoch in particular at different times were found with great accuracy. These results confirmed those of Bürg, and extended the law of the inequality to a much later time. In this state they were exhibited by the Astronomer Royal to Prof. Hansen of Gotha, who was known to be engaged in the Lunar Theory. Prof. Hansen immediately undertook a search for their theoretical causes. His perfect knowledge of the state of the existing theories enabled him at once to single out the class of disturbances produced by the action of the planets as that in which the explanation of this inequality would probably be found. In the course of a systematic search, many inequalities of long period were found; but none of sensible magnitude. At length two were found, both produced by the disturbing force of Venus, of a magnitude entirely unexpected. One depends upon the circumstance that eighteen times the mean anomaly of Venus diminished by sixteen times the mean anomaly of the Earth increases at very nearly the same rate as the mean anomaly of the Moon: its co-efficient is 27″ and its period 273 years. The other depends upon the circumstance, that eight times the mean anomaly of Venus increases at very nearly the same rate as thirteen times the mean anomaly of the Earth: its co-efficient is 23″ and its period 239 years. The combination of these two explains almost perfectly the error of epoch, which had so long been a subject of difficulty. The discovery of these two inequalities, whether we regard the peculiarity of their laws, the labours expended upon the investigations, or the perfect success of their results, must be regarded as the most important step made in physical astronomy for many years."

Tides of the Air.—Tangible Astronomy.

The doctrine of the influence of the moon and of the sun on the tides was no sooner established than it became eminently probable that an influence exerted so strongly upon a fluid so heavy as water could not but have the lighter and all but imponderable fluid of air under its grasp. I speak not of the influence attributed to the moon in the popular language and belief of nations ancient and modern,—of Western Europe and of Central Asia, in respect to disease; but of the direct and measureable influence of the moon and of the sun in respect to the air. It is now clear, as the result of the observations at St. Helena by my friend Col. Sabine, that as on the waters, so on the atmosphere there is a corresponding influence exerted by the same causes. There are tides in the air as in the sea; the extent is of course determinable only by the most careful observations with the most delicate instruments; since the minuteness of the effect, both in itself and in comparison with the disturbances which are occasioned in the equilibrium of the atmosphere from other causes, must always present great difficulty in the way of ascertaining the truth—and had, in fact, till Col. Sabine's researches, prevented any decisive testimony of the fact being obtained by direct information. But the hourly observations of the barometer, made for some years past at the Meteorological and Magnetical Observatory at St Helena, have now placed beyond a doubt the existence of a lunar atmospheric tide. It appears that in each day the barometer at St. Helena stands, on an average, four thousandths of an inch higher at the two periods when the moon is on the meridian above or below the pole than when she is six hours distant from the meridian on either side; the progression between this maximum and minimum being moreover continuous and uninterrupted:—thus furnishing a new element in the attainment of physical truth; and, to quote the expression of a distinguished foreigner now present, which he uttered in my own house, when the subject was mentioned, "We are thus making astronomical observations with the barometer"—that is, we are reasoning from the position of the mercury in a barometer, which we can touch, as to the position of the heavenly bodies which, unseen by us, are influencing its visible fall and rise. "It is no exaggeration to say,"—and here I use the words of my friend, the Rev. Dr. Robinson,—"that we could even, if our satellite were incapable of reflecting light, have determined its existence, nay, more, have approximated to its eccentricity and period."

Animal Electricity.

In Physiology, the most remarkable of the discoveries, or rather improvements of previous discoveries, which the past year has seen, is, perhaps, that connected with the labours of the distinguished Tuscan philosopher, Matteucci. I refer in this instance to his experiments on the generation of electric currents by muscular contraction in the living body. This subject he has continued to pursue; and, by the happy combination of the rigorous methods of physical experiment with the ordinary course of physiological research, Prof. Matteucci has fully established the important fact of the existence of an electrical current—feeble, indeed, and such as could only be made manifest by his own delicate galvanoscope—between the deep and the superficial parts of a muscle. Such electric currents pervade every muscle in every species of animal which has been the subject of experiment; and may, therefore, be inferred to be a general phenomenon of living bodies. Even after life has been extinguished by violence, these currents continue for a short time; but they cease more speedily in the muscles of the warm-blooded than in those of the cold-blooded animals.

The delicate experiments of Matteucci on the torpedo agree with those made by our own Faraday upon the *Gymnotus electricus*, in proving that the shocks communicated by those fishes are due to electric currents generated by peculiar electric organs, which owe their most immediate and powerful stimulus to the action of the nerves.—In both species of fishes the electricity generated by the action of their peculiar organised batteries—besides its benumbing and stunning effects on living animals,—renders the needle magnetic, decomposes chemical compounds, emits the spark, and, in short, exercises all the other known powers of the ordinary electricity developed in inorganic matter or by the artificial apparatus of the laboratory.

Etherization.

This is the subject of the influence of the vapour of ether on the human frame—a discovery of the last year, and one the value of which in diminishing human pain has been experienced in countless instances, in every variety of disease, and especially during the performance of trying and often agonising operations. Several experiments on the tracts and nerve roots appropriated respectively to the functions of sensation and volition have been resumed and repeated in connexion with this new agency on the nervous system. Messrs. Flourens and Longet have shown that the sensational functions are first affected, and are completely, though temporarily, suspended under the operation of the vapour of ether; then the mental or cerebral powers; and, finally, the motor and excito-motor forces are abrogated. It would seem that the stimulus of ether applied so largely or continuously as to produce *that* effect is full of danger—and that weak constitutions are sometimes unable to rally and recover from it; but that when the influence is allowed to extend no further than to the suspension of sensation, the recovery is as a general rule complete.

Microscopism.

In no department of the science of organized bodies has the progress been greater or more assured than in that which relates to the microscopic structure of the constituent tissues of animal bodies, both in their healthy and in their morbid states; and this progress is specially marked in this country during the period which has elapsed since the communication to the British Association by Professor Owen of his researches into the intimate structure of recent and fossil teeth.

The result of these researches having demonstrated the constancy of well defined and clearly appreciable characters in the dental tissues of each species of animal, (by which characters such species could be determined, in many instances, by the examination of a fragment of a tooth,) other observers have been stimulated to pursue the same minute inquiries into the diversities of structure of the tissues of other organs. Such inquiries, for example, have been most ably and successfully pursued by Dr. Carpenter, in reference to the microscopic structure of recent and fossil shells; and the anatomist, the naturalist, and the palæontologist are alike indebted to the zeal and the skill of that eminent physiologist: while, in another sense, all are indebted to the British Association for aiding and stimulating his inquiries, and for the illustrations with which the publication of Dr. Carpenter's Report has been accompanied in the Transactions of the Association.

Capillary Attraction.—Motion of Fluids in Tubes.

The *hairs* of the different mammalian animals offer to the microscopical anatomist a field of observation as richly and remarkably developed as the *teeth*, which formed the subject of Professor Owen's communication in 1838, and as the external coverings of the testacious mullusca, which formed the subject of Dr. Carpenter's communication in 1846. The structure of the softer tissues of the animal frame has not been less successfully investigated by microscopic observers. One of the most extraordinary, perhaps, of the recent discoveries by the microscope is that which is due chiefly to Purkingé and Valentin, and which in this country has been well established by Dr. Sharpey, relative to the important part in the motion of fluids on internal surfaces, performed by the vibratile action of myriads of extremely minute hairs or cilia which beset those surfaces. These ciliary movements, for example, raise the mucus of the wind-pipe to the throat against gravity. They have been detected in the ventricles of the brain, as well as many other parts.

The beautiful discoveries of Sir David Brewster have been carefully confirmed; and many interesting varieties have been noticed in the structure of the crystalline lens of the eyes of different species of animals.

The most brilliant result, perhaps, of microscopic anatomical research has been the actual observation of the transit of the blood from the arteries to the veins; the last fact required—if, indeed, such an expression be allowable—for the full proof of Harvey's doctrine of the circulation of the blood. Malpighi first observed the transit in the large capillaries of the frog's web. It has since been observed in most other tissues, and in many other animals.

No part of the animal body has been the subject of more, or of more successful, researches than the blood itself.

Molluscs.

In no department of the living works of the Creator has progress been more manifested than in that humble and, therefore, heretofore much neglected, class of the molluscous or gelatinous animals which people the seas around our island. Among the naturalists who have rescued this branch of zoology from neglect, the name of Edward Forbes deserves early and honourable mention.

Steam Navigation and Botany.

In the diffusion of the riches of the vegetable world, steam navigation has obviously been a most favourable auxiliary; so that "even cuttings of plants" are now "actually sent successfully to Calcutta, Ceylon, &c." In speaking of the exports from Kew, it is not unfitting to add, that "between four and five thousand plants of the famous Tussac grass have been dispersed from the Royal Gardens at Kew during the past year."

Fecundation.

In Vegetable Physiology, microscopic observers have of late been much occupied in investigating the phenomena of fecundation, and especially as to the mode of action of the pollen. On this subject, botanists are still divided. Several experienced observers adopt the theory lately advanced and ingeniously supported by Prof. Schleiden, of Berlin; while others of geat eminence deny the correctness on which this theory is founded. Among these, the celebrated microscopic observer, Prof. Amici, of Florence, very recently in an essay—communicated to the Scientific Meeting held in 1846 at Genoa—has endeavoured by a minute examination of several species of Orchis to prove the existence of the essential part of the embryo anterior to the application of the pollen, which, according to him, acts as the specific stimulus to its development.

This view receives great support from some singular exceptions to the general law of fecundation. Of these, the most striking occurs in a New Holland shrub, which has been cultivated several years in the Botanic Garden at Kew; and which, though producing female flowers only, has constantly ripened seeds from which plants have been raised perfectly resembling the parent:—while yet there is no suspicion either of the presence of male flowers in the same plant, or of minute stamina in the female flower itself, nor of fecundation by any related plant cultivated along with it. This plant has been figured and described in a recent volume of the Linnean Society's "Transactions," under the name of *Cælebogyne ilicifolia*, by Mr. J. Smith, the intelligent curator of the Kew Garden,—by whom, indeed, this remarkable fact was first noticed. It is not the least curious part of the history of the *Cælebogyne* that male flowers have lately been discovered in New Holland unquestionably of the same species. Prof. Gasparini, of Naples, has more recently communicated to the scientific meeting held in that city in 1845 his observations and experiments on the cultivated fig,—which, though entirely destitute of male flowers, produced seeds having a perfectly developed embryo, independent of fecundation: access to the pollen of the wild fig, generally supposed to be carried by insects, being in his experiments, prevented by the early and complete shutting up of the only channel in the fig by which it could be introduced.

Political and Social Influence of the Electric Telegraph.

Distance is time; and when by steam, whether on water or on land, personal communication is facilitated, and when armies can be transported without fatigue in as many hours as days were formerly required, and when orders are conveyed from one extremity of an empire to another, almost like a flash of lightning, the facility of governing a large state becomes almost equal to the facility of governing the smallest. I remember, many years ago, in the *Scotsman*, an ingenious and able article showing how England could be governed as easily as Attica under Pericles: and I believe the same conclusion was deduced by William Cobbett from the same illustration.

The system is daily extending. It was, however, in the United States of America that it was first adopted on a great scale, by Prof. Morse in 1844; and it is there that it is now already developed most extensively. Lines for above 1,300 miles are in action; and connect those States with Her Majesty's Canadian provinces; and it is in a course of development so rapid, that in the words of the Report of Mr. Wilkinson to Sir W. E. Colebrooke, the Governor of New Brunswick, "No schedule of telegraphic lines can now be relied upon for a month in succession, as hundreds of miles may be added in that space of time. So easy of attainment does such a result appear to be, and so lively is the interest felt in its accomplishment, that it is scarcely doubtful that the whole of the populous parts of the United States will, within two or three years, be covered with a telegraphic network like a spider's web, suspending its principal threads upon important points along the sea-board of the Atlantic on one side, and upon similar points along the Lake Frontier on the other."—I am indebted to the same Report for another fact, which I think the Association will regard with equal interest: "The confidence in the efficiency of telegraphic communication has now become so established, that the most important commercial transactions daily transpire, by its means, between correspondents several hundred miles apart. Ocular evidence of this was afforded me by a communication a few minutes old between a merchant in Toronto and his correspondent in New York, distant about 632 miles." I am anxious to call your attention to the advantages which other classes also may experience from this mode of communication, as I find it in the same Report. When the *Hibernia* steamer arrived in Boston, in January 1847, with the news of the scarcity in Great Britain, Ireland, and other parts of Europe, and with heavy orders for agricultural produce, the farmers, in the interior of the States of New York,—informed of the state of things by the Magnetic Telegraph—were thronging the streets of Albany with innumerable teamloads of grain almost as quickly after the arrival of the steamer at Boston as the news of that arrival could ordinarily have reached them.—I may add, that, irrespectively of all its advantages to the general community, the system appears to give already a fair return of interest to the individuals or companies who have invested their capital in its application.

The larger number of the members of this Association have probably already seen in London an exhibition of a Patent Telegraph which prints *alphabetical* letters as it works. Mr. Brett, one of the proprietors, obligingly showed it to me; and stated that he hoped to carry it into effect on the greatest scale ever yet imagined on the American Continent. Prof. Morse, however, does not acknowledge that this system is susceptible of equality with his *telegraphic* alphabet for the purpose of rapid communication; and he conceives that there is an increased risk of derangement in the mechanism employed.

I cannot refer to the extent of the lines of the electric telegraph in America without an increased feeling of regret that in our own country this great discovery has been so inadequately adopted.

In England, indeed, we have learnt the value of the electric telegraph as a measure of police in more than one remarkable case: as a measure of government it is not less important;—from the illustration which I have drawn from America, it is equally useful in commerce; but as a measure almost of social intercourse in the discharge of public business it is not without its uses also. But a few days since, I had an opportunity of examining the telegraph in the lobby of the House of Commons, by which communications are made to and from some distant committee room. As a specimen of the information conveyed from the House is the following:—"Committee has permission to sit until five o'clock;" and among the questions sent down from the Committee are the following:—"What is before the House?" "Who is speaking?" "How long before the House divides?"

Smelting by Electricity.

For that process, I believe, a patent has been recently taken out. As yet, perhaps, sufficient time has not elapsed to test its full value. We all know that an experiment succeeds perfectly in the case of a model, or in a laboratory, which may not succeed so perfectly when the miniature steam engine, for example, is extended to its ordinary size in a manufactory, or when the operation is transferred from ounces to tons. But if the hopes, expectations, and confidence of the discoverers be realised, their plan will be of the greatest value to this country, and of even greater proportionate value to some of the Queen's most important colonies. It has been said that 10,000 tons of copper ore were sent last year from Australia to be smelted in England; and that they produced no more than 1,600 tons of copper. It is evident, therefore, that, if by this process of smelting by electricity, the refuse, namely, 8,400 can be left on the spot, 8,400 tons of shipping are liberated for other purposes of commerce between the colony and the mother country; and the saving of coals in England, an object not wholly devoid of interest, is immense.

British Museum.

Our National Collection may now be compared, not ostentatiously, but thankfully, with those of other countries; remembering, also, that our collections are little more than half a century old. The ornithological, the conchological, the mammalian departments in the British Museum are equal, I believe, to those of any other capital: greatly owing to the talents and labour of the eminent head of that department, Mr. Gray,—whom I see here. The fossil divisions, under the care of my zealous, laborious and able friend, Mr. König, are perhaps superior—in some classes, beyond comparison. Last year, there was added to the palæontology of the Museum the unique specimens of the Holitherium of Kaup, the Cephalaspis of Lyell, the Lepidote of Fitton; and the collection of osteology is, as it ought to be, the first in England. The number of visitors, which six years ago was 319,000, was last year above 700,000—and the collections of comparative anatomy in the Hunterian Museum are, as they ought to be, the first in the world.

The following are some of the more interesting papers read in the various Sections of the Association, for which we are indebted to the *Athenæum*.

"*Report on Geological Theories of Elevation and Earthquakes.*" By W. Hopkins.

This lengthened report embraces too wide a range to admit of our giving at present any detailed analysis. After having stated certain leading characters of volcanoes, both with reference to the fluid volcanic mass and its containing cavity, the author proceeds to the examination of theories of volcanoes. He regards the *chemical theory* proposed by Sir H. Davy, and the theory more recently proposed by M. Bischoff, as involving mechanical difficulties of the gravest character. In considering the theory which supposes existing volcanoes to owe their origin to the former fluidity of the earth, the author is led to the discussion of the general theory based on the hypothesis of such fluidity. He examines the evidence afforded in favour of this hypothesis by the accordance between the present ellipticity of the earth, as determined by admeasurement, and its mean density as determined by the experiments of Cavendish and Baily, and the calculated value of their quantities. He then proceeds to consider the mode of the earth's refrigeration and consequent solidification, and the probable extent to which the latter process has already proceeded. Supposing the earth to consist of a fluid central nucleus and a solid envelope, it is concluded that the thickness of the latter is probably not less than one-fourth or one-fifth of the earth's radius. This conclusion is drawn from the observed amount of the precession of the earth's pole with that calculated on the hypothesis just stated, respecting the constitution of the earth; but the author also indicated another method by which evidence might be obtained on this point. He showed that if it could be proved by experiment that the temperature of fusion of solid substances is generally increased, even in a small degree, by high pressure, we should have strong reason to believe in the entire solidity of the earth; and if, on the contrary, it should appear that high pressure has no such effect on the temperature of fusion, we should be led to conclude that the present temperature of the earth is not due to its original heat. He considered such experiments necessary for the further advance of this branch of geology.

The second part of the report contains a theoretical investigation and examination into the nature and properties of the mechanical effects which would result from the action of such forces. The author proposed to consider the subterranean force as having the nature of an explosion, producing vibrations over a much wider space than that to which the original force was applied. The vibrations were compared to those produced by striking the end of a solid bar—which are of two kinds. The first set are similar, but infinitely less in extent to vibrations in air. They are produced by compression, and proceed in the direction of the axis of the bar. The second kind are perpendicular to the axis of the bar—like the vibrations of a musical chord. In this case the particles of the bar change their form, and the elastic force depends upon their tendency to resume their original shape. The velocity with which vibrations are propagated in the direction of the axis, is much greater than when their direction is transverse; and as both usually co-exist, they will after a time separate and become distinct,—both the velocity and the length of the waves of vibration being different. If the original impulse, or earthquake shock, is communicated at some distance below the surface, the vibrations produced may be compared with the disturbance produced in water by blowing up a wreck. A wave will be produced by the alternate compression and dilation of the particles, which will diverge in spheres, equally in all directions, with a constant velocity. In the earth, however, as in the solid bar, there will be two spherical waves proceeding outwards with unequal velocities. The apparent motion of these waves, when they reach the surface, will be different, from their real amount of motion below, depending upon the distance of the place of observation from a point immediately over the focus or origin of the force. Assuming the interior of the earth to be homogeneous, and the vibrations produced by earthquakes to be of the kind described, it becomes a leading point to ascertain, by observation, the position of the focus from which the vibrations originated. On this subject nothing at present is known. Mr. Hopkins stated, that if self-registering instruments of sufficient delicacy were placed at two stations in a country subject to earthquakes, the direction of the vibrations would shew immediately the point on the surface from which they originated. The depth beneath the surface might also be calculated, from the difference between the apparent movement of the wave on the surface and its real movement in the interior, as given by theory; or it might be ascertained by comparing the relative apparent motion of two waves proceeding with unequal velocities, if means were obtained for recognising the two kinds of waves by instruments indicating the nature of the vibrations.

Sir H. De la Beche observed, that if the focus of the earthquake were near the surface, the problem would become one of great complexity, on account of the many breaks in the strata, and their difference of composition; but if the focus were several hundred miles below the surface, these inequalities would be of no consequence.

Mr. Mallet enumerated the different kinds of waves which do, or may take place, with every earthquake. When the focal point is inland, there will be the shock-wave, either single or double; the sound wave in the earth; and the sound wave in the air, if the original impulse is accompanied with fracture: if the superficial vibration is sufficient, there will also be the sea-wave. When the focal point is under the sea, as in all great earthquakes, there will be the shock-wave, the sound-wave under the sea, the sound-wave in the air, the great sea-wave, and a smaller, termed the "forced sea-wave;" if, however, there is no fracture, there will be no sound-waves. It had been ascertained that magnetometers were also "seismometers" of a very delicate kind,—those at Dublin having indicated from 10 to 20 shocks last year.

"*Report on Atmospheric Waves.*" By W. R. Birt.

The author in introducing his fourth report on this subject observed, that in accordance with the resolution adopted at the last Meeting of the Association, about thirty sets of observations had been obtained from various stations in the British islands; the extremes of the area embraced being the Orkneys and Jersey in one direction and Galway and Dover in the other. As instances of the increasing interest manifested on this subject, he remarked that he had been furnished with curves from stations in the north, where the barometric movements had been considered to result from the transit of the great November wave. Each of these curves was referred to the same period; namely, from the 2nd to the 17th of November; and the observers invariably regarded the regular rise and fall that occurred between these epochs as indicating a well-marked return of the great symmetrical wave. Mr. Birt, after noticing the remarkable circumstances under which the wave returned last autumn—so remarkable that they had no small tendency to mark the wave in the south-eastern part of the island—stated that the projected curve at London strikingly developed its essential features; the *five* subordinate waves were well seen, although the inflexions were not strong, owing to the small altitude of the wave on its last return, scarcely exceeding half an inch—its whole development occurring above thirty inches prevented the boldness of the inflexions particularly noticed on the occasion of its return in 1842. The author then proceeded to notice the essential features of the curves as obtained from observations at Ramsgate, St. Vigean's near Arbroath, east coast of Scotland, the Orkneys and Western Isles, Applegarth Manse, Dumfries-shire, Largs, Limerick, Galway, Helstone in Cornwall, and St. Helier's, Jersey. Our limits will not permit us to give in detail the resemblances and differences of these curves, exhibiting, as they do, the distribution of pressure around Great Britain and Ireland, which the author traced from the south-eastern point towards the north-west; but the report will be printed in the forthcoming volume of the Transactions. We may, however, here notice that attention was called to the principle which the author laid down in his report of last year, "that the barometric curve, including a complete rise and fall at any one station, does not represent any reality in nature, but is the effect of two or more systems of waves or currents moving in different directions and crossing each other at various angles." He also pointed out the great extent of oscillation (nearly double) observed in the north-west as compared with the south-easterly observations. The great wave commenced on the 2nd of November; at the northern stations it culminated on the 12th; at the south-eastern on the 9th; and it terminated on the 17th. In explaining the differences of epoch as indicating the transit of the crest being much earlier in the south-east than in the north, Mr. Birt remarked that the observations clearly showed that the barometer passed *two* maxima, one on the 9th, the other on the 12th; and that the whole extent of the British isles might be divided into *two* barometric areas, distinguished in one case by the superiority of the maximum of the 9th, and in the other by the superiority of the maximum of the 12th. A line passing between Arbroath and Newcastle, south of Dumfries, and between Ireland and Wales, separates these areas. North-west of this line we find the maximum of the 12th superior: south-east of it we find the maximum of the 9th superior. The maximum of the 9th Mr. Birt regarded as the central wave forming the crest of the great wave, and the maximum of the 12th be considered as the crest of the first subordinate wave on the posterior slope. The author next proceeded to examine the distribution of pressure as manifested by these observations; from which, in connexion with the features of the projected curve, he deduced the following results:—1st. The return of the great symmetrical wave. This occurred in the south-eastern angle of our island under very peculiar circumstances. The area of greatest symmetry is closely in accordance with the results of former discussions, and goes far to confirm the result deduced from the examination of Sir John Herschel's hourly observations, "that Brussels is entitled to be considered as a point of comparatively gentle barometric disturbance, * * * and may be regarded as in a certain sense a *nodal* point, where irregularities are smoothed down and oscillatory movement in general is more or less checked, and such movements increase as we recede from Brussels as a centre, especially *towards the north-west.*" The curve of greatest symmetry was obtained from Ramsgate, the nearest station to Brussels. As we proceed *towards the north-west*, the symmetry is considerably departed from, especially by the greater development of the first subordinate wave on the posterior slope, by which the maximum of the 12th became superior. This portion of the wave formed a striking contrast to the similar portion in 1845, which was characterised by a considerable depression. It is not a little curious, remarked the author, and goes far to show that we are approaching the true explanation of the *nodal* character of Brussels to observe that movements so dissimilar in their character, so opposite in their value, and presenting themselves under such a diversity of aspects, should, in a certain locality and on particular lines of country, manifest, by means of the barometer, constant and well defined phenomena, that may be recognised year after year, and which give to the curves of barometric rise and fall during the period of their occurrence a peculiar symmetrical appearance. 2nd. Two systems of waves or currents, one having a *general* direction of progress from the north-west, the other from the south-west, traversed the area during the period of the great wave. This is the same result to which we were conducted by an investigation of the symmetrical wave of 1842. The relative positions of the individual waves were somewhat different from those of the wide bi-dual waves of 1842; but there were some striking points of resemblance. The north-westerly system in each case exhibited the largest wave, both as regards amplitude and altitude. The intervals between similar phases of north-westerly waves were nearly equal in 1842 and 1846. During the interval that elapsed between transits of these similar phases in 1842 and 1846 the same number of south-westerly waves passed over the area—and from the whole it appears highly probable that we have not only ascertained another return of the great symmetrical wave (the sixth) but have also detected the return of at least *three* of the individual waves contributing to its production. 3rd. The very precipitous fall of the barometer characterising the posterior slopes of the north-westerly system, as developed by the discussion of the observations of 1842, is fully confirmed: in connexion with this, the decrease of oscillation from the north-west towards the south-east is also strikingly developed, as on former occasions. The author, in alluding to the area over which these observations extend, remarked that the British Isles present a far too limited area for the purposes of examining thoroughly these atmospheric movements; he observed that in the more extensive examination which the movements of November, 1842, are now undergoing, there are four stations at which the barometric changes are of an opposite character during the first eight days of November,—namely, Christiana and St. Petersburgh in the north, and Paris and Geneva in the south. The curves at St. Petersburgh and Geneva present the most decided opposition; rising at the one while falling at the other. The turning point in each case occurred on the 5th. These opposite movements he conceived to be occasioned by the opposite slopes of two waves passing from the *south-west*, and that the *half* breadth of each wave extended at least from Geneva to St. Petersburgh. Such being the extensive character of the waves in question, in order to judge them in their totality it will be absolutely necessary to enlarge the area of observation. The centre of Europe is well dotted over with barometers, from which accurate results may be obtained; but even the British Isles, in connexion with that portion of Europe now under observation, form but a small part of the vast space over which the waves themselves extend. St. Petersburgh is an important northern station, from which we have most excellent observations; but we require them also from Iceland, the northern parts of Norway, Sweden and Lapland, and also from Archangel in one direction, and from the southern parts of France, from Spain, Portugal, and the northern parts of Africa in the other; also from the Mediterranean they would be highly important. Observations stretching from the most western point of Africa to the extreme north of Europe would go far to determine the longitudinal directions of the north-westerly systems of waves. In reporting the general progress of the inquiry, Mr. Birt stated that we are now in possession of materials for examining the great symmetrical wave, not only in particular years, as 1842, 1845, and 1846, but also over the central parts of Europe and the dominion of the Russian empire, as far as Sitka, on the north-west coast of America. He has combined observations extending from the west coasts of Ireland and the Orkneys on the one hand, to St. Petersburgh and Geneva on the other; and he apprehends that the whole of the barometric movements over this area, which occurred during the first eight days of November, 1842, are fully explained by the transits of two large waves on two sets of parallel beds of oppositely directed winds—one from the south-west, the other from the north-west. The continuation of the investigation will be submitted at future meetings of the Association. In connexion with this, the author observed that a most important point appeared to be developing itself by means of these observations. Those from the north-west appeared strongly to indicate that somewhere in that direction the origin of the great barometric disturbances (a centre of oscillation) giving rise to the waves that pass onwards towards the south-east is to be sought. We have already obtained the *nodal* point of the two great systems of European barometric undulations—namely, Brussels. Between the Orkneys, which appear to be the nearest station to the north-west centre of oscillation, and Brussels the greatest decrease of oscillation occurs. This line of the greatest diminution of oscillation appears to be well determined. The author closed his report with an allusion to the American system of atmospheric waves, especially those that accompanied the great Cuba hurricane of October, 1844, which has formed the subject of an elaborate investigation by Mr. W. C. Redfield, of New York; and was of opinion that the revolving storm, so ably brought to light by Mr. Redfield's labours, was produced by the crossing of two large long waves moving in different directions, as suggested by Sir John Herschel in his "Report on Meteorological Reductions," presented to the Association in 1843.

"*On the Decomposition of Water.*" By Dr. Robinson.

The affinity which combines the elements of water is *lessened* by any increase of temperature above that of the atmosphere, up to 202°. If the intensity exerted in opposition to that of a battery by water during electrolysis be measured, and again when the voltameter is heated, it is found to decrease. In the first instance, its measure referred to my particular standard, as deduced from a mean of 12 sets is 598·9, temperature 61° 2′. The next by a mean of 13 gives

$$e = 567{\cdot}5 \ldots t = 135^\circ\, 4'$$

and the third mean of 12

$$e = 531{\cdot}0 \ldots t = 201^\circ\, 2'.$$

Applying to these the theory of *probable errors*, so successfully used in other branches of science, I find it is more than 10,000 to 1 that the difference thus shown is not all error of observation, and an even bet that it is not 5 wrong. The expression of e is affinity of platinum for oxygen, minus *twice* that of hydrogen, or

$$e = o.\,p - 2\,o.\,h$$

and from this I compute that o. h changes 23·2 for 100°.

This process is confirmed by a different process. The formula for the intensity of zinc and copper excited by dilute sulphuric acid is

$$E = o.\,z - o.\,cu - o.\,h$$

In Daniell's cell you substitute o. cu for o. h, and have

$$E' = o.\,z. - 2\,o\,cu.$$

In the latter instance, E′ undergoes *no change* by heating the cell to 163°. The metallic affinities therefore do not vary within that range. But in the former E increases by heat, caused by the diminutive of o. h, and it gives the change = 27·9 for 100°; the mean of all being 25·1. It is curious that if this rate were uniform, the temperature of decomposition by heat would be 2386° In these experiments the conducting power of the electrolyte is greatly *increased* by heat. The only objection which I see against this conclusion is, that perhaps these effects may be due to the action of heat in facilitating the escape of gases. An experiment which I made seems to oppose this. If the apparatus be placed under the air-pump, the removal of pressure should show a similar change. This is not the case: when it is reduced to 1 inch of mercury, the measure of e remains unchanged. I think this a very curious result; it is quite the reverse of what I expected, for I had supposed heat would exalt these affinities up to a certain point, and afterwards that its action would change character. But its influence seems here always an antagonist to affinity. How then does heat ever produce the combination? The remark of Davy that hydrogen cannot be made to burn except by contact with a solid heated so *as to be luminous*, makes me conjecture that *light* is the agent which produces the molecular change of the three volumes of mixed gases into two of steam.

"*On the Precipitate caused in Spring and River Waters by Acetate of Lead.*" By Prof. Connell.

Nearly all well and river waters are known to yield a white precipitate with acetate of lead. This precipitate is rarely due to any chloride, as silver salts have too little action to countenance such an explanation; and its ready solubility in acetic acid shows that it is not caused by sulphates, unless in so far as it is not dissolved by that acid. The ordinary course I have ascertained to be the presence of carbonate of lime; but the remarkable fact is, that the reaction both of the acetate and of the acetic acid takes place even after the water has been boiled and filtered, so that carbonate of lime remains dissolved independently of the presence of carbonic acid. The waters referred to yield carbonate of lime when evaporated, after having been boiled and filtered. To ascertain whence this carbonate of lime has proceeded, I passed a current of carbonic acid through lime water, till the precipitate at first formed was redissolved, and then boiled and filtered the liquid; but it did not affect lead salts to the same extent as common waters do. Neither did distilled water which had been left some days in contact with finely pounded marble. I incline to think that the origin of the dissolved carbonate of lime is double decomposition between an alkaline carbonate and a soluble lime salt; and have found, in all waters yielding the reaction, alkalies united to acids. The common water of the town of St. Andrews contains [illegible] of carbonate of lime after being boiled and filtered. It also contains a trace of carbonate of magnesia, which substance may occasionally be, in part, the cause of the reaction referred to, although to a far less extent.

"*On the Cause of Evaporation, Rain, Hailstorms, and the Winds of Temperate Regions.*" By G. A. Rowell.

Mr. Rowell stated his opinion that amongst the variety of theories given there is none that will fairly explain *all* the phenomena of evaporation. The theory of Dr. Hutton on rain may be thought sufficient to account for moderate rains, but totally fails when applied to such heavy rain as that which fell in London, August 1st, last year. Mr. Rowell endeavoured to show that the phenomena of evaporation, clouds, rain, lightning, hail, the winds of temperate regions, and storms of lower latitudes, may be fairly explained by the hypothesis he submitted; *i. e.* electricity having no weight and diffusing itself equally over the surface of bodies, the minute particles of water, even in their most condensed state being completely enveloped in their natural coating of electricity, occupy, together with their electricity, nearly the space of an equal weight of air, and are thus rendered sufficiently buoyant to be carried away by the wind; but that when expanded by heat their specific gravity being then reduced, and their capacity for electricity being increased by the increase of surface, they are then buoyed up into the air by their electrical coatings; that when the rising particle is condensed it becomes surcharged by the contraction of its surface; if this takes place near the surface of the earth, the surcharge escapes and the particles fall as dew; but if it is condensed when above the electrical attraction of the earth, it is still buoyed up by the electricity, and on the escape of the surcharge, the particles attract each other and form clouds and rain. Hills and mountains cause clouds and rain by conducting the electricity from the vapour, and not by condensing it; and on these grounds he again suggests, as a test of the theory, the experiment he proposed to the British Association in 1840, *i. e.*. "To cause rain by raising electrical conductors to the clouds by the aid of balloons." In support of the proposition he read an extract from a letter he received from Mr. W. H. Weeks, of Sandwich, dated Dec. 27, 1842, in which that gentleman assures him that "It has several times happened that when his electrical kite has been raised immediately under a distended, light, fleecy cloud at a moderate elevation, and a *free current of sparks* has passed from the apparatus for some ten or twelve minutes, he has suddenly found himself bedewed with a descent of fine misty rain, and on looking up has seen the cloud upon which he was operating surprisingly reduced in magnitude." Electrical kites cannot reach the clouds, and can only be raised in windy weather, when the clouds must be every instant passing away from the influence of such apparatus; and if they have such effects, what may we not anticipate from the use of conductors which would reach the clouds, and could be raised in calm weather? Mr. Rowell considered that from the reduction of temperature at the height of the clouds, the vapour in those regions must be always condensed, but invisible from being so diffused; and that the formation of clouds is not owing to condensation, but to the escape of electricity allowing the particles of vapour to attract each other. In support of these views, and also to show that the ascent and support of vapour at great heights must depend on some agent which is independent of heat or cold, he exhibited the table following—

Heights.	Temperature of Air.	Water heavier than Air.
Level of the Sea	+60°	860 times.
1 mile	+43	1,083 „
2 miles	+26	1,363 „
3 miles	+ 9	1,716 „
4 miles	— 8	2,160 „
5 miles	—25	2,710 „

Another cause of rain is the pressure of the particles of vapour upon each other; for if a cloud be of great depth, say the lower part one mile high and the upper part two miles, as the electricity of the particles would be equal, those in the upper part would not have sufficient for their support, and would therefore press downwards, and those in the lower part would have more than enough to support them at that height, and would therefore press upwards, and thus press the particles in the middle of such cloud into contact and form rain, while the electricity being pressed out of the cloud, would accumulate on the surface till it could force its way to the earth or other clouds, and thus cause lightning. Violent hail-storms he attributed to the sudden equalization of the electricity of large masses of vapour floating at different heights in the air, and brought by currents and various circumstances the one over the other. The difference between the lowest mass and the top of the upper mass of clouds may amount to two or three miles. The violence of storms in such cases depends upon the density of the clouds and the height of their upper strata: as, the greater the height at which the hailstones begin to form, the greater will be the degree of cold they will acquire, and consequently the more powerfully they will act in freezing the vapour with which they come in contact during their fall; the greater also they will become by the accumulation of vapour in falling; and the greater will be the velocity with which they arrive at the earth. The lightning accompanying such storms may be caused by the lower clouds forming conductors for the electricity from the highly-charged upper clouds to the earth. The diminution of the pressure of the atmosphere previous to and during rain, he ascribed to the escape of electricity from the invisible vapour or clouds; thus causing a vacuum or rarefaction in the regions of the clouds: and the air from its elasticity rising to fill the space, decreases the pressure on the mercury. Allowing that the trade winds, land and sea breezes, &c., are caused by changes of temperature, yet he contended that the more irregular winds are owing in a much greater degree to the fall of rain and the escape of electricity from the cloud, than to any change of temperature; for as each particle of water to be buoyant must, together with its electrical coating, occupy the space of an equal weight of air, as water is 860 times heavier than air at the level of the sea, every particle of water that falls to the earth must have occupied 860 times more space when suspended in the air: therefore, if in a given time one inch of rain falls to the earth, it must, during that time, have caused a vacuum or rarefaction in the space above to the extent of 860 inches: the vacuum would in fact be greater than this, for vapour to be buoyant must occupy a greater space according to its elevation; but as the density of the air decreases according to the elevation, the effect must be the same, *i. e.* for every inch of rain that falls the vacuum would be equal to the gradual abstraction of the whole of the air to upwards of 70 feet in height over the whole district where the rain falls; which rarefaction must be filled up during the time the rain is falling by a rush of air from the surrounding districts, although such wind may not always be felt in the same locality in which the rain falls. He supports his views by referring to the storms of wind which swept over England from the north-west and west last autumn, at which time France and other parts of the continent were deluged with rain. He exhibited the following table of heavy rains (mentioned by Prof. Forbes in his Report on Meteorology in 1840) to show that they are sufficient to account for violent storms; and had no doubt that if we had accurate accounts of the *extraordinary* rains which sometimes fall within the tropics, they would be found sufficient to account for the most tremendous hurricane :—

Place.	Date.	Depth of Rain in inches.	Time.	Average Vacuum per sq. mile per second.
Catskill, U.S.	July 26, 1810 ..	18 in. ..	7½ hours..	1,331,968 cub. ft.
Genoa	Oct. 25, 1822 ..	30 in. ..	24 „ ..	693,733 „
Joyeuse	Oct. 9, 1827 ..	31 in. ..	22 „ ..	782,027 „
Geneva	May 20, 1827 ..	6 in. ..	3 „ ..	1,109,973 „
Gibraltar ..	Nov. 27, 1826 ..	33 in. ..	26 „ ..	704,406 „
Naples	Nov. 22, 1826 ..	$\frac{8}{10}$ in. ..	37 minutes	809,960 „
Perth	Aug. 3, 1829 ..	$\frac{4}{5}$ in. ..	30 „ ..	887,978 „

"*The Progress of Tides.*"—The Master of Trinity College, Cambridge, delivered a report of a Committee consisting of himself and Capt. Sir J. Ross appointed at Southampton to draw up a plan for a naval expedition for completing our knowledge of the progress of the Tides.

The knowledge which we possess of the tides, looking at the connection of the phenomena over the whole surface of the ocean, is extremely imperfect at present, and not at all likely to be completed in any material degree in any finite time, by the observations which voyagers mainly directed to other objects will supply. The coasts and islands which surround or break the waters of the Pacific, are especially the seats of this ignorance. We know the time of tide near Cape Horn, but cannot trace the progress of the tide waves along the western coast of South and North America. We know the time of tide off the coasts of New Zealand, but cannot connect this fact with the rise and fall of the water on the coasts of the smaller islands in the centre of the ocean. We know the tide hour on the eastern coast of New Holland, but cannot trace the progress of the tide to the Phillippines or to the coast of China—though some observations of Admiral Lütke, made a few years ago, supply a valuable addition to our knowledge on this subject. The course of the tide wave among the islands of the Indian Sea is likewise entirely unknown. Observations made by voyagers mainly guided by other purposes appear unlikely to supply this deficiency in our knowledge, for even when made with sufficient care and for several weeks at detached places, they are rarely connected with each other or with neighbouring places. It does not appear that while we are thus left to depend on chance for our tidal knowledge, we shall ever be able to know from observation whether the tide wave in the Pacific does or does not move from east to west. But a ship sent out on purpose to observe the tides could very soon ascertain a great body of facts of this kind. The observers would, of course, observe the facts of the tides in connection with each other; and would arrange their plan of operations so as to extend their lines of connection from known points to unknown. By such a mode of proceeding the co-tidal lines for every part of the Pacific and Indian Oceans might probably be drawn (omitting the minor details in the interior of archipelagos, &c) in a year, at most in two years.

The tide observations made, at the request of Dr. Whewell, in 1834, for a fortnight by the coast guard on the coasts of Great Britain and Ireland, prove how great an accession our tidal knowledge may receive from connected observations; and still more those made in June 1835, for a fortnight along the coasts of the whole of Europe and the eastern coast of the United States of North America. By means of these observations the general course of the tides in the year thus explored has been determined. If an expedition were sent for the purpose of making tide observations, it would not be at all necessary to have, as in the instances just mentioned, simultaneous observations along the whole line of sea observed. It would suffice to connect a few places by corresponding observations, in some cases for a fortnight, in others for a few days; then, to connect one of these places with others, and thus to proceed through the whole region observed. It appears by the experience of the surveys which we have referred to that the observations may be made by sailors, such as those employed on the coast guard, under proper directions. On those occasions the necessary apparatus was speedily constructed by the persons employed. It might, however, be useful also to employ, in several places, self-registering tide-gauges such as are already established in several English ports.

We conceive that the project contemplated by the Association in its recommendation is very desirable; and might best be attained by sending out a vessel which should have for the object of its voyage to make tide observations upon such a connected system. For this purpose, the vessel ought to carry, in addition to a crew sufficient to work her, ten or fifteen men, who, by themselves (in pairs) or under the direction of petty officers, might be trusted to make tide observations for a week or a fortnight at selected points of coast. The surveying vessel ought to be provided with a launch to be employed in carrying these observers to their station, visiting them while engaged in their work, or fetching them away when their task at each place is done. From one region to another of the ocean, standard stations ought to be selected, at which tide observations should be continued for a longer time, and the observations made in each region should be compared with those at the standard station. The comparison of the observations with each other, as the survey proceeded, would point out the direction in which it was desirable to extend the survey, and the special points to be attended to. We, therefore, recommend that application be made to the Admiralty that they would appropriate to this service a suitable vessel.

Mr. Orlebar informed the meeting that he had, while at Bombay, conducted a regular series of observations on the progress of the tides; that similar observations had been made in other parts of India, and at Aden at the mouth of the Red Sea; and that the Geographical Society had seen the importance of those observations, and had lately turned their attention to them.

The Astronomer-Royal inquired at what intervals the observations at Bombay were taken?

Mr. Orlebar replied that they were taken by a tide gauge, and were, therefore, continuous.

The Astronomer-Royal said that frequency of taking the observations was most essential. Upon analyzing the observations he had lately superintended round the Irish coast, the extraordinary fact had been ascertained that at some places four tides took place in the day; and the continuance of the waves of these tides could be distinctly traced to a considerable distance on each side south.

Mr. Orlebar said that nothing had been done in the way of analysis or reduction of the Bombay observations.

Dr. Whewell pointed out several peculiarities of the tides in the East Indies—particularly dwelling on those at Singapore. He also drew attention to the researches of Admiral Lütke on the north coasts of America and in the Northern Ocean; and begged to ask Prof. Struve whether these were not still continued.

Prof. Struve replied that the researches of Lütke were still continued, particularly along the shores of the White Sea and various parts of the Northern Ocean; and he believed he was almost the only navigator who had bestowed a large portion of attention on the determination of co-tidal lines.

"*On English Measures.*"—The Astronomer Royal stated that it would be interesting to learn that one of the chief objects of their illustrious visitor, Professor Struve, when coming to England, was to make a comparison of the English standards of length with those of Russia.—M. Struve stated that one of the special commands which he had received from his royal master was to make that comparison with minute accuracy. A knowledge of the English standard was of much consequence in Russia, as the *Sagene* of that country was exactly equal to seven English feet.—Sir John Herschel said, that although England was at this moment without a Parliament standard of length, yet one would soon be completed, as the commissioner for that purpose had nearly brought his labours to a close. The present was, therefore, a peculiarly appropriate time for both countries that the comparison contemplated by Professor Struve should be instituted.—The Astronomer Royal said that the standard now in progress under the superintendence of the commissioner was being executed with such extreme accuracy, that he felt convinced that it would not differ from what it was intended to represent beyond the minute fraction of the 100,000th part of an inch. He begged to ask M. Struve whether the relation he had stated between the English foot and Russian *Sagene* was strictly or only approximately exact?—M. Struve replied that it was a matter determined by law; and that hence the Russian *Sagene* had to be varied whenever the English foot was changed. That hence the comparison had to be made with rigid accuracy when Captain Kater's determinations had been concluded, as well as on other occasions besides the present.

"*On some Recent and Remarkable Examples of the Protection afforded by Metallic Conductors against Heavy Strokes of Lightning.*"—By Sir W. S. Harris.

The possibility of guarding buildings and other structures against the destructive effects of lightning, has been made a great question in practical science—from the time of Franklin to the present day; and it is of considerable public importance, seeing the damage which occurs to our beautiful churches and other edifices by strokes of lightning, to bring this question completely under the dominion of induction, observation, and experiment. The general principles which Sir W. S. Harris submitted as deducible from the inquiries to which he alluded are these:—If we imagine a ship or building to consist altogether of metallic substances, it would certainly be secure from any damage by lightning; and for this simple reason, that what we call lightning is the result of the electrical agency forcing a path through resisting matter such as the air, and extricating with explosive and expansive force, both light and heat in its course. When, on the contrary, it falls upon comparatively non-resisting bodies, such as the metals, then this form of lightning vanishes, and the discharge assumes, if the metallic body be sufficiently capacious, the form of a comparatively quiescent current. Our object should be, therefore, in defending any building or ship from lightning, to bring the general mass so far as possible into that passive or comparatively non-resisting state it would have supposing it a mass of metal. This is, in fact, the single and simple condition of such an application, without any reference whatever to assumed forces of attraction or peculiar specific powers manifested by certain bodies for the matter of lightning, and which really do not exist. This simple principle, by a careful mechanical arrangement, calculated to render it practical and applicable to all the duties which the general structure of a ship together with its masts has to perform, is now universally carried out in the navy, with the most perfect success; so that damage by lightning in the vessels so fitted has, for the last fifteen years, quite ceased. The masts are made completely conducting by capacious plates of copper, reaching from the highest points to the keel; and are tied into one general connection with all the great metallic masses employed in the construction of the hull, and united by the large bolts of copper passing through the keel and sides, with the copper expanded over the bottom and with the sea. It is quite impossible that a discharge of lightning can fall on the vessel in any place, and not be at once transmitted safely by the conductors, not under the form of lightning, but under the form of a current without explosion. Sir W. Harris then referred to some remarkable cases.

"*On Ancient Sea Margins.*" By Mr. R. Chambers.

The existence of marine detritus containing recent shells at various heights above the present sea level has long been well known. These deposits are sometimes met with at an elevation of 1,200 or 1,500 feet—and much more frequently at lower levels. They often appear in the form of ancient sea-beaches or terraces, marking periods in which the relative level of land and sea remained stationary. Indications of this kind abound on all the coasts of Great Britain, Ireland, and France, and are also seen more inland. The sea has left traces of its presence sometimes by wearing away the coast into hollows and caverns, at others by filling up hollows with sand and shingle, or forming rude platforms at the bases of cliffs. In shores of moderate inclination these effects are most conspicuous; since on coasts having a very small inclination the sea makes little impression, whilst on a bold coast no accumulation remains. The valleys of rivers also afford memorials of the former presence of the sea. Many of them were once estuaries, and still exhibit terrace banks and platforms of detritus brought down from distant mountains. The nature of the deposit marking the margin of the ancient sea varies with situation and circumstance, being arenaceous or gravelly, clayey, or alluvial. The author has examined numerous examples of these deposits on the coasts and in the valleys of Scotland and England, and measured their elevation above the sea. He finds them most constantly and well marked at certain particular levels, which he has called, for the sake of distinction, after the places where the phenomenon is most strikingly exhibited.

The *first* level at which indications of the former action of the sea are found is only about 11 feet above high water. The *second* is from 22 to 40 feet above the sea, and termed by the author the Chichester Beach. The *third* terrace is 64 feet high on the seaward side, rising to 80 feet inland, and called the St. Andrew's Beach, being well marked near that University. The *fourth*, or Kingstown Beach, is from 98 to 100 feet above the sea, and is seen only in a few places—as for example, near Inverness, and at Kingstown, near Dublin. The *fifth*, or Paxton Beach, from 114 to 128 feet. The *sixth*, or Bourland Beach, is very generally found at 168 feet above the sea. The *seventh*, or Paris Beach, from 180 to 186 feet. The *eighth* from 275 to 280 feet: and the *ninth*, or Versailles Beach 386 feet.

Besides these, there are at some localities indications of the sea margin at other heights, and marking stationary periods of briefer duration. One of these, at the height of 50 feet, is visible on the shores of the Firths of Tay and Forth; others occur at elevations of 113, 130, 150 feet, and near Peebles there is one at 545 or 547 feet.

The following districts were described by the author as presenting examples of a succession of sea margins at many or all of their levels:—the valleys of the Ness and Spey, the Firths of Tay and Forth, St. Andrew's, the Vale of the Esk, Preston, Liverpool, and Birkenhead, at 64 to 70 feet, and again at 128 feet; Bristol, at 280 feet; Weston-super-Mare and Brent Knoll, at 158 feet; Bath, at 186 feet; Chichester; in the Isle of Wight, Osborne House stands on the Paris Beach at 181 feet; Exeter; Torbay; London, where Mary-le-bone represents the St. Andrew's Beach, at 65 feet, and Deptford at 61 feet; Paris, along the line of the barriers, at 185 to 196 feet; Rouen exhibits the St. Andrew's Beach at 69 feet, and the Paxton Beach at 126 feet, whilst the table land around is 540 feet; the Pont de l'Arde, a broad terrace at 186 feet, and Dublin, a succession of sea margins at 60, 107, 139, 171, 272, and 280 feet.

The author considers it probable that this uniformity in the level of the successive margins of the ancient sea will be found to extend also to Norway and perhaps to North America. On the shores of the Alten Fiord are a succession of terraces, considered by Bravais to form part of only a single line of sea level, one extremity of which has remained stationary, whilst the other has been elevated several hundred feet. Mr. Chambers, however, states that the intermediate elevations correspond in level with his series of terraces, and believes they were formed at the same successive periods. Along the shores of the great American Lakes there are also terraces at various elevations, corresponding with the more remarkable elevated beaches in Britain. In conclusion, the author observes that these phenomena cannot be accounted for by supposing a number of distinct and local disturbances; but imply an equable elevation of the land (or subsidence of the sea) simultaneously over large areas: and he points to the plains of South America described by Mr. Darwin in proof of the occurrence of such uniform elevations.

Remarks.—Mr. J. PHILLIPS remarked that those who had accepted Mr. Darwin's or Mr. Hopkins's views of the nature and mode of the force by which tracts of land were elevated would believe that the surface of an elevated tract must incline from an axis, or point of greatest elevation. He considered many of Mr. Chambers's raised beaches, such as those of Brent Knoll and the Gloucestershire valleys, had in reality been produced by the removal of softer beds of horizontal rock, and that as many terraces would be found as there were alternations of hard and soft materials.

Prof. SEDGWICK contended that it was extremely improbable that the elevation of the land had taken place so uniformly all over England as described by Mr. Chambers; much less, that France and Norway and America would be raised the same number of feet at many successive periods. The elevation of the bed of the sea and its conversion into dry land had taken place repeatedly from the earliest to the latest geological periods; and strata were found in every kind of position, inclined, vertical and contorted, and seldom horizontal over any wide space.

Sir H. DE LA BECHE observed that in pursuing this inquiry the author should be careful to ascertain that the terraces were really raised beaches, formed in the ordinary way by the action of breakers on a coast. At Bath, there were certainly no indications whatever of the sea at various levels on the hills.

Prof. LYELL described the elevated beach-lines around the American lakes as being sometimes in the form of hills of sand and sometimes of low cliffs. Allowing for these changes in character, they might, perhaps, be traced for hundreds of miles, and had been seen on the opposite shores of the lakes. With respect to Norway and Sweden, where raised beaches were numerous and well marked, observation had shown that whilst the northern provinces were still rising the southern were actually subsiding.

Prof. J. FORBES stated that external form was not sufficient to determine the existence of an elevated sea margin. All instances should be excluded where there was not an actual section to show the nature of the terrace or deposit. Much difficulty would also be experienced in determining the mean level of a well-defined sea beach. The limit of doubt could not be within six feet above or below the line chosen; and as in Mr. Chambers's sections there were nine sea beaches, eight of them under the height of 280 feet, and three intercalary beaches besides, there was only an interval of about twenty-five feet between each. It became physically impossible to identify distant beaches where the levels were so ill-defined and the beaches themselves so numerous. If the intervals had been very irregular, the comparison of one series with another would have been much more satisfactory. The terraces on the banks of the Alten Fiord were found at heights decreasing in such regular progression that he was convinced they were only portions of one terrace sloping gradually away.

Mr. DARWIN referred to the prairies of North America and the great plains of Patagonia and the Pampas of South America in support of Mr. Chambers's view of the occasional uniform elevation of large tracts of land. The raised beaches in the Andes occurred at irregular intervals to a height exceeding 500 feet, and maintained a uniform level for great distances.

Mr. CHAMBERS, in reply, stated that he had necessarily omitted a great portion of the details in his paper, which would have explained or supported the particular cases, and had thrown out his general views to invite discussion and further inquiry.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

June 29.—The President in the Chair.

This was the last meeting of the session, and several papers were read in abstract because there was not time for giving them in extenso.

The first was "*On the Advantages and Economy of maintaining a high degree of Cleanliness in Roads and Streets; with an account of the Construction and Operation of the Street-sweeping Machine.*" By Mr. J. WHITWORTH.

It treated of the general advantages of street cleanliness, the comfort of the pedestrian, the avoidance of impurity to the air from the decomposition of dirt on the pavement; less dirt and dust being carried into the houses, a saving in the cost of maintenance of roadways, and a diminution of the draught of carriages. The annoyances of the common method of cleansing were then detailed—with the importance of employing plenty of water in the cleansing of streets, to liquify the mud, to cause the dirt to swell and rise from between the stones, to cool and purify the air during hot weather, and to prevent the dust from being driven into the dwellings. It then showed how much economy there resulted from having force enough to cleanse the streets thoroughly and simultaneously in wet weather, particularly by Whitworth's sweeping machine, which is a cart drawn by one horse and managed by one man; it has on one of the wheels a toothed wheel working into a pinion, which gives motion to a drum over and around which passes two endless chains passing also round another drum at the lower extremity of a light frame suspended at the tail of the machine, over an inclined plane depending from the drum frame; these endless chains carry a series of broad brushes formed of an Indian rush of peculiarly elastic and durable nature; they travel at a velocity depending upon the speed of the horse, and impinging upon the ground with a force which is regulated by a coiled spiral spring, carrying the dirt up the inclined plane into the cart, whence it is emptied when the receptacle is full.

The next paper read, was "*An account of the sea defences of Romney Marsh, commonly known by the name of Dymchurch Wall, and the probable origin of the Marsh itself, or the manner in which it was reclaimed from the Sea.*" By Mr. JAMES ELLIOT, Jun., the resident engineer.

Romney Marsh, properly so called, forms a triangle, the base of which would be a line drawn from Romney to Appledore, and the apex at Hythe, and comprises about 24,000 acres. It is probable, that this marsh was caused in the first instance by the formation of a natural barrier of shingle, nearly where Dymchurch Wall now stands, by which the sea was excluded, and that the first artificial works were executed by the Romans, when they held possession of the country. They consisted of the erection of cross walls running from the natural barrier (the "Full") to the hills, at the base of which the ancient river Limene ran. The chief of these (the Rhee Wall), ran nearly in a straight line from Romney to Appledore, and it was at that spot where probably the main work was performed.

Upon the supply of shingle from the west being cut off by the extraordinary accumulation at Dungeness Point, the natural barrier at Dymchurch gradually became weakened, and it was necessary to take some steps to prevent its total destruction; the first measure adopted was the erection of an inland wall at some little distance, at the back of the "Full," and afterwards, the construction of large stone groins on this point or sea-side, at right angles to the line of coast, in order to increase the deposit of shingle. However, as the supply of shingle gradually decreased, on account of the constant movement to the eastward, and as all that escaped in that direction was permanently lost, these means were found insufficient, and a system of "arming," with brushwood and timber-piling was adopted. This was found to answer the purpose for a considerable period, but it also, in the course of time, gradually became insufficient; and it was found necessary, at length, after numerous experiments, to adopt a stone facing with an average slope of about eight to one, up to high-water mark, gradually increasing in steepness from that point, and terminating in a curve of seven feet radius. The stones, which were laid in a bed of concrete, where they were most affected by the waves, were of different sizes, averaging from eighteen to six inches in depth, the largest of them being in the middle, where the greatest wear and tear took place, and at which place rows of sheet piling were also driven for additional security.

This plan was adopted by the author after mature deliberation on the reports of Mr. Rennie and Mr. Walker, and a very careful examination of the locality. Part of the wall has now been standing for ten years, and has required a very trifling amount of repair, while the annual expense has been reduced from 10,000*l.* to 4,000*l.*, with every prospect of a still further reduction being effected, as upwards of two-thirds of the work are now permanently completed.

The last paper was, "*On Ocean Steam Navigation,*" by Captain HENDERSON, calling attention to the fact, that in this great maritime nation, naval architecture was neglected as a science, as was proved by the experimental squadrons and some of the ordinary steam vessels lately built. Neither the public nor science had derived any advantage from these costly experiments, owing to the absence of any information, in a systematic form, that correctly described the relative size, capacity, resistance, power, or speed of steam-ships; the present tonnage and nominal horse power, for all purposes of analogy, being quite fallacious.

The meeting was then adjourned until the second Tuesday in January, 1848.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

June 28.—C. FOWLER, Esq., V.P., in the Chair.

Dr. BROMET, F.S.A., exhibited a Drawing of a Templars' Church of the twelfth century, at Metz, having an octagonal nave with a pyramidal roof, and a semicircular apsis with a semi-conical roof;—also a Drawing of a Twelfth Century Church at Mathieu, near Caen, showing an arch between the nave and choir of elliptical form, and ornamented with three rows of counterset chevrons.

A Letter was read from SYDNEY SMIRKE, Fellow, on some peculiarities in the Architecture represented on the Bas-reliefs recently brought from Nimroud, and now in the British Museum.

A paper was read:—"A Sketch of the professional life of George Dance, Architect, R.A.," by SAMUEL ANGELL, V.P.

The Premiums in Books awarded in the Students' Class at the previous General Meeting were presented as follows:—

To Mr. W. BOUTCHER, for the best Series of Sketches of Designs from Subjects given monthly by the Council,—a Copy of Chambers' Treatise on Civil Architecture, by Gwilt; and for the best Notes of Papers read at the Meetings during the Session,—a Copy of Hope's Historical Essay on Architecture.

To Mr. S. J. NICHOLL, for his Notes of Papers read at the Meetings during the Session,—a Copy of Milizia's Lives of the Architects, translated by Mrs. Cresy.

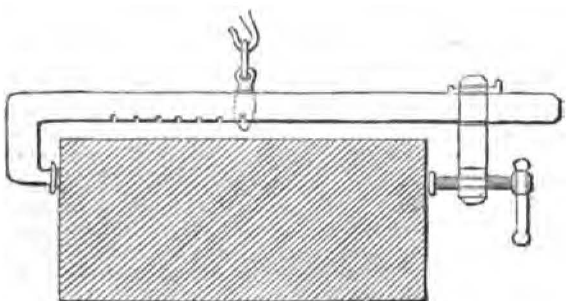
A curious Model of a Chinese Chemist's House and Shop were exhibited to the Meeting, and the several arrangements explained by Professor DONALDSON.

In announcing this as the closing Meeting of the Session, the Chairman adverted to the general proceedings of the Institute during the year, and took occasion to express the regret generally felt at the recent decease of their highly esteemed Honorary Member, Mr. J. B. Papworth.

It has been arranged to set apart an evening, early in the ensuing Session, for the discussion of the subject propounded in the paper read by Mr. CHANTRELL, at the meeting of the 14th of June, "*On the Geometric System applied by the Mediæval Architects to the proportions of their Ecclesiastical Structures,*" by which time it is hoped that those Members who feel particularly interested in the subject will be prepared to offer their opinions thereon.

A STONE-LIFTER.

Being engaged in the construction of bridges, &c., on the Great Grimsby and Sheffield Junction Railway, and the engineers objecting to lewis-holes in the face of the coping, Mr. Joshua Oliver, clerk of the works, suggested



SCALE ¼ IN TO A FOOT.

a plan to obviate the difficulty. The annexed sketch is a representation of the apparatus, which is nothing more than a bar of iron, 3½ inches wide and ½ an inch thick, with a sliding piece and screw; but should it be used for rough stones, the screw may be dispensed with by adding a key to the top of the sliding piece, as shown by the dotted lines.—*Builder.*

SULPHURIC ACID.

At the College of Chemistry, June 23, a lecture "*On the manufacture, properties, and uses of Sulphuric Acid,*" was delivered by Mr. HENRY M. NOAD.

After alluding to the great importance of chemistry and its bearings on almost every branch of social industry, the lecturer observed that it may even be classed among the principal elements of civilisation. In illustration of which, he adverted to the influence exerted by sulphuric acid on the manufacture of soap—an article, the consumption of which is not subject to the caprices of taste or fashion, but absolutely essential to cleanliness and comfort. From the year 1829 to 1834 the average importation of barilla into this country amounted to 12,600 tons. Now, however, this ash is scarcely to be met with in the market:—nearly the whole of the soda consumed in this country in the manufacture of soap and for other purposes being obtained from common salt through the agency of sulphuric acid; and the united quantity of soda ash and soda crystals annually manufactured is calculated to exceed seven times the largest importation of barilla ever made in one year. This increased consumption of soda is due to the repeal of the salt duty, and to the improvements that have been effected in the manufacture of sulphuric acid.

Mr. Noad proceeded to review the sources and properties of sulphur; and after showing how extensively this elementary substance is diffused throughout the globe and in all the kingdom of nature, he remarked on the imprudent policy of Sicily in granting to a French company, in 1838, a monopoly for the purchase and sale of sulphur—a course which, had it been persevered in, would, probably, ere this have entirely, or to a great extent, deprived Sicily of her lucrative article of commerce. During the time the monopoly lasted (only two years) no less than fifteen different patents were taken out for methods of obtaining back the sulphuric acid used in the manufacture of soda. Hundreds of thousands of pounds weight of sulphuric acid were prepared from pyrites; and a process was indicated for decomposing gypsum. Even at the present time large quantities of sulphuric acid continue to be made from pyrites; and in 1842 the importation of sulphur from Sicily was not one-third of the amount imported in 1836. The lecturer described the various compounds of sulphur with oxygen; illustrating experimentally the properties of sulphuric acid. He gave a detailed account of the present method of preparing sulphuric acid on the large scale;—imitating it on the lecture table by causing two streams of sulphurous acid and nitric oxide gases to come into contact, together with steam and common air, into a large glass globe; and he explained the theoretical nature of the reactions which took place by means of diagrams. The leaden chambers employed in some manufactories were stated to be of immense size—upwards of 180 feet long, having a capacity of 35,000 cubic feet, and being capable of preparing ten tons of acid weekly. The great saving effected by the modern improvement of substituting vessels of platinum for those of glass for the final concentration of the acid, notwithstanding the enormous price of the former, is manifested by the fall in the price of sulphuric acid from 4d. to 1½d. per pound. The lecturer performed a series of experiments in illustration of the valuable properties of sulphuric acid. He adverted to its great use as an elegant and economical means of refining silver—and to its introduction into agriculture as a solvent for bones, by which phosphate of lime is not only brought into a liquid state—and thus more intimately diffused through the soil—but a portion of phosphoric acid is likewise set free to combine with lime or other basic matters in the soil. The lecture was concluded by observations as to the manner in which the sulphates act as manures—viz., by furnishing the necessary supply of sulphur to those parts of plants in which this element is found—and of which it appears to be an essential constituent—viz. the gluten and albumen of the several varieties of grain, and the legumin of those plants which are called *leguminous.*

WARMING AND VENTILATION OF THE NEW HOUSE OF PEERS.

We have been requested to give an account of the system adopted by Mr. Barry, for the warming and ventilating the New House of Peers. We cannot do better than give Professor Faraday's account, read at the Royal Institution:—

Mr. Barry's plan of warming and ventilating the three rooms to which he has applied it (*i. e.*, the royal ante-chamber, the house of peers, and the public lobby), consists, first, in causing a current of air, of regulated temperature, to pass beneath the impervious floor of these apartments, and afterwards to rise to a chamber at the top of the building, from whence it is diffused in great abundance, but imperceptibly, throughout the three apartments; and secondly, in drawing off the vitiated air and discharging it with great rapidity into the atmosphere. To accomplish these objects, Mr. Barry has achieved expedients for,

1. Warming the building through an impervious floor, as in the case of a Roman bath. 2. Effecting a system of currents. 3. Providing means of causing ten thousand cubic feet of air per minute to proceed in a prescribed course, and with regulated velocity.

The warming is effected by a steam-cockle, supplied from one of Lord Dundonald's boilers; it is traversed by a quantity of air-tubes firmly fastened into it. The air which passes through the tubes is the source of warmth. This apparatus, with its furnace, is placed beneath the public lobby; and the current of warm air passes beneath its impervious floor, then beneath that of the House of Peers, and lastly, beneath the floor of the royal ante-chamber beyond. With warmth, the air acquires a certain degree of motive power in the rising parts of the passages, which carries it onwards till it reaches the reservoir chambers at the summit of the building; from thence it is made to pass down into the apartments by their walls, and so distributed, without draught, to be breathed by the inmates of those rooms. This gradual diffusion of the air is accomplished by a system of currents. It is caused by subjecting the air to inequalities of temperature. Descending by the walls of the building, it is cooled by windows, &c., and thus its velocity downwards is increased. Arriving at the level, at which it is at once heated and deteriorated by respiration, combustion, &c., the air again rises in the centre of the room, and passes through the ceiling into a foul-air chamber, which is in connection with a chimney. Through this chimney the air is driven by the third expedient adopted by Mr. Barry, viz, draught of the flue,—and a peculiar motive power furnished by Bell's steam-jet [see *Journal*, last month, page 230,] a source of force which has so many philosophical considerations connected with it, that Mr. Faraday expressed it his intention of making it the subject of a future day's discourse. He therefore limited himself at present, to the simple statement that steam produced under 32lb. pressure on the square inch, will set in motion 217 times its bulk of air.

In the course of his communication, Mr. Faraday described the arrangements made by Mr. Barry to clear the air, and to regulate its velocity, so as to prevent the possibility of draughts coming on any inmates of the apartments. He showed how the steam-cockle, employed to give warmth in winter, might, by filling it with water from the Artesian well, become a source of coolness in summer. These, and many other important arrangements, were illustrated by sections in relief.

The advantages expected from this mode of ventilation, are, 1. The prevention of local draughts. 2. The prevention of the stains and disfigurements resulting from such draughts. 3 The avoidance of all movement and dispersion of dirt and dust of the house by currents occasioned in it, which currents, if existing, would tend to render the air impure. 4. The avoidance of all sudden change of temperature. Finally, it was noticed that all parts of the house were fire-proof. Mr. Faraday then took occasion to remark that this scheme of ventilation was under a disadvantage in the present case, as it had to be adapted to buildings which were not planned with reference to it.

DREDGE'S SUSPENSION BRIDGES IN INDIA.

Major Goodwyn has addressed the following letter to the Editor of the *Englishman* (Published in India in reply to Mr. Dredge's remarks):—

"Sir, Adverting to a statement which lately appeared in your paper, and which, with certain comments, has found its way into the *Star* and *Madras Spectator*, relative to the failure of an iron bridge on the taper chain principle, manufactured by the patentee, Mr. Dredge, sent out by him, and put up at Jessore, I feel myself bound to offer a few words, as the measures of the Government have been misrepresented, and the facts of the case considerably distorted. The span, width of roadway, height of point of suspension, being necessary data to furnish Mr. Dredge with, these dimensions, and these alone, as connected with the required strength of the iron-work, were sent to him, and he was further particularly instructed to form the eyes of his links in a peculiar way (which, however, he did not observe). Mr. Dredge, as I before said, required the above data on which to calculate the strength of his ironwork, and the angles at which his rods were to be placed. Not one of these details was sent from here, nor was it likely he would have adhered to them if they had been, for it was naturally his interest to protect his patent by every care he could bestow, and it is sufficiently evident he did attempt it when he made the longitudinal beams 25 per cent. above what he was in the habit of doing, not 'as the drawings warranted,' for no drawing went from this country, saving a tracing of the masonry design, and section of the river, with sundry queries relative to the retention of the chains in the ground. To prove that the drawings of the iron-work came out from, instead of going to Mr. Dredge, I send you his sheet of plans, which were accompanied by most elaborate injunctions, all of which were fulfilled, and the bridge was most correctly put up. Yet the bridge fell, though it might have been standing now if it had only been subjected to the ordinary traffic of the country, and guarded from the unusual crowd to which it was exposed.

"I have said already more than I intended; suffice it to add, that once a sincere admirer of the system, I have had experience enough to discover its defects; full explanations and refutations of Mr. Dredge's statement have been sent to the scientific journals in England, and will appear in due course, as will also an elaborate treatise on the system in all its bearings: let the discriminating public *wait a little*, and hear both sides of the question."

NOTES OF THE MONTH.

Centre Punch.—It is customary, in moving the "centres" of a piece of iron intended to be turned, to drive a centre punch into the holes previously made; first, at an angle, in order to force the metal over to the side required, and then, to drive it in, perpendicularly, in order to give the hole the proper shape for the lathe centres. This is frequently repeated, until the hole is mutilated, or driven so deep as to be objectionable, and is absolutely *barbarous* on a nice piece of work. There are other modes of moving the centres of accurate work, such as the scraper and centreing drill, but this is the mode generally adopted on account of convenience, and has done injury to much fine machinery. The new plan adopted for this purpose, which I saw in a small shop at Massachusetts, appears to me to be equally convenient with the ordinary centre-punch, while it is quite as perfect and unobjectionable as any of the more tedious modes. This tool is formed by making the conical point of a centre-punch on an angle with its shaft. It will be readily seen that by using this punch, the hole will be more easily moved laterally, that its uniform conical shape will be preserved perpendicular, and that the distance of moving it may be accurately managed by the blow of the hammer upon the punch.—P. B. Tyler, *New Orleans.*

Skimming Ladles for Pouring Cast Iron.—In a foundry at Connecticut, there is a mode of skimming small ladles for pouring cast iron, which is found to be very useful. It consists in riveting a small bar of iron across the top of the ladle, just at the back of the mouth, and covering it with clay, the same as at the bottom of the ladle, to prevent its cooling the melted iron. The bar should extend far enough below the top of the ladle to commence skimming from the first, and near enough to the mouth to continue until all is poured. I saw some ten or fifteen persons pouring with these ladles, while not one was required to skim, and I was told that no objection was found to it in any respect.—*Ibid.*

The most Extensive Manual Structure is, undoubtedly, the great Chinese wall. It is 24 feet high and 10 feet wide, and reaches to the extent of from 2,000 to 2,400 miles, over mountains, precipices, and rivers, up to the sea on one side, and the inaccessible mountains of Thibet on the other. The Chinese truly call it one of *their* wonders of the world—as the stone used for its construction, if placed one beside the other, would suffice to encompass the whole circumference of the globe. The entire history of this construction is wrapt in similar obscurity with that of the Pyramids of Egypt. Chinese documents ascribe to the founders of the empire the benefit of a vast system of drainage and exsication of the land, after which came the great world-dearth of seven years, &c.

Malleable Glass.—Prof. Schönbein has discovered a substitute for glass. It consists of pulp of common paper, made transparent, by causing it to undergo a certain transformation, which the Professor calls *catalytic*. With this paper, made waterproof, is manufactured perfectly transparent window-panes, vases, and bottles, which will not easily break.

Dover Landing Pier.—The lords of the Admiralty have at length been pleased to give their sanction to the erection of a landing pier in Dover Bay, according to the plans prepared by Messrs. Birch, and submitted to them by the Town of Dover. The commissioners of the harbour also have given their assurance that the measure shall meet with every assistance from them. A company is, therefore, now forming for the purpose of carrying out this desirable work, and it is determined to use every endeavour to get the erection completed during the present season. The pier will extend 800 feet into the sea, and at its extremity will be a lozenge construction of four sides, affording to steamers not only unusual accommodation in coming alongside, but the certainty of a good lee in stormy weather. The advantages of the pier will be greatly felt by the mail establishments of the British and foreign governments, who have expressed their willingness to entertain the question of an annual grant for its use,—as well as by the continental steamers, who will thus be enabled to effect a landing of passengers at low tide, which is a question of great importance to Dover, and enables it to maintain its high position as a point of embarkation to the continent.

"*The Express*" steam vessel, built for the South Western Steam Navigation Company for the Southampton and Havre station, by Messrs. Ditchburn and Mare, and fitted with engines by Messrs. Maudslays and Field, made an experimental trip on the Thames on the 4th ult. It is stated she performed the distance from the Nore lights to Blackwall, a distance of 47 miles, in 2 hours and 8 minutes. (*Qy.* with tide.)

Brighton and Continental Steam Packet Company—The two boats built for this company have been running from Shoreham to Havre since the 1st ult., and have answered the directors' expectations in every respect. One of the boats ran the distance (84 nautical miles) in 6¼ hours. When the Dieppe railway is open, Dieppe will be the port instead of Havre. When the works at Newhaven are completed, that port will be the place of departure instead of Shoreham, by which a saving of ½ or ¾ of an hour will be effected, and in fine weather the boats will frequently go over in about four hours.

Railway Opened.—On the 20th ult., a further extension of the South Devon railway, from Newton to Totness, a distance of 8¾ miles, was opened.

Short Time for Building Operatives.—We are happy to state that a system of leaving off work on Saturdays at 4 o'clock is about to be carried out: it has, we understand, been already adopted among the carpenters and joiners of London, in the shops of Mr. Thomas Cubitt, Mr. William Cubitt, Mr. Baker, Mr. Piper, Mr. Jackson, Mr. Lee, Mr. Seth Smith, &c.

Prevention of Iron from Rusting.—The Royal College of Chemistry offers a premium of £1,000 for the discovery of a method of rendering iron, when used for ordinary purposes, as little liable to rust as copper.

Printing Types.—M. Coblentz, a topographic printer in France, states that type may be hardened by galvanism.

Grindstones.—M. Jules Pugeot, of Hérimoncourt, has adopted a plan to preserve his workmen from the ill effects presented by the use of grindstones in his factory, by applying a ventilator to carry off the siliceous dust before it can reach the mouth or nostrils.

Conversion of Diamonds into Coke.—At the meeting of the British Association, Dr. Faraday exhibited some diamonds, which he had received from M. Dumas, which had, by the action of intense heat, been converted into coke. In one case, the heat of the flame of oxide of carbon and oxygen had been used—in another the oxy-hydrogen flame—and in the third the galvanic arc of flame from a Bunsen battery of 100 pairs. In the last case, the diamond was perfectly converted into a piece of coke—and in the others the fusion and carbonaceous formation were evident. Specimens in which the character of graphite was taken by the diamond, were also shown. The electrical character of these diamonds were stated also to have been changed—the diamond being an insulator, while coke is a conductor.

Iron for Girder Bridges.—Mr. Murray, a valuable contributor to the *Mining Journal*, suggests that iron girders and similar supports ought never to be made of cast iron, but of wrought iron, and composed of plate; twisted previously into a rope, and finally moulded into the required forms a trusty "Toledo," or a Damascus blade, being so worked and moulded, will bend, indeed, but never break.

The City of Mexico.—Conspicuous among the beauty and magnificence of the grand city of Mexico is the Main Plaza. It covers an area of twelve acres, paved with marble, forming one of the most beautiful promenades in the world. On every side of this great square magnificent and costly public buildings are situated. On one side is seen the spacious cathedral, which extends the whole length of the square, and the government palace extends the whole length of another side. The cathedral is erected on the site of the great idol temple of the Aztecs, and the government palace on the ground of the palace of the great Montezuma. The amount of wealth in the cathedral is incredible. The altar is covered with plates of massive silver and beautified with ornaments of massive gold. The balustrade enclosing the altar extends a length of 100 feet; and is made of a massive composition of gold, silver, and copper, the value of which is exceedingly great. Statues, vases, and candlesticks, of gigantic size, are scattered through the building; and when we know that these, too, are made from the precious metals, we can form an idea of the immense wealth of this cathedral. There are about 80 churches in addition to the cathedral, richly ornamented with gold, silver, and precious stones; and it is supposed that the wealth which is exhibited in this manner is as nothing to the immense treasures that are kept in concealment by the priests. The city of Mexico can also boast of a splendid theatre or opera-house, which was erected at an immense cost, and is capable of seating 10,000 persons comfortably. On the western side of the city is another square of 45 acres, with a fountain in the centre. It is laid out into pleasant walks, and much frequented in the evening as a promenade. The city of Mexico, like the city of New York, has its fashionable drive—its Third Avenue. We must, however, acknowledge that our Third Avenue cannot be compared to it for beauty and extent. Some idea of its extent may be formed from the fact that it is one mile wide; on which the most splendid carriages, in innumerable numbers, may be seen every evening. It is not unusual to see 7,000 or 8,000 horsemen and 2,000 carriages on it at the same time.—*New York Herald.*

Improved Locomotive Engine.—For some time past considerable attention has been excited among parties connected with locomotive transit by the performance of an engine built upon a new principle by Mr. Crampton, civil engineer [see *Journal*, p. 153], and upon which very extensive experiments have lately been made on the London and North-Western railway. The engine in question which has been for a few weeks taking the express, mail, and ordinary trains on that line, and performing its work in such a manner as to effect a saving of from 20 to 50 minutes in a through distance of 50 or 60 miles, was tried last week without a train, for the purpose of testing its rate of speed: when it was found that with Capt. Coddington, inspector-general of railways, Capt. Simmonds, assistant-inspector, and the patentee, Mr. Crampton, on the engine, it attained the extraordinary speed of 75 miles per hour, on a level, immediately after surmounting a gradient; and that at this rate there was a total absence of all vibration, and a steadiness of movement perfectly surprising. These great advantages are effected in Mr. Crampton's engine by the centre of gravity being brought down to its lowest possible point; the boiler, in fact, being, in this machine, within 2 feet 9 inches of the rails, whilst in engines of the old construction it ran, at the very least, 5 inches above their level. The peculiarities of this engine consist in the driving-wheels being placed at the foot-plate end of the boiler; by which means the boiler itself can be brought down close to the supporting axles of the engine—and, from the peculiarity of form before mentioned, any size of driving-wheel may be used without interfering with the position of the boiler, so that longer boilers can be used if necessary. Another advantage secured by this method of building engines is, that no part of the engine overhangs the wheels; inasmuch as the fire-box is extended under the boiler and driving axle—by which also the distance between the extreme wheels is reduced 3 feet. The engine in question, the Namur, has only 13 feet between them, whilst in ordinary engines the same amount of power would require 16 feet.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM JUNE 26, TO JULY 19, 1847.

Six Months allowed for Enrolment, unless otherwise expressed.

Robert Wilson, of Low Moor Iron Works, Bradley, Yorkshire, engineer, for "Improvements in machinery and the arrangements thereof for forging, stamping, punching, cutting, and pressing metals and other substances."—Sealed June 26.

Urell Correll Hill, of New York, U.S., professor of music, for "a mode or modes of producing musical sounds."—June 28.

William Edward Newton, of Chancery-lane, civil engineer, for "certain Improvements in manufacturing wheels." (A communication.)—June 28.

Henry Hornblower, of Dalgleish-place, Commercial-road, Middlesex, engineer, for "certain Improvements in obtaining motive power."—June 28.

Frederick Chaplin, of Bishops Stortford, Hertfordshire, tanner, for "Improvements in card cases and retaining or fastening papers, deeds, and fabrics."—June 29.

Paul Gilbert Preller, of Rue de Rivoli, Paris, gentleman, for "Improvements in the manufacture of dry sulphuric acid, and in the manufacture of smoking or Nordhausen sulphuric acid." (A communication.)—June 29.

Joseph Browne Wilks, Esq., of Chesterfield Park, in the county of Essex, for "Improvements in the manufacture of oil from certain nuts, from which oil has not been before manufactured, and producing a vegetable substance, and the application thereof for the purpose of affording light and other uses."—July 3.

Elisa Tonge, in the county of Lincoln, for "Improvements in ornamenting glass."—July 3.

Robert Weare, of Argyle-street, Birkenhead, in the county of Chester, watch and clock maker, for "Improvements in clocks or time-keepers."—July 3.

Alexander Mitchell, of Brickfields, in the parish of Ballymacarrell, Ireland, civil engineer, of an extension of letters patent granted to him by His late Majesty King William the Fourth, dated the 4th day of July, in the 4th year of his reign, for the term of fourteen years, from the 4th of July, 1847, for his invention of a dock of improved construction to facilitate the repairing, building, or retaining of ships and other floating vessels, and that certain parts employed in the construction of the said dock are also applicable to other purposes."—July 3.

George Alexander Miller, of Piccadilly, in the county of Middlesex, for "Improvements in lamps."—July 3.

George Augustus Huddart, Esq., of Brynter, in the county of Caernarvon, for "certain Improved apparatus for the cultivation of land."—July 3.

John Hunt, of Birmingham, brass-founder, for "a certain Improvement or certain Improvements in effecting the combustion of gas, oil, camphine, and other substances which are or may be burned for the production of light."—July 3.

Jeremiah Brown, of Ringswinford, in the county of Stafford, roll turner, for "certain Improvements in rolls and machinery used in the manufacture of iron; also in rolls and machinery for shaping and fashioning iron for various purposes."—July 3.

John Ray, of Albion-terrace, Commercial-road, East, for "Improvements in constructing or fitting the interior parts of ships or other vessels, warehouses and other depots, for the purpose of facilitating the delivering or removing from ships, vessels, warehouses and other depots, of the cargoes or contents thereof."—July 3.

William Edwards Staite, of Lombard-street, gentleman, for "certain Improvements in lighting; and in the apparatus or apparatuses connected therewith."—July 3.

Theodore Claeys, of Ostend, in the kingdom of Belgium, and Louis François Strand, gentleman, of the same place, for "Improvements in the manufacture of various articles from cork."—July 3.

John Caer, of Blackburn, in the county of Lancaster, for "certain Improvements in looms for weaving."—July 3.

George Winslow, of Boston, in the State of Massachusetts and United States of America, merchant, for "Improvements in machinery for manufacturing files and rasps." (A communication.)—July 3.

Edmund Wheeler, of Basingstoke, in the county of Hampshire, ironmonger, for "Improvements in valves for steam and other engines." (A communication.)—July 3.

John Harvey, sadler, of Holbeck, Leeds, Scotch iron merchant, for "Improvements in constructing bridges, aqueducts, and similar structures."—July 7.

Samuel Stokes, of Monkwell-street, carpenter, for "an Improved machine for tracing or engraving from solid bodies, or subjects in relief."—July 10.

Robert William Sievier, of Henrietta-street, Cavendish-square, Middlesex, gentleman, for "an Improved material or materials for purifying or decolorising bodies, which material or materials may also be employed as manure and pigments and for other like purposes."—July 12.

William Edward Newton, of 66, Chancery-lane, civil engineer, for "certain Improvements in the manufacture of screws." (A communication.)—July 12.

William Langley Beale, of Whitstable, in the county of Kent, smith, for "Improvements in the construction of anchors."—July 13.

Alfred Vincent Newton, of 66, Chancery-lane, Middlesex, mechanical draughtsman, for "certain Improvements applicable to locomotive engines and carriages employed on railways." (A communication.)—July 13.

William Hensman, of Woburn, in the county of Bedford, for "certain Improvements in thrashing machines."—July 17.

Pierre Armand Lecomte de Fontainemoreau, of 4, South-street, Finsbury, for "certain Improvements in machinery, for preparing cotton and other fibrous substances."—July 17.

Henry Bessemer, of Baxter-house, Old St. Pancras-road, Middlesex, engineer, for "Improvements in the manufacture of plates, sheets, or panes of glass."—July 17.

William S. Henson, of the city of London, for "certain Improvements in the construction of razors for shaving."—July 17.

Robert William Sievier, of Henrietta-street, Cavendish-square, Middlesex, gentleman, for "Improvements in stamping, marking, cutting, embossing, or printing."—July 17.

John Sykes, and Adam Ogden, both of Huddersfield, in the county of York, for "Improvements in machinery for cleaning wool, cotton, and similar fibrous substances, from burs, motes, and other extraneous matters."—July 17.

James Whitley, of Botany, in the township of Merton, in the parish of Bingley, Yorkshire, for "certain Improvements in the mode of washing, scouring, and drying of wool, alpaca, mohair, cotton, and other fibrous substances."—July 19.

Edward Light, of Esther-terrace, Bermondsey, master mariner, for "Improvements in apparatus for supporting or buoying up persons, boats, and other bodies when in the water."—July 19.

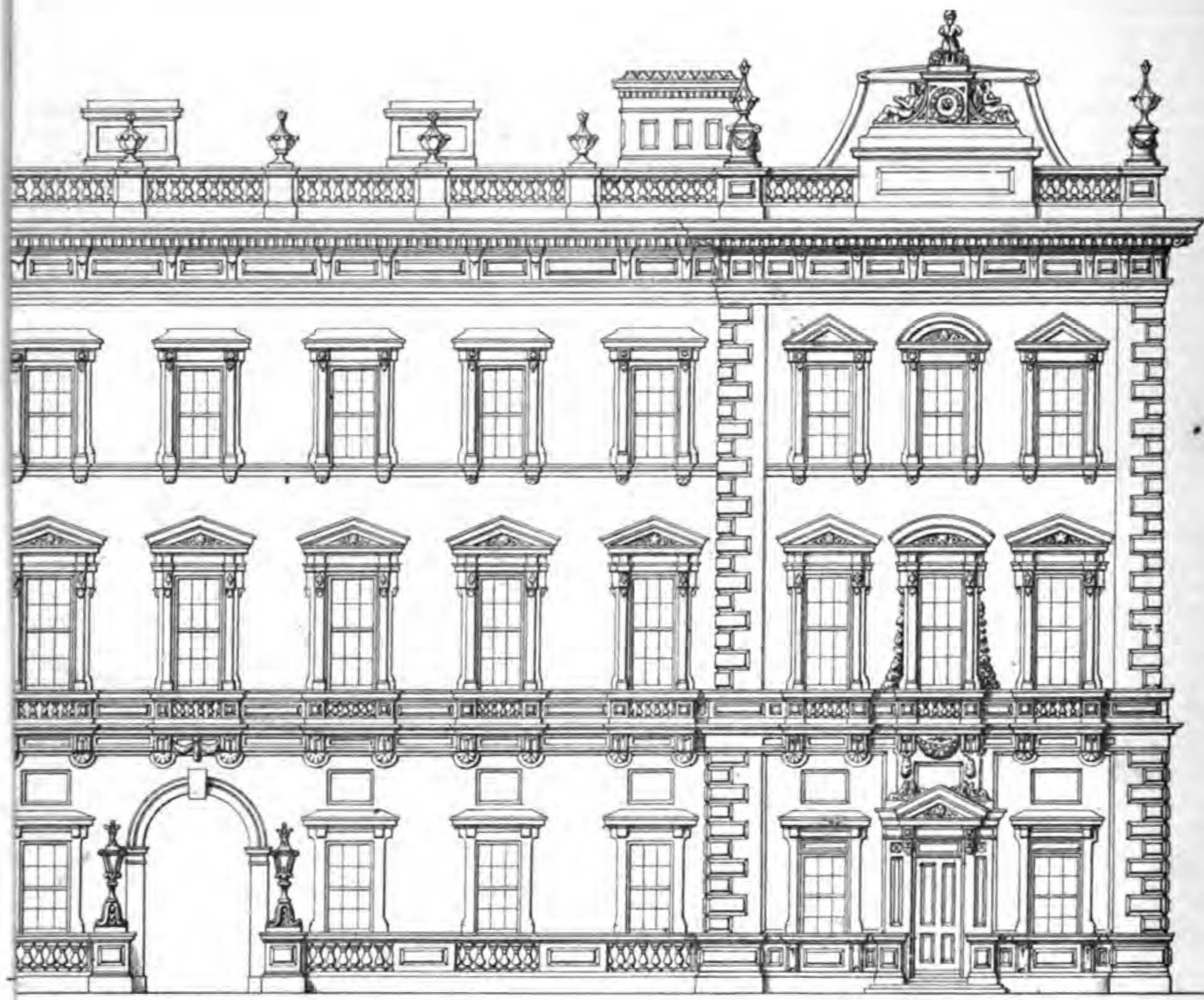
Joseph Tall, of Brixton, Surrey, builder, for "Improvements in apparatus for setting saws."—July 19.

Edward Slaughter, of Avon-side Iron Works, Bristol, engineer, for "Improvements in locomotive engines."—July 19.

Anthony Bernard Von Rathen, of Putney, Surrey, civil engineer, for "certain universal wheels or improved direct rotary engines, to be worked by steam, air, or any other elastic power."—July 19.

Joseph Jean Baranowski, of 3, Rue Neuve Clichy, in the city of Paris, gentleman, for "a ready-reckoning machine."—July 19.

PLATE XIV.



BUCKINGHAM PALACE.

(With an Engraving, Plate XIV.)

Although we exhibit the Park front of the new range of building which is being added to the Palace, we are unable to speak as to more than its exterior, the designs presented to Parliament being unaccompanied by any description or any explanatory Report by the architect himself, notwithstanding that something of the kind, in addition to drawings, might properly enough have been "presented to both Houses of Parliament by command of her Majesty." We therefore, not being so intuitively sagacious in matters of architecture as, it would seem, the two "Houses" are, are greatly at a loss to understand a variety of particulars that ought to be taken into consideration, for we do not get even so much as a single plan to make us acquainted with the general interior arrangements, and to enable us to judge how far Mr. Blore has been controlled by positive exigencies of accommodation, to the injury of external character,—which latter, if the truth may be spoken, is but ordinary in quality and commonplace in regard to composition. Had it been for what is called a "Terrace," or the side of a square, or any similar range of houses combined into a general architectural façade, the elevation might deserve the epithet "palatial," whereas being for the principal public front of *The* Palace, it partakes by far too much of "the dwelling-house" physiognomy, undoubtedly of a superior kind. Besides being divided into five markedly distinct portions, that have the look of being so many separate residences, each with its own entrance, the façade is in one respect, if no other, greatly less dignified than some of our club-houses, the latter not having—at least, not showing externally—any chamber-floor, or one of lodging-rooms, over the principal floor; whereas here, there not only is such floor, but it is made quite as important as the other, so that except what distinction it receives from its window-dressings, instead of plainly expressing itself as a lofty state floor, that first-floor is made of no more importance than the one over it. For want of plans, we cannot say whether such is really the case or not, but it does look very much as if, instead of containing a ball-room and other additional state apartments for public entertainments, the new building was intended to consist entirely of offices in its lower part, and in its upper one to afford the same sort of residence and lodging accommodation as has hitherto been provided in the original wings of the palace; and as if the latter—the south one at least—was now to be cleared out and converted into a ball-room, &c., in immediate connection with the present grand staircase. Unless one of the wings is to be entirely re-arranged internally, we do not see how there can be any suitable communication between the present state apartments and any others in the new building. By referring to the plan of Buckingham Palace, as given in the second edition of "The Public Buildings of London," it will be seen that by forming an approach from the grand staircase into the spacious octagon room on that side, converting that octagon into an ante-saloon to a ball-room or other spacious and lofty hall for public entertainments, made to occupy the whole of that wing and what will be added in depth by the new building (making altogether about 250 feet from the octagon), a most important addition might have been made to existing state apartments, in their immediate propinquity, but at the same time so as to keep the one suite perfectly independent of the other, at the same time allowing them both to be thrown open at once, with direct communication between them whenever the occasion might require it. The arrangement we have pointed out could hardly fail to be productive of an unusual degree of architectural display—of both effect and climax, even were the 250 feet of length from the octagon divided into two halls of entertainment, a larger and smaller one, the former being of course placed last. But we ourselves are now building—not exactly a palace, but a mere castle in the air. We must therefore, be content to let what we have been saying pass for mere moonshine.

Said, perhaps, it may be, that after all, the public need not give themselves any concern whatever about internal arrangement and accommodation; since all that will fall to their share will be external appearance alone. One circumstance will certainly be in favour of the New Building, namely, it being about ten or twelve feet higher, and being advanced so much forwarder it will show itself more conspicuously; at the same time, owing to its forming a single general mass, it will not possess any play of perspective, nor any of that relief and contrast of light and shade which now take place when the sun strikes on one of the wings on its side towards the court while the rest is in shadow. The aspect of the Park front of the Palace is certainly an unfortunate one,* it being such as to render that facade a mass of shadow,—an inconvenience which it has been attempted to keep out of sight in the pictorial perspective view accompanying the two elevations by a device far more ingenious than praiseworthy, the sun being there made to shine upon the building from the north-east, which graphic fiction, besides setting off the east front itself to full advantage, performs the very good-natured service also of throwing into shadow the south side,—whereas, in reality, the effect will be just the reverse, since the latter, which forms no architectural façade at all, but is, on the contrary, an arrant jumble, will be lit up by the sun, while the Park façade will be buried in shadow. Nevertheless, such is the truthfulness of a drawing "presented to both Houses of Parliament," in order to enlighten their æsthetic optics. For our part, we very much question if any of those noble personages who affixed their signatures to what was presented to them, so much as noticed the fiction palmed upon them.

Having to contend with an unfavourable aspect, Mr. Blore ought to have exercised his ingenuity by studying how not only to overcome that disadvantage, but elicit some unusual effects. He might have taken a hint from those exceedingly picturesque bits of architecture, the open loggias in the Terrace façade of Somerset place. Something of that kind, admitting a brilliant light through a double range of columns seen in bold relief against the sky (for the buildings in the rear would not be visible), would have imparted no small degree of scenic vivacity to the whole façade. Nor would such arrangement have necessarily destroyed all communication between the rooms on the principal floor, because such communication might have been sufficiently kept up by means of a corridor practised behind the loggia, carried up only so high as not to be visible from the Park. Had there been any opening of the sort through the centre of the new building, it would surely have conduced very much to the cheerfulness of the inner court and the view from the portico and rooms on each side of it in the body of the palace, by admitting a glimpse of the trees in the park, between the columns.† At present, unwelcome as the truth may be, and ungracious as it may sound, we must say that the architect does not seem to have studied the subject at all; on the contrary, to have taken up with the very first ideas that presented themselves. Most assuredly, he has stolen none from Inigo Jones's designs for Whitehall, nor—not to go out of our own country—has he caught any of that grandiosity which stamps Greenwich Hospital—a pile that, although not faultless in taste, has infinitely more the air of a royal palace than anything we now have, not even Windsor Castle excepted. Had Mr. Blore been compelled to adhere as nearly as possible to the character of what had been before done, that consideration might have mitigated criticism; but for excuse of that kind he has left himself no room whatever, the new building being treated quite differently, yet in such manner as to leave it very questionable whether the difference amounts upon the whole to much improvement;—it most decidedly does not so much as the opportunity afforded. In one respect, there will be even more littleness than before, owing to a low entresol with a series of small windows being here introduced between the ground-floor and first-floor. That entresol, no doubt, supplies a great deal of accommodation for domestics, but in the front of a royal palace, and what is in this case the only public front of it, such trivialties should not be allowed to intrude. In such, convenience ought to give way to dignity, and be provided for elsewhere; just as a sovereign must frequently sacrifice his own comfort and personal indulgence to state, and give an audience when he would much rather take a nap.

* Unfortunate, too, it is that that of the River front of the Palace of Westminster, and of the new Treasury buildings is just the same; nor, although different, is that of the Club-houses in Pall-Mall much better. However good they may be in themselves, buildings so circumstanced may be compared to good pictures hung in a very bad light. We may perceive what the details are, but they do not produce the intended effect,—not that which they do when the sun does fall upon them, which for about one half of the year it does not do at all at any time of the day. Aspect, however, notwithstanding all that is said about it, does not seem to be taken into account at all—not even so much as thought of for a moment in designing a façade. Hence, while we often see bareness in fronts fully exposed to the sun, and where ornament would consequently show itself well, we sometimes see a great deal of excellent detail almost all but quite thrown away upon others where owing to want of requisite light it does not produce any adequate degree of effect.

† We have now before us upon paper three several ideas, all widely differing in other respects, but all agreeing in providing a striking degree of effect of the kind mentioned. One of them extends the façade as far as the extremity of the present small Doric colonnades, so as to obtain a 'corps de logis' north and south, of about 200 feet frontage, and connects those two masses of habitable building by a magnificent Corinthian colonnade on the level of the state floor, entirely open in its upper part, but having the intercolumns filled in, both towards the court and the Park, for rather more than half the height, by being glased with brilliant stained glass, the effect of which, with the sun on the opposite side, could not fail to be most splendid. Internally, that part would form a conservatory or winter-garden, into which one of the new state rooms for evening entertainments would open; accordingly, when lit up of an evening, on any such occasion, the appearance would have been that of a superb illumination, with a series of glowing transparencies;

Convenience!—no doubt George the Fourth studied his own convenience, and had he inhabited the Palace, might, perhaps, have been perfectly satisfied with it; yet the public would not have been at all better satisfied with the building on that account. And surely, when palaces are built or altered, the public, who provide the money, may very reasonably expect—nay, may rightly demand that the structure shall be made a worthy public ornament, and be, as a work of architecture, of a much higher grade than usual. Extravagance is not to be measured by the ordinary shop-keeping standard of mere cost, because there is far more extravagance in laying out a hundred thousand pounds on things we are afterwards ashamed of, than in expending a million upon what we should have reason to be proud of, as a people. Don't let us have to pay both money and reputation too, as we have so often done hitherto. We do not recollect to have ever seen mentioned what was the approximating estimate for Jones's Whitehall, but enough to have erected two such vast piles has since been flung away —not, indeed, all at once in a lump, but in hundreds of thousands, or so, at a time, in building up, altering, botching up, and in some cases, unbuilding again. Could we but ascertain the exact amount of aggregate cost of the quondam Gothic palace at Kew, the Pavilion at Brighton, Carlton House, the present Buckingham Palace, up to the time of the additions now making to it, including some of our government buildings, the total would be most startling; and most grievous, too, would be the reflection that there was never any thing at all adequate got in return for it,—which after all is the real grievance.

Whether the public generally will now be satisfied with the Palace, we pretend not to say; we only know that we are not so ourselves,—quite the contrary, for if there be improvement at all, it certainly falls very far short indeed of such as there might have been. Instead of extending our remarks at present, we leave our readers to decide how far those which we have made are justified by the elevation itself, in which we think they must be struck, if by nothing else, by the excessive meanness of the state entrance through the centre. That archway is quite dumpy in its proportions, as compared with the other two, and looks all the more so in consequence of the very differently proportioned square-headed passages on its sides. Neither has the architect there provided places for the sentinels, as he might have done, making them both very characteristic and very ornamental features in the building itself, but has left it to the carpenter to put a couple of paltry wooden sentry-boxes to the principal entrance to a royal palace.

According to the scale on the drawing, the whole length of the façade is 350 feet; and height to the top of parapet of the wings 77 feet, and of the centre 84 feet, or to the top of the centre ornament, 100 feet.

CANDIDUS'S NOTE-BOOK.
FASCICULUS LXXIII.

"I must have liberty
Withal, as large a charter as the winds,
To blow on whom I please."

I. There are some others, it seems, quite as free in opinion, and as audacious in speaking it out, as myself. In an article in the "*British Quarterly*," entitled "Modern Painters and Architects," the writer says: "If a truly absurd spire is wanted, we must go the length of Fleet-street, where the stone pagoda dedicated to St. Bride has won the indiscriminate praise of ignorance for a century past. A thing without thought, invention, grace, or any property of mind; but reared as a child does its castle of cards, story above story in monotonous succession—just as many as it will bear." Nor is this all, for it is added in a foot-note below: "Christ's church, Newgate-street, with less monotony than St. Bride's, is a still worse specimen of St. Christopher Wren's belfreys." The writer has, however, the grace—which I have not—to admit that Bow steeple is "a singularly beautiful specimen" of the kind. For "singularly," read "comparatively beautiful," and the praise becomes just.—After all, a steeple does not constitute an entire church, and whatever their steeples may be, the bodies of Wren's churches are so far from possessing any beauty, as to be absolutely uncouth, and utterly negative as to style, although all decidedly partake of one and the same manner. The excuse may be that most of them are in such confined situations, so blocked up by surrounding houses, that very little of the general exteriors can be seen; wherefore to have studied beauty for them would have been study thrown away. The deformity of St. James's, Piccadilly, however, cannot be excused by any such extenuating plea,—and even those who profess to discern such rare beauty and excellence in the interior, are obliged to admit that the exterior is ugly,—not merely a plain, homely structure, for which no architectural pretension is made, but decidedly ugly and a positively disagreeable object. The design is that of a mere builder—or else of a churchwarden.

II. That same master churchwarden reminds me of one thing: speaking of the present "orthodox movement" in church building, it is observed in the article above quoted, that "Ignorant churchwardens no longer go about with their pail of whitewash, beautifying, retrenching, and destroying, according to their notions of taste. Architecture has little that is really valuable, however, to hope for from this ecclesiastical movement, beyond the conservation of what already exists. A spirit of veneration that banishes all thought of originality, *and all hope of progress*, is the utmost that it confers. When it has exhausted its models in the pitiful work of imitative production, what then?—the enfeebled emasculated copyist can only retrograde."—Bravo, "*British*"! Your prediction is in a fair way of being speedily verified. Even the very best of our recent Gothic bears that sort of resemblance to genuine productions of Gothic art during the period of its vitality, which wax-work does to life. At the first glance, the resemblance may be deceptive, but at the next we perceive the thing itself to be a mere semblance, devoid of the living breath of art,—a mere puppet skilfully put together to amuse ecclesiological and antiquarian bigots. Alas! for architecture in such hands and under such influences! While unable to comprehend art,—and at the bottom they are just as matter-of-fact in their ideas as churchwardens, the difference being that their matter-of-fact is of a different and more book-learned kind,—such protectors befriend architecture just as the man in the fable did the horse when it applied to him for assistance, namely, by clapping a saddle on its back and putting a bridle into its mouth. Thus far shalt thou go, say they to architecture, and no further, this way and no other, for it is this way which we know; for it has been formed for us by "our forefathers," and we have duly mapped it out by studying chronicles and precedents. Were we to suffer you to get off from the beaten road, we should of a certainty lose ourselves at once, and what few wits we have would desert us entirely.

III. I must be allowed to help myself to another slice of the "*British*." The writer reproaches the "Oxford divine"! as he calls Mr. Parker, for his total exclusion of Elizabethan architecture from his otherwise ample "Glossary," observing that such exclusion "is a sample of the very partial views that still prevail on all the *great* principles referring to art. The Elizabethan, forsooth, is no style at all, but a mere corruption of the orthodox models that our modern Camdenists worship. In its origin, we admit, it was so, just as the Norman style was the offspring of the corrupt Roman; not altogether in either case, however, by ignorant corruption, but by an adaptation of old architecture to new habits and the wants of the age,—*the legitimate source of all architecture*."—Precious words those last: if architecture has now become incapable of accommodating itself to the ideas, the habits, and the wants of our times, it must be regarded as effete; or if it does not do so merely because it is not permitted, it must be regarded as enslaved,—degraded to the servile and humiliating office of building according to pattern. "But so little is this idea of adaptation of style to purpose understood,"—I am again quoting from the "*British*,"—"that within the brief period of a dozen years, we have seen this same Elizabethan style proposed by a carefully-selected committee of taste, as one of the two alone fit for the halls of legislature, and rejected in the best architectural glossary that exists, as no style at all! It is characteristic of the class which the latter may be considered as representing, that it is not the *architecture alone* of the 13th and 14th centuries which they thus exclusively seek to restore. They are the same reformers who aim at the improvement of the people in the 19th century, by the revival of the maypole, and the manners of 'the good old times;' a spirit that has no onward nor upward gaze; whose golden age lies in the past, and not in the future." Good old times, with a vengeance, were those same times of "our forefathers"—to make use of a canting expression—times not deficient in examples of heroic virtue, but also marked by the most atrocious crimes,—times of spiritual, if not of intellectual darkness,—times whose vaunted piety was composed of arrogant tyrannical priestcraft on the one hand, and of the most grovelling and besotted superstition on the other.

IV. When he was paying a tribute to the artistic talent of Vanbrugh—an architect gifted, if not with taste, with real conceptive power, and that in a prosaic age,—Reynolds might very properly have thrown out a compliment to Hawksmoor, and quoted the campanile of St. George's, Bloomsbury, as a most strikingly happy composition,—one on which the eye of a painter cannot but rest with delight. Happy as it is in itself, that masterly production has been made a martyr—not to criticism, but to stupid ridicule,—to the prosing imbecillity of such old women as Ralph, and the school-boy pertness of such clever coxcombs as Master Horace.—Criticism forsooth!—why criticism rejects such grovelling, feeble-wit stuff, and leaves it to *Punch* and the penny-a-liners. Had he possessed aught of critical faculty, it would have enabled Walpole to perceive how beautifully the statue *poses* upon, how admirably it *completes*, and how essential it is to the artistic completion of the ensemble. It is not an historic statue, elevated to such a height that the personality it is intended to figure to us is utterly lost; nor is it hoisted on a pedestal of its own, clapped upon the top-heavy capital of an overgrown column—a truly unhappy combination, productive of the most harsh abruptness of outline at the general summit. Here, on the contrary, the statue is incorporated with the architectural mass, of which it is the efflorescence, springing out of it as its finial or acroterion, and continuing to a point the lines of the obelisk-shaped part of the structure which it crowns.

V. Though it does not say much for Allan Cunningham's diligence or fitness for the task he undertook, it is perhaps as well that he omitted a memoir of Hawksmoor, for it would, in all probability, have proved little more than a mere re-echo of such senseless judgments as that of him who has pronounced St. George's steeple to be "a masterpiece of absurdity"!—Would that our modern architectural absurdities were but half as poetical, as graceful, and as picturesque! In regard to that stupidly calumniated church, there is another curious fatality, for no one has ever bestowed even so much as a syllable upon its north façade. Indeed, it may be fairly questioned whether it is yet known to exist, for of the thousands who pass the portico, scarcely one, perhaps, suspects that the other side of the building shows a piece of architecture of no ordinary merit—certainly one marked by no ordinary degree of architectural energy; and so far affording an excellent and much-needed study. Still, I may be committing mischief by thus calling attention to what is by no means calculated to put us into better conceit with what has since been done upon any similar occasions. Improved we may have in some respects—such, perhaps, as normal correctness of design, and normal attention to matters of detail; but we seem, on the other hand, to have lost the valuable qualities of boldness and vigour. If we are more refined, we are also more emasculated in our taste, and our buildings show as opera castrati—Buckingham palace being one of the puniest of them—by the side of such architectural "thews and sinews" as Vanbrugh and Hawksmoor put into their works. Unluckily, however, architects seldom look to more than "orders" and other mere matter-of-fact circumstances, without perceiving, or if they perceive, without noting and investigating, artistic qualities—some of them so subtile as to elude satisfactory explanation; consequently, much less are they reducible to exact technical definition. We have, however, only to compare any one of Wren's churches with this of Hawksmoor's, to be able to account for one great difference of quality—the flatness and poorness which set their mark on the former, and the energy of expression which stamps the other. Although not entirely, this difference in a great measure arises from what is a very simple matter in itself, namely, the lesser or greater degree of relief produced according to the shallowness or depth of the external embrasures of the windows—in other words, accordingly as the plane of the glazing is approached to or set back from the plane or external surface of the wall. In the windows of all Wren's churches, there is scarcely any reveal; in Vanbrugh's and Hawksmoor's buildings, great depth of reveal—a difference that does not show itself in geometrical elevation, but which is an exceedingly important and influential one in perspective effect—consequently, in the buildings themselves; for while the former mode is attended by the insipidity arising from the absence of boldly-defining shadows, and of corresponding lights on the opposite sides of the apertures, the other secures them. Besides which, we are impressed in the one case with the disagreeable idea of the walls being unusually thin, while in the other we at once perceive that they are unusually thick and substantial.

VI. The north side or front of St. George's, Bloomsbury, has escaped the notice of architectural draftsmen as completely as it has that of other people; which, to whatever else it may be owing, most certainly cannot be because it would not show well as a subject for the pencil. In that respect, however, it is by no means singular, for hundreds and hundreds of subjects for architectural delineation in the metropolis might be pointed out, which are yet absolutely untouched, although draftsmen go or appear to go again and again to very spots and places where they are to be found. Entirely fresh pictorial representations of them might easily enough be made of buildings which, although they have been shown again and again, are shown almost invariably in just one and the same way, and that their most formal and unpicturesque attitude. Now, it is all very well to have such a general view of a building as serves to exhibit it in mass, but we do not want so many repetitions as we get, of what is identically the same view,—unless, indeed, there be visible improvement also in regard to architectural delineation and artistical effect. Instead of which, deterioration is far more frequent than improvement, and many views of the kind that are published are only wretched, vamped-up copies of better ones which have preceded them.

VII. Many both extol the simplicity of Grecian architecture and speak of simplicity itself in the abstract, as if it were the most excellent and paramount quality in art, and which ought therefore, on every occasion alike, to be the predominating one. Not content with admiring simplicity themselves, they insist not only that others shall admire it too, but that, like themselves, they shall admire it exclusively, and be intolerant of the qualities opposite to it, even though they should be so applied as to be merits. Of Grecian architecture, the simplicity was by far too much of exactly the same kind. The simplicity of one building just resembled the simplicity of another; and, in fact, the simplicity was in a great measure quite involuntary, and of a rather negative kind, arising as it did chiefly out of the absence of complexity, or any other counteracting circumstances. How could it fail to be obtained in buildings constituted like the temples of the Greeks, which admitted of no combination, scarcely any other variations from one uniform general design than as they were tetrastyle, hexastyle, or octastyle, and deriving their individual character entirely from the particular order employed, and the nuancing given to it in its details and execution? As far as we ourselves are concerned, pure Grecian architecture is all very well for us in theory, but not to be thought of by us for actual practice. We may study the Parthenon as we study the Iliad, but would do well to desist from copying the one until we begin seriously to think of imitating the other, and endeavour to bring the lofty Epic strain into fashion again.

VIII. It looks very much as if the decision of the Army and Navy Club had been arrived at in deference to Count D'Orsay's opinion, as expressed by him in a note to the *Builder*, contradicting what had been rumoured as to his being concerned with Messrs. Parnell and Smith's design (No. 46), but expressing his hearty approbation of the design itself—of "the taste which selected one of the most beautiful palaces (palazzi) in Europe for the model," and declaring, that for the embellishment of the metropolis he should very much like to see it executed. It is singular enough, I may remark, that what is "one of the most beautiful" pieces of architecture of its kind in Europe—viz., the Palazzo Cornaro at Venice, by Sansovino, should hitherto have obtained so very little notice—scarcely any at all, beyond the mere mention of its name—from either architectural writers or cognoscenti travellers. Woods, for instance, does not even name it. We ought, therefore, to be the less surprised at the Club's not being struck by its pre-eminent merits, until their eyes were couched by the Count,—and had they discerned them before, they would doubtless have awarded the second premium, at least, to Messrs. Parnell and Smith. All that we ourselves can now recollect of that design is, that we merely glanced at it and passed on, perceiving at once that it was a direct and very palpable copy of some Venetian architect of Sansovino's time; and we wanted not to look at mere copies and leaves out of books, or published designs, but to discover what fresh ideas had been produced for the occasion. In what position, then, do Messrs. P. and S. put themselves, if not in that of mere architectural *transcribers?* And in what position is architectural design now put, except that of mere copyism, to which a bonus is thus directly held out by the success of those who are unable to produce anything sufficiently passable of their own—such, at least, is the very natural inference, because no one who has any power as an artist would voluntarily forego the opportunity of displaying it, and take up with other men's ideas, when he might bring forward his own,—least of all so, when that opportunity is one which does not present itself every day, but is, on the contrary, an exceedingly rare one. Not a little curious it surely is, that of two club-houses, one partly executed and another about to be begun, the designs should be by Jacopo Tatti—or, to give him the name he is more generally known by, Jacopo Sansovino. Not less extraordinary is it, that in what calls itself a Fine Art, wholesale plagiarism of the kind should be practised without so much as any attempt at concealment, just as if it were decidedly meritorious instead of being at all reproachful. To endeavour to appropriate to ourselves the excellencies of former works is not only allowable, but praiseworthy; yet, to be legitimate, such appropriation must be that which results from that thorough study of the original, which enables us to extract from it its better qualities and finer essence, and to infuse them into what the express occasion demands.

HISTORY OF ARCHITECTURE IN GREAT BRITAIN.

A Brief Sketch or Epitome of the Rise and Progress of Architecture in Great Britain. By James Elmes.

"Epitomes are helpful to the memory, and of good private use."
Sir Henry Wotton.

(Continued from page 238.)

Wren's immediate successors were his cotemporary, Sir John Vanbrugh; his friend and colleague, Robert Hooke; his pupil, Nicholas Hawksmoor; Gibbs, who finished the church of St. Clements Danes; and a few others of less notability.

Robert Hooke was the assistant and sometimes rival of Wren, during the greater part of that architect's career. He, like Wren, was an experimental philosopher; like him, had received a doctorial degree, when that honour was conferred only upon men of first-rate talent. To use a theatrical phrase, Hooke may be considered as Wren's double, and took the part of his principal whenever called upon. Hooke added much to the useful inventions of the day, as may be seen in his memoirs by Dr. Waller, and in the cotemporary proceedings of the Royal Society. He appears to have been more of an imitator than an inventor, for when Wren, or any other original genius of the day, brought forward a scheme or an invention, Hooke was always ready with another of a similar nature.

The great and extensive charge which devolved upon Wren after the fire of London, induced him to take to his assistance his ingenious and able associate, Robert Hooke, the learned professor of geometry at Gresham college; whose avocations, under Wren, were chiefly those of measuring, adjusting, and setting out the ground of the houses in the private streets to the several proprietors, while he reserved the higher and more important works of designing and superintending the execution of the public works to himself. Hooke, at the same time, divided the labours and honours of the Royal Society with Boyle, Moray, Wren, and other philosophical members. Among the subjects submitted by Hooke to the Royal Society, were a new method of making bricks, with less charge and more speed than had been then practised, and a design for a collegiate building for the use of the Society, to be built on a site of ground presented to them by their munificent associate, Mr. Howard of Norfolk. This volunteer design did not please the Society, nor did the manner in which Hooke appeared to trench upon his master's ground, for at a meeting of the council on May 4, 1668, the president (Lord Brouncker) moved, that the building of the Society's college might be begun forthwith, and Dr. Wilkins was desired to procure, at the next meeting of the council, Dr. Wren's design for the building.* This was done, and Hooke ordered to get a model made of the approved design, to contract with proper persons for the execution of the work, as also to find someone to be constantly present, and to see the workmen do their duty: thus appointing Wren as architect, Hooke as surveyor and valuer, with a resident clerk of the works.

Of Hooke's repeated invasions into his master's province, abundant proofs are found in the records of the Society, and Wren at last complained of these interferences. Few men had more reason to say *sic vos non vobis* than Wren. Hooke appears throughout to have followed, thrust, and attempted to supersede in the public estimation his friend, patron, and principal, in every thought, invention, and discovery. Not content with his inroads upon Wren's reputation, he dared to impugn the philosophical theories of the then youthful Newton, whose important discoveries were the constant theme of the discussions of that eminent Society of which he had just been admitted a member. It may not be irrelevant to mention in this place, that this greatest of modern philosophers was, at the commencement of his illustrious career, in such straitened circumstances, that it is recorded, in the history of the Royal Society for 1675, that at a meeting of the council, Mr. Oldenburg having mentioned that Mr. Newton had intimated his being in such circumstances, that he desired to be excused from the weekly payments, it was therefore agreed to by the council that it should be dispensed with. Hooke's audacity in impugning the doctrines of our great philosopher is not without its parallel, even in our own times, when the truth of all his theories has been so firmly established. The late Sir Richard Phillips, author of many clever imaginative works, has informed the writer of this article more than once, that all he desired after his death, was to be buried in Westminster Abbey, and to have inscribed upon his tomb—"Here lies the Refuter of Sir Isaac Newton."

Hooke's attempts to supersede Wren have been alluded to. Among the most prominent is that recorded in the transactions of the Royal Society, of his submitting to the council on September 19, 1666, a model for rebuilding the city, with which the Society is said to have been well pleased. It appears that he had previously shown it to the lord mayor and some of the aldermen of the city, as Sir John Laurence, the late lord mayor, addressed himself to the Society, and expressed the lord mayor's (Sir Thomas Bludworth) and aldermen's approbation of the said model, and their desire that it might be shown to the king, they preferring it very much to that which was drawn up by the city surveyor. The president answered, that the Society would be very glad if they or any of their members could do any service for the good of the city; and that Mr. Hooke should wait upon the king with them and his model, if they (the lord mayor and aldermen) thought fit to present it: which was accepted, with expressions of thanks to the Society.

Dr. Waller, in his life of Hooke, affects to wonder why this model was not accepted. The reason was, that the superior and more digested plan of Wren, to say nothing of Evelyn's, had been previously before the king and council. Wren had no opportunity to communicate his design either to the Royal Society or to the city authorities, before it was sent to the king; and it is probable that neither of these bodies had then seen it.

Hooke is believed to have been the architect to the Duke of Montague's house in Bloomsbury, afterwards the British museum, and recently pulled down to make room for Sir Robert Smirke's improvements. Of his authenticated works, the best are the royal Hospital of Bethlehem, which formerly stood on the site now occupied by Finsbury-circus, Moorfields,—and Aske's Hospital, at Hoxton, built and endowed by Sir John Aske, an alderman and past lord mayor of London, for the use of aged and decayed liverymen of the worshipful company of haberdashers, of which he was a liberal and distinguished member. The former of these buildings had a Frenchified palatial look, not in accordance with its destination—a hospital for lunatics; and the latter, a collegiate appearance, with colonnaded ambulatories for the aged inmates, a hall and chapel for their accommodation, and a school for the education of orphan boys of the company, with a handsome statue of its founder in the centre. The style of both these buildings may be seen in the various illustrated histories of London; and a large perspective drawing of Aske's Hospital, by the architect, is among the pictures that decorate the court room of the haberdashers' company, who are the trustees and governors of the hospital. This building has also been pulled down, and its place supplied by one of smaller dimensions, and of less architectural pretensions.

It must be recorded, however, to the honour of Robert Hooke, that he, Boyle, and Wren, formed that illustrious trio of philosophers that paved the way to the important results established by Sir Isaac Newton.

He died, after a long and useful life, on the 3rd of March, 1705, in the 68th year of his age. He was buried in the church of St. Helen, Bishopsgate, and was attended to his resting-place by all the members of the Royal Society who were then in London.

Hawksmoor, the pupil of Wren, one of the most original and inventive architects that England has produced, was born, singular enough, in 1666, the year of the great fire of London. He erected many fine and substantial

* Birch's Hist. Roy. Soc. Vol. II. p. 275.

buildings in the metropolis, and other parts of England, which still remain to prove his skill as a builder, as well as his taste and science as an architect. In his seventeenth year, he was placed as a domestic clerk, or pupil, with Wren. His genius is unquestionable, but his taste not of the most refined order—nearer approaching the bold flights of Vanbrugh than the chastened correctness of his master. His knowledge of every science connected with his art is allowed, and his character has been spoken of, from authority, with commendation. He was deputy-surveyor, under Wren, at the building of Chelsea college, and clerk of the works at Greenwich hospital; in which offices he remained during the reigns of William, Anne, and George I., at Kensington, Whitehall, and St. James's. He was appointed superintending surveyor to all the new churches, and of Westminster abbey after the death of Sir Christopher; and designed many that were erected in pursuance of the statute of Queen Anne, for building fifty new churches.

Hawksmoor's best works are the churches that he built pursuant to the above-named statute: among which are, Christ church, Spitalfields, that was seriously injured a few years since by a destructive fire—but which, owing to the substantial nature of its construction, did comparatively little damage to the body of the fabric;—the church of St. George, Middlesex, called St. George's in the East, to distinguish it from its namesake in Bloomsbury: this is also a large and capacious edifice, with a singular tower, which with its lofty flag-staff, when viewed from the opposite side of the river, looks, amidst the forest of masts with which it appears to be encircled, like a tall ship with its white sails dangling from the topmast;—its neighbour, St. Anne, Limehouse, alike distinguished for originality of design, solidity of construction, and utility of its interior arrangements;—and St. George's, Bloomsbury, which has been condemned by hasty critics, from not falling within their narrow rules of art. This church is a bold, original, and striking composition, built in a masterly and scientific manner, and designed in a masculine style. The interior is commodious, appropriate, and picturesque—worthy of its author, his master, and his school. The portico, of the Corinthian order, is remarkably handsome and well proportioned, and the tower is placed in a judicious and proper situation. The steeple is novel, ingenious, and picturesque; and the statue of George I., in spite of the epigram, looks like the father of his people, surveying his good city with complacency, and holding forth his protecting hand over it. Nor must his beautiful church of St. Mary Woolnoth, Lombard-street, be forgotten. Its exterior is singularly substantial and well proportioned; its twin towers, resembling, in application only, those of some of our Gothic cathedrals, look particularly striking from Mansion-house-street, since the destruction of the old houses by which it was formerly surrounded, and the opening of the vista of King William-street, to which it forms a beautiful architectural foreground. The interior is well arranged for the service of the Anglican church, and is characterised by a most happy union of elegance and substantiality. The proportions of the Corinthian order that support the richly-panelled roof and coffred ceiling are scarcely inferior to those in the interior of Wren's masterpiece—St. Stephen's, Walbrook. A correct and well-engraved plan and section of this church are given in Britton and Pugin's 8vo. work of "London Edifices."

Hawksmoor also rebuilt part of All Souls college, Oxford, but, I believe, from Wren's designs; as also the mansion of Easton Neston, in Northamptonshire; restored a defect in Beverley minster with great skill; and repaired the west end of Westminster abbey in a judicious manner: and at Blenheim and Castle Howard was associated with Vanbrugh. He died in March, 1736, in nearly his seventieth year.

The witty, but too often indecent, Vanbrugh, of whom Pope says—

> "Van wanted grace, but never wanted wit,"

contributed in a considerable degree to the architectural reputation, as well as the dramatic literature, of his country. Blessed with considerable talents, good education, and manners deteriorated by a profligate age, Vanbrugh figured as a gentleman, a dramatic author, a builder and manager of theatres, a herald, and a would-be engineer. Swift ridiculed this latter propensity and his ludicrous imitation of a fortified residence in his Vanbrugh castle, Greenwich, by saying, that he expected the queen (Anne) would

> "make next year
> A mousetrap-man chief engineer."

In 1696, shortly after the commencement of Greenwich hospital, Vanbrugh was appointed secretary to the commissioners, on the nomination of Mr. Evelyn. In 1716, he was appointed surveyor of the works at Greenwich hospital, comptroller general of his majesty's works, and surveyor of the gardens and waters: thus superseding his illustrious predecessor, who was still in the full possession of his faculties. This was not the only insult that this eminent architect had to encounter, at a time when bribery and corruption existed in a greater degree than ever before known in English history. Mr. Ker, of Kersland in Scotland, asserts in his autobiography, that "it is very well known that Mr. Benson was a favourite of the Germans; and I believe nobody had more occasion to be convinced of the power of this influence than myself: so great, indeed, that Sir Christopher Wren, the famous architect who contrived the stately edifice of St. Paul's church, and finished it in his own time, was turned out of his employment of being master of the King's works, which he had possessed with great reputation ever since the Restoration, to make way for this favourite of foreigners." The influence of Benson over the king and his German advisers, obtained by means to which Wren could not stoop, was so great, that even Walpole, who resisted, with just indignation, an open offer of a large sum, which Benson made to the minister for a place for his son, was obliged to succumb to this back-stairs influence.

Benson and Vanbrugh were thus in full possession of Wren's offices, the principal of which Wren had held, with unparalleled honour and abilities, for nearly half a century. But what a contrast did these disgraceful transactions present! Benson held the situation scarcely a twelvemonth, with unexampled incapacity, and was disgraced by an ignominious expulsion from his office to avoid a prosecution, and by an immortality in the "Dunciad;" while Wren retired to a peaceful home at Hampton Court.

In the first edition of the "Dunciad," this architectural empiric is thus celebrated:—

> "Beneath his reign shall Eusden wear the bays,
> Cibber preside Lord Chancellor of plays,
> BENSON sole judge of architecture sit,
> And namby-pamby be preferr'd for wit."

In the subsequent editions the poet altered these lines to—

> "See, see, our own true Phœbus wears the bays!
> Our Midas sits Lord Chancellor of plays!
> On poets' tombs see BENSON's titles writ!
> Lo! Ambrose Phillips is preferr'd for wit!"

And in a note he adds—"In favour of this man, the famous Sir Christopher Wren, who had been architect to the crown for above fifty years, who built most of the churches in London, laid the first stone of St. Paul's, and lived to finish it, had been displaced from his employment at the age of near ninety years."

But of Wren our great poet says:—

> "See under Ripley rise a new Whitehall,
> While Jones' and Boyle's united labours fall;
> While WREN with sorrow to the grave descends,
> Gay dies unpension'd with a hundred friends."

Vanbrugh built the first theatre in the Haymarket, and managed it conjointly with Congreve. It is singular that this theatre has been rebuilt by the late John Nash, himself an actor, manager, and architect. An eminent comedian of the present day, who was originally an architect and joint surveyor to a public company with the author of this article, before he had quite abandoned his former profession, requested him to state in his "Life of Wren," as an apology for his uniting the two professions, that in addition to Vanbrugh and Nash, might be added the name of our great English Vitruvius, as being an actor as well as an architect. He informed me that in an old quarto play, translated from the "Plutus" of Aristophanes, is the following manuscript remark, in the handwriting, and with the signature, of Isaac Reid, the commentator:—"This is the play in which Sir Christopher Wren, our great English architect, performed the character of *Neanias*, before the Elector Palatine, Dr. Seth Ward, and many others, probably in 1652."

The works of Vanbrugh are solid and judicious; but he neglected the lighter graces of his art, and is, in spite of all his picturesque beauties, cumbrous and inelegant in detail. Swift's epigram on this architect is well, and in some instances he merited the satirist's

> "Lie heavy on him, earth, for he
> Laid many a heavy load on thee."

There is, however, another version in a rather better spirit, and more like the *sit levis* of the ancient Romans, and is

> "Lie *light* upon him, earth, though he
> Laid many a heavy load on thee."

Yet, Castle Howard and Blenheim will keep alive the memory of the witty and accomplished Vanbrugh among those of our greatest architects. A fair specimen of his picturesque and singular style may be gathered from his own house near the Privy-gardens, which was also a subject of Swift's satire, who compared it to a dirt pie heaped up by children.

Sir Joshua Reynolds, in his inimitable discourses on painting, gives great and deserved praise to the artist-like compositions of this architect, particularly as to his mode of making his buildings rise from the earth with judicious basements—not breaking abruptly from it, as if it had no foundation or connexion with the plot upon which it stands.

Vanbrugh was a bold and erratic genius in his art, picturesque and poetical in his imagination; rather resembling the painter-architects of Henry the Eighth's time, than a follower of Palladio, Jones, or Wren. Blenheim, near Woodstock in Oxfordshire, one of the best of his works, and the most characteristic of his peculiar style, was begun in 1705. It was intended as a tribute of a grateful nation to their illustrious soldier, but servile intriguer, the Duke of Marlborough, and was named after the greatest of his victories. The secret history of this transaction forms an amusing feature in D'Israeli's "Anecdotes of Literature;" but appertains more to the political intrigues than to the architectural history of our country.

In this period arose those prominent ornaments of our metropolis, the churches of St. Mary-le-Strand and St. Martin's in the Fields, from the designs of James Gibbs, who also finished that of St. Clements Danes, begun by Wren. Gibbs was an architect of the school of Wren, but affected by laborious detail and superabundance of ornament—as may be seen in his works, particularly in the interior of the church of St. Martin—what Wren accomplished by more simple and scientific means. The exterior of St. Mary-le-Strand is of two orders in height, which presupposes two stories to the interior—a fault committed by Jones in his Banqueting-house, Whitehall; and by Wren in his St. Paul's cathedral. The former has for an apology, that his building was part and parcel of an enormous palace, and corresponded with such portions of it that had two stories, and this required the omission of one for height in the interior. For Wren it may be said, that his two stories of coupled columns in the western front, have nearly the same proportions of one; and that viewing his cathedral from a distance—the best position for seeing its beauties—the lower order is entirely concealed from view by the houses that surround it. The circular portico in the western front of Gibbs's church in the Strand, is a palpable and clumsy imitation of Wren's beautiful semi-rotunda to the north and south transepts of St. Paul's. The summit of its cupola was to have been surmounted by a farthingaled statue of Queen Anne, somewhat like that horrible monstrosity in St. Paul's churchyard, for which was substituted the present funereal vase.

The exterior of St. Martin's in the Fields is in a bolder style and purer taste. The columns *in antis*, or, to speak less technically, the columns between the antæ or pilasters, that form the retrocessed porticoes of the north and south aisles, are both novel and effective; and the Corinthian hexastyle portico of the western end would be unexceptionable, were it not for the cumbrous steeple that bears down its apex. No such monstrosity disfigures any of Wren's churches, whose steeples always rise from external and visible towers. The interior looks fine from a redundancy of ornament—divested of which, it would degenerate into common-place. It is, however, a large and commodious edifice, well adapted to the parochial church service of the establishment; the arrangement of which, Chambers did not disdain to imitate in his German Lutheran church in the Savoy, near Waterloo bridge.

Of Gibbs's other work, the Ratcliffe library, Oxford, it can only be called a practical blunder; for devoid of the necessary scientific skill in construction that is requisite to complete the character of an architect, he intended to have executed the cupola with stone, but it would not stand: it was obliged, therefore, to be taken down and to be built of lath and plaster.

Gibbs published a treatise on the "Elements of Architecture," which possesses nothing new, and is to be considered more as a student's guide to drawing the five orders of Italian architecture according to that master's proportions—which are not sufficiently correct to be considered as models—than a treatise on the art of which he aspires to be a teacher.

The state of architecture at the end of the reign of George II., and for some time previous thereto, had been as low as at almost any period of the English history. From the death of Kent and the great Earl of Burlington, two accomplished architects of the Anglo-Palladian school, to the commencement of the reign of George III., we have no account of any native architect worthy of notice. The profession seemed almost to have been lost; and new buildings, repairs, and alterations, to have been performed by that anomalous being, that sort of uno-dual mixture of artist and artisan, the building surveyor, or surveyor and builder, as he generally termed himself.

The school of architects which ended with Hawksmoor, had left no disciples, and the only one who can lay claim to the name was Archer, whom Walpole describes as holding the office of groom-porter in the royal palaces. The church of St. John the Evangelist, Westminster, which has been falsely attributed to Vanbrugh, is characterised by a bold originality in its quadrifrontal form, of an Italian-Doric order, surmounted by four Corinthian turrets. It has been ludicrously compared by Swift, or some other satirist, to an elephant on its back, or a huge butcher's block reversed, with its clumsy legs rising upwards. But had it been finished as intended, with a lofty cupola or lantern in the centre, it would have had a different and perhaps a good effect.

As an example of the state of architecture and its patrons at this period, may be cited the fact, that when the corporation of London proposed building a mansion-house for the official residence of their lord mayors, Lord Burlington submitted to them an elegant design by Palladio, which the citizens rejected as being the work of a foreigner and a papist, and executed the present building from a design of the elder Mr. Dance, who was both a citizen and a Protestant. This architect has been said to have been originally a ship-builder, and the two lofty attics that were formerly over the Egyptian-hall and the ball-room have been sarcastically compared, from this circumstance, to the bulk-heads or poops of a deeply-laden Indiaman. The plan is well arranged for the purposes it was built for; some of the apartments are magnificent, though somewhat heavy in style, and there is no feature in any part of it but what may be traced to some of the then existing books on Italian architecture. The Corinthian orders of the portico and of the Egyptian-hall have more the character of the Stadt-house at Amsterdam, than those of any of the fair cities of Italy; and the whole building bears more affinity to the Batavian than to the Italian style of architecture.

Dance was, however, a man of some genius, and exhibited much skill in his churches of Bishopsgate and Shoreditch. The Roman-Doric portico of the latter is as well proportioned and as happily applied as any similar structure in the metropolis. The spire, though inelegantly placed behind the portico, which occasions its tower or basement to be hidden, and gives it the appearance of being mounted on the roof, is a free and successful imitation of Wren's St. Mary-le-Bow, and is one of the handsomest spires in London, The deeply indented scotia that supports the terminating obelisk is boldly original, is productive of a fine effect, and could only have been executed by a man of science. The bodies of both these churches present the appearance that their author had studied his Vitruvius in a Dutch translation.

Hogarth has satirised the want of architectural taste in England at this period in one of his inimitable pictures of *Marriage à la Mode*, where the portico of the mansion in progress for the noble father of the bridegroom, is formed of five columns, the middle one being under the apex of the pediment. The satirist little dreamt that his pointed ridicule would find an imitator, yet it is so, for the architect, if so he may be called, of Bedford-square, has on two of its sides perpetrated the atrocity of a sham portico of five attached pilasters, the middle one being after the mode of Hogarth's architect—under the apex of the pediment.

Batty Langley who flourished about this time, had a school or academy of architecture, but his disciples were all carpenters; and although his taste as an architect was deservedly derided, he formed a school of excellent workmen, and gave form to many a skilful artisan in a certain line of art.

Emlyn, in an after age, attempted the forlorn hope of inventing a new order of architecture, as if those of Greece and Rome and Italy were not sufficient for the grasp of his capacious mind. He used oak leaves instead of acanthus or parsley for foliage, the star of the order of the garter for the rosette between the volutes; the shaft was single, one-third of its height, where it divided itself into two, like a forked elm, and terminated of course with twin capitals. He was permitted to dedicate his book, entitled "Emlyn's New Order of Architecture," to George III., who with that good nature which always characterised that monarch's patronage of artists, allowed him to execute a specimen of his biforked "*British order*," at Windsor: but I believe it has been removed.

Batty Langley however soared higher, for he published his invention of no fewer than five new orders, namely, *The Gothic Tuscan! The Gothic Doric!! The Gothic Ionic!!! The Gothic Corinthian!!!!* and *The Gothic Composite!!!!!* The principal novelties were making the shafts of the columns treble, quadruple, and quintuple, clustered and banded like the pillars of our ancient cathedrals, making the tops of the triglyphs pointed like lancet windows, the friezes coved and filled with frets, and other equal absurd alterations. Some specimens of these "*Gothic orders of my invention*" were, and perhaps are, to be seen in a street near the north-east corner of St. James's-park,—Fludyer-street, I think.

During this state of transition, several elegant and substantial mansions of considerable dimensions were erected in various parts of the country. Wanstead-house, a splendid edifice, with a magnificent Corinthian portico and extensive wings, worthy the name of a palace, was built by the opulent and plebeian family of the Longs; and has since been torn down, its pictures, statues, and materials sold, and the park disforested of its lofty oaks, by an aristocratic parvenu, who married and illtreated the last heiress of the Tilney Longs. Harewood-house, near Leeds, in Yorkshire, one of the residences of the noble family of Lascelles, is a fine imitation, without being a servile copy of the mansion at Wanstead, but with the advantages of a fine situation, and of being surrounded by a truly princely demesne, and commanding some of the finest views in the country. The mansion of the late Sir Gregory Page, at Blackheath, a truly Palladian villa, on a vast scale, was too extensive for the fortunes of his successors, and met the fate of Wanstead-house. Some others, possessing no originality of character, were erected about this time some of them from the designs of Giovano Battista Leoni, an Italian architect of skill and taste: the best of these are recorded, with plans, elevations, and sections, in the "Vitruvius Britannicus" of Colin Campbell, himself an architect of industry and talent.

Such was the state of architecture when George III. ascended the throne of his German ancestors, neither of whom loved art or literature, and one of whom could see no merit in the transcendant works of Hogarth, and abused him for ridiculing, as he said, his German guards in the celebrated picture of "The march to Finchley;" this offence the painter revenged by dedicating the print to Frederick the Great of Prussia. Nor could he discover any genius in Garrick, but talked German and took snuff while the British Roscius was illustrating Shakspeare's Richard the Third; but rose, commanded silence, and made an obeisance to the low-comedy actor who personated the lord mayor, saying, "Gentlemen, we must pay respect to my lord mayor." Such were the military goths who had the art, literature, and science of the kingdom, in an enlightened age, at their command.

Frederic, Prince of Wales, father of George III. received an English education, was a mild gentlemanly man of no great abilities, but possessed a real love for the amenities of literature and art. He patronised Thomson and Gay, and his little court was divested of the rougher manners of his father's. He was upon ill terms with his father, did not live happily with his wife, a princess of coarse mind and manners, and died young. The education of his son was thus left to the care of his mother, who neglected the more solid parts of his studies, and applied the money entrusted to her for that purpose to her own pleasures.

King George III., fortunately for the arts, and particularly architecture, was endowed with an innate love for such pursuits which soften and improve the human mind. He was also well acquainted, for a prince, with both the theory and practice of the graphic arts. When Prince of Wales, he studied architecture, under Mr. Chambers, and was taught to delineate its proportions with accuracy from the rules of Palladio and Vitruvius. From the before-mentioned circumstances, there was no Englishman who practised architecture as a profession. Chambers, who had been a naval officer, was partial to the art, and had travelled in countries where architecture was better understood than in England. The young Prince also studied the science of perspective, under Mr. William Kirby, whose practical work, founded on the theories of Dr. Brook Taylor, was formerly in much esteem, and has obtained great celebrity from Hogarth's sarcastic frontispiece of faults likely to occur from the want of a knowledge of that science. Prince George contributed, it is said, a design for his tutor's work; and his drawings are reported, by persons who had seen them, and they were extant in the royal library in the late Buckingham-house a few years since, to have been correct in detail, and, for their day and style of art, tasteful and elegant.

George III. ascended the throne of Great Britain with more advantages than most of his predecessors. Born and educated an Englishman, he gloried, as he said in his first speech from the throne, in the name of a Briton. Unpractised in the cruel scenes of warfare, he had been bred in peaceful retirement—perhaps too recluse for the government of a nation then involved in such momentous transactions. He loved art, was fond of literature, particularly that of his own country, was slightly skilled in music, and read Shakspeare with propriety and enthusiasm. A speech from the throne, delivered in correct and elegant English, was a novelty unknown to almost all its auditors. The exclamation of Quin, the tragedian, who had been his master in elocution, and was admitted to a place in the House of Lords to witness the debut of his royal pupil, of "Bravo! I taught the boy," was more sincere than courtly. Artists and literary men were no longer huffed for their intrusion into the palace, nor debarred the royal presence. Chambers was appointed to the office of royal architect. Ramsay, a well known portrait painter, was employed to depict the youthful sovereign and his consort; other artists and their interests were attended to, and the management of the academy, or association of artists, in St. Martin's-lane, began by Hogarth, Thornhill, and others, was patronised, and its concerns investigated. The king concerned himself even with their little quarrels, and suggested measures for the enlargement of its utility; it being then merely a school of adult artists, for the study of the human figure, and not an academy of the fine arts, which the king desired to see established in England. It had, however, its series of annual public exhibitions of the works of its members, which the king duly honoured regularly with his presence.

Chambers, from the circumstance of being the royal architect, and repairs and additions to the royal palaces being necessary, had more interviews with his royal master than others; and their former relations of master and pupil, had given more than usual freedom of intercourse to these interviews. The king designed to establish a Royal Academy of painting, sculpture, and architecture, upon the plan of those founded by the illustrious Colbert and Cardinal Richelieu in France, and to build a palace for its occupation. The king entered into this grand project, and Chambers became the organ of communication between him and the leading artists of the day upon this important subject.

Having now adopted architecture as a profession, and being a Chevalier of the order of the Polar Star, his royal master honoured him with English knighthood, when such an honour was more rare than in later days. Hence the origin of the Royal Academy of the fine arts and the building of Somerset-house.

Sir William Chambers threw no new lights on the art over which he was destined to preside. In its practice and more scientific department of construction he was, comparatively with such men as Wren and Hawksmoor, totally ignorant. His taste was Roman, and, being unacquainted with the sublimer beauties of Grecian art, was consequently less refined; yet his works have a chastened correctness of detail of the best style of Italian art. He is less exuberant than Scamozzi, Serlio, and Borromini, and even than Palladio himself, except in his very best examples. He may be called the *Palladio riformato* of the Georgian era. In the course of his travels he had visited parts of China, and published a treatise on the gardening and architecture of that strange people. The royal gardens of Kew and its lofty pagoda are among the results of the Chinese phantasy that he had inflicted on his royal master, and led to the introduction of that fanciful and inelegant style. Yet the Somerset-house of this architect has many redeeming beauties, and his work on "Civil Architecture," in spite of bad taste in reviling the architecture of ancient Greece, of which he knew nothing, abounds with sound doctrines, and is the best elementary work that we possess. A new edition, remarkably well edited by the late John Buonarotti Papworth, whose recent death, full of years and honour, the profession have to deplore, was published a few years since, and also a smaller one, with a treatise on "Grecian Architecture," by Mr. Joseph Gwilt.

The establishment of the Royal Academy by George III. is the next great epoch in the arts of this country, after the fire of London, and will form the subject of the next section.

(To be continued.)

RAILWAY LEGISLATION, ACCIDENTS, AND INSPECTION.

A paper was published some short time ago, to show that if it had not been for the operation of prejudice, we might have been in as full possession of the railway system in 1817 as 1847, and that we had spent some half century in keeping back and thwarting improvements. Much the same kind of thing might be said of railway legislation: at this date we are fighting for the same points as we have been for years. Surely no bantling ever suffered so much from officious nurses than has the railway system; never were bandages, rollers, and go-carts more unmercifully applied to hinder, under the name of fostering, growth.

The pages of our *Journal* will show that we have always stood up against all legislative and government interference with any form of engineering enterprise. If this be a prejudice, we are quite willing to own it, and stand by it, and we have held most unflinchingly to it. It happens, however, that if we have stuck to a prejudice, our opponents have not fared in the least well with their several legislative and inspectional measures; and we are at this late hour strengthened in our views by their ill-success, which they have on many occasions acknowledged. At all events, then, they cannot say that experience has been against us, whatever they may choose to say and think about the soundness of our theories.

We believe by this time everything has been planned and tried about the railway system, except letting it alone, but we very much fear this is the only experiment with it that will never be tried. It is, nevertheless, one encouragement to persevere, to us and other friends of non-intervention, that the experience as to railways, and the enlarged experience of every similar establishment and institution, results in confirming the propriety of our convictions.

In the teeth of the truism, that all human undertakings are fallible and all new undertakings imperfect, no allowance is made for the railway system, but every accident is seized hold to authorise its condemnation and restraint. The result of such interference has never been followed out, but a careful examination of railway accidents from the first returns would show, that while many accidents are due to carelessness beyond the control of any authority, still more are due to the progressive condition of the railway system, and still more to the attempts for the prevention of accident. Luggage trucks used at first to be put between the passenger carriages and the engine, to provide against the possibility of injury from explosion of the engine. A train having been run into from behind, the luggage and goods trucks were then, on the demand of the public, put behind. This was followed by an accident, from a train being injured from the front. The public then required trucks to be put fore and aft. Notwithstanding this, a train was cut in halves at a junction.

In order to give stability to the trains, it was an early practice to mix goods and passengers. This was, on the public voice, given up, but there was a demand for empty horse-boxes and luggage vans to be mixed with the trains for safety. We believe these have been the cause of very many accidents, from their unequal weight and construction leading to their being thrown off the way, and to the passenger carriages riding upon them.

From the public demand for signals, signal-men, and pointsmen, has resulted certainly no greater safety, but certainly many more accidents from neglect of signals.

While the jumble of passenger carriages, trucks, and horse-boxes might do very well for the 20-mile-an-hour speed of 1836, it is very unsuited for the 50-mile-an-hour speed of 1847. A new system must require new safeguards, and to no one can the care of these be more properly entrusted than to railway managers.

As non-interference seems to us the best mode of legislating for railways, so railway managers seem to us to constitute the best and only safeguard against accident, and the only one on which no reliance has been placed. It cannot now be very well denied, that a railway accident, whomsoever else it may affect, inflicts a certain, and nearly always a very heavy, loss upon the railway company, exposes the directors to very great odium, blame, and misrepresentation on the part of the public press, and subjects railway officers to the fear of losing their appointments. Pecuniary and moral responsibility of this kind is what our institutions teach us to rely upon in every other case, but the word "railway" has the magic power of shaking our convictions and our prejudices and banishing our common-sense. It is contended that railways are only to be treated by exceptional law, and this has only to be asserted to be allowed,—so much the worse.

To find out the means of avoiding accident is to find out a means of saving money, and this is a further inducement, which affects railway managers and no other parties. The time is not so far back when the engine-drivers on the newly-opened railways were ignorant, drunken, brutal, ill-conducted, and desperate barbarians from the coalpits of the north of England, who were extravagantly paid, and who were under no restraint. It is well known that having no fear of death, they have purposely risked accidents for the sake of the fun, as they esteemed it, whereby human life was perilled and property injured and wasted. Fines they paid by common contribution from their large wages,—criminal punishments had no terrors for those whom death and danger did not scare. As to dismissal, it was only a change of employment—perhaps at higher wages. The man who was dismissed from an old line went to a new one; and after having made the tour of England, accepted higher wages abroad. More enginemen were wanted than could be found, and, though wages were so high, respectable men could not be got to enlist themselves in a body the members of which were so desperate, the nature of which was then so hazardous, and which the legislature were called upon to brand with a special penal code.

Thus the lives of passengers and the property of the companies were fully and truly at the mercy of a set of desperadoes. This is language which is strange now, but which was that of the press only a few years ago. The companies exerted themselves, they gradually trained a better conducted body of men, and they have now engine-drivers more intelligent and more trustworthy, at very much less than the wages which they then paid. The saving to the companies under this head is very great; so is the consequent saving which they have been able to effect in the consumption of fuel and the wear and tear of the working stock. All this is over and above the greater freedom from accident.

It seems strange to look back and peruse the virulent attacks and abuse which were lavished on railway directors at the time of which we are speaking, and the *Times* did not forget to demand that directors should be made criminally responsible for the engine-drivers. We believe there was but a very narrow escape from a Draconian code, whereby railway directors, officers, and engine-drivers would have been left open to criminal pains and penalties. This is an *ultima ratio* for railway abuses which is a great favourite now, though how it would work it needs no great cleverness to foretell. The office of a railway director at the present moment is one of much more honour and vanity than emolument—sometimes nothing a year and a vote of censure being the salary, but most frequently the liberal sum of fifty or a hundred pounds a year; which latter is, we believe, the sum forming the civil list of a railway king.

The establishment of a body of gentlemen, who are not to be well paid nor to be greatly honoured, but who are to be marked out for the application of the most hateful criminal proceedings for acts and persons beyond their control, would be a novelty in English society. What class of persons would succeed members of the legislature as railway chairmen and directors, we do not pretend to say: we only know that the present class of directors would retire, and that a lower class would take their places. The nearest model we can get of the effect of such legislation is supplied by the newspaper press, wherein the wisdom of parliament has so hedged the proprietorship with criminal liabilities, that it is most rare for the real proprietor to be registered and published, and an ingenious deceit is practised which would do credit to China. In some provinces of that enlightened empire, substitutes are to be obtained for the price of seventeen pounds in hard money, who will undergo the penalty of death or the greatest tortures; and, in England, the Attorney-General is fain to content himself with a substitute, who, for a given consideration, will consent to be fined in the Exchequer, or sentenced to imprisonment in the Old Bailey. Instead of the class of newspaper proprietors being raised by the presence of Sir John Easthope, Bart. M.P., or John Walter, Esq. M.P., whose public character and responsibility might be brought publicly to bear, the legislature has effectually provided that public and personal standing shall be of no value, and a virtual protection shall be given to the libeller and scandalmonger, for whom under no circumstances has the law any terror, and whose calumnies now only have power, because personal character is allowed to be of no weight in the decision. The same results would attend the application of criminal responsibilities to railway directorship, and the least of all consequences of such ill-advised legislation would be the substitution of men of straw for men of character and responsibility.

What benefit has resulted from Board-of-Trade-inspection we do not know, and we are hardly aware that the inspectors put forward any very prominent claim. Indeed, so small is the appreciable benefit, that we apprehend the days of railway inspection are numbered, and that many years will not elapse before it becomes obsolete. We have an example of this in gas inspection. It is singular that the progress of the steam-packet, gas, and the locomotive engine, was impeded by explosions at an early date. The blowing-up of one of his first engines in Wales was the true cause why Trevithick's locomotive remained unused, and it was charged with the two faults of a dangerous construction and a want of bite, which in the present day do not present themselves as common objects of fear. The dangerous explosion of a locomotive is now one of the least-known causes of accident, and two cases only have, we believe, occurred of late years—one in the United States, and one on the Sheffield and Manchester Railway. The blowing-up of one of the first steamboats gave this mode of conveyance the character of great danger; and those who remember the defective construction of the boats which first ran on the Thames, can bear witness to their clumsiness and liability to derangement. Within two years of the establishment of a gas company in London, a gasometer blew up with a terrific explosion, and so much were the public alarmed at the seeming hazards of these magazines of dangerous combustible, that an act was passed, which is we believe still unrepealed, placing very great restrictions on gas companies, and requiring them to comply with certain regulations and to undergo a government inspection, before they were allowed to open their works.

Whereas the Board of Trade now claim to be the inspecting department over public establishments, the Home Department was the one at that time to which the gas companies were subjected, and in conformity with the same predilections which now rule at Whitehall, a military officer was appointed as inspector-general. Thr first inspector-general of gas-works was the celebrated and ingenious Sir William Congreve, but, except as the means of giving large fees to the gallant general, the inspection, even in his hands, became quite a nullity, and we believe that since his death, no inspector-general of gas-works has been appointed; and at the present day, no one knows anything of the safeguard of gas inspection or places any faith in it, while the explosion of gasometers is so rare that it is not thought of.

If steamboats and gas-works are now able to do tolerably well without inspection, and are daily brought nearer to absolute safety, it may be expected, by cool-minded men, that in due time railways may likewise be able to do without inspection. As, too, so many public establishments have been formed and matured without public inspection, we can see nothing so peculiar in railway undertakings as to prevent them from advancing to perfection without government help.

At any rate, the present inspection is fruitless and unsatisfactory. The only person who has been able to find any kind of utility in it has been *Punch*, who says that when an accident takes place, and the public mind is in great alarm, General Pasley or Captain Coddington is sent down, and makes a report, complimenting everybody and everything, and showing that nobody is to blame; and thereupon the public terror is quieted. Certainly the inspectors' reports contain nothing else, and it would be vain to seek in them for any practical suggestion or any original contribution.

Whether this state of affairs is attributable to the employment of military engineers we do not allege, but, nevertheless, whatever value we may attach to our mililitary brethren in their own department, we cannot, either *à priori* or from any acquaintance with their actions, place any faith in their civil capabilities. We very early pointed out the consequences of putting officers of the Royal Engineers in a false position, and pitting them in an unequal contest with the heads of the engineering profession here, who are acknowledged to be the greatest civil engineers in the world. Civil engineers have exercised the greatest forbearance under the insult to which they have been exposed, of the intrusion among them of incompetent persons; but opportunities have necessarily arisen, in which eminent men in this country have been compelled to express their contempt for the judgment and attainments of the government functionaries. General Pasley, who, among all the proceedings of the Board of Trade, has remained exempt from the suspicion of corrupt motives, and whose character as a highly honourable and well-intentioned man, secure for him personal respect, has lately, by an officious interposition on the subject of the Menai Bridge, laid himself open to the observation of Mr. Robert Stephenson, that he does not know anything about the plan, to which the General supposes he offers insurmountable objections.

One objection we made in the first instance to the appointment of government officials, was the impossibility of government paying an adequate salary to secure the services of individuals against the competition of private enterprise. Sir Charles Pasley being a general no one of course wants, and Mr. G. R. Porter is content to be promoted to Mr. Macgregor's place as joint secretary to the Board of Trade; but most of the other parties attached to the railway department have passed over to the side of the companies. The celebrated Mr. Samuel Laing, who concocted the whole system of aggression on railways, and who was the ambitious spirit of the Board of Trade, has for some time been a flourishing railway parliamentary counsel, and is the author of a pamphlet against the railway department. Captain O'Brien is a railway man; Sir Frederick Smith is still, we believe, chairman of the Belgian Eastern Junction Railway, and we think in directorship; Captain Coddington has accepted the managership of a railway. The time is perhaps not far distant, when the Railway Board being disbanded, the Right Honourable Edward Strutt, M.P., may succeed the Right Honourable George Hudson, M.P., in a chairmanship;—nay, who knows but in time, when he has seen a railway, and gets to know something as to what it is, the Right Honourable Sir Edward Ryan may be elected to a seat at some board? These things would not be more extraordinary than Mr. Laing writing pamphlets against the Board of Trade.

In the men of the Railway Board we have no confidence, and in their measures no more; and we are very little disposed to trust a progressive institution like railways to their mercies. In a new age we have got a new experience to learn, and we must have time to learn it. The only thing we have to fear is lest, by our prejudices and our ill-timed meddling, we keep back the benefits which are tendered for our enjoyment. We have kept back railways and we have kept back electric telegraphs, but we are still on the verge of enjoying a vast extension of the resources of science. This year the telegraph will speak with its lightning tongue to the ends of the land; the word which is said in London shall in the same time be known in the great cities of the island, and shall meet with its instant answer from beyond the utmost limits of the hearing or gaze of man. The electric telegraph will be claimed by the same despots as the railway; gentle dulness will find evils in the telegraph which demand its chastening care, and the concessions in railway inspection will be urged as a reason for placing our correspondence under the same inquisitorial regime.

The effects of the electric telegraph prudence forbids us to limit or assign, but it is evident a very great change must be produced in our habits and associations. Not only must the whole range of commercial transactions be affected, but even the operations of the law must be modified. It may be questioned whether, in the present state of jurisprudence, the beneficial use of the telegraph in arresting the course of criminals be not illegal, for it must often involve the absence of a writ or trespass on a jurisdiction. We leave it to the lawyers to determine what form of writ and what form of service they will adapt to the electric telegraph, in what manner a Master in Chancery in Southampton-buildings shall take the examination of a party at Liverpool, or how a Telegraph Affidavit Office is to be organised in Paper-buildings, Temple; but they are very likely to be called upon to provide for a new state of circumstances, caused by the revolutionary influence of the telegraph.

We cannot but think it fortunate in every respect that the monstrous Railway Bill of 1847 was not carried, for it would have greatly aggravated the difficulties which now beset railway enterprise. How it can have been brought forward in a country claiming to have a great school of political economy seems wonderful, still more so that it should have received the sanction of a department, which claims to be the scientific political department, and boasts of Huskisson, Lord Sydenham, Deacon Hume, Macgregor, and Porter. We know no greater slur on the political economy of this country than the series of railway bills, and we fear that it is to be attributed to the sacrifice of political principles to personal ambition. The foundation of political economy as applied to trade is the doctrine of non-interference, which is violated by every railway bill.

The provisions of the Janissary Bill of 1847 were intended to improve railway administration, and to prevent undue speculation: the result would have been to diminish directorial responsibility, and to favour the operations of stags. Of all provisions, that immediately affecting the surveys is the one, which coming in our own line, most interests us, and we are able to affirm that nothing could work worse. To require the deposit of 200*l.* a mile in addition to the other exactions would have the exact effect of injuring many good undertakings, of impeding all during times of commercial distress, and of promoting the views of the stags in times of speculation. The demand of any deposit as a security for the *bonâ fide* origination of an undertaking is a fallacy, which has nothing but the imagination of its inventors to give it countenance. It is evident that during any tightness of the money market the enforcement of a deposit must act as a strong check; but then it touches good undertakings as well as bad. In a time of speculation, whether the deposit be 5 per cent., 10 per cent., 50 per cent., or cent. per cent., it is perfectly immaterial, so far as the possibility of raising it is concerned, and the unfortunate experience of 1825, before the time of railway manias, proves this. It makes a great difference to the projectors how much they can get into their hands to spend, but it makes no difference to the speculators, who are imagined to furnish the deposit, as the deposit, in a financial point of view, is for the most part fictitious.

The famous deposits of 1845, which were used by the *Times* as such a bugbear, involved only a few changes of figures in the bankers' books, and it may be said that they never were in existence. Even of those sums which got into the hands of projectors, the whole was not wasted, for as they largely dabbled in scrip, and gambled with each other, so they in effect worked for scrip, which may be considered an etherial medium.

An acquaintance with the circumstances of railway engineers, surveyors, solicitors, secretaries, and projectors, will fully convince the inquirer that whatever the supposed gains of these parties in 1845, their present possessions, taken generally, are very small; and the solution of this is, that their wealth in 1845 resolved itself into that proverbial bubble —scrip, the certificates of which, for that matter, they may still possess, but the imaginary value and premium of which they have lost for ever. Making allowances for scrip operations, the actual waste of capital in the gambling of 1845 was very small, and certainly very far below that of 1825, when so much capital was sunk abroad in worthless and unprofitable operations.

That some few engineers, lawyers, brokers, and capitalists have realised money is indisputable, but the number of these, and the gross amount of their acquisitions is very small, and the mass of speculators and operators have not realised anything.

What is the real amount of capital wasted or lost to the country in 1845, it is hard to calculate, but we do not believe it can anyhow be more than two millions, while perhaps it may be only one million—perhaps it may be that, comparatively speaking, it is nothing. In this country a great number of persons are always maintained in idleness, so that it does not make much difference if some of the funds of these classes are distributed for a time in making some of its members railway committeemen and surveyors, instead of keeping them, as they otherwise would be, cigar smoking, billiard playing, or fox-hunting.

If, moreover, we consider that a larger amount of real and effective labour was performed by the population of England in 1845 than in any previous year, and a larger amount added to the fixed capital and resources of the country, it becomes still more questionable whether on the balance of transactions the country was in anywise a loser by the gambling share transactions of 1845. We know that we are great gainers by the extension of the railway system.

For whatever purpose the leading organ of the world, the *Times* newspaper, is pleased to devote itself to a crusade against English railways, which it seems determined to injure *per fas aut nefas*, by any means, by any representations, by their merits and by their demerits, by truths and by falsehood. With an ignorant population, and with railway managers not overskilled in political lore, a subtle and unscrupulous adversary is able to represent every thing according to its own ends; and little more than good fortune, and some want of faith in the objects of the *Times*, has secured this country from being victimised into surrendering a most valuable institution to the clamour of a most audacious system of misrepresentation.

Without going back to the earlier efforts of the *Times*, it may be enough to signalise some of the later assertions of the *Times*. The charges against the railway system for its operations in 1847, include the following:—

1st. A large importation of foreign corn.

2nd. An increased consumption of foreign luxuries during a time of severe privation, when greater saving was the more needful.

3rd. A diminution in the stock of cotton and other raw materials of manufacture.

4th. An increased use and higher price of iron at home and lessened consumption abroad.

5th. Causing the stock of gold to be sent abroad.

6th. Depriving government and the commercial interest of capital.

7th. Depressing and ruining the manufacturing industry of the country.

We believe this sample is such a one as the *Times* will accept, as not going beyond the bounds of its accusations.

There was in this year a very large importation of foreign corn, in consequence of the failure of last year's harvests. This failure could only be supplied by import from abroad, and has no connection with railways.

It is quite true that in 1847 there was an increased import of foreign sugar, meat, butter, cheese, and other provisions, but which has no connection with railways. Had there been no such increase it would have been duly noticed by the *Times*, and charged against Sir Robert Peel and Lord John Russell, as a failure of their tariff measures, which were purposely framed to increase the consumption of sugar and foreign provisions.

The diminution of the stock of cotton was owing to the failure of the cotton crop in the United States, and with a short crop there must be short stocks and high prices. All this has no connexion with railways.

There has been a greater demand for iron at home in consequence of a greater number of railways; but as these are very useful, we do not think this is any harm. A higher price of English iron in foreign markets is a necessary consequence. This charge *has* a connection with railways.

Gold was sent abroad to pay for foreign corn, and nothing else could be sent. Whatever the League partisans and currency theorists may persuade themselves, gold must always be sent out to meet a sudden demand for gold. Mr. McCulloch showed this long ago. The failure of a harvest is a sudden and irregular event, requiring a sudden and irregular supply, which can only be settled immediately in gold, and not in goods, as the theorists expect. The farmer on the banks of the Mississippi or the Vistula will not lay in a stock of cotton or ironwares enough for four or five years' consumption, and take the hazard of fire, damp, and waste, let the goods be offered to him at any price however low. He will always prefer to take English goods as he wants them, and at the price of the day. The merchant of New York or Dantzic, though he may be tempted to a small extent by cheapness to increase his stocks, will not do so to the full extent required, because the risks are not not worth the advantage. The English manufacturer and merchant will always be left to bear the risks of the stock, as he does now, while as a mercantile fact it is well known that from the greater wealth of England the stocks are in her hands. The gold therefore must go out, and it will come back, as the goods are ultimately taken in the final liquidation of the account. The gold always has come back and always will, while the goods instead of being sold at a depression are sold at more favourable prices.

It is a recognised expedient of the Bank of England, supported and inculcated by the highest authorities, to raise the rate of discount to a ruin pitch in the event of gold going out of the country, with the view to force goods abroad and prevent gold going. It is supposed that by causing sales here at ruinous prices, foreign merchants are induced to take goods instead of gold, and that thereby the gold is kept in the country. As, however, the larger stocks of English goods are always in English hands and not in foreign hands, no great increase of sales can take place, but only a depreciation in price. The goods offered in the market, however small, determine the price of the stocks, however large.

In the face of this admitted doctrine we assert that the effect of raising the rate of discount, or putting on the screw as it is called—

Does not cause goods to be sent abroad instead of gold.

Does not prevent gold from going out of the country.

What it does do is—

To cause severe distress at home.

To depreciate all our stocks of goods abroad.

Our deduction is—

That the screw does not effect the proposed end, that it does no good, and does great harm.

If no "screw" were applied, the country would suffer no possible harm; no more gold would go out without the "screw" than with the screw; but distress would not be produced at home, nor would our goods be disposed of at depressed prices abroad.

Although the "screw" principle has passed unquestioned, it has no single statistical fact, and no solid mercantile experience, to recommend it. It is quite groundless.

Railways did not deprive government and the commercial interest of capital. Government has got the capital it wants, and if it has to pay a higher price it is not on account of the competition of railway companies, but chiefly in consequence of the "screw" having been applied by the Bank of England. The commercial interest, on account of the depression, has required a smaller amount of capital, and there is no statistical foundation for the assertion of any interference on the part of railways. What has been wanting during this year has been confidence and not capital, —the want of confidence being greatly aggravated by the exertions of the *Times* newspaper.

The railways have not depressed or injured the manufacturing interest of the country in any way. They have not diminished the gross amount of capital; they have not interfered with the manufacturers' share; they have not diverted labour. The manufacturing interest has suffered from the famine, the want of raw material, depression of prices, and want of confidence: the two latter circumstances made much more oppressive by the "screw" and its votaries.

While the railway system has been falsely accused, it has had no acknowledgement of the vast good it has done. Putting aside the large addition made to the fixed capital and permanent resources of the country, the railway system has, during a year of grievous famine and great commercial distress, allowed an efficient scheme to be carried out for the employment of a large body of the population. If no railway works had been provided, the population of England would still have been fed; but in 1847 they would have been unemployed and discontented, and while their labour would have been lost to the country, there is no saying what would have been the political and social consequences; whereas in no year even of prosperity has there been less political agitation than in 1847, when a general election is held, during which party feeling is almost extinct.

The experience of every fact confirms the truth of that theory which asserts that railways are not made with new capital or new labour, but by the increased energy of the labour of the country. This or something like it must be the truth, and it is neither inconsistent, nor improbable; no more so than the admitted fact, that while the ratio of agricultural labourers is diminishing, the extent of cultivation and production is increasing.

If new labourers and new food be not required for railway purposes, new capital cannot be required to the amount proposed, and the capital required can only be the small amount of ready money necessary for the temporary representation or "clearing" of the transactions.

This may appear very difficult of belief to those who conceive that every figure of £ s. d. put forward must be the representation of solid bullion; but it has nevertheless the guarantees of truth. The development of the machinery whereby a hundred million's worth of railways is produced in a year may elude analysis in our imperfect acquaintance with the true operations of currency, but it does not invalidate the conclusions. We may expect that as the machinery acquires perfection the operations will enlarge, and it is instructive to look back for a few years and to witness our present progress. In 1840 a return of railway calls, made by Mr. Earle Langston, a Manchester sharebroker, gave as the total for that year, £7,491,890. This sum, during the time of getting it in caused the greatest alarm, the calls in the first quarter of 1840 amounting to no less a sum than £2,106,090, and it was pronounced utterly impossible for the resources, capital, income, and surplus revenue of the country to produce any such sum. It was, however, produced.

In 1847 the amount of calls in some single weeks was as much as the whole yearly amount of 1840; and we are not aware, notwithstanding what the *Times* says, that the capital of the country is exhausted.

We cannot conceal the uneasiness with which we contemplate the prospects of the country in reference to railway operations, in consequence of recent operations and events. When the continuous period of depression arrives, and when it is most difficult to work the financial machinery, the construction of railways will have so far diminished, that the means of adequate employment and exercise for the working population will not be found. If, in consequence of this year's abundant harvest, and the fall in prices which will result, a period of speculation and share gambling should next year arise, it cannot now be directed towards railways, and will therefore, in all probability, take the only open field of foreign mining, which is under no such restrictions; and therefore the evil of 1825 may be renewed.

We will only say a few words by way of conclusion. "Let railways be free, and the less legislation and inspection the better for the country."

THE BRITISH MUSEUM.

No. II.

The dispersion of the Greek and Roman antiquities consequent upon the demolition of the old rooms, and the non-completion of the new ones, causes some confusion, and there is a difficulty in finding them; but this will soon be remedied. The arrangement is altogether so imperfect, that it leads us to remarks more discursive than they otherwise would be. It is, however, the temptation of a large collection like that of the British Museum, to present a great variety of objects to the gaze, and to excite at each moment some new thought, little dependent on those which have just gone before. This is the great medicinal power of such collections to a mind diseased or worn down; it is a quality of refreshing the jaded thoughts, of awakening new ones, of alluring the weary gaze, a temptation now to close and busy scrutiny, anon to sit down in quiet meditation. We may call such a place a *sanatorium* for the artist and man of taste, while it is the best place of exercise and refreshment for one in the full vigour of his powers. The Museum is however much less visited by architects and other artists than might be expected, though it is not neglected by the amateur. If we are to judge by their modes of acting, our English professors have strange ideas as to the cultivation of taste, for they seem to think that it will grow and feed, like some exotic plants, on air, or rather grow without feeding. How many men are to be found not wanting in means, who have neither library nor museum, who never read, and who never study works of art at home and abroad, but trust to the daily plodding of an office as their only school.

In going round the Museum, and seeing the number of unintelligent, nay even of brutalized and debauched countenances among the visitants, the question is naturally raised, "Can the Museum do such parties any good?" Take, for instance, those least capable of appreciating the immediate worth of the objects they see, who pass round, scarcely moved by the wonders about them—the observer will not deny that even they feel a beneficial influence. Novelty or strangeness will always operate upon every mind to awaken it to some extent, and it is a great object to effect this in those minds which are most brutalised: to awaken attention is to cultivate the first quality of the mind, and to lay the way for its further exercise.

It is scarcely possible to look at any department of the Museum, without finding some useful example, even if wandering amid the chaos now reigning. Who, for instance, can look at the collection of tombs and urns, without seeing the great superiority of the Romans in all artistic exercises over ourselves? An English churchyard is a set of stereotyped stone or wooden tablets, sometimes varied by a pile of monstrous ugliness. One head-stone is like another, except in as far as it is necessary to inscribe it to John Thomas, instead of Thomas Johns; for, could the inscriptions be interchanged, the spectators of the head-stones would be none the wiser which is which. The cemetery system has in some degree broken in upon this monotony, and created a greater variety of forms; but still they are limited, and confined, as we may say, to sets. The mourner may purchase a No. 1 obelisk, or a No. 3 urn, as he would select a knife from a Sheffield pattern-card, or a printed muslin from a numbered specimen. A large lot of number ones and number threes is manufactured and worked up; for as to individuality of design, it is out of the question. It is not asked for, and the tomb-makers are guided accordingly. Any one who goes into a tomb-yard either in the New-Road or elsewhere, will find that the tradesman has an urn, an obelisk, a cross, a sarcophagus, a broken pillar, an altar-tomb, a coffin-tomb, and one of each of the recognised patterns.

In looking at the Roman urns in the Museum, and which being for one general purpose, are in some degree restricted in form, it is notwithstanding exceedingly pleasing to notice the great variety of design. It would be hard to find an English grave-yard which, with a greater number of tombs, could show such a pleasing application of artistic taste. Limited as to size, which goes little beyond a foot or fifteen inches cube, the Romans have made the most of their small material. The block of marble, alabaster, or stone, is carved into various forms. Some are perfect vases, one is a circular temple, another a fragment of a column; this is a square block decorated with a simple festoon, another has a façade with pilasters *in antis*; again, the proportions being those of a double cube, a raised oblong with festoon and tablet is flanked by torches at the corners; on some, the deceased is represented in various attitudes. The form and decorations vary in each example.

The Roman urns must have been wrought at little expense of material and little cost for workmanship, and yet very pleasing works are produced: while with us, great material and lavish workmanship are unattended with artistic effort. The same degree of labour which with us is bestowed on the mason's work, would suffice for that of the carver. While we acknowledge the artistic qualities of the Roman examples, their design is not always the most fitting, and it is very rarely applicable for modern purposes; some of the emblems are suitable only to Roman associations, while some seem to have no significance. Other designs are, however, pleasing. An urn, which is not numbered, has two very sharply cut medallion half-lengths of husband and wife; others have high relief busts of the deceased, or of a married pair. Again, the deceased is sometimes represented reclining on a couch in such an attitude half-raised as to allow the likeness to be given. We, who like cabinet pictures and cabinet works of art, might imitate this.

We have long thought that the establishment among us of public grave-yards and cemeteries is well calculated to promote the application of art to memorials of the dead, and though we have noticed above our present deficiencies, yet we are quite ready to acknowledge the great improvement which has taken place of late years. We believe the chief obstacle now is the want of proper workmen, for the execution of a common design of foliage or flowers is still expensive. The Schools of Design are partly remedying this, by supplying better trained men; but the demand is still great, and the remuneration is too great for a class of labour which cannot be valued much higher than mechanical labour. Had the prejudices of the academicians been complied with in the establishment of the School of Design at Somerset House, and the declaration enforced, we should have been worse off than we are now. A declaration that a student in a school of design would not become a history painter or sculptor, portrait painter, animal painter, landscape or flower painter, whatever supposed monopoly it would have given to professional artists, would have deprived the public of workmen, instructed to execute at a cheap rate common carvings and decorations. Whatever the sculptor academician may arrogate to himself as his province, he does not undertake a cheap tomb-stone or chimney-piece; and there is therefore no reason why the public are to have no choice between a costly work of art, and a work without any art at all.

It will be one result of the establishment of a body of cheap workmen in art, that the man of taste will be able to suggest his own design; and thus there will be a greater application of intellect and taste than can be contributed by the artists alone. Hitherto we have been dependent for our applied taste on the body of artists, and we can expect no greater progress than we have made with such a body, which is little in comparison with what might be effected by the co-operation of the great mass of the educated community. To arrive at this will be to arrive at a new era in art, and it will likewise supply a great defect in our artistical economy as it now stands; it will bring to bear that refined scholarship and education, in which our artists almost without exception are lamentably deficient. How few artists in the present day are able to take their stand as scholars and men of learning by the side of Michael Angelo and Leonardo da Vinci, to say nothing of artistical proficiency?

There is a strong call for the home application of art among us, but this can never take place until it ceases to be an extravagant luxury, and becomes an accessible pleasure. If a gentleman of scholarly tastes and refined education have the disposition to suggest the decorations and furniture of his house, he has not the pecuniary means of accomplishing it. He must at high rates choose furniture as cabinet-makers choose to give it, chimney pieces made by machinery, wood carving from the patent process, statues in terracotta, mouldings in cannabic, papier maché, or leather; everything on the stereotype plan, and yet at prices for which he should be able to have something original.

What could be more pleasing to one of good taste than to have, from his own suggestions or designs, and at a moderate price little above that of mechanical or ready-made articles, the furniture of a room, the chimney pieces, fire-grates, carpeting, and decorations made in harmony with his own habits, associations, and sympathies, the events of his life, the feeling of his home circle, or the traditions of his family? One who has the power may just as well have for emblem and design his own armorial bearings, his own loved flowers, or even favourite objects, as be dependent on the good graces of the manufacturer, whose object is perhaps to sink individuality for generality. Wherever gentlemen, even under present circumstances, have the means, a preference is always shown to individualise themselves. It is much more agreeable to go into a room in which the decorations are so formed than where they have no relevance. If family crests and badges are introduced in a cornice, or animals or flowers are adopted in ornament which recall perhaps some distant climate where honour has been achieved or wealth attained, there are ideas communicated to the mind beyond even the pleasure from well designed and well executed artistical productions, and the mind likes what is most practical, most individual, and most human.

Pursuing the train of these reflections, we have little doubt, and with the evidence there is, we ought perhaps to say no doubt, that it was the cooperation of all intelligent minds which among the Greeks and Romans gave a catholic impulse and progression to art. The suggestions of a Pericles must have been of value to Phidias; the inspiration of Michael Angelo was refreshed by his associations with the learned of his day; the companionship of Johnson and Goldsmith had its charm on the works and writings of Sir Joshua; and we believe that the energies of Barry may be upheld by his copartnership with those who are most eminent in scholarship, most refined in taste, and most illustrious in political action. Looking at our group of tombs it is not displeasing to imagine that sometimes the design was prompted by the mourner, or was a tribute to the feelings of the deceased; that there was something higher than the compliance with a form of society, or the self-satisfaction of paying a last debt, and accepting a free discharge from all further claims on sympathy or remembrance. If the ready wit of the carver sometimes prompted the design, we may allow that quite as often the hallowed feelings attendant upon affliction and death may have influenced the inspiration; at any rate, on looking around us we cannot recognise our English church-yard characteristic—"To headstone as per pattern.'

Among the urns is a small one to which we should like to refer, but which is now unnumbered. It is a square block, has a bas-relief of a husband and wife, each a half length in profile, looking at the other. The design of the comb in the wife's head is worthy of notice, it is in shape something like the crest of a helmet. The execution of these figures is good.

No. 12 is a sepulchral vase or bowl of alabaster uninscribed, which is elegantly covered with foliage. It was found in a tomb near Naples.

No. 22 is a square block with a carved top. One face of the square is carved, and bears a tablet surrounded with ivy foliage, freely designed. It is dedicated to Claudia Fortunata, by her husband, and was at one time in Sir Hans Sloane's collection. As these urns were for holding the ashes of the dead, they mostly have a top, which in the case of cubic blocks, is designed like a pediment with returned ends.

A tablet to Cornelia Servanda (13) has a female figure in relief sitting or lying on a couch, so that her face is shown. On each side of the couch is a larger sized medallion, half length. The size of the tablet is about 18 inches by 16. This small space is well filled by the several parts of the design, and is much more pleasing than the tablets usually seen on our church walls, and having more surface than work.

Letter-cutting seems to be the chief art in tomb-making here, and even in this mechanical pursuit we have not gone beyond the ancients. Most of the Greek votive inscriptions in the Elgin room are by professed letter-cutters, and are remarkable for their sharpness, neatness, and regularity. The lines are straight and equidistant, the characters uniformly cut and placed in exact accordance with each other. On the Roman tombs the inscriptions are often cut by the workmen, and are not so regular.

No. 11 is an urn of a flat square altar-shape. It is dedicated to Julia Attica, and was formerly in the Burioni Villa. The composition is very pleasing, though the details are inappropriate. The top forms as usual a pediment.

No. 27 is a square altar-shaped urn, dedicated by Marcus Junius Hamillus to himself and his wife, Junia Pieris. The size is about a foot cube. The composition represents a pediment supported by two pilasters, and is, like some others, of an architectural character. The pilasters are filled in with foliage. Within these there is an oblong tablet bearing the inscription, and supported by two griffins. Underneath the tablet, and between the griffins, is a wreath surrounding a medallion.

The urn of Pompeius Justinanus (No. 7), is original. It may be called a slice of a cylinder fluted, and having in front a large tablet with dentelated ends. The labour on this is not much, but it is recommended by the singularity of the design.

No. 4 is dedicated to Vernasia Cyclas, the wife of a man of liberal rank. This is one cube placed on the top of another, with a pediment cover. The composition shows much variety of detail. The pediment is supported by two jointed torches flaming, and which rest on lions' claws. The upper part of the space within is occupied by the tablet, which is inscribed. Hanging over this is a festoon of flowers, the ends of which fall down nearly to the bottom of the composition. Below the tablet is a doorway with a pediment; within are the figures of the husband and wife in high relief. The whole rests on a moulded base, but which is perhaps modern.

No. 18 was presented, in 1837, by Mr. Mackinnon, M.P. It is dedicated to Tiberius Claudius Lupercus, a freedman. It is a square block with a pediment top. Within the front of the pediment are two birds pecking at a vase. The corners of the cover have a honeysuckle ornament. The face below is filled with an inscription within an oaken wreath, which is held up on each side by a winged genius, forming likewise a support to the corner. The plinth is moulded, but is modern.

No. 1 is remarkable for being solid and without any inscription, and therefore it can never have been used. It is a square block, having on its front a bas-relief of a figure leaning on a couch and offering a fillet or wreath to a boy. This is said to represent a funeral feast. This unfinished urn was likewise presented by Mr. Mackinnon.

No. 8 is a square block dedicated to Titus Titulenus Isauricus, formerly in the Mattei collection. It has on its front a relief of a figure reclining on a couch, and below it an inscription. The pediment is enriched.

No 23 is a square block urn, with a plain pediment top. In this case, there is no artistic decoration, and the simple inscription is the only matter of interest about it, for the means of him who raised it were most likely less than his affection. The inscription, which is in large letters covering the front, is—"To Lucretia, who lived xii years and viii months. Her father raised this to her manes."

No 26 is an urn dedicated to Decius Albiccus Cilicinus. It is a flat cubic block, with a high pediment top, which is enriched with a vase at which two ravens are pecking: they are freely carved. Below is a tablet with a masque of Bacchus on each side, from which a festoon falls, amid which are other ravens.

No. 17 is dedicated to Cossutia Prima, and was found, in 1788, in the grounds belonging to the Villa Maroni, near Rome. It is a cube and a half without a top. At each corner is a pilaster, filled in with foliage. Within is a large tablet, surrounded at the top and sides by rich foliage, or what is called arabesque. Below is a Cupid in a car driving four horses, perhaps those of the Sun. The whole is very pleasing. The sides of the urn are ornamented with pine-trees.

No. 32 is a vase of a broad oval form. On the front is a small tablet. On each side is a stork, between which, twining around their beaks, is a serpent. On the back are two storks drinking out of a vase. There are other enrichments. The urn was discovered in what is called the *Ager Romanus*, in the neighbourhood of Rome. It is remarkable as being dedicated to Pompey Locusto, aged 65, Attilia Clodia, his wife, aged 60, and Pompey Locusto, their son, aged 21, who all died of poison in one day.

The introduction of the stork in this monument suggests how frequently and appropriately it might be used in our tombs, as the emblem of filial piety, while the fabled pelican may be made to represent maternal piety.

While speaking of the urns, we cannot but regret the destruction of the No. V. Room of the Townley Gallery, which was fitted up with niches like a Roman family vault. The niche was called a *columbarium*. One sepulchre near Rome, that of the dependents of Livia, the wife of Augustus, broken open in 1726, contained at least 300 urns. Fabricius asserts that the freedmen formed themselves into guilds for building these tombs at a joint expense, the niches being appropriated by lot, or otherwise. Perhaps there were speculators among the Romans who sold niches to the lower classes, in the manner of grave-yard trading in London.

No. 6 is a specimen of an *olla* or round urn of earthenware. One is dedicated to Anniolena Servilia. The ollæ were used for persons of the lower classes, freedmen, and slaves, and were sunk in the wall, within an arch, the lids only being visible. An inscription was put in front.

On the urn No. 13, a family are represented mourning over a dead female. Under the couch are her sandals and a dog.

No. 14 is an urn formed as a round temple. The cornice is upheld by three Termini and by six Ionic pilasters. The whole decorated with festoons. It is dedicated to Serullia Zosimenes.

No. 15 is not remarkable for its subject, but as having been engraved so long back as 1596 in Boissard's "Antiquitates Romanæ."

No. 21 is not Roman, but Etruscan. It is of baked clay, with a bas-relief representing, it is said, Echetlus fighting for the Greeks with a ploughshare at the battle of Marathon. The top has a leaning female figure, lying on a pillow. This is rudely executed, and has an Etruscan inscription undeciphered.

No. 25, a plain urn or vase, dedicated to Flavia Valentina, still contains the ashes of the female to whom it is inscribed, and was found, in 1772, on the Latin Way, two miles from the Gate of the Lateran at Rome.

Many of the urns are brought from the immediate neighbourhood of Rome, and are, therefore, specimens of the metropolitan workmanship. They are, however, chiefly of late date. The locality of No. 4 is not stated, but from its being dedicated to the wife of a *Scriba Cubicularis*, it is most probably Roman. In Gruter's time it was in a collection at Rome. There has been some discussion, by the bye, as to the letters F. A. P. on this monument. They are, perhaps, the carver's initials. No. 17 was found, as already stated, near Rome. Nos. 20, 31, and 38, were found in the Villa Pelluchi, near the Pincian Gate at Rome. No. 26 was found at Rome. No. 30 seems to be Roman. No. 32 is already described as Roman.

Some of the urns are Neapolitan, as Nos. 12 and 29, from Sir William Hamilton's collection.

Besides the urns are Roman *cippi*, in the form of a low square or round column, or rather portion of a column. They resemble altars in form, and were used for other purposes besides monuments. There are many inscribed sepulchral cippi in the British Museum, the designs of which are equally worthy of attention with the urns.

Though we have alluded to Etruscan tombs, we shall not here give any description. The collections of funeral monuments in the Museum are large. The Roman have been already extensively described; the Etruscan are no less interesting. The Lycian tombs in the new rooms are on a large scale. Many of the Egyptian relics are of a monumental character; and the Etruscan paintings in the upper rooms are likewise from tombs. There are various specimens of Greek monuments.

It is much to be regretted that the collection of Roman busts is not larger, for a series of this kind is very interesting from its practical and individual character. Such an assemblage as that in the Louvre, the Vatican, and other continental galleries, awakens very agreeable emotions. The countenances are truthful and life-like, while there is an independent interest in the historical associations they suggest. Thus there is a double influence of art and liberal study, which is well worthy of cultivation. Whoever compares the two, will find far less attraction in the most beautiful busts of the ideal—even in the Apollo, Venus, or Diana—than in the company of a few plain Romans. There is generally a steadiness and solidity in Roman features, which is agreeable to an English spectator; he seems at home among a people who have been dead for fourteen hundred years, and under the influence of the conformability of character he recognises little difference of race. Strange as it may seem, a gallery of Romans is not un-English, and is much less strange than a gallery of ancient Greeks or modern Frenchmen. We should, therefore, much like to see the series of heads and busts in the Museum extended, even by the addition of copies, which can be readily obtained, as so many busts of Roman emperors and public characters have been found.

When put in comparison with portrait heads, the ideal busts of gods and heroes are tame, and they suggest strong doubts as to the soundness of idealization in art. This is to be accounted for on simple principles: in nature there is nothing without its beauty, so there is nothing without its defect; still less is there to be found the unalloyed preponderance of any quality, for the balance is always kept up. It may be said that the idealization of a Jupiter or a Venus in which imperfection is not to be found, is therefore beyond humanity and godlike; but as the mind of man has a greater sympathy for manly attributes than for godlike qualities, of which it knows nothing, so whatever praise may be awarded to the ideal, it is disenchanted by reference to the natural, and a higher idea is communicated by the latter than by the former.

In the Museum, the busts are, for the present, arranged in groups on shelves. Thus we have a group of gods, of heroes, of emperors, and of, empresses. We recommend the visitor to compare Minerva, Bacchus, Apollo, Diana, and Juno with Julius Cæsar, Hadrian, Nero, and Severus, or even with Otacilia, Sabina, Faustina, Domitia, and Olympia.

We believe a greater development of the department of portrait busts would be found useful in its influence on the public mind, being congenial with the English character. It is much to be regretted that in the metropolis there is not as yet any large collection of ancient or modern busts, though the Palace at Westminster promises in some degree to supply the loss of the latter. This Palace will give us the example of an historical gallery, of which the French have a specimen at Versailles, and the Bavarians at Munich. A zealous chief commissioner of the Woods and Forests might cheaply distinguish himself by collecting together the portraits and historical pictures in the royal palaces and national museums, and laying the foundation of an historical gallery. It is true we have fragmentary collections now, as that of portraits in the British Museum in the Natural History Rooms, and of marine pictures at Greenwich. It might, perhaps, be worth the while of the British Institution, or some other artistic body to get up an exhibition of historical works of art. The Society of British Artists is ambitious of distinction—it may take advantage of the hint.

The British Museum collection of heads, although small, has many of interest. In the Greek series are two attributed to Homer and Pindar. No. 42 is Periander, a tyrant of Corinth, one of the seven sages, who lived about 2470 years ago. It may be questioned whether this is a likeness. No. 36 is the tragedian Sophocles, the contemporary of Pericles, Thucydides, Phidias, Eschylus, and Euripides. No. 32 is Pericles, and these two busts bring us in association with the illustrious men of twenty-three centuries ago. It is to be noted that Pericles wears a helmet, which Plutarch says was adopted by the sculptors to conceal the bad proportions of his head, which was likened in shape to that of an onion. No. 20 is thought to be Hippocrates, the physician. It is from Albano, from what are thought to be the remains of the collection of M. Varro, who says Pliny collected seven hundred portraits of eminent men. No. 26 gives us Diogenes, the cynic, the contemporary of Alexander the Great; and No. 38 is another, the great orator Demosthenes. No. 34 is the philosopher Epicurus, the head of a sect. No. 3, Room XII., is the head of Aratus, a poet and philosopher, and bears the name of Eraclite. Sophocles, Pericles, Demosthenes, and Epicurus are Athenians. Whoever views this collection cannot but regret that it is not larger, that we might become more familiar with the countenances of the favoured heroes of our boyhood. We think it would be no unfitting compliment to the memory of an eminent promoter of art, to place the bust of Pericles in the Elgin collection, the chief beauties of which were created under his patronage, for Phidias could not have wrought but under the treasureship of Pericles.

The Roman heads are happily more numerous, but far from enough to satisfy curiosity. No. 51 is Augustus, a Napoleonic countenance. No. 53 is an original bust of Marcellus, the favourite nephew of Augustus, dedicated by the body of Decemvirs. Tiberius Cæsar follows Augustus in time. No. 65 is Messalina, one of the wives of Claudius, and the most infamous woman of her day. The fashion of her hair is worthy of notice, as indeed is that of most of the empresses. Some of the modes of head-dress are far from inelegant, while others are quite as peculiar as anything modern, as for instance those of Sabina and Domitia. At any rate, a Roman collection is one of the last places in which any support can be got for the doctrine of classicality in busts. The Romans were quite content to be featured according to the fashion of the day—the women in particular; while the greatest fear of a modern sculptor is to pay any such homage to the costume of his time.

No. 44, Nero, pins attention. His low forehead, marked eyes and nose, and large lower jaw, countenance the unfavourable accounts of his character, and we confirm our prejudices and dislikes, as most probably the Romans did, by looking at the likeness of the man.

No. 13 is the glutton Vitellius. No. 1, Room IV., is Trajan, a very business-like looking man, with a forehead not over large. Of Hadrian there are two busts.

No. 58 is Julia Sabina, niece of Trajan and wife of Hadrian, a matronly lady with her hair plaited and netted, as already mentioned, in rather a peculiar manner. No. 18 is Antinous, the notorious favourite of Hadrian. No. 42 is Ælius Cæsar. No. 11 is the illustrious Antoninus Pius. As we have noted of the hair of the ladies, so may we of the other sex. There is much variety in the mode of wearing it, which often approaches the modern style. No. 6, Room IV., is Marcus Aurelius, another philosophic emperor. He is dressed as a Frater Arvalis, a priestly officer. No. 32, Annia Faustina, is his wife. Her hair is worn quite plain, simply parted. No. 7 is Lucius Verus.

No. 29 is Severus, one of the emperors who visited Britain, where he died at York. No. 51, Room VI., is Caracalla, a fitting companion head to that of Nero. No. 39, his wife, Plantilla, has a fanciful mode of wearing her hair, but one not ungraceful. No. 85 is the elder Gordianus. No. 51, Room XI., is that of a Roman lady of rank, whose head-dress is remarkable and rich. As the lady is not known, it is most valuable as an illustration of costume. No. 54, the bust of a little girl, shows one of the fashions of wearing the hair, made up into little plaits and tied in a top-knot.

(To be continued.)

PHOTOGRAPHIC MANIPULATIONS.

The great beauty of photographic pictures and the varied uses to which the art of photography may be applied, invest this wonderful discovery of modern science with surpassing interest, and to the successful operator it possesses great fascination. As the manipulations, however, are numerous, and require great care—for a defect in a single one may prevent any results from being obtained—the art has not yet been so extensively practised as it deserves to be, and as we have little doubt it will be ere long. Many have been prevented from commencing by the difficulties which encompass the process, and many, after making the attempt, have abandoned it in despair of being able to succeed. These obstacles are in a great measure owing to the want of clear and satisfactory directions for conducting the various manipulations, and though it is extremely difficult to describe the processes of an art requiring so much nicety so as to insure success, we will endeavour to give such directions that we trust will enable most persons, by a little practice, to produce good photographic pictures. We are the more induced to hope that we shall succeed in this attempt, from having worked out the problem with such imperfect light only as the printed directions afford, and having experienced by many failures the points wherein such directions are vague and imperfect.*

* The most comprehensive work on the subject that we have seen is "Photogenic Manipulation," published by Messrs. Knight and Sons, which within a small compass treats of most of the varied photographic processes, but it falls in many points as a guide to the uninitiated.

Since the original discoveries of the means of fixing the images of the camera obscura, by M. Daguerre and Mr. Talbot, many variations in the processes have been discovered, but we shall confine ourselves to the description of the Daguerreotype and Calotype, which have hitherto been unrivalled in practice by any. The distinguishing characteristics of the inventions of M. Daguerre and of Mr. Talbot are, that in the former the image is impressed on a metal plate, and is subsequently rendered visible by the vapour of mercury; whilst in the Calotype process the picture is produced directly on paper, by the influence of the rays of light on the salts of silver. We propose in the first place to describe the manipulations of the Daguerreotype.

The apparatus essential to the Daguerreotype artist, in addition to the silvered plates, consists of the following articles: an achromatic camera obscura fitted with appropriate slides for holding the plates, iodine and bromine boxes, a mercury-box, three or more "buffs," and a spirit lamp with stand for holding the plates. The chemical and other materials are iodine, bromine, spirits of wine, mercury, cotton wool, tripoli powder, rouge or "finishing powder," and nitric acid.

The plates are now so well finished in the manufacture that with new plates comparatively little preparation is required. There are two kinds sold by philosophical apparatus makers, the one French, and the other English; the former of which are cheaper, but the plating of silver being much thinner, it is adviseable for beginners to pay the higher price, as in the course of cleaning the plates after failures, they soon come to the copper, and the plate is then useless. In order to clean the plate it must be placed on a holder of some kind, to keep it firm when rubbed. For small plates a piece of wood, nearly the same size, will answer very well, the plate being held by the edges. Then take a small piece of prepared cotton wool, freed from all grease and dirt, which form into a ball, and dip it into a mixture of tripoli powder and of nitric acid diluted with one fifteenth part of water; a few drops of the mixture will be sufficient. In rubbing the plates, it is usual to direct that the cotton wool should be moved in a circular direction, forming circles on the plate of different sizes; but we believe the most successful artists polish their plates by a motion directly across. In giving the last polish, indeed, it is essential that the motion should be in lines across the plate, otherwise it would look misty when held in the direction in which the picture is to be viewed. This effect is owing to the minute scratches which will remain even after the most careful polishing, but when the plate is looked at transversely to the lines of the scratches they are invisible, and a black mirror-surface is presented. After rubbing with cotton wool and tripoli, take some fresh cotton wool, and rub till a bright polish is obtained. The finishing polish is given with the "buffs," which are pieces of wood covered with well washed cotton velvet. Some finishing powder, consisting of lamp-black and rouge, is dusted over the first buff, and the plate is rubbed along it briskly, taking care that the fingers do not touch. This operation is repeated on two or three other clean buffs, in order to remove the slightest trace of grease. When the polishing is finished, the plate should have a fine black mirror-surface, when held in the direction in which the picture is to be looked at. If the plate after use becomes scratched, it will be requisite to apply some fine emery powder and oil with cotton wool before applying the tripoli. In case any drop of mercury should adhere to the silvered surface, the plate should be heated by holding it over the spirit lamp with a pair of pliers until the mercury is evaporated. Some operators, always heat the plates, for the purpose of expelling greasy particles. It cannot indeed be too strongly impressed on the Daguerreotype artist, that the perfection of his pictures will depend in a great measure on the cleanness of the plates.

The next operation is to coat the plate with iodine. The iodine must be scattered evenly over the bottom of the iodine-box, and the plate exposed on its frame with its silvered surface downwards. In about half a minute the silver will become a gold colour, in consequence of the vapour of the iodine having entered into combination with it, and formed an iodide of silver. The length of time requisite for exposure to the iodine depends much on the temperature. At about 70° Fahrenheit, 30 seconds will be sufficient for a small plate, but it must remain till it acquires a golden tint, distinct from the brassy hue it at first assumes. If it remain longer, the colour changes to pink and to lead colour; in which case the plate must be polished afresh, and the operation renewed. The light need not be excluded during the iodising process, but the plate should only be exposed to its action instantaneously. The iodised plate might now be put in the camera, and in the course of five minutes, in a very bright light, a perfect picture would be obtained after exposure to the vapour of mercury. It was in this mode that M. Daguerre operated; for in his original invention iodine alone was used. The inconvenience of so long an exposure to light, however, especially in taking portraits, was seriously felt, and after many investigations for the purpose of quickening the process, it was discovered that bromine in addition to the iodine would act with great efficacy as an accellerator; and now Daguerreotype pictures are by this means sometimes taken in less than a single second.

In submitting the iodised plate to the action of bromine the greatest care is required; for if the bromine be deficient, the plate will not be sufficiently sensitive, and if the bromine be in excess, the picture will either not be formed, or the plate will be covered with a mist. The simplest way of operating is with the common bromine pan, which is a shallow flat-bottomed vessel, with a cover of glass, ground tight to the edges, to keep in the suffocating vapour. A ledge inside the vessel holds a support, usually made of slate, for the plate to rest on with its silvered side downwards. It is most desirable to ascertain accurately the strength of the bromine water, and to have it uniform in all operations; a close approximation to uniformity may be obtained by mixing a given measure of distilled or rain water with saturated bromine water. The saturated bromine water is easily procured by pouring some bromine into a stoppered bottle of water, taking care that there is more bromine than the water will dissolve. A convenient solution for use is 40 parts of water to 1 of the saturated solution, which will then be of the colour of pale sherry. As much of this diluted solution must be poured into the bromine pan as will cover the bottom, and then introduce the iodised plate. If the plate has been well iodised, the vapour of bromine will impart a rose tint to it in about thirty seconds or less; but it is safer to remove the plate before it has received as much bromine as will give extreme sensitiveness rather than run the risk of giving it an excess. The plate is usually returned to the iodine-box for a few seconds, but this is not absolutely necessary. It must be observed that in the process of bromining, the length of time required will depend in a great measure on the iodising. A plate that has but a pale gold tint will require less bromine than one that has become of a darker colour. The tone of the picture is much improved by adding about 50 drops of muriatic acid to each ounce measure of the saturated bromine. A preparation of bromine has lately been made, called "accellerating powder," which is very convenient in use, and produces a pleasing tone of colour. It has also the advantage of greater certainty, if a fresh quantity of the powder be used each time; for this, as well as the bromine water becomes rapidly weaker by exposure, therefore it is advisable for beginners to renew the accellerating mixture each time of using. When experience has been gained, it will be sufficient to add a few drops of the saturated bromine till the water attains the proper colour. Care must be taken to exclude the light of day from impinging on the plate after it has received the sensitive coating, and it must be viewed only by the light admitted through the chink of a door or of a window shutter. The necessity for this precaution will be evident on considering that the rays of light which are sufficient to produce an impression in the camera in a few seconds are admitted through but one small aperture, and that when a plate is exposed to the light it receives rays from all surrounding objects.

When the plate is properly prepared and enclosed in the sliding case which accompanies the photographic camera, we have arrived at that part of the operation which requires the most judgment and experience—the exposure to the influence of light. The first things to be done are to select the point of view, and to adjust the focus of the lenses so as to obtain a distinct image with sharp outlines on the trial screen of ground glass. If the object to be taken be a building or a view, no directions need be given, as the judgment of the artist will guide him; but in taking a portrait much attention to minute particulars will be requisite to bring out a satisfactory result. The following general directions will be found useful aids in the endeavour. Care must be taken that no dark shadows fall on one side of the face, as they will be exaggerated in the Daguerreotype likeness and give great sternness to the expression. To avoid this, it is almost indispensable to operate in the open air. The camera should be elevated to the level of the face, in order to obtain the greatest perfection in the delineation of the features. The dress should not expose any large surface of white, for those parts would be solarised before other parts have had sufficient light; therefore it is usual, when collars or shirt-fronts appear, to cover them with black, which is withdrawn when half the time of intended exposure to light has elapsed. When the sitter has large overhanging eyebrows, it is extremely difficult to prevent the eyes from being thrown in shade, which gives a fearfully disagreeable expression; it is best in these cases to take the likeness *en profile*. The background should be sufficiently light to throw out the figure and face without being too bright; but this is a point that the judgment and taste of the operator will determine, bearing in mind that the red rays make little more impression on the plate than black, and that the brightness of yellow and orange is also greatly diminished. Another point which it will be advisable to attend to is the personal appearance of the sitter. If a child, or a handsome young person, be the object, the focus should be as accurate as possible; but for those advanced in age, or who have defects on the skin, it is advisable to adjust the focus of the lenses so as to obscure those defects by blending the rays of light. There are many other minor points that will require attention, but taste and experience will guide the artist to perfection in such details; and the general directions here given will be found sufficient for most occasions.

When everything is properly adjusted, the case which contains the prepared plate must be substituted for the screen of ground glass, and the slide that exposes the plate to the image must be drawn up, taking care not to shake the camera so as to alter its position. The instant that the light impinges on the plate an effect is produced on the sensitive iodine coating; and it is the most critical point of the whole process to determine how long the action of light should continue. As there is no visible impression made on the plate by the rays of light, to guide the operator, he can only judge by experience—after numerous failures and a few succesful efforts—when the light should be excluded. To aid in gaining this experience, however, some general directions may lessen the number of failures.

We will suppose the artist to have prepared plates in a uniform manner, and of such a degree of sensitiveness, that they will take a building on which the sun is shining in three seconds. When the sun is obscured, the plate will require six, eight, ten, twenty, or thirty seconds to sufficiently receive the impressions of the ray from the same object, according as the clouds are rarer or more dense. As so much, therefore, depends on the state of the atmosphere, and as a second more or less will effect a much greater change when the sky is bright than when it is obscured, it is always much better, especially for tyros in the art, to operate on a gloomy day, for then the error of a few seconds will not much impair the effect; taking care to give, under such circumstances, what is considered rather an excess of light. In taking the largest-sized view that the camera will admit, a diaphragm is used to confine the rays to the centre of the glass, for the purpose of avoiding the effects of aberration; and as the diaphragm greatly diminishes the quantity of light, it will be necessary to make allowance in the time of exposure in proportion to the covered surface of the object-glass. For portraits, it is desirable of course to diminish the time of sitting to the least possible quantity, and some portraits have been taken in the fraction of a second, but the chances of success under such circumstances are greatly diminished. It is hazardous, therefore, to attempt to operate in so bright a light, and the effect is not nearly so pleasing, even when successful, as when the portrait is taken under a more sombre influence. We have been most successful when operating in the open air, about six o'clock on a summer's evening, with the sun obscured by light clouds, allowing the plate about twenty-five seconds exposure to the light in the camera, which is one of Mr. Ross's manufacture, with double lenses and 1⅝-inch aperture. When portraits are taken in a room, a longer time is required, because the light is then screened from the sitter on all but one side. Much, again, will depend on the colours of the objects to be depicted. If they be light, the impressions will be more quickly made, and if dark an additional time should be allowed. The effect when a Daguerreotype plate has had too much or too little light is easily perceived. Too much light will cause the white parts of objects to appear blue, the blacks become brown, and the finer demarkations of shading are destroyed. Such a picture is said to be "solarised" or "burnt." On the contrary, in a picture which has not had sufficient light, the lights and shadows are in strong contrast, and the darker portions of the object are not developed. With a still less degree of light, there is a general feebleness of impression, which no length of exposure to mercury vapour will strengthen.

The plate having been withdrawn from the camera, it is next transferred, in the dark, to the mercury-box, to bring out the latent picture. This is the most interesting part of the process, for now we have to ascertain whether all the trouble and care we have bestowed have been thrown away, or whether we have succeeded in obtaining a perfect picture most exquisitely finished. The impressions made on the iodine and bromine by the rays of light, though invisible, have yet such efficacy as to expose those portions of the silvered plate to the action of the vapour of mercury, whilst the other parts are impervious to its action. The mercury vapours thus form the lighter parts of the picture, whilst the dark polish of the silver plate constitutes the shadows. The particles of mercury deposited on the plate are so minute as to be scarcely visible by a powerful microscope, and the evaporation of the liquid metal at the ordinary temperature of the atmosphere is sufficient to bring out the Daguerreotype picture when placed over it—but this would require three or four hours. To facilitate the operation a spirit-lamp is used, which should be carefully applied, that the mercury may not be too much heated. The mercury-boxes usually sold have thermometers attached to them, and the temperature should not exceed 150° Fah.; but a little experience will teach how to regulate the heat without a thermometer, by applying the fingers occasionally at the bottom, which should not become too hot to be touched. In a minute or two the picture will begin to develope itself, and will then gradually come out till it attains its greatest distinctness. If it remain too long, the details become less sharply defined; it is better, therefore, to remove the plate when all the objects appear distinctly developed. It is generally recommended to heat the mercury to the highest point allowed, then to withdraw the lamp till the mercury cools, and apply heat again, and so on until the deposition of mercurial vapour is completed; but we prefer lowering the flame of the spirit-lamp, so as to produce a mere glimmer, and to allow it to remain burning for three or four minutes, after which to leave the plate undisturbed till it cools. If, when this process is completed, there appears a perfect picture when the operator peeps into the box with a taper's light, the pleasure he experiences amply repays all the trouble he has taken, and he will feel disposed to exult as much at the product as if it were the result of his elaborated skill, whereas his only achievement has been that of having fixed the pencillings of Nature.

The picture is now obained, but it is not yet secured. Were it to be exposed to light, the sensitive coating still upon the plate would pass through a variety of changes of colour, and darken into a purple. To prevent the further action of light, the plate must be immersed in a solution of hyposulphite of soda, in the proportion of not less than half an ounce to a pint of distilled water. This solution should be poured into a shallow vessel—a soup plate will answer very well—and the Daguerreotype should be immersed with its face upwards. Lift the plate gently up and down on each side, and in a few seconds the iodine will be removed. Then take the Daguerreotype carefully out, and immerse it in another vessel containing distilled water, if warm the better, and again in another bath of distilled water, to remove all traces of the soda. If these washings be done carefully the picture will be uninjured, but it will require great care in the subsequent process of drying to avoid impairing its effect. The plate must be held in a slanting direction for the water to drain off; care being taken to see that no particles of dust have settled on it, for if there have it must be again immersed in water. The spirit-lamp should be applied at the upper edge of the plate, and by blowing on it the drying will be promoted. Should the water collect on parts of the plate as if it were greasy, instead of spreading over the surface evenly, it must be blown away if possible before it dries, otherwise a mark will be left on the plate that may spoil the picture. Numerous annoying occurrences of this kind will happen, and it may be observed that the more strongly the picture is brought out, the more liable it is to be injured in the washing. It has occurred to us that one of the most beautiful pictures we have succeeded in obtaining, which was very distinct in details, forcible, and a pleasing likeness, was completely spoiled by stains in the subsequent process. The soda solution and water should not be twice used, lest any iodine remaining in the vessel should cause a stain.

After washing, the picture is permanent, and in this state all the first Daguerreotypes were finished. The thin film of mercury, however, is yet easily removed by a touch, nor has the picture attained the brilliancy and tone which it receives from the subsequent process of fixing by gilding, which was invented by M. Fizeau, to whom the Daguerreotype art is much indebted. For gilding the plate, a diluted solution of chloride of gold and of hyposulphite of soda is employed; in the proportions of 15 grains of the chloride to a pint of distilled water, and 45 grains of the hyposulphite in the same quantity of water. These should be dissolved in separate vessels, and then the gold solution poured very gradually into the other, stirring with a glass rod all the time. If this mixture of the two solutions be not carefully made, or if the soda solution be poured into the gold, the resulting mixture will be black, owing to the deposition of sulphate of gold. The quantity indicated will serve to gild a great number of plates, and may be kept for use as wanted. The plate to be gilded must be placed horizontally, with its face upwards, on the lamp-stand. The surface is to be then floated over with spirits of wine, which may be poured on it and quickly drained off,—the only use of the spirits being to facilitate the flow of the gold solution. As much of the diluted chloride of gold is poured on as the plate will retain on its horizontal surface, and then the spirit-lamp is to be applied beneath to heat all parts equally. Presently the liquid will emit vapour, the picture will improve in brilliancy, and soon afterwards small bubbles will appear, at which point the process must be stopped. The gold is then poured off, and the plate washed with warm distilled water, and dried with the aid of the spirit-lamp, in the same manner as after the first washing.

The operation is now completed, and if every part of the process have been conducted with care and judgment, the artist is in possession of a picture which, in accuracy of outline and in the exquisite beauty with which it is finished, far surpasses any work of mere art. He may gaze long on its wondrous details with delight, which will be not a little enhanced by the pleasing self-deception that it has been done by himself! All his trouble seems recompensed—all his failures but increase the pleasure of this one complete success—and the difficulties he has had to encounter in gaining the prize only add to its value. He sees henceforth all difficulties removed, and in full confidence of his powers he even hopes to attain still greater perfection.

Let not the variety and required care of the manipulations discourage any who have a taste for the art from commencing the work, since perseverance is almost sure to be crowned with success. For two whole days were we in our first efforts without obtaining the trace of an image; and when at length a perfect picture burst into view in the mercury-box, the delightful feelings of the days of childhood seemed to be restored. By attending to the directions which our experience and recollection of difficulties surmounted suggest, the way will be in a great measure cleared, and it will be a source of gratification to think we have removed any obstacles that obstruct the attainment of success.

THE HOUSE OF PEERS.

Sir—My ideas and notions may be so very peculiar that there is no danger whatever of their contaminating public taste; which being the case, you will, perhaps, allow me to express my own opinion of the House of Peers. In a word, then, I take it to be if not exactly a failure, very far below what was to be expected—at least desiderated. As to conception, it is positively null: the character is that of a chapel, not of a senate-house; such is certainly the general idea, without any attempt at further or different idea. No original and poetic grasp of mind has been exhibited by the architect, who has merely appropriated to the occasion what he found ready made. The impressive solemnity which befits a hall in which are held the councils of a widely extended empire, does not there express itself. On the contrary, if there be too much of the chapel in some respects, there is too much of the ball or banqueting room in others. There is by far too much of glare and garishness, and not a little of *mesquinerie* also. Yes, I venture to say it, of mesquinerie, which reproachful epithet may, I think, be very justly applied to the throne. Instead of forming a principal feature of the general composition, that seat—not perhaps exactly an "easy chair"—is no more than a piece of furniture which might be put into any room,—a mere gilded chair, instead of being made to form an important, and leading feature in the ensemble. Judging from the one already executed, the frescos will be altogether insignificant—mere spots in the general decoration, and by no means brilliant ones; rather very flat and insipid specimens of pictorial art, and will show all the more so in consequence of the injurious contrast with the painted windows, which latter, in turn, owing to the same contrast, must appear harsh and glaring in colour.

Such at least is my feeling; and I must be allowed to say that I am greatly disappointed in the new House of Peers. No doubt it is calculated well enough to strike and also satisfy those who merely go into it, and just look about them; and who therefore giving themselves up to the mere first impression, are captivated by the sumptuousness of the place. Yet the test of architectural excellence is not the mere first impression alone, before the judgment has time to rally and collect itself, but the increased satisfaction produced on every fresh visit. If I did not exactly expect, I desiderated and still desiderate more convincing evidence of artistic power and artistic grasp of mind than I there discover; for while on the one hand the "house" is decidedly too ecclesiastical in character, it is on the other more characteristic of a ball-room or a banqueting room than of a senate-house where the most momentous interests are to be discussed. I may be wrong; and if so, either you or some one among your correspondents will take the trouble to set me right. In the meanwhile I remain,

Zero.

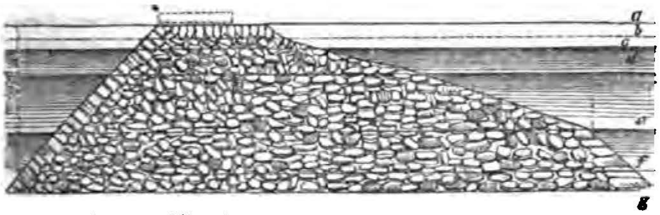
[We have given insertion to the above communication, not because we agree with the observations, but to give an opportunity to our readers for fair criticism.]—Ed.

CONSTRUCTION OF SEA WALLS.

(Continued from page 254.)

BREAKWATER IN DELAWARE BAY.

ANNEX (L.)—*Report of Commission of the United States' Engineers and Naval Officers on the Form which should be given to Breakwaters, and Report on the Construction of the Breakwater in Delaware Bay.*



Section of Breakwater in Delaware Bay, United States.

a, Top of breakwater, 30 feet wide.—b, Highest tide known.—c, Highest spring tide.—d, Lowest spring tide.—e, Level 15 feet below lowest spring tide.—f, Bottom 27 feet below lowest spring tide.—g, Average bottom 29·4 feet ditto.—The dotted lines on the top show a parapet to be made, if needful, 22 feet wide.

The following description of the Delaware Breakwater is compiled from the Report of a Board of Commissioners to the Secretary of the Navy, which was approved by the President of the United States in February 1829. The commission was composed of Commodore Rodgers, U.S. Navy; Brigadier-General Bernard, U.S. Engineers; and William Strickland, architect and engineer:—

With respect to these objects, upon which the solidity and durability of the work so essentially depend, it must be acknowledged that theory and mere speculation are utterly incompetent to fix, within precise limits, the degree of resistance to be given to a work exposed to so many and such incalculably violent efforts of the sea. But valuable inferences may be deduced from experimental results afforded by the construction of similar works in Europe, and described in an able paper presented to the French Institute by M. Cachin, general inspector of French Civil Engineers. Thus the stupendous works erected in Cherbourg in France, and at Plymouth in England, have been resorted to as guides in the investigation of the leading principles upon which the breakwater under consideration should be constructed.

If the road of Cherbourg is of the highest importance to France, that of Plymouth is probably of equal importance to Great Britain; as, among other advantages, it enables her to assemble at one point the fleets destined to watch the movements of her neighbours in the roads of Brest and Cherbourg; added to which, the connexion of the road of Plymouth with an extensive naval arsenal makes it a matter of much consequence that it should be rendered perfectly secure.

The works at Cherbourg fully answering the purposes for which they were erected, and demonstrating their importance, the Government of Great Britain caused the erection of a breakwater to be undertaken in the road of Plymouth, which was accordingly commenced in 1812.

At Plymouth the interior slope has an inclination of 57 feet altitude to 90 feet base, making an angle of 32° with the horizon. At Cherbourg this slope is of 45° inclination; and, since it has stood firmly under an altitude of more than 70 feet, it may be inferred that at Plymouth the interior slope might also have been kept at 45°.

The Board was, therefore, of opinion that, as the Delaware Breakwater must be 18 feet lower than that of Plymouth, and 30 feet lower than that of Cherbourg, there should be no hesitation in adopting the slope of 45°.

At Cherbourg, as at Plymouth, experience has taught that, if human power was able so to heap up materials as to fill up such a space in the deep, it required the agency of tempestuous waves so to dispose of them as to secure their permanent stability. On this score it would seem that the results obtained at Cherbourg from vicissitudes in 1812 were but partially known to the able projectors of the Plymouth Breakwater. Indeed, the base of 180 feet of that work, and its altitude of 57 feet, have received precisely the same ratio as that which the action of the sea had fixed between the base of $228\frac{48}{100}$ feet, and the altitude of $72\frac{99}{100}$ feet of the work at Cherbourg. The surface of the former work having been assumed to be a plane, while at Cherbourg the efforts of battering waves have produced a curvated surface, it is hence to be apprehended that at Plymouth it may become necessary, in progress of time, to add new materials to the lower part of the slope.

The slope herein submitted has been framed out of the following facts and principles afforded by the Cherbourg Breakwater.

1. The part above the highest spring-tide having been for a short time battered by the waves, which had lost by their ascension a portion of their momentum, received from the action of the sea an inclination of nearly 2 feet base to 1 of altitude.

2. The part comprehended between the highest and lowest spring-tide is exposed, during the time of its rise and fall, to the greatest violence of the waves. Thus permanently swept by the sea, this portion of the slope has received an inclination of 11 feet base to 2 of altitude.

3. The part comprised between the lowest spring-tide and a horizontal plane 15 feet below it, is exposed to the shock of the waves only during the interval between the termination of the fall and the commencement of the rise of tide: it has, therefore, to withstand the efforts of the sea under a less inclination, viz., 3 feet base to 1 of altitude.

4. The lowest part of the slope comprehended between the latter plane and the bottom of the sea, remaining permanently submerged, and to a depth at which the agitation of the waves has attained its minimum, has assumed an inclination still less than the preceding, viz., 5 feet base to 4 of altitude.

These experimental results show that the effect of water against loose materials is to give to the mass in progress of time a slope, the inclination of which will increase in proportion to the force exerted against it.

It is on these data that the profile of the Delaware Breakwater has been delineated.

This fact, with others not dissimilar which have happened at Cherbourg, shows that the top of a breakwater must be elevated beyond the reach of submersion, and loaded with the largest and heaviest materials that can be procured, which should be laid in such a way that each shall present to the action of the sea the smallest possible superficies, and to the lateral materials the largest surface of friction.

These considerations induced the Board to recommend for the Delaware Breakwater a profile, or transversal section, of the following dimensions:—the inward slope at 45°, the top 30 feet in breadth, and at $5\frac{1}{2}$ feet above the highest spring tide; the outward slope of 39 feet altitude, and of $105\frac{1}{2}$ feet base; both dimensions measured in relation to a horizontal plane passing by a point taken at 27 feet below the lowest spring-tide. The base bears to the altitude nearly the same ratio as similar lines in the profiles of Plymouth and Cherbourg Breakwaters.

The experience acquired at Cherbourg has taught—

1. That stones of small size are not sufficient to withstand even a moderate action of the waves; for, being constantly tossed about, they acquire by attrition a round and smooth surface, which prevents their assuming any settled place in the mass.

2. That stones measuring 18 or 24 cubic feet, and weighing $1\frac{1}{2}$ to 2 tons, present a suitable resistance to the efforts of a moderate sea.

3. That larger blocks are required to withstand a violent sea; and that in the more exposed parts of the work their sizes should be still larger.

4. That if small materials were to be used, it would be indispensable to protect them externally by others of larger size.

5. That the smaller the external surface of a large block, the greater will be its stability.

6. That the largest blocks should be placed towards the top, in order to compensate, by their greater steadiness, the loss of weight and of stability caused by immersion to the materials located immediately under the water line.

The foregoing description of the Delaware Breakwater includes, with occasional alterations, the Report of the Board of Commissioners. The work has been executed so far in accordance with the views and plans therein detailed. The dimensions recommended in the Report have been adopted in its erection, with the exception of that portion designed for a breakwater, which is 1,000 yards in length; the length recommended was 1,200.

The work may be considered now so far finished as to have accomplished materially the purposes for which it was projected. Indeed, the plan of commencing the work at the adjacent extremities of its two portions has tended to yield a shelter to vessels during the whole progress of its construction.

CHERBOURG HARBOUR.

ANNEX (M.)—*Extracts from the Memoire of* Mons. J. M. CACHIN, *on the Breakwater of Cherbourg.*

At the close of the 16th century, the French Government had resolved to provide, by means of art, those advantages for France which nature has conferred with such prodigality upon England, in the many ports she possesses in the English Channel.

It was more particularly, however, after the battle of La Hogue, that this necessity was more strongly felt, and the Government determined to create at Cherbourg a grand naval establishment, which in providing a safe and convenient harbour for their fleet, should give to the French nation the degree of power befitting its maritime position.

The American war had reanimated in the French mind the ambition of disputing with England the empire of the seas; and at the general peace, immediate steps were taken for fortifying the roadstead of Cherbourg.

The Bay of Cherbourg was selected as being opposite to the many almost natural harbours which Great Britain possesses in the Channel; as being in a very advanced position upon the ordinary track of ships, and offering every desirable facility for watching the movements of the enemy, interrupting his convoys, and for concentrating all the details of a grand maritime expedition.

The War Departments, which had been charged with proposing the divers projects for this grand enterprise, neglected to sound the roadstead, and to observe its maritime properties; and judging its extent as a harbour by its apparent surface, proposed the adoption of a plan which had been submitted to the French Government in 1778, by the director of fortifications at Cherbourg, for closing the roadstead by means of caissons filled with masonry, forming a jetty or "digue" from Point Homet to Pelée Island.

This project was most insufficient: it left exposed and without defence the most essential portion of the bay, that part best suited for the anchorage of large ships; and the very circumscribed area which it was proposed to protect against the violence of the sea and the attacks of an enemy, would have been accessible only to trading vessels, privateers, and other small craft.

In the year 1777, M. de la Bretonniere, capitaine de vaisseau, who was thoroughly acquainted with the localities, had proposed to cover the roadstead by a breakwater of sunken rocks. He republished in 1796 a memoir containing much valuable information in regard to the soundings, and other matters of great interest in regard to the general advantages of Cherbourg as a port of refuge for all classes of ships under all circumstances of wind and weather.

The project of constructing the breakwater in the direction of Point Homet, was abandoned at the remonstrance of M. de la Bretonniere, and, in 1780, it was resolved to adopt the direction which has since been given to it, viz., from the point Querqueville to Pelée Island.

After a long delay as to the means to be adopted for enclosing the anchorage by advanced works, M. de Cessart recommended the ingenious system of wooden caissons, in the form of truncated cones, 149 feet diameter at the base; 65 feet diameter at the summit, and 65 feet of vertical height.

It was proposed to sink 90 of these cones in all, leaving a passage at the east end of 2769 feet, and one at the west of 7674 feet.

It was, in the first instance, intended to fill them entirely with loose stones, but it was subsequently determined to fill them up with regular masonry, above the level of the equinoctial low tides, and to connect the cones with strong iron chains, thus forming a sort of open net work, which should divide the action of the sea, and create smooth water in the roadstead.

The proposed construction, mode of launching, and immersion of these cones, appeared to promise every success. One was built at Havre, and floated in 1783. It was then taken to pieces, transported to Cherbourg, and after some delay, caused by a gale of wind, was floated and sunk, on the 6th of June 1784, at a distance of 3835 feet from Pelée Island.

A second was sunk tangent to the base of the first, in a westerly direction, on the 7th July following, but a gale coming on on the 18th of August, before this second cone was filled with stones, it was carried away down to low water mark. This event was the cause of, or the pretext for, great changes in the dispositions which had in the first place been adopted.

It was found that the stones, dispersed by the breaking of the second cone, would entail the necessity of sinking a third at such a distance from the first, that the interval would not be protected from the violence of the sea. It was likewise considered, that, as the cones could be sunk only during the spring tides, the completion of the work would require 18 or 20 years' consecutive labour, and would cost 80,000,000 of francs. These considerations led the Government to direct that the cones should in future be only employed at intervals of 58 metres, 50 centimetres, and the intermediate space filled in with large blocks of stone, and thus to form a breakwater, which was to be carried up to low water level. These intervals were subsequently increased to 1280 feet; but after sinking 18 of these cones at different intervals, thus isolated and imperfectly filled, they soon experienced repeated damage, and this system of construction was accordingly soon abandoned. All the cones which the sea had spared being deemed useless, they were cut down to low water in the year 1789; one alone was left entire, to indicate the limits of the passage, but in spite of some care bestowed on its preservation, it fell to pieces on the 12th of February 1799. The successive destruction of all these cones, led to the recognition of the system of breakwaters of sunken rock as the only process calculated to ensure success.

From this period the sinking of stones was carried on with such activity, that by the end of the year 1790, the quantity of material sunk was computed at 2,665,400 metres cube. Hitherto but vague notions had been entertained of the depth of water, nature of the bottom, and of the force and direction of the currents at different stages of the tide. These essential considerations were neglected, and the establishment of the digue was resolved upon, at a distance of about 3,898 metres from the entrance of the merchant vessels' harbour, in an easterly and westerly direction, forming towards the centre a salient angle to the north of 169 degrees, which divides the "digue" into two branches, of which the westerly one is 2,232 metres, that on the east 1,536 metres in length, measured from the centres of the two cones which had been sunk at the extremities.

The angular disposition of the work thus determined, without regard to the principles which prescribed a configuration quite the reverse, in order to render it susceptible of the greatest resistance, was dictated by the necessity of not obstructing the fire of Forts Royal and Querqueville, destined to defend the entrance to the roadstead.

At this early stage, it would have been possible to modify the dispositions in regard to these forts, of which the one was only planned, and the other barely commenced; but the War Department insisted on carrying out its own plan of defence, and the Marine Department saw itself compelled to renounce the advantages which would manifestly have accrued from placing the breakwater more to the north, thus increasing the area of the anchorage without any serious increase of expense, or augmentation of the difficulties of construction.

This first error was followed up by a second no less grave, and which leaves no doubt that the soundings of the bay were then but very imperfectly known. The cone which was to form the eastern end of the digue was sunk in 25 feet (8 metres 12 centimetres) water at low tide, hence the water gradually shoals in the direction of Pelée Island, which is distant about 975 metres. This passage was thus narrowed with the view of obliging large ships to pass within good range of the fort on the island; but this purely military consideration led to the neglect of a most essential maritime condition, for the depth of water in this passage is insufficient for ships of the line at low water. It was likewise proposed, with the same defensive view, to narrow the western entrance; but after a careful examination of the depth of water, it was found necessary to establish the western extremity of the digue at a distance of 2,339 metres from fort Querqueville. But the passage of ships of the line thus established beyond good range of the above fort, sensibly affected the utility of this fortress; and had the naval and military projects been well concerted, it is not to be concealed, that the defences would have been susceptible of a more advantageous disposition, and that the greater part of the expense of the fort in question might have been saved. But all these inconveniences were discovered too late.

It was only in the month of July 1789 that orders were first given for taking correct soundings of the bay, and for ascertaining with accuracy the places accessible to vessels of all classes.

In 1792 the Legislative Assembly, convinced of the extreme importance of this great undertaking, procured a statement of the progress already made at an expense of 31,000,000 of francs, including cost of establishment and administration. Having fully recognised that the faults hitherto observed in the execution of the works proceeded from want of concert and combination in the different projects hitherto adopted, the Assembly ordered the Executive Government to name Commissioners, chosen by the departments of War, Marine, and the Interior, to report upon the merits of the works already executed, and to propose the best means of perfecting what had already been commenced, and of completing this great undertaking.

This Commission, amongst other important suggestions, give it as their opinion that the stability of the upper part of the digue could not be reckoned upon without the employment of larger stones than those hitherto used, and which had become much diminished in size by their frequent displacement and friction; that large blocks, 51 to 60 centimetres cube had a presumed stability sufficient to resist the action of the sea, and that this stability would increase with the volume of the blocks of stone employed.

The general dispositions recommended by the Commission of 1792 were adopted by the Government, upon the strength of the advice of a committee, composed of several general officers and admirals, and engineers of the greatest eminence in the three departments of War, Marine, and the Interior.

It now only remained to determine the height to which it was necessary to elevate the breakwater, in order, not only to procure smooth water in the roadstead, but at the same time to afford every possible protection to fleets and convoys against the attacks of the enemy.

It was the unanimous opinion of all the practical persons who had observed the effect of the sea upon the digue since its commencement, that at low water, in bad weather, from seaward, the roadstead was perfectly calm; but that, as the tide rose, it became troubled; and that, two hours before and after high water, when the wave appeared to acquire a greater force in breaking upon the breakwater, the vessels, particularly those near it, were much troubled by the sea.

After having noted the height above low-water mark to which the sea reached two hours before and after high water, it appeared a constant rule, that when the waves became troublesome to the ships in the roadstead, the sea had risen 4 metres 70 centimetres.

Hence it was naturally concluded that it would be advisable to carry the summit of the breakwater at least 4 metres 70 centimetres (14 ft. 6 in.) below the level of the highest tides; that is to say, to 2 metres 44 centimetres (7 ft. 6 in.) above the level of the lowest tides, the rise in the sea outside being calculated at 22 feet, or 7 metres 15 centimetres.

But viewing the great advantages which would result from its being carried up to the level of the highest waves, it was not hesitated to propose its elevation to 9 feet (2 metres 92 centimetres) above the level of the highest sea outside; that is to say, to 31 feet (10 metres 7 centimetres) above the lowest tides.

But the revolutionary troubles put a stop to all further proceedings connected with the recommendations of the Commission of 1792; and the completion of this vast enterprise appeared to be indefinitely delayed, when, in November 1800, a new government turned its attention to this important object of public utility, and named a Commission, upon whose report in 1802, the government directed that the centre of the breakwater should be elevated 2 metres 92 centimetres above the level of the highest tides, with a breadth of 195 metres, whereupon to construct a battery of 20 pieces of artillery of the largest calibre; and that the extremities of the breakwater should be, ultimately, similarly constructed for a like purpose.

This was recommended in consequence of the great distance (7,017 metres) between Forts Royal and Querqueville, which was deemed too great to prevent enemies' ships from anchoring to the north of the breakwater, thence firing on vessels within the roadstead, themselves being beyond good range of the forts.

At this period (1802) those works previously undertaken, which had been carried up to the level of low tides, had entirely disappeared. The sea had carried away from 15 to 18 feet of the summit, giving to the breakwater the following configuration:

	Base.	Height.
The interior slope, or that to the south..	12 50	12 50
Superior slope, north	47·50	6·20
Inferior slope, north..	9·	6·30

Upon this base, thus formed by the action of the sea, it was determined to attempt the erection of an artificial island, exposed to the most violent agitation of the waves. By the end of the year 1803, the central portion of the work was completed to low-water mark of ordinary tides. The modification and changes which the original breakwater had undergone, left no room to doubt that the small stones of which the then elevation was composed, would not resist the winter gales; that it would be necessary to consolidate the whole by a superstructure on the south side, composed of immense blocks of stone, to be raised to the height of the highest tides, as the only means of preventing the smaller materials from being washed away into the interior of the work by the north-east and north-west gales of winter. As anticipated, this superstructure resisted the force of the sea, prevented the washing away of the smaller materials, which, arrested by this barrier, gradually augmented the height of the breakwater, forming a solid and compact surface at a new slope, of which the base was about quadruple the vertical height.

It was, however, soon observed, that these small stones pressed up, and, transported by the northerly winds to a level above that of the sea, equally yielded to the same action in north-east and north-west gales. Under these circumstances of weather, of frequent recurrence in the winter of 1803, a portion of the stones which had been thrown in on the sea side became subject to a lateral displacement, and were deposited in great abundance in a conical mound at each extremity of the recently elevated central portion of the digue.

It was remarked, that the winds and the currents had both tended to give these mounds the precise configuration of the tracing of the proposed batteries; and thence it was naturally concluded, that the form proposed was that best adapted to insure stability, since it agreed so perfectly with that which the sea itself had assigned to the mass of stones set in motion in bad weather.

From motives of economy, the interior of the fort was composed of small materials; but the whole was necessarily revetted with large blocks, capable of offering an adequate resistance to the action of the sea. This was performed in a very simple and easy manner: in bad weather the blocks were cast overboard from the stone vessels, above the places which were dry at low water. In fine weather this was discontinued, and the stone vessels were moored over the required spot, or were sunk, so as to rest upon a berm or slip which had been left in the slope at the foot of the revetments. From the vessels thus sunk or moored, the blocks of stone were hoisted by their own tackle clear of their decks, when they were transported by cranes, or derricks, disposed on the summit of the breakwater, and deposited in their proper places on the revetments. By these simple and expeditious means, the central portion of the breakwater having been raised to the height of 2 metres 92 centimetres above the level of high-water, spring-tides, upon an extent of 195 metres in length, and 19 metres 50 centimetres in breadth, a battery was established thereon, armed, provisionally, with four 36-pounders and two heavy mortars.

In the subsequent construction of the terreplein and part of the parapet of the battery, owing to the bad weather and too great haste in constructing it, the precautions necessary to its thorough solidity were neglected, and a violent gale coming on ere the exterior revetment was completed, a portion of the temporary parapet, which had been formed with small materials not cemented, was destroyed. The mass of the battery suffered no injury; and the centre and the extremities of the terreplein resisted the action of the sea without the least alteration, and, notwithstanding the insufficient height and imperfect state of the exterior revetments, a garrison of 60 men remained in the battery in perfect safety.

In May 1805, the works were sufficiently advanced to arm the battery with 20 pieces of heavy ordnance within 24 hours.

The works suffered little material injury until the 12th February 1808, when, during a dreadful gale from the north-west, the sea submerged the battery, destroyed and upset the epaulements, and the wooden barracks of the garrison.

The main effect of this violent gale was to put an end to any further displacement of the materials; and the work has ever since presented the appearance of a natural slope of rocks, over which the ordinary "varechs" cross, and are developed in an unbroken undisturbed mode which proves the perfect stability of the work.

The examination made at this time of the new configuration which had been given to the mass of stones, confirmed and verified by subsequent experience, has established the fact, that jetties thus constructed, and exposed to the action of the sea, assume, between their summit and their base, four slopes essentially different, and which vary according to the violence of the waves, the duration of their action at the several parts in the rise and fall of the tides.

The situation of the exterior revetments of the battery being the effect of the natural action of the sea in its greatest agitation, was considered as that most suited to insure the permanency of the materials of which the work was composed; and accordingly, after the storm of 1808, new barracks were constructed for 60 men; a new parapet was raised to cover the artillery of the port, but without making any modification in the exterior slopes, which have ever since maintained the exact degree which the sea had assigned to them, though these slopes have, since that period, never had the least care bestowed on them.

The digue, thus completed in its central portion, remained armed with 20 pieces of artillery during the whole war. In the year 1811 it was decreed to substitute for this temporary fort a permanent defence, thus described in the decree dated 7th July of that year:

The battery to be established upon the breakwater of Cherbourg will be constructed in an elliptical tour of masonry, of dressed blocks of granite, of which the great axis shall be 35 toises, and the smaller 19 toises, in conformity with the plans and sections annexed to the present decree, and to the following specifications.

The foundations will be established on the rock-work at low-water level.

Upon this massive foundation, which will be 28 feet high, and at the level of the terreplein of the existing battery, will be placed a barrack, of which the walls will be pierced with 78 loopholes, capable of containing a garrison of 60 men, water-cisterns, and powder-magazine.

The gorge of the battery will be defended by two flanks.

A general platform upon the roof of the barracks, which will be bomb-proof, will serve for the site of a casemated battery for nineteen 36-pounders. The embrasures will be 30 feet above high-water mark.

A second platform will be constructed above the casemates, to serve, in case of necessity, for another tier of guns.

That portion of the existing battery without the site of the tower will be preserved, and the slopes towards the sea, which protect it, will be carefully kept in repair.

BREAKWATERS OF CHERBOURG AND PLYMOUTH.

ANNEX (N).—*Report made to the Academy of Sciences, Paris, by* M. GIRARD, *in the name of the Commission composed of* Messrs. PRONY, GIRARD, and DUPIN, *upon a Mémoire by the* Baron CACHIN, *Inspector-general of Bridges and Roads, entitled*, "*Mémoire upon the Digue of Cherbourg, compared with the Jetty or Breakwater at Plymouth.*"

The perpetual secretary of the Academy of the Mathematical Sciences certifies, that the following are extacts from the proceedings reported in the sitting of Monday, May 8, 1815.

The Commission appointed in 1792 assured itself by an attentive observation of the effects of the sea upon the digue, that the materials of which it was constructed had no stability until they were faced with large blocks of from 15 to 20 feet cube at least; but the most important modification which this Commission proposed in the construction of the work was, to carry the summit to the height of three metres above the highest spring tides, as the only means of guaranteeing the solidity of the work itself, which was the main object it was intended to effect.

The old digue or jetty, which had been provisionally carried up to the level of low-water mark in the year 1784, had now offered an experience of 20 years. It was ascertained that the storms during this interval of time had lowered the summit from four to five metres; the interior slope had preserved the inclination which had been originally given to it of 45 degrees, but its exterior slope, which had been originally formed upon a uniform inclination of three metres of base to one of height, was found to be entirely changed, and presented two distinct slopes; that of the lower portion was of 9 metres of base to 6 metres 39 centimetres of vertical elevation, whilst the inclination of the superior or upper slope had become five times less; that is to say, of 47 metres 50 centimetres base to 6 metres 20 centimetres vertical height.

These observations demonstrated what was the profile of the greatest stability, which was the most important point to know; and as it was remarked that the principal effect of the action of the sea, in strong winds from seaward, was to carry from the outside to the inside of the breakwater the materials of which it was composed, it became necessary, after having opposed a sufficient obstacle to this displacement, to abandon to the action of the sea itself the task of arranging the exterior surface which was exposed to its force in the manner and in the slope most suited to their object.

Accordingly, towards the end of the year 1803, M. Cachin caused to be raised on the top of that portion of the digue which had been already elevated, a sort of parapet, built with very large blocks, of which the summit was carried up to the level of the highest tides; thus the smaller stones which had been cast into the sea, by chance as it were, on the exterior of the digue, at the depth of low water, were borne up by the force of the waves to the foot of this parapet, and were there disposed on a regular slope, which, offering the least resistance to the movement of the waves, possessed the greatest stability. During the production of this effect, the horizontal base of the exterior slope became about quadruple that of its height.

Besides the movement of the materials in a vertical direction, whenever the wind blows hard from the north, or perpendicularly to the digue, these materials receive an impulsion from the effect of the winds which blow from the north-east and north-west, and in consequence of this impulsion two accumulations have been formed at the extremities of that central portion of the digue destined to support the battery, in the shape of two conical mounds, which serve for épaulements for the work.

This peculiar configuration, the effect of natural causes, is also found to coincide with that which the author of the Mémoire had indicated for the two end batteries.

It is here seen how, in leaving exposed to the action of the waves such materials as they can put in movement, these dispose themselves in the manner best adapted to their stability and preservation in a vertical position; but as nothing opposes itself to the movement which would be given to these materials in the direction of the length of the digue, the definitive effect of which movement would be the obstruction of the passes, it is indispensable, in order to prevent this effect, to face the whole exterior of the work with blocks of stone, sufficiently large to resist these oblique impulsions.

After having indicated the proceedings in detail, as well as the several modifications which it was judged expedient to adopt in the execution and dimensions in the central portion of the digue, M. Cachin gives an account of the effects which were produced on this, as it were, isolated mound by the gales of the 18th February 1807, of the 29th May of the same year, but, above all which, of that of the 12th February 1808, from the north-west.

A combination of extraordinary circumstances produced such a heavy sea that it submerged the floor of the battery, upset the parapet, and destroyed the wooden buildings which had been constructed on the terreplein of the work for the accommodation of the garrison.

The last-mentioned storm, the most violent on record, stowed the large blocks of stone with which the digue had been faced in fresh slopes, and with such regularity that they appeared to have been cemented by the hand of man; the successive examinations which have since been made have proved that, by the effect of this extraordinary overthrow, the materials have acquired a most perfect stability.

These examinations have also taught, that this equilibrium once established, the transverse section of the digue, on the sea side, assumes four essentially different slopes from the summit to the bottom of the sea.

Thus, the upper part, which is only reached by the tops of the waves, presents a slope of which the vertical height is to the base as 100 to 185.

The portion immediately below this, comprised between the high and low water (equinoctial) marks, is exposed to the most violent action of the sea during the whole flood and ebb; its slope is likewise the most inclined, the height being to the base as 100 to 540.

Below the low spring tides the surface is only exposed to the agitation of the waves during the first moments of the flood tide and the latter part of the ebb. The height of its slope to its base is as 100 to 202.

Lastly, the lowest part of the digue, which remains always submerged, not being exposed to the action of the waves, preserves a slope of which the height is to its base as 100 to 125.

After having pointed out the dimensions, and having described the means of construction of the Jetty at Plymouth, M. Cachin establishes a comparison between the real quantity and extent of the works respectively requisite to complete the Digue of Cherbourg and the Jetty or Breakwater of Plymouth; and also between the probable expense of each. The result of this is very simple, and easy to comprehend.

The length of Cherbourg Digue is 3,768 metres, and the area of its transverse section is 1,350 metres square. The expense of one metre of this profile, upon an experience of 16 years, is 8,717 francs. The length of Plymouth Breakwater is 1,364 metres; its profile, 998 square feet; and the expense of construction, 16,491 francs the metre.

After the experience of these two works, incomparably the greatest of their sort which the mind of man has ever contemplated to undertake, M. Cachin concludes with the observation, that, if man be strong enough to heap together rocks in the midst of the ocean, the action of the sea alone can dispose them in the manner most likely to ensure their proper stability.

Your Committee, partaking in this opinion, consider that this able engineer, in making known the result of his observations on the difficulties which he has encountered in the execution of his important labours, the means he has put in operation to surmount them, and, above all, his observations upon the configuration which bodies of water, violently agitated, tend to give to obstacles opposed to them, has rendered eminent service to those who may be hereafter called to the direction of similar operations.

We have the honour, in consequence, to propose the insertion of M. Cachin's Mémoire in the collection of the foreign men of science.

DECORATION OF THE PALACE AT WESTMINSTER.

Report *of the Committee appointed to select subjects in Painting and Sculpture, with a view to the future Decoration of the Palace at Westminster.*

Your Committee have first to observe that the general plan on which subjects were proposed to be selected has been defined by the Commissioners in their sixth report to her Majesty, in the following words:—"In accordance with the principles which have already guided us in deciding on the plan of Decoration in the House of Lords, viz., with reference to fresco-paintings, stained windows, and statues, proposed for that locality; and also in the selection of statues proposed for St. Stephen's Porch, St. Stephen's Hall, and the royal approaches: we conceive it to be the duty of this Commission, for the better guidance of present and future artists, and in order to maintain a character of harmony and unity worthy of such a building, to determine a complete scheme for the future decoration of the Palace. We are of opinion, that in determining such a scheme, the especial destination of each portion of the building should be attended to; that in the selection of subjects, the chief object to be regarded should be the expression of some specific idea; and the second, its illustration, by means of some well-known historic or poetic incident adapted for representation in painting."

The duty which has devolved on your Committee being thus defined, their labours have been directed to the selection of subjects in accordance with the principle above explained. They have, for the present, given their attention to subjects for painting; a considerable number of names of distinguished persons to whom statues might with propriety be erected, having been before proposed, and of these, some have been selected by former Committees for particular localities.

St. Stephen's Porch,

Containing two compartments, one measuring 26 feet high (to the point of the Gothic arch) by 16 ft. 8 in. wide; the other measuring 18 ft. 8 in. high, to the point of the arch, by 11 ft. 4 in. wide.

In this Porch will be four pedestals, on two of which it has been recommended to place the statues of Marlborough and Nelson; and your Committee were of opinion that the subjects of Peace and War would be appropriate in the two compartments intended for painting.

St. Stephen's Hall,

Containing on the side walls, eight compartments, each measuring 14 ft. 5 in. wide, by 9 ft. 8 in. high; and two end compartments, one measuring 20 ft. 9 in. high, to the point of the arch, by 11 ft. 6 in. wide; the other measuring 17 ft. 6 in. high, to the point of the arch, by 11 ft. 3 in. wide.

An opinion has before been expressed, by the Commission generally, that as St. Stephen's Hall stands on the spot where the House of Commons was, during many centuries, in the habit of assembling, it should be adorned with statues of men who rose to eminence by the eloquence and abilities which they displayed in that House. Twelve personages selected on this principle, were accordingly named in the fourth report of the Commission to her Majesty.

Your Committee conceived that the walls might properly be decorated with paintings, illustrating some of the greatest epochs in our constitutional, social, and ecclesiastical history, from the time when the Anglo-Saxon nation embraced Christianity to the accession of the House of Stuart; and that the following subjects would be well adapted for this purpose:—

I. In the State—(For the Side Compartments).

A Sitting of the Wittena-gemot.	An early Trial by Jury.
The Feudal System. The Homage of the Barons to William the Conqueror.	The Signing of Magna Charta.
The origin of the House of Commons. The first Writ brought down to the City of London.	The Abolition of Villeinage.* A Lord, on his death bed, attended by the Clergy, manumitting his Villeins.
The termination of the Baronial wars. Stanley and Oxford crowning Henry VII. over the dead body of Richard III.	The Privileges of the Commons asserted by Sir Thomas More against Cardinal Wolsey.

II. In the Church—(For the End Compartments).

West End.	East End.
The Conversion of the Anglo-Saxons to Christianity. The Preaching of St. Augustine.	The Reformation. Queen Elizabeth receiving the Bible in Cheapside.

The Central Hall,

Containing four compartments, each measuring 17 ft. 7 in. high, to the point of the Gothic arch, by 12 ft. 7 in. wide; and three small panels underneath three of the large compartments, each measuring 5 ft. 5 in. high, to the point of the arch, by about 4 ft. 6 in. wide.

Your Committee, bearing in mind that this Hall is the central point of the whole building, were of opinion that the nationality of the component parts of the United Kingdom should be the idea here illustrated, and would be appropriately expressed by representations of the four patron saints, St. George, St. Andrew, St. Patrick, and St. David, in the four compartments intended for painting; and that in the three small spaces underneath three of the compartments the heraldic emblazonings of the Orders of the Garter, of the Thistle, and of St. Patrick, might be introduced.

Corridors from the Central Hall,

Consisting of the Peers' Corridor, the Commons' Corridor, and the Central or Public Corridor.

Your Committee were of opinion that the corridors which join the two Houses might properly be decorated with paintings illustrative of that great contest which commenced with the meeting of the Long Parliament

* "The holy fathers, monks, and friars, in their confession, and specially in their extreme and deadly sicknesses, burdened the consciences of them whom they had under their hands: so that temporal men, by little and little, by reason of that terror in their conscience, were glad to manumit all their villeins."—Sir Thomas Smith's 'Commonwealth,' book iii. c. 10.

and terminated in 1689. It will be seen that the subjects have been selected on the principle of parallelism, and that an attempt has been made to do justice to the heroic virtues which were displayed on both sides.

The Peers' Corridor,

Containing eight compartments intended for painting, each measuring 9 ft. 6 in. wide by 7 feet high.

Charles I. erecting his Standard at Nottingham.	Speaker Lenthal asserting the Privileges of the Commons against Charles I., when the attempt was made to seize the five Members.
Basing House defended by the Cavaliers against the Parliamentary army.	The setting out of the Train Bands from London to raise the Siege of Gloucester.
The Expulsion of the Fellows of a College at Oxford for refusing to sign the Covenant.	The Embarkation of a Puritan Family for New England.
The Burial of Charles I.	The Parting of Lord and Lady Russell.

The Commons' Corridor,

Containing eight compartments intended for painting, each measuring 7 ft. 9½ in. wide by 6 ft. 6 in. high.

Charles II. assisted in his Escape by Jane Lane.	Alice Lisle concealing the Fugitives after the Battle of Sedgemoor.
The Executioner tying Wishart's book round the neck of Montrose.	The Sleep of Argyll.*
Monk declaring for a Free Parliament.	The Acquittal of the Seven Bishops.
The landing of Charles II.	The Lords and Commons presenting the Crown to William and Mary in the Banqueting House.

The Central Corridor,

Containing six compartments, each measuring 8 ft. 9 in. high by 7 feet wide.

The paintings in St. Stephen's Hall, and in the corridors which join the two Houses, illustrate the gradual progress of our institutions during the interval which elapsed between the introduction of Christianity and the Revolution. It has been thought that the central corridor might with advantage be adorned with paintings exhibiting in strong contrast the extremes which are separated by that interval. With this view, six subjects have been selected: in three, Britain appears sunk in ignorance, heathen superstition, and slavery; in the other three, she appears instructing the savage, abolishing barbarous rites, and liberating the slave.

The Phœnicians in Cornwall.	Cook in Otaheite.
A Druidical sacrifice.	English Authorities stopping the Sacrifice of a Suttee.
Anglo Saxon Captives exposed for sale in the Market-place of Rome.	The Emancipation of Negro Slaves.

The Upper Waiting Hall.

The subjects for six (out of eight) compartments in this locality, have been before proposed to be selected from the following poets: Chaucer, Spenser, Shakespeare, Milton, Dryden, and Pope. The choice of such subjects being left to the artists appointed, or to be appointed, to execute them, after they shall have been approved by the Commissioners.

The House of Peers.

The subjects for the six compartments intended for painting, and the selection of historical personages proposed for statues to be placed in the 18 niches, as well as the decorations for the stained windows, have been determined by former Committees.

The Peers' Robing Room,

Containing three large compartments, two measuring 20 feet wide by 10 ft 6 in. high, the third measuring 22 feet wide by 10 ft. 6 in. high; and six smaller compartments, each measuring 7 feet wide by 10 ft. 6 in. high.

Your Committee being desirous to vary the proposed decorations, and conceiving that Scripture subjects, as affording scope for the highest style of design, and as being especially eligible on other grounds, should by no means be excluded, considered that the above-named locality, in which the principal compartments intended for painting, are of considerable magnitude, would be well adapted for such subjects. Your Committee were of opinion that the illustrations should have reference to the idea of Justice on earth, and its development in Law and Judgment, and that the following subjects would be appropriate.

In the single large compartment on the west side, 1. Moses bringing down the Tables of the Law to the Israelites.

In the two small compartments on the east side, 2. The Fall of Man, and 3. His Condemnation to Labour.

On the south side, in the larger compartment, 4. The Judgment of Solomon; and in the two smaller, 5. The Visit of the Queen of Sheba, and 6. The Building of the Temple.

On the north side, in the larger compartment, 7. The Judgment of Daniel; and in the two smaller, 8. Daniel in the Lion's Den, and 9. The Vision of Daniel.

The Royal Antechamber,

Containing in the upper part of two of the walls, six large compartments (three on each side), measuring 13 feet wide by 10 feet 9 inches high. Twenty-eight upright narrow compartments, measuring 5 feet 7 inches high, by about 2 feet 6 inches wide; and 12 panels for carved work, four measuring 6 feet 9 inches wide, by 2 feet 9 inches high; and eight measuring 2 feet 2 inches square.

Your Committee considered that the six large compartments in this locality, being at a considerable height, might be filled with copies in tapestry, of the defeat of the Spanish Armada, taken either in part, or altogether from the designs of the tapestry originally existing in the House of Lords, which your Committee conceived, it is of great importance to preserve, as far as possible, to the nation.

That the 28 upright compartments might be appropriately filled with portraits relating to the Tudor family:

1. Henry VII.—2. Elizabeth of York.—3. Arthur, Prince of Wales.—4. Katharine of Aragon.—5. Henry VIII.—6. Anne Boleyn.—7. Jane Seymour.—8. Katharine Howard.—9. Anne of Cleves.—10. Katharine Parr.—11. Edward VI.—12. Queen Mary.—13. Philip II.—14. Queen Elizabeth.—15. Lewis XII.—16. Princess Mary, Queen of France, Duchess of Suffolk.—17. Charles Brandon, Duke of Suffolk.—18. The Marchioness of Dorset.—19. Lady Jane Grey.—20. Lord Guildford Dudley.—21. Princess Margaret, Queen of Scotland, Countess of Angus.—22. James IV.—23. Douglas, Earl of Angus.—24. James V.—25. Mary of Guise.—26. Mary, Queen of Scots.—27. Francis II.—28. Lord Darnley.

That the twelve panels might be filled with the following subjects in carved work.

1, 2. The Field of the Cloth of Gold, and the visit of Charles V. to Henry VIII., in the two compartments on the east and west sides.

3, 4, 5. The Escape of Mary Queen of Scots, the Murder of Rizzio, and Mary looking back on France, in the three compartments on the south side, west of the door. The Escape of Mary Queen of Scots occupying the centre panel.

6, 7, 8. Queen Elizabeth knighting Drake, Raleigh spreading his Cloak as a Carpet for the Queen, and Raleigh landing in Virginia, in the three compartments on the south side, east of the door. The subject of the knighting of Drake occupying the centre panel.

9, 10, 11, 12. On the north side, Edward VI. granting a Charter to Christ's Hospital, Lady Jane Grey at her studies, Sebastian Cabot before Henry VII., Katharine of Aragon pleading.

The Royal Gallery.

A considerable space on each side wall, measuring 77 feet 6 inches wide, not being subdivided into compartments, your Committee were of opinion that such space should be occupied by one large, and two smaller subjects; the smaller corresponding in width with the width of one window, and measuring 12 feet 6 inches wide by 11 feet 6 inches high; the larger comprehending the width of three windows, and measuring 45 feet wide by 11 feet 6 inches high. Of the remaining compartments, defined by the architect, two on the side walls measure each 13 feet 3 inches wide by 11 feet 6 inches high; four on the same level, in the end wall, measure 12 feet 2 inches wide by 11 feet 6 inches high; the six remaining compartments, three at each end, in the upper part of the walls, measure 12 feet 2 inches wide by 19 feet 7 inches high. The compartments would therefore be eighteen in number.

Your Committee were of opinion that the subjects for the Royal Gallery should relate to the military history and glory of the country, and that the following subjects would be appropriate.

In the three upper compartments in the south wall:—

1. Boadicea inciting her army.
2. Alfred in the Camp of the Danes.
3. Brian Boroimhe overcoming the Danes at the Bridge of Clontarf.

In the three upper compartments in the north wall:—

4. Edith finding the dead of Harold.
5. Richard Cœur de Lion coming in sight of the Holy City.
6. Eleanor saving the life of her husband, afterwards Edward I., by sucking the poison from a wound in his arm.

In the compartments next the proposed large compartment on the west wall:—

7. Bruce, during a retreat before the English, protecting a woman borne on a litter, and checking the pursuers.
8. Philippa interceding for the lives of the citizens of Calais.

In the lower compartments on the north wall:—

9. Edward the Black Prince entering London by the side of King John of France.
10. The Marriage of Henry V., at Troyes, with the Princess Katharine of France.

In the compartments next the proposed large compartment on the east wall:—

11. Elizabeth at Tilbury.
12. Blake at Tunis.

In the remaining compartment on the east wall:—

13. Marlborough at Blenheim.

In the lower compartments on the north wall:—

14. The Death of Wolfe.
15. The Death of Abercrombie.

In the remaining compartment on the west wall:—

* See Woodrow, 'Church History,' book iii, c. 9, s. 9.

16. Lord Cornwallis receiving the Sons of Tippoo as hostages.

In the large compartment on the west wall:—

17. Trafalgar; the Death of Nelson.

In the corresponding compartment on the east wall:—

18. Waterloo; the meeting of Wellington and Blucher.

The Queen's Robing Room,

Containing compartments of various dimensions, adapted for painting and other decorations.

Your Committee, influenced by the considerations before expressed as to the expediency of varying the character of the decorations proposed, were of opinion that a series of paintings, and other works of art, illustrating the legend of King Arthur, would be appropriate in this locality; and your Committee unanimously agreed to recommend to the Commission, that the execution and entire superintendence of such decorations should be entrusted to Mr. Dyce, who has already executed a fresco in the House of Lords.

The Guard Room,

Containing two compartments, each measuring 12 feet wide by 8 feet high.

Your Committee conceived that these compartments might be filled with the following subjects:—

1. Young Talbot defending his Father in Battle.
2. Isabella Douglas barring the Door with her Arm to protect James I. of Scotland.

The Lobby of the Guard Room,

Containing one compartment, measuring 14 feet 5 inches high, to the point of the Gothic arch, by 10 feet wide. For this locality your Committee selected the subject of St. Edmund the Martyr slain by the Danes.

The Norman Porch,

Containing two compartments, each measuring 18 feet 2 inches high, to the point of the Gothic arch, by 10 feet 10 inches wide.

It was the opinion of your Committee that these compartments would be appropriately filled with the two following subjects:—

1. Canute reproving his Courtiers.
2. Queen Elizabeth on the sea-side after the defeat of the Spanish Armada.

Your Committee conceived that the subjects in all the localities mentioned should be accompanied with inscriptions, and, in some instances, with appropriate mottoes; that in the last named subject the motto might be "Afflavit Deus et dissipantur," and in the subject of Canute, "Nemo Dominus nisi Deus."

The Peers' and Commons' Refreshment Rooms.

The compartments in the two Rooms belonging to the Peers might be appropriated to views of places of the chief importance within the United Kingdom. The compartments in the other Rooms to views of the most remarkable places in India and the Colonial possessions of the Crown. Space might also be found for subjects connected with rural scenery, the Harvest, the Chase, &c.

The Painted Chamber, being the Hall of Conference between the two Houses,

Contains 13 compartments adapted for painting: two on the east side, measuring 10 feet 4 inches high by 7 feet 4 inches wide: five on the west side, the centre compartment measuring 10 feet 4 inches high by 16 feet 4 inches wide; two compartments next the corners measuring 10 feet 4 inches high by 9 feet wide, and two over the doors, measuring 4 feet 6 inches high by 6 feet 9 inches wide. Three on the north side, the centre compartment measuring 10 feet 4 inches high by 14 feet 3 inches wide, and two smaller compartments, each measuring 7 feet 10 inches high by 4 feet 8 inches wide: and three on the south side corresponding with those on the north side.

Your Committee conceived that the subjects for painting in this locality might have reference to the acquisition of the countries, colonies, and important places constituting the British Empire; and that the following subjects would be appropriate:—

In the centre compartment on the west side, 1. The Marriage of Strongbow and Eva, daughter of Dermot, King of Leinster.

In the centre compartment on the south side, 2. Edward I. presenting his infant Son to the Welsh as their Prince.

In the centre compartment on the north side, 3. James VI. of Scotland receiving the news of the Death of Queen Elizabeth; or Setting out for England as James I.

In the two compartments, next the corners, on the west side:—

4. Lord Clive in the Battle of Plassy.
5. Penn's Treaty with the American Indians.

In the two compartments on the east side:—

6. The Colonization of Australia.
7. The Treaty of Nankin.

In the two compartments over the doors on the west side:—

8, 9. Incidents illustrating the Voyages to the North and South Poles.

In the small compartments on the south side:—

10, 11. Incidents relating to the acquisition of Mauritius and the Cape of Good Hope.

In the two small compartments on the north side:—

12. Sir George Rooke planting the Standard of England on Gibraltar.
13. The Surrender of Malta.

The entrance from Old Palace Yard is also intended to contain some compartments for painting, but your Committee conceived that it would be proper to postpone the consideration of subjects for this locality as it is not yet certain whether paintings can be seen in it to sufficient advantage.

With regard to the technical method in which the paintings proposed should be executed, your Committee, although not prepared to offer a general recommendation on this subject, were of opinion that the pictures in the three corridors leading from the Central Hall, and the pictures in the Refreshment Rooms should be painted in oil; and that the Queen's Robing Room, St. Stephen's Hall, and the Royal Gallery should be painted in fresco. The representations of the four Patron Saints, from their size and situation, might be advantageously executed in Mosaic (like the four Evangelists in the pendentives of the Cupola of St. Peter's), thus giving an opportunity for the introduction into England of an art highly valued in other times and countries.

Your Committee have further to observe that moveable oil paintings, not coming within the general plan proposed, might be placed in Committee Rooms and in other parts of the building.

BRITISH ASSOCIATION.

(*Continued from page 261.*)

"*On Anemometers and Resolving Scales.*" By Captain Cockburn.

The advantage of a correct statement of the winds at sea has, for some years, been most apparent to me. Since the introduction into the naval service of a certain formula for stating the force of the wind, represented by numbers from 1 to 12, according to the sail carried and speed of a well-conditioned man-of-war, and this depending upon the opinion of the officer of the watch, the notations are as various as the opinions on such a subject must be; and I certainly have seen great discrepancies noted on the ship's log-book. This evident evil is the immediate cause of my attempting to make an anemometer which might correct it. The concave form of the revolving wings of this instrument was taken from a paper read on the subject last meeting. The concave surface holding one-third more wind than the convex, by theory it would revolve one-third as fast as the wind; consequently, three times the distance described by a cup in a revolution would be the velocity of the wind in the time occupied; this is supposing the form of the cup to be a perfect hemisphere, and no friction either in the mechanism of the instrument or in the air; but as there must be friction and resistance from both these causes, this necessarily involves a correction, which must be determined by experiment, in order to establish the value of the revolutions. From the experiments I have made on the top of railway carriages and in steam boats, the correction for the large sized cups is ·5 or ½. I do not by any means consider this to be decisive; the results have been various, from the unsteadiness of the wind during the trials, and from the mass of air carried along by the moving body: this will make the multiple 3·5 instead of 3. I am persuaded, also, that a different multiple will be required at moderate and at great velocities; but I have not been able to ascertain it. This value depends also upon the circumference of the circle described by the cups, their form, and weight. I shall not enter into the relative advantages of the forms and sizes of those I have had made: the diameters of each are, from centre to centre of the cups, including the arms, 12, 10, and 8 inches. Those simple multiplying wheels I have used may be substituted by the plan adopted for gas-meters, which I think preferable.

"*On Changes in the Position of the Transit Instrument occasioned by the Temperature of the Earth, from the Observations of* Prof. C. P. Smyth, *of Edinburgh.*" By Prof. Powell.

Mr. Mallet, in an address to the Geological Society of Dublin, mentioned that Sir W. R. Hamilton had noticed certain *changes of level* in the transit instruments at his observatories; and that Dr. Robinson had also found such a change both in the general level of the observatory and also a *motion in azimuth*, recurring at annual periods, and apparently depending on the temperature of the earth;—but no details of such observations were given. Prof. C. P. Smyth has pursued such observations in detail at the observatory on the Calton Hill, Edinburgh, aided by the thermometric determinations of the changes of the temperature in the subjacent soil, made under the direction of Prof. Forbes, by thermometers sunk in the ground. The data he used were those obtained at depths of 5 feet, 3 feet, and in contact with the pier of the observatory. The movements, both in the *level* of the transit, and also *in azimuth*, are laid down graphically in curves, and exhibit a remarkable agreement with the changes in temperature, the western end of the *level being highest in summer*, and the deviation of the *west end* of the transit axis being *greatest towards* the *south* in *winter*.

"*On the Coloured Glass employed in Glazing the new Palm House in the Royal Botanic Garden at Kew.*" By R. Hunt.

It has been found that plants growing in stove houses often suffer from the scorching influence of the solar rays, and great expense is frequently incurred in fixing blinds to cut off this destructive calorific influence. From the enormous size of the new Palm House at Kew, it would be almost impracticable to adopt any system of shades which should be effective—this building being 363 feet in length, 100 feet wide, and 63 feet high. It was therefore thought desirable to ascertain if it would be possible to cut off these scorching rays by the use of a tinted glass, which should not be objectionable in its appearance, and the question was at the recommendation of Sir W. Hooker and Dr. Lindley submitted by the Commissioners of Woods, &c. to Mr. Hunt. The object was, to select a glass which should not permit those heat rays which are the most active in scorching the leaves of plants to permeate it. By a series of experiments made with the coloured juices of the palms themselves it was ascertained that the rays which destroyed their colour, belonged to a class situated at that end of the prismatic spectrum which exhibited the utmost calorific power, and just beyond the limits of the visible red ray. A great number of specimens of glass variously manufactured were submitted to examination, and it was at length ascertained that glass tinted green appeared likely to effect the object desired most readily. Some of the green glasses which were examined obstructed nearly all the heat rays—but this was not desired, and from their dark colour these were objectionable, as stopping the passage of a considerable quantity of light, which was essential to the healthful growth of the plants. Many specimens were manufactured purposely for the experiments by Messrs. Chance of Birmingham, according to given directions, and it is mainly due to the interest taken by these gentlemen that the desideratum has been arrived at. Every sample of glass was submitted to three distinct sets of experiments—1st. To ascertain, by measuring off the coloured rays of the spectrum, its transparency to luminous influence. 2nd. To ascertain the amount of obstruction offered to the passage of the chemical rays. 3rd. To measure the amount of heat radiation which permeated each specimen. The chemical changes were tried upon chloride of silver, and on papers stained with the green colouring matter of the leaves of the palms themselves. The calorific influence was ascertained by a method employed by Sir John Herschel in his experiments on solar radiation. Tissue paper stretched on a frame was smoked on one side by holding it over a smoky flame, and then while the spectrum was thrown upon it the other surface was washed with strong sulphuric ether. By the evaporation of the ether the points of calorific action were most easily obtained, as these dried off in well defined circles long before the other parts presented any appearance of dryness. By these means it was not difficult, with care, to ascertain exactly the conditions of the glass, as to its transparency to light, heat, and chemical agency (actinism). The glass thus chosen is of a very pale yellow-green colour, the colour being given by oxide of copper, and is so transparent that scarcely any light is intercepted. In examining the spectral rays through it, it is found that the yellow is slighly diminished in intensity, and that the extent of the red ray is affected in a small degree, the lower edge of the ordinary red ray being cut off by it. It does not appear to act in any way upon the chemical principle, as spectral impressions obtained upon chloride of silver are the same in extent and character as those produced by the action of the rays which have passed ordinary white glass. This glass has, however, a very remarkable action upon the non-luminous heat-rays, the least refrangible calorific rays. It prevents the permeation of all that class of heat-rays which exist below and in the point fixed by Sir William Herschel, Sir H. Englefield, and Sir J. Herschel, as the point of maximum calorific action. As it is to this class of rays that the scorching influence is due, there is every reason to conclude that the use of this glass will be effective in protecting the plants, and, at the same time, as it is unobjectionable in point of colour, and transparent to that principle which is necessary for the development of those parts of the plant which depend upon external chemical excitation, it is only partially so to the heat-rays, and it is opaque to those only which are the most injurious. The absence of the oxide of manganese, commonly employed in all sheet glass, is insisted on, it having been found that glass, into the composition of which manganese enters, will, after exposure for some time to intense sun-light, assume a pinky hue, and any tint of this character would completely destroy the peculiar properties for which this glass is chosen. Melloni, in his investigations on radiant heat, discovered that a peculiar green glass, manufactured in Italy, obstructed nearly all the calorific rays; we may, therefore, conclude that the glass chosen is of a similar character to that employed by the Italian philosopher. The tint of colour is not very different from that of the old crown glass; and many practical men state that they find their plants flourish much better under this kind of glass than under the white sheet glass, which is now so commonly employed.

"*On the Potassium Battery.*" By Mr. Goodman.

An amalgam of mercury and potassium was placed in a vessel closed with a diaphragm at one end, and holding mineral naphtha. This was plunged into an acid solution, or a solution of sulphate of copper, containing a platina plate. By the action of the acid through the skin, the oxidation of the potassium was effected; and by connecting these plates with a voltameter, water was readily decomposed, or with a galvanometer a considerable deflexion produced.

"*On a System of Colouring Geological Maps.*" By J. W. Salter.

Hitherto geologists have represented the British strata by colours taken from the general hue of the rock, modified by the necessity of using bright tints and distinguishing adjacent formations by colours strongly contrasted. Continental geologists have not entirely adopted these colours, nor is there perfect accordance even in the maps of Englishmen. Mr. Salter proposed to remedy the inconvenience and uncertainty attending the present method of colouring maps by introducing a system capable of universal adoption. The same colour, he says, should always be employed for the same group of rocks, various shades of that common colour being sufficient to distinguish, and at the same time combine, all the subdivisions of that group. Again, the colours used to designate systems of strata should follow in some constant order. The chromatic scale naturally suggested itself as the most harmonious gradation of colours, and accordingly Mr. Salter proposed to represent the Silurian strata by *Violet*; Carboniferous, *Blue*; Triassic, *Green*; Oolitic, *Yellow*; Cretaceous, *Orange*; Tertiary, *Red*. It was necessary to use a more intense red, with the addition of various markings, for the granitic rocks.

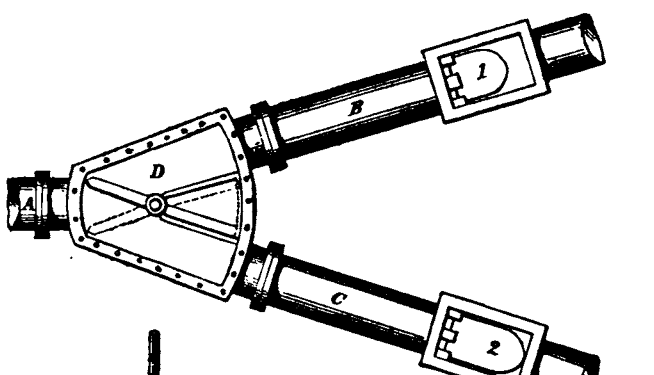
Mr. Greenough referred to the pamphlet accompanying his geological Map of England, for an exposition of the principles by which he was guided,—which were approved of by the English geologists, and from which the French had departed with regret.—Mr. Phillips and Sir H. De la Beche recommended the adoption of one colour for each system, employing engraved lines of various kinds to distinguish the subdivisions, thereby diminishing the cost and increasing the accuracy of coloured maps. —Sir R. I. Murchison said he had once attempted to apply the scheme now advocated by Mr. Salter, but found it, practically, less serviceable than Mr. Greenough's, which was the basis of all the other maps.

HYDRAULIC MACHINE FOR RAISING WATER, &c.

Invented by Michael Scott, *Engineer of the Liverpool Water Works.*

This machine was originally planned as a substitute for the common air pump in marine steam engines. As such I will first speak of it. Some years ago I was engaged in designing an engine which it was desirable to compress into the smallest possible bulk. The chief difficulty was the air pump and its attachments, which, if the ordinary arrangement was adopted, would occupy valuable space and make the engine complex. Observing this, I determined, if possible, to get rid of this pump altogether, and with this view, designed the machine as represented in fig. 1, where A is a pipe passing through the bow of

Fig. 1.



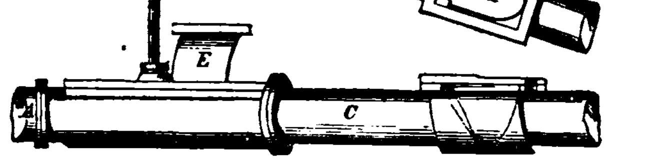


Fig. 2.

the vessel, which, at a convenient distance aft, diverges into two branches, which branch pipes again respectively debouch into the sea near the stern. D is a double hinge valve, moveable by a brass rod passing through a stuffing box on the top of the pipe. By this rod the valve D may be thrown to either side of the chamber so as to shut the communication between the pipe A and the pipe B or C, as the case may be, on the one side, and on the other side, so as to open the port between one of the pipes B or C and the pipe E, which descends from the condenser.

It will be observed, also, that there are two valves marked 1 and 2, one in each pipe opening upwards, which allow the water to pass out, but prevent its return. These valves may be equilibriated, and also opened or shut, by a crank joined to the axle which passes through the side of the pipe. So much for the configuration; now for the mode of action. Suppose the ship to be in motion (going ahead) and the valve D in the position shown, then the water will rush through the pipe A, and there being no obstruction offered, will pass through C and out at the stern. But let us throw the valve D to the other side of the chamber, as shown by the dotted lines, the water entering at A now flows through pipe B, but the water in pipe C having been in motion its momentum will carry it onwards in the original direction, leaving a vacuum behind; at the same time it will be observed, that the port has been opened between pipe C and the condenser, and the water of condensation and vapour will rush out of the condenser into the pipe C. On again reversing the valve D, the same effect is produced in pipe B, and so on alternately.

Having thus briefly explained the form and operation of the machine, we have now to inquire what extent of vacuous space is likely to be obtained under ordinary circumstances.

Let $P =$ the weight of the column of water in lbs.; $G =$ the co-efficient of gravity $= 32$; $V =$ the velocity in feet per second.

Then the vis viva of the water $= \frac{P}{G} V^2$.

Again, let $A =$ the area of the pipe in square inches; $R =$ the resistance due to the immersion at atmospheric pressure; $L =$ the length of the vacuum in feet.

Then we have the mechanical effect overcome by the water while stopping $= A \times R \times L$. But this mechanical effect is equal to half the vis viva.

$$\text{Hence, } A \times R \times L = \tfrac{1}{2} \frac{P}{G} \times V^2, \text{ or } L = \frac{P \times V^2}{2 \times G \times A \times R}.$$

Let us now apply this formula to a particular case. Suppose the vessel to be 110 feet between the perpendiculars, and the length of the pipe to be 90 feet, diameter 6 inches; say she is propelled by one engine of 30-inch cylinder, and 3 feet stroke, then the air-pump would have a capacity of about 4,300 cubic inches.

Again, take the speed of the vessel at 14 miles per hour, or 20 feet per second, then we have—

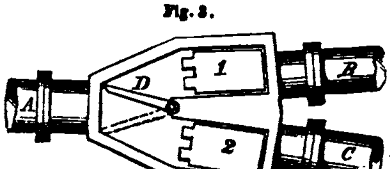
$P = 1092$ lb. $A = 28$ square inches.
$G = 32$ $V = 20$ feet per second.
$R = 17$

$$\text{Hence } L = \frac{1092 \times 20^2}{2 \times 32 \times 28 \times 17} = 14 \text{ feet 4 inches.}$$

The contents of which is 4896 inches, and with a velocity of 20 feet per second, the machine will make one stroke per second, whilst the engine will not go above 45 strokes at most; therefore, the machine would be one-third more powerful than the pump.

Though the above example proves the practicability of the application as a substitute for the air-pump in such cases as contemplated, viz., light river boats moving at a high velocity, still I wish it to be clearly understood that in ordinary cases, such as we meet with in this country, I would prefer the common air-pump, which is a most effective instrument, but there are circumstances in which this machine might be adopted with advantage, and which may excuse the introduction of the foregoing.

Fig. 3.



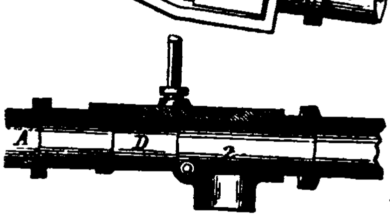


Fig. 4.

Applied as a Ship's Pump.—The arrangement for this purpose is remarkably simple, being identical in principle with that just described, but different in detail. Fig. 3, is a plan and fig. 4 a vertical section, showing the valves. It will be observed that the general form is similar, but the construction of the valves, unlike the machine previously explained, is less complicated. First, the valve D is a single hinge valve, moveable as before, by a rod passing through the top of the pipe; secondly, instead of the valve at E, figs. 1 and 2, we have two valves marked 1 and 2, opening upwards, being placed on the top of pipes E, passing into the bilge; and, lastly, we dispense altogether with the valves in the branch pipes. Presuming I have made myself understood so far, let us suppose the ship at sea in a gale of wind, and leaking badly, and let the valve D be in the position shown, then the water will rush through the pipe A, pass through C, and out at the stern; then reverse the valve D, the water now flows through B, and at the same time we have the water in pipe C passing on by virtue of its own momentum, leaving a vacuum behind; when this takes place, the valve 2 will open and admit the water from the bilge to fill the vacuous space. On reversing the valve D, the operation is repeated, and so on.

Let us now apply the formula, that we may acquire some conception of the power of the apparatus. I shall take that celebrated ship, the "Great Britain," with a length of keel $= 282$ feet; and as it is an object to keep the perforations made by the pipes as small as possible, they must be situated where the line of pipe meets the bend at bow and stern, as nearly as may be, at a right angle. This condition will diminish the effective length of the column to, say 250 feet, diameter of pipe $= 12$ inches, area 113 square inches, ship's load, draught 16 feet, immersion of pipe 11 feet, or 5 lb. pressure per square inch, speed of ship 12 miles per hour, 17·6 feet per second. Then

$P = 12250$ lb. $V = 17{\cdot}6$ $R = 5$ lb. per square inch.
$G = 32$ $A = 113$ square inches.

$$\text{We have } L \; \frac{12250 \times 17{\cdot}6^2}{2 \times 32 \times 113 \times 5} \; 105 \text{ feet.}$$

The contents of which is 82·3 cubic feet nearly. Again, our velocity is 1056 feet per minute, and if we reverse the valve D, when the water has passed on, only 52 feet, then we get the initial velocity 1056 feet, and the final velocity 528 feet, the mean of which is 792 feet. The machine, at this rate, might make 15 strokes per minute, but if one-third be deducted for friction, &c., or if we get 10 effective strokes (that is 5 to each pipe) we shall have 411 cubic feet, or nearly 12 tons of water thrown out of the ship every minute, equal to 180 pumps four inches diameter, and 11-inch stroke, going 30 strokes per minute, and if kept working during 24 hours requiring from 900 to 1000 men. This machine can be kept in operation during the same time by two men, and if desired may be made self-acting.

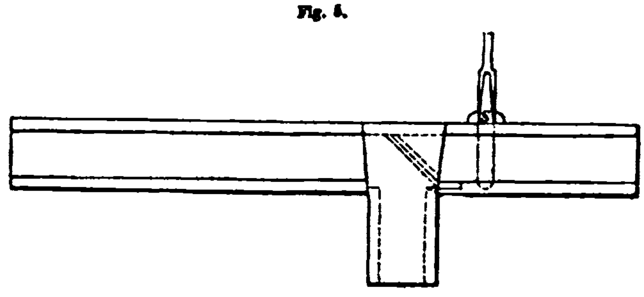
If the machine be worked at a low velocity, say four miles per hour, it will then discharge 127 cubic feet per minute, which is equal in efficacy to 60 pumps, worked by 300 men.

With respect to the machine as a substitute for the air-pump, it will be observed by referring to figs. 1 and 2, that on reversing the valve D, the branch pipe into which the water is flowing is nearly vacuous, that is, there will probably be a vacuum equal to 10 or 12 lb. per square inch (I speak of the indicator), and the pressure being thus removed from the end of the column, the external pressure of the water and atmosphere will force the water through the pipe with a great increase of velocity. Suppose, for instance, that the length of the vacuous space (irrespective of that occupied by the water of condensation) was 10 feet, and the elasticity of the vapour filling this space equal to 1 lb. per square inch, then, according to the law which regulates the elasticity of gases under pressure, if we take half the length—five feet, and half the difference between the initial and final pressures—7 lb. per square inch, this will give the force tending to accelerate the velocity of the water through the pipe, viz., 7 lb. per inch acting over a space of 5 feet, and this power is available every time the valve D is reversed.

In the event of the vapour being of greater elasticity in the condenser, say 7 lb. per inch, still as it would tend to keep the water in motion in the after part of the pipe, it would reduce the quantity of resistance from 17 lb. per inch, as it stood in the calculation, to 10 lb., so that either view is favourable to the machine. In fine, a considerable amount of the power taken to produce the vacuum is again given out.

Figs. 5 and 6 show an arrangement which might be used advantageously to withdraw water from a cofferdam where there was a

Fig. 5.



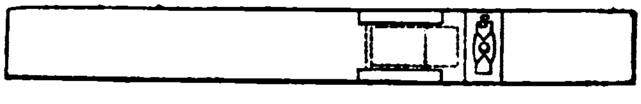


Fig. 6.

current, produced either by the natural stream of a river or the influx and efflux of the tide. The apparatus is supposed to be formed of four planks of wood nailed together, and a suction pipe constructed in a similar manner. On the top of this suction pipe there is fixed a clack made of leather, with a plate of iron secured to the flap; and as a substitute for the hinge valve, formerly described, we have a piece of wood made to slide through the top, and in two grooves, one at each side of the pipe. The machine being immersed beneath the surface of the river, and a communication made between the suction pipe and the interior of the dam, it only remains to raise the slide S, and permit a current to be established inside of the main pipe or box; then by pushing the slide down, a vacuum would instantly be formed, which, as before explained, would elevate the water from the interior of the dam, to be expelled into the river when the slide was again raised.

I have erected a machine of this form; and as it can be constructed and put in operation in a few hours, and as it is both effective and costs but little, I recommend it to parties who have hydraulic works in progress, where the situation will admit of its being employed.

In conclusion, this machine is obviously applicable to the raising of water, or producing a vacuum, in every situation where we can command a fall or running stream; and experiment having proved it to be superior to the undershot water-wheel, for these purposes, whilst with this great power it combines simplicity, durability, and cheapness, in the highest degree, I am humbly of opinion that it is likely to be extensively employed, in which case, the foregoing description will not have been written in vain.

RAILWAY-CARRIAGE BREAKS.

At the last quarterly meeting of the Institute of Mechanical Engineers, held at Birmingham, Mr. J. G. M'Connell in the chair, the following communications were read:—

Mr. G. Stephenson, President of the Institute, "*On a new Self-acting Break*,"* a beautiful model of which accompanied the paper.

"The various accidents on railways arising from concussions and collisions (and especially the late accident at Wolverton) have induced me to draw my attention to the construction of a self-acting break, which I have for several years had in view, a plan and model of which I have had made, and now lay before the Society, with my description of its action and effects. When a railway train is moving at the rate of from 40 to 60 miles an hour, the momentum is so great that it cannot be stopped in any reasonable distance by the breaks at present in use; or if an axle-tree breaks, or any accident happen to the engine so as to prevent its progressing, the sudden shake causes the carriages to overturn each other, and those next the engine are almost certain to be crushed. In an accident of this kind, neither engine-driver, stoker, or guard can be prepared, and before there is time for any of them to put on the break at present in use, so as to be in the least degree effective, the collision or concussion has taken place. When the engine-driver shuts off the steam or applies his break on the tender, the self-acting break is immediately brought to bear upon every wheel attached to every carriage in the train so powerfully, if necessary, as to bring every wheel into the condition of a sledge. I think the train will be brought to a stand by this break in one tenth of the space in which it can be by the breaks at present used. My plan is as follows:—I attach a couple of spiral springs to the levers of the break of every carriage, and also connect them with the buffers, and if the carriage requires gentle breaking (which will always be the case when a train approaches a station), the engine-driver, by shutting off a portion of the steam, or applying the break gently, will have complete command over the train, without any of those violent uneasy motions, which are very frequent and excessively disagreeable to passengers; and as the guard is frequently compelled to apply his break so powerfully as to make the wheels slide on the rail, and cause a considerable amount of wear and tear on the tyre of the wheel, by which it becomes flat-sided, and makes the carriages uneasy, and creates a jumping motion on the rail. Suppose a train of carriages moving at the rate of from 30 to 40 miles an hour, and a signal is held out for the engine-driver to stop; the moment he shuts off the steam, the whole of the breaks are brought into instant application of sledging the wheels, which will be more effectual than fifty men applying the common breaks, as the mischief is frequently done before the guard is apprised of the approach of danger. It is frequently necessary for the trains to be backed into a siding. When this is required, the train will first have to be stopped, and in one minute the whole of the breaks can be disengaged from the buffers, as is shown in the model, and when the train proceeds they are again dropped into gear. The plan altogether appears so simple that any ordinary mind can easily understand the whole of it; and I think the cost of putting the breaks on each carriage would not exceed more than from 5*l.* to 10*l.* Any effectual plan for increasing the safety of railway travelling is, in my mind, of such vital importance, that I prefer laying my scheme open to the world, to taking out a patent for it; and it will be a source of the greatest pleasure to me to knew that it has been the means of saving even one human life from destruction, or that it has prevented one serious concussion."—In consequence of Mr. Stephenson's absence, the invention was not discussed, it being agreed that a special meeting should be called to consider the subject.

* A railway break, answering a similar purpose as the one described by Mr. Stephenson, has been patented by Mr. Bunnet, and described in the "Journal" for 1842, page 72. —Ed. C. E. & A. Journal.

The consideration of Mr. Buckle's experiments on fan blasts, now exciting considerable interest, was then resumed. The chief object of Mr. Buckle was to show that the present fan blasts were imperfect in construction and expensive in operation. He proposed, as the result of experiments extending over a period of nine years, to have a series of fans, revolving in such a way as that the blast of air thrown from one would be communicated to each. He also showed the advantages of having a large inlet-pipe. By these means he estimated that not only would the blast be stronger with less horse power, but it would also be uniform; thus improving the quality of the iron, as well as producing it at a cheaper rate.

DREDGE'S SUSPENSION BRIDGE.

Sir—I beg, in reference to an extract you made from a Calcutta paper, in the last number of your *Journal*, to observe that I published no statement in the *Mechanics' Magazine* that I have not documents and drawings by me to substantiate.

Bath, Aug. 23, 1847. James Dredge.

REVIEWS.

Tables for the Calculation of Earthworks. By F. Bashforth, M.A.

In our last notice of Mr. Bashforth's tables, we explained to our readers the method of determining the volume of earthwork when the height of the slopes on either side was the same, and the calculation involved only integral numbers in feet and chains; we now propose to show how the tables can be applied to determine the amount of earth both in ordinary and side-long cuttings, when the heights contain decimal portions of feet. Suppose, as before, the slopes of the side-long cutting to be produced until they meet in some straight line below the formation level; then if the vertical sections of such a cutting be similar triangles, we can apply the tables to determine the quantity of earth excavated; all we have to do then is to determine the area of these triangular sections a chain apart, take the square root of the areas, and substitute them for the a and b of the tables. For the method of using the scale of proportional parts we shall quote the following example, given by Mr. Bashforth himself:—

"Suppose $a = 37{\cdot}68$ $\qquad b = 12{\cdot}53$.

$$\begin{array}{llll} \text{By the general table } \{37{\cdot}12\} & & = & 1595 \\ \left.\begin{array}{l}\text{Place } 37 \text{ on (A)} \\ \text{opposite } 12 \text{ on (B)}\end{array}\right\} & \text{for} & \left\{\begin{array}{l}{\cdot}6 \text{ we get} \\ {\cdot}08 \quad ,,\end{array}\right. & \begin{array}{r}42 \\ 5{\cdot}61\end{array} \\ \left.\begin{array}{l}\text{Place } 12 \text{ on (A)} \\ \text{opposite } 37 \text{ on (B)}\end{array}\right\} & \text{for} & \left\{\begin{array}{l}{\cdot}5 \text{ we get} \\ {\cdot}02 \quad ,,\end{array}\right. & \begin{array}{r}24{\cdot}9 \\ 1{\cdot}49\end{array} \end{array}$$

Therefore $\{37{\cdot}68,\ 12{\cdot}53\} = 1669{\cdot}$ nearly."

The mode of construction of the scale is so minutely explained by the author, that any illustrations of our own would be quite superfluous. In conclusion, we cannot but express a hope that this will not be the last time we shall have the pleasure of recording Mr. Bashforth's useful labours. It is not saying too much to assert that no other member of the profession possesses an equal amount of scientific knowledge with Mr. Bashforth; and we trust that gentleman will not allow the talent committed to his care to be idle. There is plenty of room, and plenty of occupation for men of science amongst engineers; and while we are willing to admit the paramount importance of a practical acquaintance with details, we must firmly declare that unless the engineer combines with that knowledge of facts a knowledge of principles, the lives of the public will be jeopardied whenever they are intrusted to the stability of his structures.

The Double Gauge.—Observations by Mr. R. Stephenson, *on* Mr. Brunel's *report on the Double Gauge.*

The public were greatly indebted to the scientific labours of Mr. Robert Stephenson for opposing the fallacious reasonings of the advocates of the atmospheric railway system, in the height of its popularity—he has now, in a work recently issued under the above title, in a masterly manner laid the axe at the root of the double gauge system, recently promulgated and proposed to be adopted on the Oxford and

Rugby railway. He has in his report exhibited in their true light the great danger and difficulties attending such a project. We shall here briefly give Mr. Stephenson's reasons for the conclusions at which he has arrived.

Although Mr. Stephenson admits the possibility of laying an intermediate rail, he entirely disagrees from Mr. Brunel as to the number of crossings required. He states that on the 112 miles of the London and Birmingham line, 58 crossings are required, and where there is a mineral traffic a still larger proportion. Even on the Great Western no less than two crossings are allowed to the Slough station. Working out in detail Mr. Brunel's rough sketches, he shows that according to one plan there must be at each crossing two additional half switches, two additional crossing points, two additional pairs of overcrossing points, four additional gaps, and three additional meeting points. On another plan, two additional switches, two crossing points, two overcrossing points, six gaps, and four meeting points—all additional, to be passed over by trains of either gauge. On another, two automaton switches of dangerous construction, to be passed over by all trains—one of which being placed the wrong way, would meet all the trains in one direction—with two half switches, four crossing points, two overcrossing points, six gaps, and four meeting points—all additional, to be passed over by every train.

From this Mr. Stephenson argues that great difficulty and danger would be brought into railway transit, and that the increase of interruptions or gaps in the line would be as two to one in the present system. Mr. Stephenson concludes, 1st. That the mixed gauge system increases the complication very much, so as to be inadmissible. 2nd. That it increases the danger greatly. 3rd. That it increases the expense. His estimate of the increased expense per mile of a narrow gauge line added to a broad gauge line is 5,794*l*., and of the increased yearly expense of maintenance of way and working, 500*l*. He calculates the gross capital cost as equivalent to 18,474*l*. per mile, while he denies that there is any equivalent advantage.

The drawings of points and crossings attached to Mr. Stephenson's report show the great complexity to which they have arrived in the progress of railways, and the great attention now required in their study. Members of the profession will therefore derive great advantage from these practical examples.

The Baronial and Ecclesiastical Antiquities of Scotland Illustrated. By R. W. Billings and W. Burn. London: Blackwood, 1847. Part II.

The second part of this work illustrates the chapel of Holyrood, as the first part did the cathedral of Glasgow, and we can now recommend it with still greater confidence as worthy of support.

The Engineer's and Contractor's Pocket-Book, for the Years 1847 and 1848. London: Weale.

This work contains the usual very valuable information, and much additional matter that will be useful to the engineer; but we doubt the policy of leaving out the standing orders, which, in consequence of the alterations made this year, particularly interest engineers and surveyors.

REGISTER OF NEW PATENTS.

GAS RETORTS.

Richard Walker, of Rochdale, Lancashire, cotton-spinner, for "*Improvements in the apparatus for the manufacture of gas for illumination, which said improvements are also applicable to the manufacture of other products of distillation.*"—Granted January 26; Enrolled July 26, 1847.

The improvement is for preventing the choking of the ascending pipe, which conveys the gas from the retort to the purifier, by the accumulation and incrustation of tar and other carbonaceous matter, and consists in breaking the immediate connection between the inner surface of the retort and the ascending pipe, by causing the latter to project inside the retort about two inches, instead of its being flush with the upper side, which improvement allows free egress of the gas, and allows the tar as it ascends the sides of the retort, instead of passing up the pipe, to fall from the top, and accumulate on the bottom, and from thence it is easily removed.

GAS METERS.

Thomas Friend Dickenson, of Newcastle-upon-Tyne, sharebroker, and John Falkous, of the same place, gas engineer, for "*certain Improvements in gas-meters.*"—Granted December 15, 1846; Enrolled June 15, 1847.

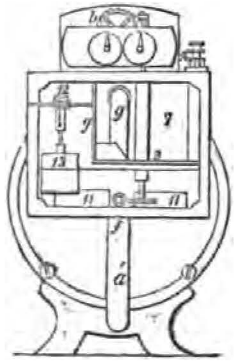


Fig. 1.

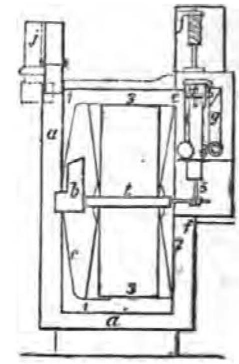


Fig. 2.

This invention relates to the construction of wet gas-meters, for preventing any tampering with the meter, by tilting it, to produce a greater flow of gas through the meter than indicated by the index. By the improved meter, if it be tilted, no gas will pass through it.

Fig. 1, is a front elevation of the improved meter, showing part of the interior, and fig. 2, a vertical section through the centre of the same; 1, 2, is the exterior case, within is the drum, 3, on a horizontal axis, 4, with an endless screw on the front end, which takes into a worm at the bottom of the vertical axis 5. The upper end of this axis 5, is also provided with an endless screw, gearing into the first wheel 6, of the index apparatus. The front plate 2, has a chamber, 7, in front divided by a partition 8, 9, 10; the space beneath the lowest part 8, is for water, it communicates with the water in the case 1, 2, through two openings 11, 11, the space above the partition 8, is divided into two, being for gas. An exit valve 12, with a float is fitted to an opening in a partition, so that if the water be at the proper level, the float will raise the valve to allow the gas to pass through the partition 10, to the exit-pipe; but if there be a deficiency of water, the float will decend and close the valve. On the top is a pipe 14, with a stopper for supplying water to the case under the partition 8, to the required level. If there be any excess of water it will overflow as hereafter explained.

The above parts are similar to the ordinary gas-meters; but the following, indicated by letters, vary. *a*, gas entrance-pipe communicating with the drum 3, by means of an elbow-pipe *b*, at the back of the case 1, and protruding through the additional end-plate *c*, of the drum. The pipe *b*, rises a little above the water in the case, for the purpose of introducing gas above the water: the pipe *b*, is introduced into the space between the additional end *c*, and the real end of the drum, as in common gas-meters, excepting it is at the back of the meter, instead of the front. *a'*, is a continuation of the pipe *a*, which descends at the back of the case 1, and is then continued at right angles along the bottom and again at the front, where there is a small hole at *f*. Any excess of water in the case 1, 2, will flow over the top of the pipe *b*, and pass down the pipe *a*, *a'*, and escape at the hole, *f*, so that no water will stand higher in the pipe *a*, *a'*, than the level of the hole *f*, and consequently no obstruction is offered to the flow of the gas from the pipe *a*, into the pipe *b*. But if the meter be tilted backwards, the water in the case will flow through the pipe *b*, and the escape hole *f*, being raised, in consequence of the tilting, the water will be retained in the pipe *a*, *a'*, at the same level as the hole *f*, and will prevent the gas passing through the pipe *b*, into the case 1, 2, and consequently the measuring will be suspended so long as the meter remains in that position.

The gas, which during the revolution of the drum 3, is discharged from the compartments into the upper part of the case 1, 2, passes through an opening *e*, into the space above the partition 8, and then enters through a protection-valve *i*, into an elbow-pipe *g*, and is then conducted into the space above the water in the lower part of the chamber 7. From thence the gas ascends through the valve 12, then through the exit-pipe *j*, which extends over the upper part of the case 1, 2, to the back of the meter; so that both the exit and entrance-pipes for the gas will be at the back of the meter.

If the meter be tilted forward, the water in the case 1, 2, will rise in the front part of the meter, within the space beneath the partition 8, 9, 10, and against the upright part 9, of that partition, whereby the open end of the pipe *g*, will be closed, and the flow of gas stopped. The same is effected by the valve *i*, on the upper end of pipe *g*; the stem of the valve being jointed to a weighted pendulum *i'*, which closes the valve, on the meter being tilted forward, and stops the flow of gas. The pipe *g*, may be used without the valve *i*; or if the valve *i*, be employed, the lower end of the pipe may occupy a higher position in the upright side 9, of the partition, so that it will not be closed by the water on the meter being tilted.

There is a small air-passage at *k*, bored vertically through the nozzle at the upper end of the upright pipe 14, to permit air to escape from the interior of the meter when water is poured into it. A washer of leather or india-rubber is applied beneath the shoulder of the stopper, screwed on the pipe 14, to securely close the orifice of the pipe 14.

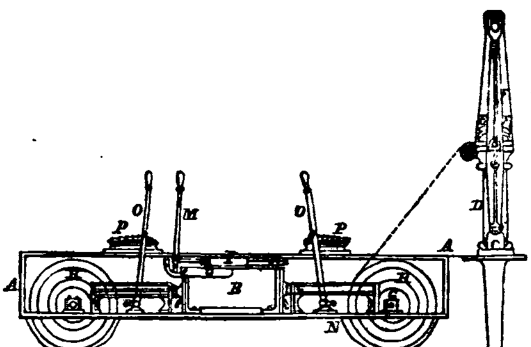
STEAM POWER FOR CRANES.

William Johnson, of Grosvenor Wharf, Milbank, Westminster, gentleman, for "*certain Improvements in machinery for raising or lifting and lowering weights or ponderous bodies.*"—Granted Dec. 1, 1846; Enrolled June 1, 1847. [Reported in *Newton's London Journal.*]

This invention consists in a peculiar adaptation of steam power to a drum barrel or cylinder, round which a rope or chain, for raising the weight, is passed. Rotary motion is given to the draught-barrel or pulley by a steam-engine; the outer end of its piston-rod being attached to a chain or rope, coiled round a winding-drum, of small diameter, fixed upon the axle of the draught-barrel.

Fig. 1 represents the apparatus in elevation, a portion of the frame being removed to show the internal parts of the machinery more per-

Fig. 1.



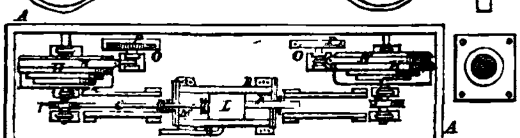


Fig. 2.

fectly; and fig. 2 is a horizontal view of the same. A, is a rectangular frame of iron, which contains and supports the machinery. It may be fixed firmly into the ground, or mounted upon wheels to admit of its being transported to different parts of a wharf or warehouse. In or near the centre of this frame A, the working cylinder of a steam-engine, B, is fixed,—its piston-rod, C, C, passing through both ends of the cylinder, for the purpose of rendering the machinery capable of raising and lowering heavy bodies, through the agency of cranes, fixed one at each end, when the machinery is required to be made double-acting, as it is supposed to be in the drawing, although but one crane is shown; but in a single-acting machine it is obvious that the duplicate parts of the apparatus may be dispensed with. D, D, are the upright parts or standards of a crane, with the usual jib E, and pulleys F. G, is a horizontal axle, turning in plummer-blocks, fixed upon the bottom of the frame. This axle carries a conical pulley H, which has several grooves formed in it, of different diameters, for the purpose of receiving severally the draught-chain or rope of the crane; the different diameters of the conical pulley being designed to effect different powers of draught. This pulley is enabled to slide laterally along the axle G, for the purpose of bringing either of the grooves into a line of coincidence with the leading pulley of the crane; and the pulley is confined to the axle, when it revolves, by a key passed through a notch in the pulley; or it may be by the axle in that part being formed square. Upon the axle there is also a smaller pulley I, fixed to the axle, and turning with it. This pulley is intended to receive the coiled chain attached to the end of the piston-rod C, so that as the piston recedes in the cylinder the chain may draw the pulley I round, and with it the axle and the cone-pulley H. It will be seen that there is a cone-pulley H, connected to a draught-chain, at each end of the working steam-cylinder B; and that upon the axle to which this cone is keyed, there is affixed a small pulley I, with a chain connected to the end of the piston-rod, as before described,—thus making the machinery double-acting; that is, when a heavy weight is raising at one crane, a heavy weight may be lowering at the other crane.

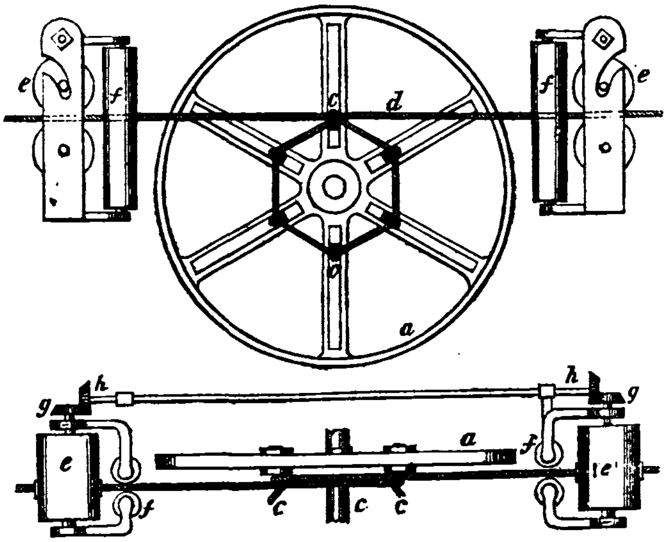
In working this machinery steam, at a high pressure, is to be provided in a boiler contiguous, from which the steam is to be conducted to the working-cylinder B, by a pipe K, shown as broken off in the drawing. The steam when passed through this pipe will occupy the steam-box L, and by the sliding of the valve within the box the steam will, in the usual way, be admitted into the cylinder at its ends, for the purpose of working the piston: the action of the slide-valve is produced by the hand of a workman applied to the lever M, so that the operations of the machine shall be always under command. Supposing that the piston in the cylinder B, is, by the pressure of the steam, passing from the right-hand end of the cylinder to the left, the chain connected to the piston-rod and to the pulley I, will draw round the pulley I, its axle G, and the cone-pulley H; and the draught-chain of the crane being attached to the periphery of the pulley H, as the pulley revolves the chain will draw up the weight suspended from the jib-head. Now, to prevent the raised weight, suspended from the crane, from descending, the pulley H must be made fast; this is effected by means of a break, formed by a band N, and lever O. The band being passed round the pulley H, as shown in fig. 2, the workman by moving the lever O, will cause the band N, to be drawn tight round the pulley and prevent its rotation; the lever being held in its position by a click or pawle, resting in the teeth of a ratchet P, as shown in fig. 1; and in lowering the weight the break may be gently released until the weight has reached its proper situation. The steam may be allowed to escape from the cylinder by a pipe Q, into the air; and it will be seen that a similar arrangement of parts being adopted to the reverse end of the machine, heavy weights may be either raised or lowered by their reciprocating actions.

WARPING VESSELS.

George Beadon, of Taunton, Somerset, a commander in the navy, and Andrew Smith, of Princes-street, Leicester-square, engineer, for "*Improvements in warping or hauling vessels, which improvements are also applicable to moving other bodies.*"—Granted Jan. 21; Enrolled July 21, 1847. [Reported in the *Patent Journal.*]

These improvements consist in the use of certain machinery for warping or hauling vessels on rivers or canals, and which machinery, with slight modifications, is also adapted for propelling carriages on railways or common roads by ropes or chains.

The first part of the specification consists of a description of the improved apparatus or machinery for moving bodies on water, and



which, by the aid of the annexed engraving, will be readily understood. *a* represents the hauling apparatus or *whelp-wheel*, mounted upon standard bearings, in the usual manner, and fitted to the deck of a vessel, with a horizontal crank-shaft passing through it; this shaft is firmly keyed to the whelp-wheel, and receives motion from two reciprocating steam cylinders, in connection with double cranks, on the driving-shaft; each arm of the wheel which is employed for the purpose of receiving the whelp, is furnished with a slot, diverging from the centre to the periphery of the same, and forming in all six radial guides or channels, in which six adjusting whelps, *c, c, c*, are to be fitted, and placed at equal distances from the central driving-shaft, and are made fast by wedges, which can be withdrawn at pleasure, and allow the circumferential or radial distance of the whelps to be increased or diminished, producing thereby corresponding rates of motion when required. By this arrangement the whelps form a reel, on which the coil of galvanised wire-rope or chain, *d*, is wound, and so grip the warping-line, which is fixed firmly at each end to some stationary object or holdfast upon the land or water; so that when the wheel, *a*, is caused to rotate, the vessel, by reason of the rope aforesaid, alternately embracing and leaving the whelps forming the reel, is propelled backwards or forwards, by motion being given to the wheel carrying the whelps in the required direction; *e, e*, are horizontal rollers mounted in cast iron standards, fore and aft of the warping-wheel *a*, and serve the double purpose of guiding the warp-line and keeping it tight on the reel; *f, f*, are two pairs of vertical guide-rollers, mounted on bracket bearings. On the axle of each of the lower horizontal rollers, *e, e*, a bevel-wheel, *g*, is mounted, which gears into others on the horizontal shaft *h, h*; the pair of bevelled wheels, *g, g*, at the forward end of the shaft *h*, is intended to be of a less speed than the aft pair, for an object hereafter explained. The friction of the warping-rope, as the vessel moves, will cause the rollers to revolve, and as the upper rollers, *e, e*, by their weight, press or nip the rope or chain against their under rollers, and the speed of the fore ones is less than the aft pair, the latter will have a tendency to take up the rope or chain quicker than it is given off from the reel, and thus keep it taut.

In order to allow one vessel to pass another on a single line of warping-chain or rope, it will be necessary to throw one vessel out of connection with the rope temporarily; for this purpose the rollers *e, e*, may be readily lifted out from their bearings, which will admit of the warping-chain or rope being thrown off from the rollers *e, e*, when required.

A further modification of the above arrangement is next described, which consists of a roller, mounted upon suitable bearings, having two smaller ones above it attached to the same framing, the upper ones being pressed down by means of screws or springs, or otherwise made to nip the chain or rope sufficiently, so as to prevent its slipping when the lower roller is caused to revolve by the steam-engine or other motive power employed in the vessel.

The next mode described by the patentees for applying such arrangements to locomotive purposes, consists of placing in the front of the engine the whelp-wheel aforesaid, and attaching it thereto, causing it to be driven by means of connecting rods from the crank-shaft; in other respects, differing but slightly from the ordinary construction.

The fourth part of this invention has reference to different modes of nipping the rope or chain, and consists first of three or more cylinders fixed to the arms or periphery of the whelp-wheel, which is placed across the vessel, with its guide-pulleys fore and aft; pins are inserted in the periphery of the wheel *a*, for the purpose of receiving the coil of rope or chain around it, and preventing its slipping; the cylinders, which are placed at equal distances apart, are supplied with steam at different intervals through the same shaft on which the wheels rotate, having suitable valves for that purpose; every cylinder so placed has a piston and piston-rod, and, when in operation, receives the pressure of steam on one side of the piston only, while on the other is fixed an elastic medium, such as a spring or otherwise suitable contrivance, the effect of which will be thus understood:—The rod of the piston, which in this instance forms the nipper, having a notched end for the purpose of holding the rope or chain, is pressed forward by the force of the steam acting behind the piston, and made to nip the rope or chain against the off flange of the whelp-wheel *a*, through which the rod on one side passes; when, upon the steam being condensed in the ordinary mode, the action of the spring being free to move, the piston-rod or nipper is again withdrawn and the rope wound upon the wheel. When the wheel *a*, having the warping rope or chain passing round, is employed for the purpose of propelling, it will be at times necessary, in order to ensure a firm hold for the rope or chain and prevent its slipping upon its drum or periphery, to resort to other means, such as a bar of iron or any other arrangement for pressing the rope or chain in the running groove against the sides of the flange, until another nipper or wheel is brought to bear upon the rope or chain, alternately pressing and nipping the rope or chain during the revolutions of the wheel.

The application of vibrating-levers with sliding-rods is next described, for the purpose of pinching or nipping the rope; these levers are mounted on centres resting on the sides of the wheel, to the outer ends of which two sliding bars are attached, and pass in a horizontal direction through one flange of the wheel, so as to press upon the inside of the other, against which the rope is wound; the requisite action is communicated to them by means of a fixed cam, situated near the centre of the wheel, whilst the re-action is effected by springs, the cam pressing the sliding-bars by the motion of the lever against the rope, and the springs releasing them. Placed on the wheel are small boxes having springs, with a tendency to draw into their boxes the sliding-bar aforesaid, which, by being attached to one end of the vibrating-levers worked by the cam, keep the rope tight by throwing the hook or notch upon the same; thus enabling each bolt, nipping rod, or buffer (forced back against the chain in succession) to release its hold alternately as the wheels revolve.

The adaptation of the principle hereinbefore mentioned, when applied to steam tug-boats, consists in arranging the apparatus in the centre of the boat, and casing it in upon the top, that the central portion thereof may act as a bridge, and thereby offer sufficient resistance to the strain, at the same time enabling the steersman to perform his duty without any interruption from the warping line or rope.

Lastly is described the means employed for raising boats and barges from one level to another, and consists in forming at convenient distances along a canal, a number of inclined surfaces or banks crossing the stream, between which the water of different levels is confined; each bank so formed being at an angle of 45°, and having on its face trams or rails. The boats or barges on the lowest level, in order to be raised to a higher one, are mounted upon wheels for the purpose of traversing the rails; other boats or barges on the next level are then attached by means of ropes to the lower ones, and when the apparatus is put in motion from above by steam or other motive power, the lower boats or barges are drawn up the incline, and thus caused to pass from one level to another by the use of the hauling apparatus hereinbefore described.*

* An invention similar to this latter part has been adopted on the Morris Canal, U. S. America, and described in the Civil Engineer and Architect's Journal, for 1842, page 104. —Ed. C. E. & A. Journal.

ELECTRO COPPERING, GILDING, AND SILVERING.

Louis Hypolite Piaget and Philip Henry Du Bois, of Wynyatt-street, Clerkenwell, Middlesex, for "*Improvements in producing ornamental surfaces.*"—Granted November 12, 1846; Enrolled May 12, 1847.

This invention consists of improvements in depositing metal, by the employment of a bath in the following manner, as shown in fig. 1. The bath consists of an earthenware vessel, A, with a similar plate B, perforated, and with one or more apertures C, to receive tubes D, and a long opening, E, in the centre, for suspending the model or electrotype plate.

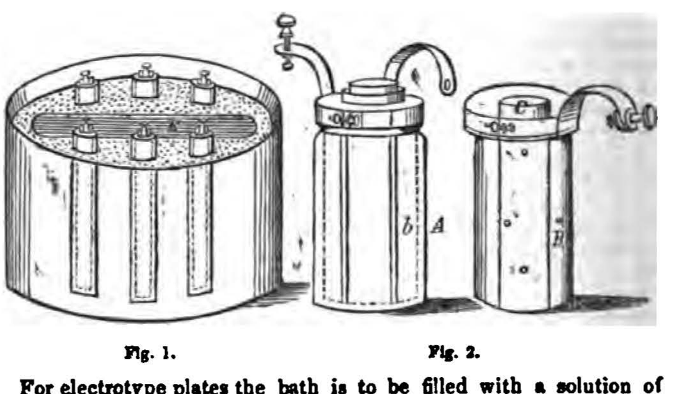


Fig. 1. Fig. 2.

For electrotype plates the bath is to be filled with a solution of 14 lb. blue vitriol dissolved in 7 quarts of water, and when it is cooled put on the plate B, with some pieces of vitriol laid on the top; then fill the tubes D with a preparation consisting of 5 pints of water, ½ lb. common salt, ½ pint of fresh human urine, and 6 drams sulphuric acid. The tubes to be filled up every six hours, until the third day, when they must be emptied and refilled, as before, till the deposited plate is as thick as desired. Care is to be taken that not a drop from these tubes falls into the bath.

The model to be used in the bath, either of gold, silver, or copper, is to have soldered on the back a piece of copper wire, for a conductor; and the model is to be well cleaned with plumbago and a brush, and its back fixed in wood, leaving only the required surface exposed. Take a piece of zinc, about five ounces, and fasten on a screw, then attach the copper wire to the screw, and place the piece of zinc in one of the tubes D, suspending at the same time the model through the centre hole, E, of the plate B, into the bath; when the plate is taken out of the bath, and taken off the model, it will exhibit a burnish polish or dead appearance, according to the preparation of the model; it will also be found to be good and pliable metal, bearing to be made several times hot without injuring or destroying the copy of the finest engine-turning or engraving.

Preparation for Silvering.—First dissolve 700 drams of sulphate of soda recently prepared in four parts of warm filtered water. Secondly, dissolve 25 drams of carbonate of soda (when for use with electric currents, but when to act by simple immersion, 75 drams are used) in a pint of warm filtered water. Thirdly, dissolve 31 drams of moist carbonate of silver. When these solutions are cold, mix the sulphate of soda and the carbonate of soda together, then add the carbonate of silver, and stir all well with a glass stick till the silver is well incorporated. This preparation is to be used cold.

Battery.—When electric currents are to be used with the above purposes, it is preferred to employ the battery shown in fig. 2, which is constructed as follows: *a* is a glass jar; *b*, a tube of charcoal; *c*, a porous vessel; and *e*, a tube of amalgamated zinc. In making small articles of silver, or of gold as hereafter explained, such as watch-cases, three such batteries connected together form a proper strength for the purpose; but for larger articles, more such batteries must be used. Into the vessel *a*, put nitric acid and water, mixed in equal quantities; the tube of charcoal, *b*, is introduced into such vessel, *a*, and the porous vessel, *c*, is introduced into the tube, *b*, and the liquid should then nearly fill the vessel *a*. Into the vessel, *c*, put a mixture of ½ oz. sulphuric acid, 1 oz. common salt, and two pints of water. The copper bands, *d*, of the three or other number of batteries used are to be connected together, and these metal connections are to be made between the models which are introduced into the bath to receive precipitations thereon; the copper straps, *f*, are to be connected to each other, and the one from the last battery is to have a piece of platinum wire soldered at its end, and this platinum wire is to be dipped about half an inch into the liquor of the bath.

Preparation for Gilding.—First dissolve 375 drams of pure phosphate of soda in 4½ pints of warm filtered water. Secondly, dissolve 50 drams of recently-prepared sulphate of soda in half pint of warm filtered water. Thirdly, dissolve 7 drams of perfectly dry chloride of gold in half pint of warm filtered water. Take the solution of gold and mix it with the solution of phosphate of soda, then add the sulphate of soda. Care must be taken that they are well mixed. This preparation is to be used warm, but not boiling. This bath is to be used with electric currents, preferring to use for this purpose the battery above described for silvering.

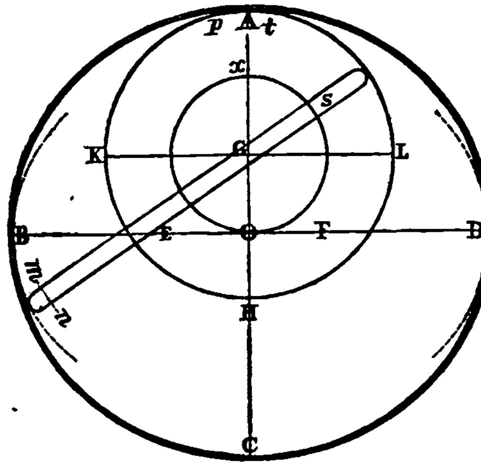
Preparation for Gilding by Immersion.—First dissolve 700 drams of pure pyrophosphate of potash in five pints of warm filtered water; if this solution is not clear, filter it and let it remain till it is cold. Secondly, dissolve 7 drams of dry chloride of gold in half pint of water, then pour this gently into the pyrophosphate of potass, taking care to stir it well. This preparation to be used warm. This bath is to be used in like manner to what has heretofore been done when gilding by simple immersion, without the aid of electric currents.

To prepare an electrotype model plate for gilding or silvering, after it has been in the hands of the workman, first, put it in the essence of turpentine for ½ hour, then wash and brush it well, after which put it in nitric acid diluted with water (½ oz. of nitric acid of commerce with two pints of water), to take away the oxide; then place it in cold water, and again brush it with rouge to give brilliancy; place it next in fresh-made human urine for eight or ten minutes, and then again in cold water; the plate is now fit for gilding or silvering by the bath above described. By this process a coating of gold or silver will be obtained, which when taken from the bath will only require to be brushed with spirits of wine and rouge, and in less than half-a-minute it will be as brilliant as when taken from the model. It is not necessary to use the scratch-brush, or to burnish any part of the plate, which is always required after other modes of gilding and silvering, and which always injures fine engine-turning and engraving.

ROTARY ENGINES.

WILLIAM BREYNTON, of the Inner Temple, in the city of London, gentleman, for "*certain improvements in rotatory steam-engines.*"—Granted January 21; Enrolled July 21, 1847. [Reported in the *Patent Journal.*]

This specification is accompanied by a diagram (see the figure) illustrative of the principle on which the rotatory engines are to be constructed. A, B, C, D, is an ellipse, described with foci, E, and F, half the major axis, or transverse diameter of which, is represented by O, B, = *a*, (a known number = 1·5904) whilst half the minor axis or conjugate diameter is represented by O, A, = *b*, (another known num-



ber = 1·5); the focal distance is represented by O, E, and O, F, = *c*, (= ·524). A, K, H, L, is a circle described with centre G, and radius, G, A, which radius, = *d*, (= ⅓ of O, A,). X, Y, represents a circle described with centre, G, and radius G, O, = *e*, (= ·5); the remaining parts will hereafter be more particularly described and alluded to; but it may be as well to observe that N, S, represents a piston passing freely through the centre of the circle, A, K, H, L, (and having a sliding motion in the direction of its length,) whilst *m*, *n*, is intended to show the thickness thereof. In an engine constructed upon the principle above shown, A, B, C, D, then would represent the outer iron case as it would appear in vertical section, and which case, therefore, would be of an elliptical form, although employed for a similar purpose to that part of an ordinary steam-engine known by the name of the cylinder; below, or at C, would be the foundation-plate, upon which the said elliptical case would have to be fixed. A, K, H, L, marks the place that would have to be occupied by a hollow cylindrical shaft or piston-rod (of considerable diameter), and which is placed at such a distance, it will be observed, from and above the centre of the elliptical case, A, B, C, D, as that the circumference of the said shaft or piston-rod shall come in contact with the inner surface of the elliptical case at the point, A, and at which would be the slide-valve so arranged, that the steam might be introduced into the elliptical case, say at or near to such point, A, or at *p*, when by acting upon the sliding-piston, N, S, it must, thereby, impart a rotatory motion to the shaft, A, K, H, L, and the steam ultimately would be discharged through an aperture or eduction-passage, somewhere near also to the point, A, or at *t*; or the steam might be introduced and allowed to pass off through the ends of the case, if found advisable. For reversing the engine, or causing the piston and shaft to move in a contrary direction, it would only be necessary to make the eduction-pipe available for the passage of the steam out of the cylinder, by altering the position of the cock or slide-valve, and in the usual way, the shaft, A, K, H, L, must pass through steam-tight stuffing boxes at each end of the case, and revolve in bearings in the upright frame attached to the foundation-plate. The sliding piston, N, S, will be rectangular, its breadth being equal to the distance between the ends or side-plates of the elliptical case, whatever that may be, and its length (as shown at N, S,) equal, or nearly so, to the shorter diameter of the same. This piston must slide through a slot or aperture in the shaft or piston-rod, so that whilst the rod moves in a circular direction, the sliding piston moving with it and through it, performs an elliptical course by reason of the pressure of its extremities against the inner surface of the case; and the ends of the piston, as the patentee observes, should be kept in close contact with such inner surface of the case by aid of metallic packings and of springs, the elasticity of the latter, by exerting a constant outward pressure against the former, serving to accomplish such object.

The shaft or piston-rod may be of any proportional part of the shorter axis of the ellipse, the longer axis being varied accordingly, and so that the correct principle of action may still be retained; but the proportion, which the patentee recommends as having been found to be most efficient in practice, is that the revolving shaft shall (as seen in the diagram) have a diameter of not less than two-thirds of the shorter diameter or minor axis of the ellipse, and which will make the longer diameter or major axis about 1·06 times such shorter diameter; for if the diameter of the revolving shaft or piston-rod be materially smaller than this, the figure of the case must either cease to be a perfect ellipse, and thereby become very difficult to bore, or else the increased length of the piston will involve the necessity of the metallic packing moving through a very considerable space, and which would be inconvenient.

MAKING ZINC AND GAS.

Daniel Towers Shears, of Bankside, Southwark, for *"Improvements in the treatment of zinc ores for the purpose of producing zinc ingots, which improvements are applicable to the reduction of other ores and metals."* (A communication.)—Granted January 19; Enrolled July 19, 1847.

The invention relates to making zinc from ores in combination with the making of gas for the purposes of light and heat by using a blast high furnace and anthracite, coke, charcoal, or other suitable fuel, and other metals may be made at the same time.

Fig. 1.

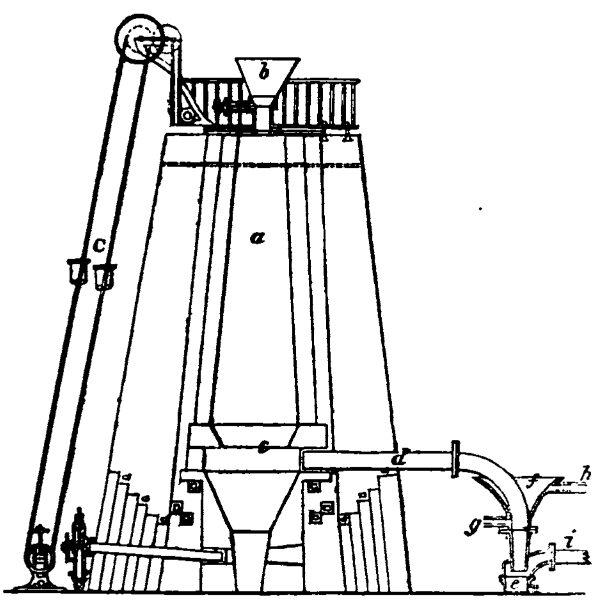


Fig. 1, is the section of the furnace and apparatus. The furnace *a*, is charged through a funnel *b*, at the upper part, there being slides to prevent the passage off of the gas which may be at the upper part of the furnace, the lower slide being closed when the upper one is opened at the time of introducing a charge; the upper slide being closed when the lower slide is drawn out to allow the materials to descend into the furnace. The materials for charging the furnace are raised by an endless chain C. If iron be contained in any of the ores or materials to be used (and such is found sometimes to be the case), then the lower part of the furnace is to be made suitable for tapping off the iron from time to time in precisely the same manner as iron furnaces have heretofore been constructed. No claim is made for the construction of such furnaces, but only the mode of making zinc therein. At the upper part of the boshes *c*, the furnace is contracted under which the gas and the vapours of zinc accumulate and pass off through the pipe, *d*, into the receiver *e*. The pipe *d*, passes through the vessel *f*, which has a flow of water constantly through it, passing into it by a pipe *g*, at the lower part and off at the pipe *h*, at the upper part. Or oil may be used in place of water, in which case, as long as the oil is kept below its boiling point, it will indicate that the gases are not carrying off zinc vapours, and the receiver is kept sufficiently heated to prevent the zinc solidifying, which it is preferred to do by a gas burner supplied with gas from the apparatus, and there is a tap hole at the lower part of the receiver to draw off the zinc. The gas passes from the receiver through a pipe *i*, in order to convey the gas to be burned for any desired purpose, whether for light or heat, and it may be used for roasting the ores before they are used by placing the same in suitable ovens or retorts, and heating such retorts with the gas. This furnace is similar to that described by Mr. Constable, in his patent for making gases from anthracite and other fuel in blast or high furnaces, and would, if no ores or matters capable of yielding zinc be introduced with the fuel simply produce gas, but by introducing roasted zinc ores with the fuel from time to time, zinc will be made and be received into the receiver, thus beneficially employing the heat of the furnace. The quantity of ore introduced into the furnace may be varied according as it is desired to make a large or a smaller quantity of zinc. Any quantity up to one part by weight of roasted ore to three parts of the fuel employed is recommended. Iron or other ore may be introduced and treated with the zinc ore.

ELECTRIC TELEGRAPHS.

Alfred Brett, of Holborn-bars, gentleman, and George Little, of High-Holborn, electrical engineer, for *"Improvements in electric telegraphs, and in the arrangements and apparatus to be used therein and therewith, part of which improvements are also applicable to time-pieces, keepers, and other useful purposes."*—Granted Feb. 11; Enrolled Aug. 11, 1847. [Reported in the *Mechanics' Magazine.*]

The improvements claimed under this patent are ten in number. We shall give the claims in the words of the inventors; and such explanations of them as may be necessary to show their general scope also nearly in their own words.

First Claim.—"We claim, as an improvement in electric telegraphs, the use of a ring, or piece of metal, partially magnetised, in combination with a reel or coil of wire, whereby and wherein the electric current so acts, that the motions take place in a direction transverse to the axis of the coil, and parallel, or nearly so, to the planes in which the wire, constituting the coil, lies."

The electric fluid is made to pass through a number of coils of fine wire, properly coated or covered with silk, or other suitable non-conducting material; which wire is wound round a flat reel, or reels, of ivory, or other suitable material. The ends of these fine wires are alternately brought into contact with the galvanic battery, by suitable arrangements, whereby the current is made to act on and give motion to a partially magnetised ring, or piece of metal, suspended and moving on a fixed centre in a plane parallel to the side, or face, of the flat reel, about which the wire is coiled; that is to say, parallel to the planes in which the wire is so coiled; the motions of this partially magnetised ring being communicated to an indicator, or indicators, whose motions in connection with a peculiarly arranged dial-plate with symbols thereon, may be employed to designate letters, figures, or other conventional signals, and transmit intelligence by means of electricity.

The patentees say, "We wish it to be perfectly understood, that although we have described the foregoing, by the application of circular coils of fine wire prepared as above described, wound round or upon a flat circular reel or reels, in conjunction with a flat metallic partially magnetised ring, moving parallel with such coils of fine wire for the giving motion to inductors, by which letters, figures, or other conventional symbols are designated; the same motion can be obtained, and the same principle applied, by other modifications and arrangements, but we prefer using and adopting the arrangement above described."

Several exemplifications of such modifications are afterwards given.

Second Claim.—"We claim, as an improvement in electric telegraphs, an indicator, or indicators, deriving motion respectively from a current of electricity transmitted through a coil arranged and acting on a partially magnetised ring or piece of metal, as above described, and the adaptation of such motions to communicating intelligence between distant places."

Third Claim.—"We claim, as an improvement in electric telegraphs, the adaptation of an indicator or indicators to a dial-plate, constructed and arranged as described."

On the dial-plate are two vertical columns containing numerals from 1 to 25. The centre of the plate is retained for the symbolic arrangement of letters and figures by which the whole of the letters of the alphabet can be designated. When the indicators are in a state of rest they are in an angular position; but when put in action they move to a position nearly vertical, but are prevented from passing the vertical line by a pendant bar. In transmitting a signal or signals the letters of the alphabet are designated by single or repeated motions of either of two indicators (right and left hand), or both in conjunction. Thus the letter A, which is placed opposite to fig. 1, is indicated by one motion of the left-hand indicator; the letter B, which comes opposite to fig. 2, by two motions of the same indicator; the letter E by four motions, two left and two right; and so on.

Fourth Claim.—"We claim, as an improvement in electric telegraphs, the working *two* indicators, so as to give the requisite motions by means of a *single* handle constructed and arranged as described."

Fifth Claim.—"We claim, as an improvement in electric telegraphs for giving audible signals, the use of a ring or piece of metal, partially magnetised, in combination with a reel or coil of wire, as above described, whereby and wherein the electric current so acts that the motions take place in a direction transverse to the axis of the coil, and parallel, or nearly so, to the planes in which the wire, constituting the coil, lies, and actuate suitable apparatus for giving such audible signals."

A bell or gong is substituted for the dial-plate and indicators, and the signals expressed by striking one, two, or more successive blows on the bell or gong, which is effected by wheelwork, for which no separate claim is made.

Sixth Claim.—"We claim, as an improvement in electric telegraphs, the use of an apparatus for conducting the atmospheric electricity to the earth, in which the two semi-spheres of the lightning-conductor, as usually constructed for that purpose, may be adjusted to or from each other, as circumstances may require."

In lightning-conductors, as ordinarily constructed, there are two metal plates (say A, A′), which are fixed to and kept apart by blocks of ivory, and two semi-spheres (*c* and *c′*), which are made fast, one to each plate. The improvement here consists in making the semi-sphere *c* fast to the plate A (as usual), but attaching the other by a screw to the plate A′, "by which means, and by the aid of a regulating screw-nut, the semi-sphere of metal may be brought either closer or farther distant from the semi-sphere *c*, as may be rendered necessary by the expansion or contraction of the instrument, or other circumstances."

Seventh Claim.—"We claim, as an improvement in electric telegraphs, the insulator, and stretching of the long circuit wires upon and by means of an insulator, bell-shaped in the interior, so as to prevent the rain establishing a circuit for the electricity from the wire to the support upon which the insulator is affixed, and so shaped on the exterior as to admit of a stretcher, constructed as described, being applied at pleasure, to stretch the long circuit wires from insulator to insulator."

These insulators are to be made of glass, earthenware, porcelain, or metal.

Eighth Claim.—"We claim, as an improvement in electric telegraphs, a deflector, constructed and arranged as described, in combination with an earth-plate to each instrument, whereby the electric current may be diverted, and the instruments insulated in such manner as to allow the instruments at two or more stations on a long line to communicate with each other, independently of the other stations."

Ninth Claim.—We claim, as an improvement in electric telegraphs, the use of the apparatus called 'the hydraulic battery,' in which the acid to the sand, or other retainer of moisture, is supplied from above, drop by drop, and escapes from below, drop by drop, so as thereby to keep up continuously a percolation through the sand, or other retainer of moisture, and, by such percolation, carry off the sulphate of zinc, and prevent its becoming crystallized on the plate; and we claim the said hydraulic battery, both as an improvement in the working of electric telegraphs, and as applicable to the working of time-keepers or clocks, where electricity is employed as a motive power, and for other purposes in which a steady uniform current of galvanic electricity is required."

Tenth Claim.—"We claim for time-keepers, in which electricity is a moving power, the use of a ring or piece of metal, partially magnetised, in combination with a reel or coil of wire, as above described, whereby and wherein the electric current so acts that the motions take place in a direction transverse to the axis of the coil, and parallel, or nearly so, to the planes in which the wire, constituting the coil, lies, and are adapted to suitable apparatus for measuring and indicating time."

As electric time-keepers require but a small power for keeping their pendulums in motion, "a sufficient current may be obtained from two series of any one kind of metal (for which purpose zinc or iron is the most economical), buried in the earth;" and "when zinc is used for the series, the supply of electricity may be augmented by surrounding one set of the plates of the series so employed with a solution of ammonia."

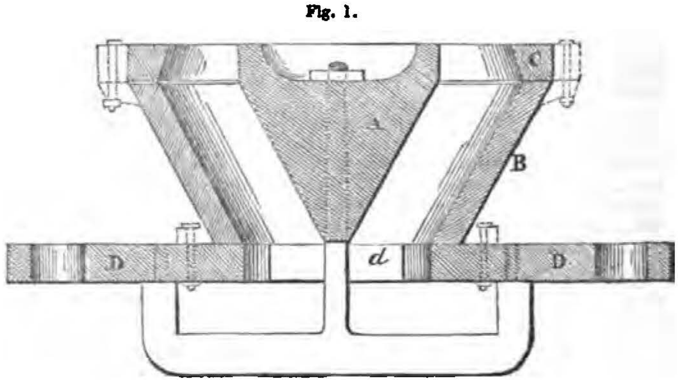
IMPROVED EXPANDING DIE

FOR MAKING DRAIN-TILES, CONDUITS, TUBES, CHIMNEY-POTS, AND OTHER ARTICLES MOULDED IN CLAY.

Registered by JOSEPH SALT, *Brick-Maker, Uxbridge-Common, Middlesex.*

The advantages of the improved die are, that with the same machine, much larger pipes and tubes may be made than heretofore. The improvement is shown in the section, fig. 1, which consists of

Fig. 1.



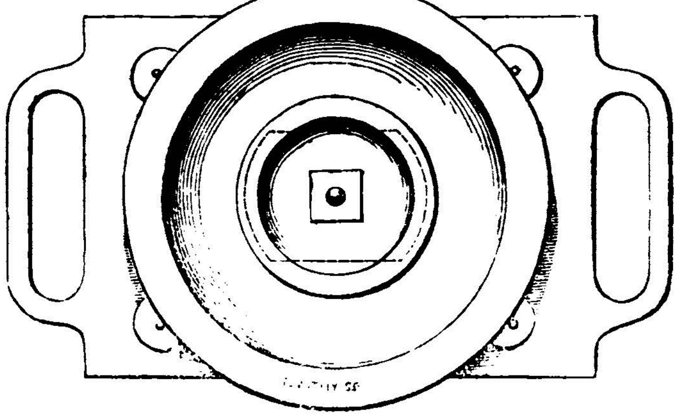


Fig. .

three parts: A, the centre piece, B the expanding tube, and C the die, to be made of iron, brass, or other suitable material.

The centre piece, A, is secured to the plate D by a spindle, and the external expanding tube B is also secured to the plate D by screws or bolts, and the die C is secured to the expanding tube by screws or bolts.

The clay to be moulded is forced through the aperture, *d*, of the plate D, and then between the centre piece A, and the expanding tube B, and out at the aperture C.

Fig. 2 shows the application of the expanding die for making circular tubes or pipes.

NOTES OF THE MONTH.

Railway Lift Bridge.—In last month's *Journal* we gave Mr. Rastrick as the engineer who designed the bridge; we have since been informed that it was designed by Mr. Hood, the resident engineer of the Brighton railway, and that some alterations have been made in the design.

An "Architects', Builders', and General Fire and Life Insurance, &c., Company" is about being established; already a preliminary meeting has been held, and an "ad-interim committee" formed. Among the names we see Mr. George Smith, Mr. Donaldson, Mr. Salvin, Mr. Sidney Smirke, and several other architects and builders.

University College.—The classes of Engineering and Architecture at University College have been rendered more complete by the recent appointment of Eaton Hodgkinson, Esq., as Professor on the Strength of Materials, and on Machinery. The lectures to be given by this competent experimentalist will include important results not previously given, and the theory will be illustrated by a description of a great number of original experiments upon most of the materials used in construction, such as cast and wrought iron, building stones, timber, &c., and the results of which have not been published. The distribution of prizes occurred on the 1st of July, Sir H. De la Beche being in the chair. First year's course:—*Fine Art:* Charles Poland, 1st prize and 1st certificate; T. Watts, 2nd prize and 2nd certificate. *Science—Construction:* H. Darbishire, 1st. prize and 1st certificate; Charles Poland, 2nd prize and 2nd certificate; T. Watts, 3rd certificate. Second year's course:—*Fine Art:* W. Tarne, 1st prize and 1st certificate; G. B. Smith, 2nd prize and 2nd certificate; J. W. McKenzie, 3rd certificate. *Science—Construction:* G. P. Boyce, 1st. prize and 1st certificate; W. Tarne, 2nd prize and 2nd certificate; G. B. Smith, 3rd certificate.

The Royal Italian Opera, Covent Garden, has now closed, and the results of the season, while we hope they have given every encouragement to the lessee, have fully responded to the exertions of the architect. The arrangements for hearing, seeing, ventilation, and accommodation have been perfect, and have given a good example of the progress of comfort in public buildings.

Kew Gardens.—The works at these gardens are proceeding, and Sir William Hooker seems determined to carry out a botanic garden, which shall be the finest establishment in the world. The grand palm-house is in a forward state, so far as the frame-work is concerned, but we doubt whether the house will be in a fair state for opening before 1849. A small museum has been built, as a Museum of Economic Botany, which will in time rival the Museum of Economic Geology.

The New Parliament is now filled up. It includes many parties connected with the railway interest. Mr. Robert Stephenson and Mr. Locke represent the engineers; Mr. W. Cubitt and Mr. S. M. Peto, the railway contractors. What may be the political merits of these new members we do not know, but as practical men they will not be without their value.

Damp Walls.—Dr. Murray recommends when damp walls proceed from *deliquescence*, in the case of muriate of soda, &c. in intimate combination with sand in the mortar, it is only necessary to wash the wall with a strong solution of alum. This converts the deliquescent salt into an efflorescent one, and the cure is complete. Or alum may be added to the plaster in the first instance.

Portable Cannon.—The American papers make mention of a new sort of cannon, invented by a Mr. Fitzgerald, which is so constructed that it may be carried by hand or on horseback over mountains, forests, or marshes, where an ordinary cannon would be altogether useless. It consists of a series of circular perforated plates of the best wrought iron, ½ to ⅛ inch thick, with well planished faces, which are arranged in contact, and are connected together by wrought iron rods or bolts, passing through holes near the periphery; the bolts having strong heads at one end, and a screw nut at the other, whereby the plates are held firmly together. Several of the plates at the breach are, of course, solid, and without the hole in the centre. The series being thus connected, they are bored and polished inside, and turned off to the proper shape outside. While this cannon is stronger than those of common cast iron, it can readily be dissected, and each section may be shouldered by either pedestrian or equestrian artillerists, and when required, the parts may be put together and secured ready for action in ten minutes.

A Wire Suspension Bridge is now erecting over the Ohio, which will be the largest structure of the kind in the world, having a span of upwards of 1,000 feet, whereas that of Fribourg is but of 800 feet.

A Railway Club for engineers, architects, parliamentary agents, and solicitors, is proposed to be established in the vicinity of the Houses of Parliament.

The *Revue du Havre* states that a young chemist of that town has invented a system of lights for ports and coasts, consisting of a thick globe of glass, in which is enclosed a preparation giving a light like that of the moon, and the cost of which for one year will not exceed a franc.

Improvements in Gun-Cotton.—Mr. Coathupe recently forwarded to the Chemical Society two specimens of gun-cotton, with a view to illustrate the greatly increased explosive effects that are to be derived from a subsequent immersion of the gun-cotton, when properly prepared in the ordinary way, in a saturated solution of chlorate of potash. "Having experimented with solutions of nitrate of ammonia, nitrate of potash, nitrate of soda, bichromate of potash, &c., for the purpose of increasing the explosive properties of this interesting substance, I can affirm that none of the results will bear the slightest comparison with those obtained from the solution of chlorate of potash, either in rapidity of ignition, or in intensity of flame. The process adopted for preparing the enclosed specimens was as follows—viz.: into a mixture of equal measures of strong nitrous acid, and of oil of vitriol, spec. grav. 1·845, the cotton was immersed and stirred with a glass rod during about three minutes, it was then well washed in many waters and dried; a portion of it was then soaked for a few minutes in a saturated solution of chlorate of potash, well squeezed and dried."

New Fulminating Powder.—M. Sobrero in a paper to the *Academie [des] Sciences*, Paris, described what he calls *mannite nitrique;* viz., the s[ub]stance called mannite obtained from manna, honey, &c., and treated nitric acid. The *mannite nitrique* or fulminating mannite, explodes u[nder] the blow of the hammer with the same violence as fulminating merc[ury] and produces in its decomposition sufficient heat to ignite gunpowder. Sobrero has prepared capsules in which, instead of fulminating merc[ury] is placed a little nitric mannite crystallized in alcohol, and discharge[d a] fowling-piece with them several times with the same certainty as with ordinary capsules.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM JULY 24, TO AUGUST 23, 1847.

Six Months allowed for Enrolment, unless otherwise expressed.

John Platt, of Oldham, Lancashire, and Thomas Palmer, of the same place, for "[cer]tain Improvements in machinery or apparatus for making cards, also for preparing spinning cotton and other fibrous materials, and for preparing and dressing yarn, weaving the same."—Sealed July 24.

Charles De Bergue, of Arthur-street, West, City, for "Improvements in buffing traction apparatus, and in springs for railway and other carriages."—July 26.

Alfred Ceal, of Aldgate, manufacturer, and Henry Bear, of New-road, manufacture[rs] "Improvements in the manufacture of tobacco."—July 28.

Edward Ryan, of Park-place, Bayswater, Middlesex, for "Improvements in consu[ming] the smoke and economising the fuel of steam-engines, breweries, and manufac[tories] generally."—July 28.

James Morison, of Paisley, shawl manufacturer, for "Improvements in applying p[ower] in propelling or moving carriages, and in giving motion to machinery."—July 29.

Joseph Paul, of Thorp Abbott's-hall, Norfolk, farmer, for "Improvements in cu[tting] or forming drains in land, and for raising subsoils to the surface of land."—July 29.

Francis Starr, of Warwick, for "a new jet for the delivery of water and other f[luids] which he styles the 'Protean Jet.'"—July 29.

William Baines, of Norwich, inspector of railways, for "Improvements in the m[anu]facture of parts of railways, and in the bearings of machinery, and in apparatus use[d in] constructing railways."—July 29.

Alfred Vincent Newton, of 66, Chancery-lane, mechanical draughtsman, for "a[n im]proved kiln, or oven, for firing porcelain and other similar ware."—July 29.

William Phillips Parker, of 48, Lime-street, City, gentleman, for "an Improved [mode] of manufacturing cigars."—July 29.

George Witherell, of New York, America, for "Improvements in manufacturi[ng] working iron for various useful purposes."—July 29.

Stopford Thomas Jones, of Stamford-street, Surrey, for "Improvements in st[eam] engines, and in machinery for propelling vessels."—July 29.

John Hastie, of Greenock, Scotland, engineer, for "Improvements in the applic[ation] of steam power to turn certain kinds of mills or machines with a continuous [rotary] motion."—July 29.

Hector Sandeman, of Tullock Bleachfield, in the county of Perth, bleacher, for "[cer]tain Improvements in the materials and processes employed in dressing, cleaning, s[tarch]ing, and bleaching certain textile fabrics, and the materials of which such fabric[s are] composed."—July 31.

Theodore Fletcher, of Birmingham, brass-founder, for "an Improved manufact[ure of] speculums for various purposes."—August 3.

John Yule, of Sanchiehall-street, in the city of Glasgow, practical engineer, for "[cer]tain Improvements in railway chairs used on railways, and in fixing the same."—Au[g.]

Joseph Bourne, of Derby Pottery, in the county of Derby, for "Improvements i[n the] construction of kilns for burning stone ware and brown ware."—Aug. 4.

Arthur Boyle, of Birmingham, umbrella-frame maker, for "Improvements in the [ma]nufacture of buttons."—Aug. 4.

William Broadbent, of Manchester, for "Improvements in the manufacture of pa[per]"—Aug. 5.

James Simister, of Birmingham, manufacturer, for "Improvements in the manufac[ture] of stays and belts."—Aug. 5.

Thomas Birchall, of Ribbleton, in the county of Lancaster, for "Improvements [in] folding newspapers, and other papers."—Aug. 5.

Benjamin Bailey, of Leicester, machine-maker, for "Improvements in the manufact[ure] of knitted fabrics."—August 6.

Edward William Eaton, of New Windsor, Berks, bachelor of medicine, for "certa[in] Improved machinery for preventing accidents on railways."—August 19.

Osborne Reynolds, of Dedham, Essex, clerk, for "Improvements in making hop-pol[e] bundles, fencing ropes, baskets, or wicker-work, and other similar articles."—August 1[9.]

William Bacon, of Bury, in the county of Lancaster, engineer, for "certain Improve[ments] in steam-engines."—August 19.

William Eaton, of Camberwell, Surrey, engineer, for "certain Improvements in rai[sing] water and other liquids from one level to another."—August 19.

Orlando Brothers, of Blackburn, in the county of Lancaster, for "certain Improvements in the method of manufacturing retorts, and in the machinery or apparatus con[nected] therewith."—August 19.

Archibald Tarries, of Preston, in the county of Lancaster, gentleman, for "Improve[ments] in propelling carriages on common roads."—August 19.

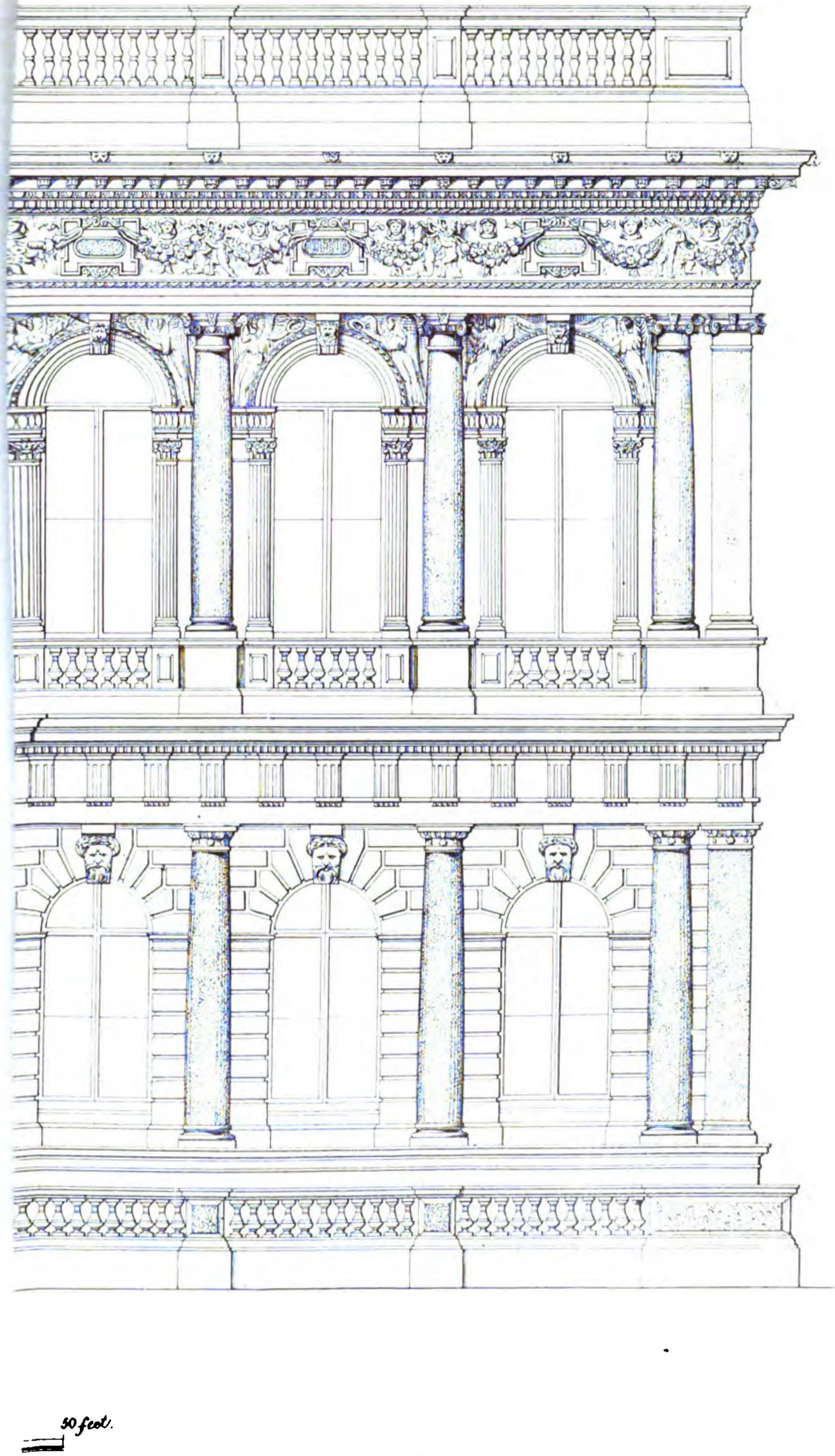
Francois Augustus Renard of 40 Rue du Rocher, Paris, merchant, for "Improve[ments] in preserving and colouring wood."—August 19.

James Webster, of Sneinton, in the county of Nottingham, engineer, for "an atmo[s]pheric buffer, to be applied to carriages and other vehicles travelling on railways."—August 19.

Aime Boura, of Rathbone-place, Middlesex, dyer and scourer, for "Improvements [in] extracting colouring matters."—August 19.

Alexander Speid Livingstone, of No. 7, Bridge-place, Lewisham, Kent, civil engin[eer,] for "certain Improvements in the construction of locomotive engines intended to be u[sed] on railways."—August 21.

Thomas Dawson Pruday, of the Freemason's Tavern, Great Queen-street, Middle[sex,] cook, for "certain Improvements in apparatus for reducing vegetable and other su[b]stances to small particles."—August 23.



50 feet.

THE CARLTON CLUB-HOUSE.

(With an Engraving, Plate XV.)

Since Mr. Smirke chose to forego the opportunity of exhibiting a production of his own, under such peculiarly advantageous circumstances as the occasion afforded, we are, for several reasons, very glad that for a work of *reproduction* he has gone to the example he has done. Independently of its intrinsic merit, we welcome that composition of Sansovino's as being likely to disabuse us of many prejudices,—although prejudices are apt to be so dreadfully obstinate and inveterate, that it may be questioned if even ocular demonstration will help to correct them. The Library of St. Mark at Venice,—of which, we presume, our readers are fully aware that the new façade of the "Carlton" is a direct copy, the original design being so well known by engravings of it in various architectural publications,—is so admirably contrary to all rules and all systems of the orders, as quite to confound them, and to nonplus that plodding sort of criticism which speaks according to book, orthodoxly enough, of course, but sometimes very stupidly. Had Mr. Smirke himself ventured to deviate in the same degree, or even half as much, from "approved recipes" for the orders, he would most assuredly have been taken to task by small critics for his extravagant licentiousness,—would perhaps have been put into the same category with Borromini, at least have been sneered at by the fribbles, for his conceit in presuming to make so exceedingly free with the established and only legitimate proportions of the ancient orders. To one who is acquainted with the orders only formally,—who knows them only by rote, as a schoolboy does his grammar, Sansovino's treatment of them must appear most extravagant, and little less than detestable; to the eye of an artist, on the contrary, it will show itself to be truly admirable, because highly effective;—and what, let us ask, is the purpose and object of architecture as art, except to produce effect?—since, take away that, and it becomes mere building, than which common-sense, if we are to abide by mere common-sense, demands no more.

In Sansovino the artist predominated over the architect,—that is, over the regularly-trained one, he being less attentive to direct authority and precedent —as far, at least, as the orders are concerned—than to artistic sentiment and effect. He* was more of the sculptor, or we may say of the artist, than the *mere* architect. As if for the purpose of exemplifying that line of Pope's, which says:

"And snatch a grace beyond the rules of art,"

he snapped his fingers at rules, and proportioned the entablature of the Ionic or upper order, rather to the entire elevation than to the columns themselves, it being, in fact, somewhat more than half the height of the latter, in bold defiance of the regulations laid down by such exemplary martinets as Messrs. Vitruvius, Palladio, Vignola, and Co. In palliation of this enormity, it is alleged to have been in a manner forced upon him by the necessity, at least desirableness, of making his building agree in height with the adjoining Procuratie Vecchie in the Piazza di San Marco. Yet as no such consideration can possibly have influenced Mr. Smirke, it may be presumed that he adopted the license for the sake of the happy artistic effect attending it, knowing also that be himself was well shielded from the reproach of desperate innovation and disregard of all system, since he has only adhered to his precedent for it.

Besides serving as an excellent lesson against narrow priggish systems respecting proportions—which some have laboured to reduce to the "rule of thumb,"—such an example as Sansovino's, and as here carried out by Mr. Smirke, may be efficacious in correcting that excessive tameness and penuriousness in architectural design which we have been wont to dignify to ourselves by the flattering epithets of "chaste" and "simple." It is true, thanks in a great measure to Mr. Barry, the miserable "starvation style"—more intolerable perhaps than even the mere "hole-in-the-wall" style—has been brought into disrepute; still, some specimens of bolder, freer, and more copious modes of decoration than we have hitherto been accustomed to in *modern*† architecture, are desirable. We need something too to correct our taste for that flashy and frivolous mushroom sort of design which puts a showy barrack-looking front to a mile-long range of houses, and then dubs such brummagem a "Terrace."

Not very many years ago,—when such truly prosaic buildings as Stafford-house were looked upon almost as architectural marvels, and as indicating nearly a seven-league-boot-stride forward in taste—the idea of such a façade as is the new portion of the Carlton Club-house, would have been deemed most startlingly extravagant. It certainly does make the original Club-house, which still stands by it entire and intact, cut a more dowdy and dismal figure than ever. The contrast between the two is positively curious, and worth being recorded by the pencil, ere the first-mentioned structure be removed to make way for the completion of the other. Not the least curious circumstance of all is that two such strongly antithetical and antagonistic tastes should be exhibited in the works of two brothers, who most assuredly do not at all fraternise in their architectural sympathies. The contrast presented by the old (although not very old) and the new Club-house may, besides, be taken as an index of the revolution in architectural taste generally, for perhaps neither would Sir Robert venture to propose such a design now, nor would Mr. Sydney Smirke have thought of bringing forward Sansovino in the days of architectural purity, innocence, and water-gruel. Sir Robert's work will, of course, be very shortly expunged; not so, however, that of Soane in the adjoining ducal residence, unless his Grace of Buckingham should now be spirited up into contributing his share towards the architectural *eclat* of Pall-Mall, by giving his mansion a new façade in aristocratic *palazzo* costume, to which latter it makes no pretensions at all at present, although when first erected it was perhaps considered both ducal and dignified enough. Whether that be ever done or no, the ducal Buckingham-house in Pall-Mall will be less shamed by comparison with the new Carlton, notwithstanding that it is in immediate juxtaposition with it, than the royal Buckingham-palace in the Park, the building added to the latter being a contemporary work. Sansovino was surely wanted there,—at least might have been consulted on that occasion.

With regard to what Mr. S. Smirke is doing in Pall-Mall, we could wish that as the design is so notoriously a copy, he had adhered more strictly to the original in one or two particulars wherein he has now deviated from it, not at all for the better. Some, indeed, there are which called for correction, —the balustrading in particular, for it is not of the best proportions; and the balusters themselves are, at least in our eyes, decidedly ugly, and seem designed rather for wood-work than stone. But the omitting the moulded archivolts to the arches within the lower order is assuredly no improvement, because it does away with that attention to keeping and consistency of character with which Sansovino treated both his orders in that composition, assimilating them as to general style. The Doric is of professedly ornate, or we may say florid, desciption. It does not even so much as pretend to Doricism, except normally and nominally, by having the usual indicial marks appropriated by custom to that order. Quite as much do we regret the omission of sculpture in the metopes of the frieze; and regret it all the more because such embellishment would have been a very great novelty here, there being, as far as we are aware, not a single example in all the country of a Doric entablature so enriched—not even among those ultra-Greek porticos which modestly call themselves "after the Parthenon." The only excuse that might else have been alleged for the omission—and a most provoking one it is—is taken away by the building itself, which totally forbids the supposition that the retrenchment of such decoration, which contributes so much to the unity of *ensemble* in the original structure, was occasioned by any mere money-sparing considerations. If the tone of decoration was to be at all moderated, it ought to have been done more uniformly, so as to preserve keeping. Happily, it is still in time to amend the error in some degree; wherefore we would advise, that in the centre part of the composition the Doric frieze should have its metopes sculptured. Such variation there from the rest of that entablature, while it would give us a very desirable specimen of such embellishment, would be a difference conferring no more than a very allowable kind of distinction on the central portion of the façade. At any rate, we would not only recommend, but earnestly entreat Mr. Smirke to re-consider, ere it be altogether too late, his entrance porch and the door within it. How, with Sansovino before his eyes, he could have conceived the idea of such a porch is to us incomprehensible,—a small loggia of that kind, with an entablature whose architrave is supported on columns alone, being quite at variance with the mode so systematically observed for the rest of the façade. Why not fill up the front of the porch with an open arcade similar to those of the ground-floor in the original building? Besides keeping up consistency of design, it would give the expression of compactness to that projecting feature, and boldness of effect in regard to light and shade. It would produce greater richness also, as the arch would, almost as matter of course, have archivolt mouldings, as ought also to have the window on each side of the porch in that division of the front; not forgetting sculpture in the spandrels of the arches

* For some account of him we refer our readers to what can be more easily referred to than Temanza, the second series of Gailhabaud's Ancient and Modern Architecture, accompanying the description of the very edifice which has now been repeated in Pall-Mall.

† We here employ the term "modern" in contradistinction from mediæval architecture and imitations of it.

as in the upper story, at least not for that of the porch. Hardly need we add that the doorway ought to form a corresponding arch to that in front, or that the ceiling should be likewise semicircular and coffered. If this would not materially improve the whole design, and render it more true to the spirit of Sansovino's work, we are willing to forfeit for the future our pretensions to judgment in such matters.

With regard to the species of polychromy introduced in the exterior, by employing dark polished granite for the shafts of the columns, it remains to be seen how it will bear the test of time, when the granite shall have lost its lustre, and the rest of the stone-work be tarnished and discoloured. At present, the effect—of which an outline elevation conveys no idea—is striking and vivacious enough, perhaps somewhat more so than is exactly desirable for other neighbouring façades. It is, however, a question whether colour does not require to be carried out a little more, and whether, if they were not to be sculptured, the metopes of the Doric frieze might not very properly have been filled in with polished granite also, like the panels on the Ionic frieze, the form of which last-mentioned ornaments might have been improved, they being now of more fanciful and arbitrary than tasteful design.—Our remarks are as impartial as they are free: whoever had been the architect, whether Mr. Barry or Sir Robert Smirke, we should have spoken of the "Carlton" façade just the same, except that had it been the latter, we should have heartily congratulated him on his emancipation from pseudo-Grecism, and his adoption of a style that, be it ever so *impure*, recommends itself by *Artistic* spirit.

CANDIDUS'S NOTE-BOOK, FASCICULUS LXXIV.

"I must have liberty
Withal, as large a charter as the winds,
To blow on whom I please."

I. Archæology may be likened to fire,—not on account of any brilliancy and vividity that it possesses, for to say the truth, it is apt to give out far more smoke than flame, but this it has in common with fire, that it is a good servant, but an intolerably bad master. So long as archæology is made only an auxiliary study to Architecture and Fine Art, it is serviceable enough. With that, however, it is not content, or more properly speaking, those who call themselves archæologists, are not content to have it kept within its proper bounds. They insist upon its being allowed to become quite dominant and rampant,—completely dictatorial. They themselves, knowing merely what has been done, and limiting the powers and capabilities of art just to their own little *ne plus ultra*, beyond which they have not an idea, insist upon nothing being done that cannot be shown to have been done before; thereby either insolently denying that we of the present day possess any sort of genius or talent, or still more insolently refusing us the privilege of exercising it. And what do architects themselves do? They quake and—are silent, or else fawn and flatter, thankful, perhaps, that nothing worse than mere indignities are cast upon them. Nay, some, who would be thought to have the interests of architecture chiefly at heart, seem to do all in their power to throw it into the shade, and bring forward in lieu of it the most anile rubbish imaginable,—such arrant rotten lumber that a sensible antiquarian is downright ashamed of it.

II. Unless it be restrained by that judgment and discrimination which will render it subservient to the advancement of Art, archæological study comes to be considered an end rather than a means, as which latter alone it is of any value to the architect, *quoad* architect. It may, indeed, enable him to talk or write very learnedly, and to display a deal of recondite erudition and curious research; yet, if he addicts himself to it in such manner as to make it at all his hobby, it will play him—or else cause him to play, many strange hobbyhorsical pranks. He will be always looking backwards when he should be looking forwards,—will even be afraid of getting onward a step forwarder than Precedent will permit him. That same Precedent—or rather the nonsensical and superstitious reverence affected for it, is made a positive dead weight—a millstone hung round the neck of Art. It is a chain apparently bestowed on it as a badge of honour, but made use of in reality as a halter wherewith to strangle it. Nor is it an overweening fondness for mediæval archæology alone that is to be deprecated, that for classical antiquity, with its consequent blind and indiscriminate deference to classical authority, being equally apt to mislead —or if not exactly to mislead, to fetter, impede, and retard. Far better, in all probability, would it have been for Wilkins, had he never seen either Athens or Magna Grecia;—better at least had he dismissed them and Vitruvius entirely from his thoughts whenever he sat himself down to design, and instead of thinking of what had been done, had studiously bethought him how to make the most of the subject in hand, had considered what new ideas it might be made to produce, and how artistic effect might best be secured for it. But, alas! artistic composition and artistic effect were almost the very last things that he, like many others, ever thought of. Had not such been the case, Downing College would have exhibited a very different piece of design from what it now actually does,—pseudo-Grecism in all its pedantry and all its dulness. Neither would the same architect have vapoured so much as he did about the mere intercolumniation of the portico of the National Gallery, but would have attended much more to the general composition of that façade. The eye of an archæologist, and that of an artist—and an architect ought to be one—have very different powers of vision. The former is so myopic that it cannot discern a single inch beyond Precedent, while the other—we are speaking of the true artist—can discern with prophetic ken, *what will be Precedent* to after-ages. It is all very well to understand Precedent, but to be enslaved by it is equally absurd and despicable.

III. In a letter from a friend who is now a temporary resident at Edinburgh, I have lately received some exceedingly clever and welcome criticism on the architecture of the self-styled Modern Athens,—which designation, by-the-by, he observes is a complete misnomer as far as architecture is concerned, although Scotchmen may be sufficiently *Greek* in some respects. After expressing a rather mean opinion of the Gothic architecture of Scotland generally, which, he says, affords no studies worth the attention of an English architect, my correspondent adds, "the general rate of recent imitation of that style, in Edinburgh, is lamentably below even the local standard of antiquity. The exterior of the Assembly Hall has unquestionably many fine parts, but where is the climax which the ancient builders produced, in the interior? The Scott Monument again, the boast of all Edinburgh, obtrudes itself upon you in twenty different sizes in every print-shop—is painted on every snuff-box—graven in metal—yea! built up in confectionary; yet no architect would now get practice in England in the Gothic *line*, on the strength of such a master-piece—I might say such a *missy* piece as that same Scott Monument;—so defective is it in detail, and most signally so in the proportion and graduation of its lower story, which, from almost every point of view, reduces its apparent height one-third. Instead of the thousand-and-one representations of that precious Monument, I would far rather see one *satisfactory* view of Donaldson's Hospital, the finest building in Edinburgh, ancient or modern. In this structure, designed for similar objects as George Heriot's foundation, we have a very successful adoption of the combined forms known as Elizabethan, and exemplified in Burleigh. Like Heriot's Hospital, its plan is quadrangular, with a tower at each corner, flanked by four ogive-domed turrets, and a corresponding tower of bolder and loftier design marks the centre of the principal or southern front."—Thus much by way of specimen, and I hope my friend will be induced to work out his remarks fully *in extenso*, and give them in some shape or other to the public, who will then for the very first time get any thing at all like intelligent criticism relative to the architecture of the northern capital, and its public buildings. One thing there is which the Edinburghers themselves might do, at least get done, which is, instead of publishing again and again *ad nauseam* the Scott Monument, to publish a collection of some of their best edifices, illustrated architecturally by plans and elevations, in some such economic form as the "Public Buildings of London," and Landon's "Edifices de Paris." Surely Playfair, Hamilton, Rhind, and others who have shown talent in some of the recent structures, would gladly promote an undertaking of the kind,—in which sections and interiors ought not to be quite forgotten—certainly not such as the hall and principal apartment in the new Commercial Bank, which last-mentioned apartment appears from description to be quite unique as a public "business-room," it having a Corinthian colonnade on each side, and being moreover enriched with decorative painting, marbling, and gilding, most probably by Mr. Hay—although that is merely my own conjecture. The hexastyle Corinthian portico of the exterior, with its pediment filled in with statues in full relief, might pass for classical, were not such character sadly marred by the two ranges of windows within; whereas had there been none below, but only the doorway there, the upper ones might have been excused.

IV. Leaving the question untouched as to the propriety of making the palace of the legislature a sort of museum and gallery of art, we may reasonably hope that when they come to be in the very atmosphere of art, the members of the Two Houses will be in some degree infected by it. How much—that is, how little they now understand or care for art is tolerably evident from the truly unfortunate *nem. con.* that sanctioned the adoption of such a design for the new façade of Buckingham Palace as the one "presented" to them by Royal Command. Not a single voice was raised to protest against the architectural iniquity of inflicting upon us such a piece of commonplace and even vulgar design—the subject considered—for the front of a royal palace, at the present day; and after all the revilings, too, that have been heaped upon the original building, as concocted by George the Fourth and John Nash. To sneer at their taste now would be akin to questioning the sublime taste of Queen Victoria and Edward Blore, and be compromising our loyalty. Nevertheless, I do wish that Ben D'Israeli's excellent advice were taken, and that an architect were hanged *in terrorem* to the rest of the tribe. And if such wholesome example is to be made at all, let it not be on some paltry Pecksniff, the architect, perhaps, of a gin-palace, but on some higher offender—even the architect of a royal palace.

V. Extolling the elaborate richness of the Palace of Westminster, one critic has very naïvely expressed his astonishment at Mr. Barry's herculean task in having to design such a prodigious quantity of details, there being hardly a square foot of plain surface in the building, either externally or internally. The manual labour and workmanship are of course prodigious, but the number of drawings required is comparatively very moderate, those for one bay or compartment of the structure serving almost for an entire side of it; inasmuch as a single portion of the kind once designed becomes the pattern for as many others as are to be made similar to it. Or does the sapient critic imagine that an architect makes working drawings for every individual column, window, and other part that are repeated again and again without variation? If so, he must be first cousin to the Irishman who went to a tailor to order two suits, and having being measured, stood waiting the renewal of that operation, exclaiming, "I told you that I wanted two suits, and you have taken the measure for *one* only."

VI. Some who, if not more talented, are cleverer than Mr. Barry—that is, show greater cleverness in sparing themselves trouble—make very short work indeed of designing details, taking them ready-made, and applying them on every occasion alike. One architect, who shall be nameless—for proper names are sometimes highly improper things—has had for his whole stock of ideas, in the course of a long practice that must have been a profitable though hardly can it be called a successful one,—just a couple of patterns for columns, and the same number for windows, which he has served up again and again, with an abstinence of invention and imagination truly marvellous. Let us hope, however, that the day is approaching when it will be exacted of architects that they shall exhibit *bonâ-fide* design in their compositions, and also that their compositions shall be legitimately entitled to such name, by being framed according to artistic principles, instead of being, as is now generally the case, mere crude hap-hazard compilations, in which, though every one of the separate features may be good in itself, being taken from here and there, they do not well assort together, or else are not so suitable as they ought to be to the express occasion. Detail ought to proceed invariably from the architect's own pencil; or if he be incapable of producing it, and be so far a mere mechanic, by what right, or rather with what specious show of right, does he usurp the style of ARTIST?—rendering himself thereby a mere quack. Or if, as seems to be the case, we really do not care for having Artist-architects, let us have the honesty to declare so at once, let us desist from vapouring about the excellence of architecture as a Fine Art, and let us fling ourselves into the arms of those two doxies—Camdenism with its vinegar-visaged orthodoxy, and Pecksniffism with its drunken, gin-palace heterodoxy.

VII. The following, from Donaldson's Maxims, can not be too earnestly recommended to a great many, both in and out of the profession:—"He who expects to be a good architect by knowing the history of all the styles, and the phases which it (architecture) has assumed through each period, will find himself much mistaken when he begins to practise. He may be a good historian, and a judicious critic, but not necessarily a good artist." —Certainly not, for, on the contrary, he may be a very bad one—that is, no artist at all. Even with regard to criticism, too, mere historical knowledge without æsthetic feeling and intelligence will go but a very small way, and produce nothing better than one of those very small critics who, profound in dates and authorities, are exceedingly shallow indeed when it comes to questions of real, unprejudiced criticism; and, to give them their due, they seem to have the grace to know it, for most studiously do they avoid approaching any question of the kind. We have one learned Professor who goes about surveying cathedrals very much in the spirit of an appraiser, and with just as much eye for their peculiar artistic beauties. For my part, I never take up an account of a building without most devoutly wishing that it had no history at all, and that there was nothing else to be spoken of but the structure itself, which is now generally converted into a mere peg to hang a tissue of musty gossip and anecdotes upon. *Et tu Brute!* I apostrophized Jovellanos the other day, on turning over his "Carta Historico-Artistica sobre el Edificio de la Lonja de Mallorca,"—for it is as dull as if it had been written by Dr. Dryasdust or Professor ———. The *Artistica* is certainly quite superfluous—nay, worse, positively deceitful, and most maliciously so, exciting as it does the most agreeable expectations only to disappoint them. "*Heureux les peuples,*" says Voltaire, "*dont l'histoire est ennuyeuse;*" and if so, architecture ought to be in a most enviably happy condition indeed, since nothing can be duller than its history as it is usually served up to us.

VIII. Of detestable heresies in matters of Art, the most detestable of all is that which would persuade us that Art can be taught by rules, and ought to subserve to rules. It is the most detestable because the most grovelling and abject,—the most alien from the very spirit of Art. Rules are for dull-witted pedants and schoolboys; the artist, if he really be one, has got beyond them, and abandons himself to those inspirations. Inspirations!—if I smile, I also groan while I write that word in reference to architecture. Inspirations! where do we find them in our *Art?* Nor may we hope to find them so long as a merit is made of the most barefaced copyism, and of the most servile regard to Precedent. Now, if *Architecture* really be not a Fine Art, let it be exposed as a mere pretender and impostor, and let us hear no more of it. For my own part, I would much rather pronounce its doom at once, and say with the stern Roman patriot, "*I, lictor, colliga manus.*"

IX. While there is a great deal of verbose gabbling and prosing about styles, scarcely anything at all is ever said or written upon the subject of what belongs or ought to be made to belong equally to all styles, it being a *sine qua non* in Architecture properly so called in contra-distinction from Building,—namely, Æsthetic or Artistic effect. Yet it seems to be the very last thing of all that is either thought of or studied. The effect that comes by chance—because it is, perhaps, just that which the forms employed must of necessity produce under any circumstances—is but of a feeble, ordinary kind, whereas the higher quality of Artistic effect never comes by mere good luck. If it is to be at all, it must be provided by the architect himself; nor can he possibly provide it without understanding it, studying it, and aiming at it. He must study it, too, in regard to composition, adjustment of masses, play of both *plan-line* and outline, and relief and chiaro-scuro, as well as in regard to subordinate parts and details; which latter are now generally made all in all, although they are seldom more than borrowed; and, indeed, such borrowing is now made a positive merit, and is accepted if not exactly as evidence of talent, as an all-sufficient substitute for it. In Fine Art of whatever kind, effect is every thing, and all the rest no more than the means of producing it. Would, therefore, that architects would begin to attend to it much more than they have hitherto done, and then we should have something very much better than the correct dulness they now so frequently present us with. And if they want a study for effect, they may find one in the north-west corner of the Bank of England, which, if they have any eye or feeling whatever for effect, ought to inspire them. Nevertheless, most strange to say, there is not one who has since caught an idea from that exquisite little architectural gem—Soane's best and truest monument. The Institute ought to have a well-executed model of it, both as a most valuable study, a truly admirable precedent, and as a compliment to their benefactor. Nay, without any particular affection towards the man, I should rejoice to see a statue of Soane himself placed within that classical loggia, where its *effect* would be almost enchanting.

X. All-incredible as it is, it is nevertheless fact—a dismal and a damning one—that at the late meeting of the Archæological Association at Norwich, not one of the egregious architectural cognoscenti there assembled thought it worth while to pay a visit to Cossey Hall, although it is in the immediate neighbourhood of that city, and is in many respects a *chef d'œuvre* specimen of Ancient English Domestic architecture of the palatial class. It is true it is but a modern production, still it is a charming artistic imitation, strongly reminiscent of Thornbury, and other excellent examples of the same period. Very ill indeed does it become archæologists to turn their backs upon, or turn up their noses at, modern works of that description, when they themselves are all the while labouring with might and main to bring modern-antiquity into general vogue among us. Such people have a most strange way of showing their gratitude, and an equally strange way of showing their taste. As to the latter, both that and their admiration of what they do condescend to admire, appear to be regulated entirely by dates and registers. Such learned owls see best in obscurity and darkness. The broad daylight of the actual truth quite dazzles and scares them.—If it be strange that the archæologists should have treated Cossey as they did, it is hardly less so that none of our architectural draftsmen, who sometimes seem very much at a loss for fresh and interesting subjects, should have exercised their pencil upon that mansion, which is certainly not deficient in varied and highly piquant parts. But the shadows of archæology are fast falling upon and darkening the whole land of Art,—enwrapping it in its own morbid gloom, till Dulness, universal Dulness, reign. Then take my advice in time: Fling physic to the dogs and Precedent to the devil.

HISTORY OF ARCHITECTURE IN GREAT BRITAIN.

A Brief Sketch or Epitome of the Rise and Progress of Architecture in Great Britain. By James Elmes.

"Epitomes are helpful to the memory, and of good private use."
Sir Henry Wotton.

(*Continued from page* 271.)

The four great epochs of architecture in England are, as hath been shown, —I. The introduction of the art into Britain by the Romans, until its decadence by the Saxons.—II. The introduction of the Ecclesiastical or Pointed styles by the Normans, through all the rich exuberance of the florid Plantagenet and Tudor styles, to the mixed anomalies of the Holbein, Elizabethan, or picturesque styles, which fell into desuetude shortly after the death of Elizabeth.—III. The revival of the Roman and introduction of the Italian styles by the Stuarts, to the absence of all style and schools which marked the reigns of our first two princes of the house of Hanover.—IV. The patronage of all the polite arts which distinguished the accession of George III., and the establishment of the Royal Academy, to the present day; in which period all the styles have been revived and practised, with various degrees of success, and to which we owe the introduction of the pure simplicity and unrivalled elegance of the Greek style, as well as the eccentric architecture of the Chinese and the ponderous eternities of the Egyptian. This latter epoch, so abundant in materials both in theory and practice, will form the subject of the following section.

The overflowing exuberance of our English language, which soars above the pure simplicity of a mother tongue, borrows its words, phrases, and idioms from the Hebrew, Latin, Saxon, Norman, German, French, Dutch, and even from the Arabic and other Eastern tongues, at pleasure; engrafts such as are suitable for its purpose, rejects the useless or those which are merely pedantic, and thus renders it the most powerful and rich of modern languages. So have the architects of the Georgian-Victoria period, by a similar usufruct of every known style of their art, rendered the architecture of our time more exuberant and usefully elegant than any other single people. They have not used the Greek style to monotony, the Italian to littleness, the Gothic to florid pedantry and heraldic exaggeration, nor any to satiety; but, with a few solitary exceptions, have engrafted a freedom of style and an unfettered selection from the beauties of every clime to their productions. Hence, although we have no style of architecture that can be properly called English, we have a rich engrafting upon our parent wild stock, domestic utility, a mixed but not incongruous style, rich and exuberant as is our language. Therefore, the architecture of England, if it cannot be called English arcnitecture, is like the Venus of Praxiteles, composed of the choicest elements of beauty.

In the early part of the reign of George the Third, Sir William Chambers enjoyed the royal favour and almost the whole of the architectural employment of the day. Fond of ease, he indulged in his professional reveries in his office at the Board of Works. Not being a regularly bred architect, or even builder, he educated no pupils—that is to say, as the word is now understood: he therefore formed no school, and left little more than his Somerset-house, his Royal Exchange, Dublin, a few edifices of lesser notoriety, his Chinese buildings at Kew, and his "Treatise on Civil Architecture," to perpetuate his fame; but his name will always hold a distinguished place in the list of British architects. His only followers or pupils were bred in the office of the Board of Works, in which he held the situation of surveyor-general. Among the principal of these were his friend and associate, John Yenn, for whom he obtained from his royal master the diploma of R.A. and the honourable office of treasurer to the Royal Academy; William Gandon, who distinguished himself by his able editing of the last two volumes of the "Vitruvius Brittannicus," his splendid buildings of the Custom house, the four Courts, and Parliament house, Dublin, and some private edifices in other parts of Ireland; the late Mr. Hardwick, father of the present eminent architect of that name; and the late Mr. John Buonarotti Papworth, who received sufficient directions for his professional studies and advice in the selection of models, to warrant a small claim to that title. This gentleman's father and elder brother were the eminent plasterers to the Board of Works, and as they executed the beautiful ornamental plastering and stucco work to the cornices, ceilings, coves, and panels of Somerset-house, some of which in the Royal Academy form frames for decorations from the pencils of Reynolds, Cipriani, Regaud, Mary Lloyd, and other members of that institution, the young Buonarotti, who exhibited early in life a decided love and taste for ornamental design, had often easy access to the architect and to the building.

Of the first of these, namely John Yenn, notwithstanding the honourable addition of R.A. to his name, his only known work is that part of the Treasury which faces St. James's Park, and grins horribly upon Holland's pretty edifice of Melbourne-house, and Kent's picturesque composition of the Horse Guards: and this is his only voucher to the honourable title of Royal Academician, in the newly-established Royal Academy of Painting, Sculpture, and *Architecture!* This extraordinary event the architect commemorated by presenting his brother academicians with a geometrical elevation of his design, shaded with Indian-ink and tinted with gamboge, in the manner of the day, and framed and glazed, with his autograph (John Yenn, R.A., Architect). Of his right to this title Dr. Johnson bears witness in his Dictionary, wherein he says that "Architect" is a noun substantive, and means a contriver of anything;—*ergo*, John Yenn is an architect, for he contrived the north front of the Treasury. His original (?) design for that contrivance is still in the collection of works presented by the Royal Academicians to the Academy, and is preserved, though rather in an obscure corner, in the council-room of that institution, honoured by a companionship with the self-selected works of Reynolds, West, Lawrence, Hoppner, Wyatt, Dance, and other eminent cotemporaries; his successors being purposely omitted from the comparison.

The first symptom of a regular-bred genuine architect in the reign of George III. was James Wyatt. Being the son of an eminent and opulent builder in the city of London, who was much concerned in government and other large building contracts, he received the elements of a sound scientific education necessary either for the builder or the architect. After being thus far qualified in his father's establishment, he refined and purified his taste by investigating the finest ancient and modern structures, and in visiting the best schools of architecture in France and Italy. Foreign travel in those days was absolutely necessary for one who aspired to the eminent profession of an architect; for, with the exception of Sir William Chambers's little Goshen in Scotland-yard, there was no school or master of the art, properly so called, in England. It is true, that at the commencement of the Royal Academy, Thomas Sandby, brother of the facetious painter Paul Sandby, an architectural critic and draftsman, read occasional lectures on architecture in the Academy; but of his works and lectures we have no records. His brother Paul, an amiable, agreeable, and facetious man, and a considerable artist for his period, was among the earliest R.A.'s, and doubtless persuaded his brother Thomas to read Vitruvius and Palladio, and to transmute their stern lessons on their art into agreeable essays, suited to the mixed assembly of painters, sculptors, incipient architects, engravers, drawing masters, and others, who were admitted as members, associates, and students, to draw from the antique and living figure, and to listen to the biennial discourses of Reynolds, and the annual platitudes of Penny, R.A., Professor of Painting, of whom we have no more room than to say, that he painted the death of General Wolfe with all nude figures,—modern drapery being in his opinion beneath the dignity of an historic pencil;* the clever compilations of Thomas Sandby on architecture, and the few but earnest prelections on anatomy by the celebrated Dr. Hunter. Wisely then did

* This work is still preserved, among some really fine works of art, in the Picture Gallery at Oxford.

Wyatt determine to increase his store by visiting the academies, schools, and buildings of France and Italy; and the result was, that on his return to his native country he gave proofs of a taste that wanted nothing but a visit to the still more refined climes of Greece to have completed. But alas, a residence in that country, owing to the wars between the Turks and Venetians, and other turbulences, rendered it even more unsafe than it was in the time when Stuart and his fellow travellers visited that afflicted and long-suffering country. On his return to his native land, he astonished the connoisseurs and travelled patricians of England, by his first work, the Pantheon in Oxford-street, a work which more deserved the name of the building it professed to imitate than any other in Europe, as pictures and engravings still extant sufficiently prove. It required but to have been built of more substantial materials than was the timber cupola, niggardly allowed him by the proprietors, to have rendered the Pantheon of London incomparably the best imitation of that of Rome. The best part of this fine work, the cupola and all its decorations, was unfortunately destroyed by fire, and was never afterwards adequately restored. After its re-instatement, it was used as a saloon for masquerades, ridottos, and exhibitions of pictures, and once of Lunardi's monster balloon, which was constructed to ascend with fifty people. The upper half alone of this stupendous machine reached from the eye of the cupola, from which it was suspended, nearly to the pavement, as was witnessed by the writer of this article. The superior part of the balloon was to have represented the cupola of a temple, from which was suspended a circular tambour of cloth, painted in imitation of columns and entablature of the Corinthian order, to complete the peristyle. At the base of this was to have been attached a gallery with pedestals and balusters for the aeronauts, with doors to the interior of the peristyle, leading to the car which carried the furnace and fuel,—it being on Montgolfier's principle, of rarified air produced and supported by fire. The Pantheon was afterwards converted into a dramatic theatre, for the exclusive performance of English opera, but it was put down by the managers of the patent theatres, by arresting some of the leading performers, of whom one or two had been members of the Covent-garden company. After many vicissitudes, it has been nearly rebuilt as to its interior construction, and used as a bazaar for the sale of works of art and fancy articles.

The front of the Pantheon next Oxford-street consisted of two slightly-projecting wings, and an Ionic portico projecting from the receding centre, the upper part of which was finished by a balustrade, and was covered by a terrace which was entered by a large central Venetian window. The whole façade was marked by a timidity of design more befitting a student than a master of his art; wanting boldness and a greater diversity of light and shade. The Ionic order of the portico bore marks, however, of an attempt at invention, being copied from no known example. It singularly enough fell into the flat volutes of the Greeks, instead of the angular volutes of the Romans, proving that if Wyatt had not seen the temple of the Apollo Dedymæus, he could at least compose a more tasteful capital than he had seen in Rome; which he certainly did far above any Roman example, but far indeed below the purity of the worst of the Greek specimens.

Wyatt not only surprised the admirers of architecture by this work, but also by his designs and drawings that he brought from Italy, and the extensive knowledge he possessed of the arts in general. His polished manners and numerous polite accomplishments gave facility to the development of his ideas, and secured him a host of patrons and friends among the great. He became the principal architect of the day; was consulted by all the leading peers and commoners of the two kingdoms who were about to build, enlarge, or improve their mansions; corporations sent to him for designs for town-halls and assembly-rooms; bishops for new palaces; deans and chapters for repairs of their cathedrals; and players for designs for theatres. In fact, Sir Christopher Wren had scarcely more employers or more buildings in hand at one time, than had James Wyatt in the zenith of his employment.

At the death of Sir William Chambers, Wyatt succeeded to his chair in the office of surveyor-general of the Board of Works, and was admitted to that easy familiarity and confidential intercourse with his royal master, George III., surpassing even that of his predecessor, whom the king always regarded with somewhat of the respect due to a tutor. Indeed, the intercourse which is necessary between a sovereign and his chief architect was as complete between George the Third and James Wyatt as was possible between two such persons; the king never desiring to be treated by any one whom he condescended to consult otherwise than as an English gentleman, and Wyatt was too well bred to be either servile or part: indeed, the familiarity that existed between Charles the Second and Sir Christopher Wren much resembled it, except that in this case the king was occasionally too much of a roisterer, and loved to indulge in a few jokes upon his little architect's want of sesquipedalian stature;—that between George the Fourth and John Nash was as professionally perfect, except that here the king was too well bred to notice, in his walks with his little architect in the crowded saloons of Carlton-house, the difference of their stature, any more than he did when he was walking with his little friend, Count Boruwlaski. For these, if an apology be necessary, we must have recourse to Churchill, who says—

> "Before such merits all defects must fly,
> Pritchard's genteel and Garrick six feet high."

The before-mentioned qualifications possessed by James Wyatt, till then unknown in one man since the days of Jones and Wren, had previously to the accession of George III. led to the employment of Italian architects, now reverted through the influence of that sovereign into English channels. Possessed of genius, taste, and feeling, Wyatt revived a correct style, and introduced one still purer than any of his predecessors,—remote, it is true, from all the transcendent purity of the genuine Greek school, but nearer approaching to it than the best Italian known. The ancient architecture of England, the neglected and almost forgotten Gothic, came, by desire of his sovereign, under Wyatt's investigation. Here was a new field opened to him; but he had seen many of the finest Gothic cathedrals of France and Northern Italy in his travels, and the style was therefore not so new to him as to Wren. Nor did he so thoroughly despise it as Wren: yet he never comprehended it in all its exquisite niceties. The restoration of Windsor-castle and the repairs necessary to be done to the venerable cathedral of its diocese, Salisbury, led both the monarch and his architect to close Vitruvius, Palladio, Serlio, and all books treating on the "five orders of architecture," for a time, and to open Dugdale and other musty writers on the cathedrals and castellated buildings of England. The additions to Windsor-castle show that Wyatt thought that if he could not amend he would not alter the original styles of the buildings, and he completed these labours with great credit to himself and to the entire satisfaction of his royal and munificent patron. The celebrated abbey at Fonthill, which was erected entirely from his designs, for the rich and tasteful Beckford, the celebrated author of "Vathek," was a brilliant instance of Wyatt's genius, but was not so pedantically correct in its details as to please the hypercritics of the Camden school. The tower was lofty and imposing in effect, visible at a great distance, as was the intention of its proprietor; its apartments were numerous, gorgeous, and elegant, replete with all those exquisite niceties that so marked the fancies of Beckford, and was a vast shrine, cabinet, or jewel-case, filled to every corner with gems of art and literature of the most precious description that the lordly wealth of its splendid owner could cram into it. The design and execution of this unique building reflect the greatest credit both upon the talents and taste of its architect. Its unfortunate fate is too well known to be described here, but the enquiring reader may be fully gratified as to its plan, general effect, and details, in Mr. Britton's elaborate and careful work on Fonthill-abbey.

Wyatt's greatest offences against the rigid laws of Gothic architecture are the exterior of the palace at Kew, and the west front of the Parliament-houses that were burned down some few years since. Both consisted of a series of sash windows and piers, in the manner of any common dwelling-house, *Gothicised* as plasterers call it by Roman cement, splayed reveals, Gothic water tables over the apertures, a splayed coved moulding over the upper tier, and a series of little port-holes by way of a parapet. The arcade or cloister to the House of Commons was below criticism. Although the style of these two buildings receive the *sobriquet* of the Wyatt-Gothic, it is more than surmised that a higher power had a hand in it and Wyatt bore the blame. His houses, villas, and mansions are among the most convenient, splendid, and tasteful in the country, and bear upon their face that their builders were not their own architects. As an instance of his power of combining splendour and elegance with comfort and convenience, uniting the state-rooms of the Italian palace (where one room is but a passage to another) with the comforts of an English mansion, which was often rendered intricate by too many passages for the sake of privacy, Wyatt's own mansion, at the western end of Foley-place, with its two well projecting wings that gave it the complete appearance of a town house, and its garden-front next Portland-place looking like a country villa, is a forcible instance. I have often visited it in the architect's life-time, when my late friend and fellow-student, John Westmacott, a younger brother of Sir Richard Westmacott, R.A., was his pupil. I have since revisited it about five years ago, and can bear testimony to the truth of this assertion. It is a pity that the family of this eminent architect do not permit some competent person of leisure and talent to publish some of the choicest of their father's works, the size of the "Vitruvius Brittannicus," for the use of the architectural students of the present day. In the eastern front of this mansion, Mr. Wyatt has used that very elegant specimen of the Corinthian order without modillions in the entablature, and with the horns of the abacus of the capital coming to a point, instead of being cut off immediately above the volute, as in every other known specimen, given in Stuart' "Antiquities of Athens." This is the only instance, I believe, of this order ever having been used since the time of the Athenians, and is a proof of Wyatt's great taste in seeing the beauties of Athenian architecture through the works of Stuart. The capital, however, loses much of its fine effect by being made the finial of an attached pilaster, instead of a detached column as in the original. A popular legend was common, soon after the completion of this mansion, among the office boys and junior pupils in architect's offices, which proves how much it was the admiration of the travelled cognoscenti of England,—which was, that Mr. Wyatt had as many rooms in his house as there were styles in architecture, each appropriated to an order or style; the Tuscan in the basement, the Doric on the ground-floor, and so on upwards: which was as near the truth as Isabey's belief that Fuseli, who was notoriously fond of nice cookery, lived upon raw beef-steaks, to encourage those horrible phantasies of the brain with which he stored his pictures.

One more instance of Wyatt's great power to arrange the apartments of an English mansion will suffice to show how much this portion of his works would pay for their contemplation by the aspiring student for architectural fame. It is Ardbraccan-house, near Navan, in the county of Meath, the palace of the bishop of that diocese. In its exterior it is a plain, well-proportioned, gentlemanly-looking edifice, with the windows and their intervals in harmonious relation to each other. The customs of the Irish prelacy oftener causes their residences to be filled with visitors on the occasions of ordinations, meetings of the clergy at the cathedral (always near to the palace), and other public gatherings, than is usual in England. Irish hospitality also leads them to follow the scriptural exhortation for bishops to use hospitality, who not only invite their clerical brethren to take their bed and board at the palace, an invitation which is always extended to the wives, and sometimes to the brothers and sisters of the invited, but Irish custom allows barrack-rooms on such festive occasions, which causes a dozen or a score perhaps of single men being plased together, as close as beds will admit, into one room, and a similar establishment for single lasses on the women's side of the house. The whole establishment is, in fact, on these occasions, like a barrack on a small scale, and good quarters found for every one, there being often no inn in the place or for miles round. I was an inmate at this house for some weeks, on the invitation of the late bishop of Meath (Dr. O'Beirne), whilst writing my life of Sir Christopher Wren,—Miss Wren, the great granddaughter of our illustrious architect, having been for many years domiciled with Mrs. O'Beirne, in the bishop's family. The lady would not trust her manuscripts to the uncertain risks of perils by land and by water in their transmissions to and from Ardbraccan and London; therefore, as the mountain would not come to Mahomet, Mahomet was obliged to go to the mountain. There it was I first became acquainted with this peculiar characteristic of Wyatt's architecture, and sorry am I now that I did not take a plan of at least its principal story; but I was occupied entirely with other objects. The worthy prelate, a tasteful and a travelled man, the friend of the Duke of Portland, Lord Shelburne, Charles Fox, Sheridan, and other illustrious men of his age, was proud of his house and his friend Wyatt, and often pointed out both to me as models to follow. He called his house an elastic, an expansive, a contractile house, for when opening all its apartments and arranging them according to art, he could by closing certain doors, and excluding certain passages and apartments, reduce it to the very moderate size that his small and unostentatious family required, and with as much comfort as if residing in a house no larger than they wanted for themselves. My apartments, consisting of a sleeping and dressing room, and a sitting room, where I wrote and had all the Wren papers entrusted to me, communicated with the bishop's library. This suite of apartments, so complete in itself, was as private and detached from the other part of the house as a set of chambers in the Temple; and if I was ever called upon to leave my study without time to put away my papers, I could either lock that room or at the end of an outer passage the whole suite, so that no one could enter them but myself, and yet they could all be made subservient to the hospitable purposes of an Irish ordination.

James Wyatt received and educated many pupils, some of whom obtained eminence, as may be mentioned hereafter, and not a few are enrolled in the list of gold and silver medallists, emblazoned originally by that elegant penman, Tomkins, and continued to the present time, that hangs framed and glazed among the records of the Royal Academy. The portrait of this eminent penman, who surpassed all his predecessors in this line of art, and has been equalled by none since, was the last that Reynolds ever painted. Mr. Wyatt was never knighted, whether it was ever offered is unknown; but it may have been declined on account of his being a widower. He was elected a fellow of the Royal Society, much to the annoyance of Sir Joseph Banks, its then president, who preferred twaddlers and titled nonentities to men of genius, whom he feared would discover his shallow pretensions to fill the chair, so gloriously occupied in by-gone days by Brouncker, Wren, and Newton. Wyatt was one year, during a misunderstanding among the Royal Academicians, as to which of their important selves should supersede Benjamin West, who was then growing aged, in the presidential chair, elected president without his knowledge. It was upon this or a similar occasion that Fuseli, who wanted a younger and more effective president than the aged painter of the death of Wolfe, wrote in his ballotting paper the name of Mary Lloyd. One of West's supporters asking the sarcastic Swiss why he voted for an old woman, he replied, "Why should I not vote for one old wooman as well as anoder?" Wyatt proved a perfect *King Log* during his reign, for he never troubled either himself or them, and on the few nights that he ever took the chair at a lecture, he fell asleep during its delivery, to the great amusement of the students, who laughed at every oscillation of the presidential cocked hat from shoulder to shoulder. This propensity to doze after dinner was unconquerable in poor Wyatt, who indulged it even at Beckford's table, the most entertaining man of his day, when Nelson was present, interesting the whole party by the recital of his hair-breadth 'scapes and gallant deeds performed by himself and his valiant brothers in arms in the then recently fought battle of the Nile. *Honor est á Nilo;* not so thought the lethargic architect, for he dozed, and dozed, and dozed again.

This eminent man was unfortunately overthrown in his carriage, on a return from Windsor, from the effects of which he never recovered. The office of surveyor-general of the Board of Works, as held under the crown from Inigo Jones and other eminent architects to his death, has never since been filled up; some of its duties having devolved upon the office of Woods an Forests, and others being filled up by special appointment of the crown, or acts of parliament, as in the cases of Sir Jeffery Wyatville, and Messrs. Nash, Blore, and Barry.

(To be continued.)

THE BRITISH MUSEUM.
No. III.

The collection of Etruscan antiquities carries the mind back to a most interesting period, that of a people possessing a high degree of civilization, and a great extent of political power, the masters of the Iberian seas, the teachers of the Roman commonwealth. Yet of such a people the chief records are those monuments now before us in the Museum. Of their origin, their language, their political institutions, and their history, we know almost as little as if they were pre-Adamites;—so unstable is human power, so fickle is human glory, so great the vicissitudes of national progress. In this Museum we have, however, before us the liveliest paintings of their persons, their dress, and their manners; and the scholar will be able in time to restore the Etruscans on the page of history, as he is now able to restore the Egyptians and the Assyrians. Thus the jealousy and neglect of the Romans, although for so long they overshadowed the Etruscans, will not be able to hide them from us for ever; perhaps also we may in the end make the monuments of Africa speak of those other rivals, the Carthaginians, whom Roman envy has shrouded in darkness. Had the Romans told us more, we should have had less to discover, and less pride in the success of our endeavours.

The origin of the Etruscans is at present involved in doubt—the legends of the ancients have the air of fables, the discussions of the moderns want the support of facts. We can neither admit of a Lydian origin nor can we refute it, and we must know more of the early history of Italy before we can assign the exact value to facts or conjectures. Nevertheless, it does not seem beyond the compass of sound historic synthesis to enable us to solve the problem of Etruscan origin; and this must be done to allow us to determine that of the Romans, for notwithstanding all that has been written, this latter question is by no means set at rest.

If we avail ourselves of the comparison of facts in other countries, we shall first have to learn the events affecting the Celts, for that these were settlers before the Pelasgians appears, from the names of the rivers and mountains, and from other such signs, very certain. It is moreover much more likely that the Pelasgians and Etruscans should drive the Celts back, as the Germani did on the Rhine, and the Belgians in Britain, than that the Celts should drive the Pelasgians from Cisalpine Gaul. Although we have very strong assertions of this latter event, we have every reason for not admitting them in their full bearing. Gauls might have passed the Alps, and settled in a Celtic country, weakened perhaps by war with the Etruscans; and this will satisfy to the full the declarations of the Roman historians, while it will be in accordance with historic science.

The spread of the Pelasgian tribes would cause the withdrawal of the Celts; and we can then conceive, in accordance with what took place in Greece, that the new settlements would receive the elements of civilization from the busy spirits of Phœnicia and the centres of the arts, who sought, among ruder people, the field of distinction which at home was already too crowded.

If we allow for a Celtic action in Italy, we ought likewise to be prepared for a Germanic influence. This alone will account for some of the phenomena affecting the Romans, for which Pelasgic or Greek causes are incompetent. Allowing to the full for the indirect action of Greek civilization through Etruria, Rome certainly owed little to the Greek spirit.

That Etruria had a very close fellowship with Greece is certain, and her sea trade would help this, but we are not therefore to admit that Etrurian civilization is purely a Greek derivative. The people represented to us in the Museum, particularly those in the paintings from the tomb at Vulci, found in 1832, have so little of a European cast, and so much greater likeness to the Indo-Persic and Syriac types, that we can hardly refuse to acknowledge some eastern influence. It might be said that the Etruscan artists adopted an artificial or conventional type, as the Greeks for instance did with regard to the form of the eye. Those, however, who will take the trouble to compare, will find that there is every difference between the grim outlines of early Greek art, and the paintings of the Etruscans. In the several specimens we have of the latter, the same portraiture is not observed throughout, and there is difference enough between the personages of Vulci and those of Tarquinii to enable us to determine that the paintings are in portraiture of a people, and not in simple conformity with a conventional type. The paintings from Vulci present us with an eye, nose, and profile belonging to those people who now and then lived in the west of Asia, and the features in the Vulci paintings are as strongly marked as the features of Arabs, in some of the Egyptian paintings of Rameses II. or Seti-Menephtha, in the adjoining rooms. It may perhaps be said that the representations of the Etruscan Charon in the Bronze Room are conventional, but these are more strongly marked—the nose is a large aquiline nose, like that of the Syrian or Arab race. The countenances represented in the Tarquinian paintings approach nearer to a Pelasgic type, but are peculiar in their formation.

From what we know of the Etruscans, it is by no means incompatible with facts, that they may have received a civilization independent from that of the Greeks. The Phœnicians we know ranged the Iberian seas, as well as the Ionian, and it was quite competent for a Cadmus to carry Phœnician letters to Etruria as to Thebes. It is much more satisfactory to suppose that the Etruscans and Greeks drew from a common spring, than to suppose that the Etruscans drew only through the Greeks. There was an intercourse between the Phœnicians and Etruscans as between the Phœnicians and Greeks--for anything we know, a greater intercourse between the former, while the Etruscans were susceptible enough of cultivation, that they were hardly likely to have been unimpressed with their first visitors, the Phœnicians, and to have waited for the Greeks before they took the seeds of civilization. There was no sympathy of language to cause a greater favour for the Greeks, for the Etruscans were decidedly not Greeks, whatever kindred they bore to the Pelasgic family. Commerce with the Phœnicians would account for the likenesses between the Etruscans and Greeks, as well as for the differences. The Etruscans would draw from the same springs of letters, arts, laws, manners, and belief, as the Greeks did, and it is as easy to picture the growth of Etruria, as of Athens, Corinth, or Thebes; while after-intercourse with Greece would fashion a greater likeness between Etruria and Greece, as intercourse between the cities of Greece brought them to one common form of civilization. There could have been no large Greek settlement in Etruria, or we should have had results equivalent to those of Magna Grecia or Massilia, instead of being able to trace only general proofs of Greek intercourse and influence.

Perhaps a large fusion of Phœnician blood determined the formation of the Etrurian people, though we must not expect to find an equal influence throughout Etruria. The prevalence of so many large commonwealths shows that Etruria rose, as Greece did, from the gradual development of separate settlements, which would each possess a distinctive character. Hence we are able, even in the few remains we have in the Museum, to trace great differences between the works of Tarquinii and those of Vulci. A Phœnician settlement would account for the Etruscan taste for shipping and sea trade, and perhaps for other characteristics. If we allow of such a settlement, yet we need not suppose that it would permanently influence the language or national features; for a small body of settlers among a larger people would be absorbed, as the Longbeards were in the north of Italy, and the Northmen were in the south. This is a simple explanation of a common historical phenomenon; but where the foreign population is concentrated, as the Jews in the Ghetti, and the Greeks in South Naples, national characteristics may be long preserved even among a small community.

The study of Etruscan antiquities is likely to have a special value as illustrating the early history of Rome, which is now hidden in mist. The Etruscans were a highly-polished people when Rome was a nest of robbers; and from Etruria was derived much of the laws, learning, manners, and belief of the Romans. It is an interesting historical investigation to determine how Rome, of late growth, succeeded in undermining and upsetting Etruria, though we can acknowledge that it was effected as much by the greater moral vigour of the former, as by any other circumstances.

The Etruscan collections in the British Museum comprise several stone tombs, a vast number of vases, and copies of large paintings from the inside of tombs. In these latter we have represented, with all the vigour of life, the domestic manners and public games of the Etruscans, and there is not in the Museum any collection which is in this respect so complete or so interesting. The paintings and bas-reliefs relating to the Egyptians, Greeks, or Persians, are fragmentary, except the frieze from the Parthenon, a work wonderful in itself, but teaching us little of the Athenians as a people. In the tombs from Tarquinii we have however banquets and public games, wherein men and women are represented in all the brightness and distinctness of colour. We have the dresses, the furniture, the vessels, the animals, the instruments, and these, as well as the persons, drawn so naturally, as to leave nothing to be desired for our well-understanding of the home life of this long-lost people. Subjects so varied offer of course many illustrations of the habits of the people, and on one of the Tarquinian tombs we have all the public games in which the people indulged. Although the representations from the Egyptian tombs are painted, and often enable us to distinguish portraits, national characteristics, and details of dress, yet their conventional execution wants the charm of the Etruscan designs. Seti-Menephtha, of a colossal size, occupies the greater part of a picture, and attacks a chief of the Tahennu, who again overtops the people, who in diminutive shape are scattered in the corners of the panel. The Egyptians, moreover, want life, even if in any degree they comply with the requisites of a likeness to the human form. They are curious, but are not pleasing; whereas the works of the Etruscans have both qualities, and are the expression of a very agreeable type of civilization.

The Etruscan collection in the British Museum was chiefly formed by Signor S. Campanari, who explored many tombs in Etruria, and made copies of the paintings. The whole of these were exhibited for some time in London and other towns, under the name of the Etruscan Tombs, as will be remembered by those who saw them some few years ago. The Trustees of the British Museum showed a very laudable exercise of judgment in purchasing this collection from Signor Campanari, and securing it for England. Besides the Campanari collection there are great numbers of vases of various dates and styles, purchased or received by the Trustees, and which include many Etruscan specimens.

The collection may be considered as forming three parts. 1st. The paintings from the tombs. 2nd. The sculptured tombs. 3rd. The vases and terracottas. It is to the paintings we shall direct our attention chiefly on the present occasion.

They include four principal divisions, two in the Etruscan Room, and two in the Bronze Room. The paintings are placed on the walls above the cases, but the figures are of sufficient size to allow of their being well seen. Each subject contains the paintings on the inner walls of a tomb, and above is shown the ceiling of the tomb. The decorations therefore which once lined four walls, are now spread out flat lengthwise, which is well suited to display the grouping. On account of the distribution around the walls, the composition is arranged into a centre group, with one on each side, the remaining space being left for the doorway.

In the Etruscan Room both subjects are from the ancient city of Tarquinii. We are obliged to distinguish them as the Right Tomb and the Left Tomb, according to their situation on entering the room. The Left Tomb includes three couples banquetting, attended by ten musicians and dancers, five on each side. The Right Tomb is in two compartments, and includes in the lower compartment three couples banquetting, attended by twelve musicians and dancers. In the upper compartment, or over the heads of the banquetting party, is a long subject with smaller figures, which represents all the varieties of public games, with two stages of spectators looking on. In the Bronze Room are two tombs from Vulci. That on the left has male figures, with Etruscan inscriptions, engaged in various games; that on the right is very much mutilated, and the subject cannot be ascertained. Two seated figures seem to be Pluto and Proserpine. This is in a very different style as to countenance and treatment than the others, more nearly approaching the Greek style.

Besides these four principal subjects are some smaller. In the Etruscan Room are paintings from a tomb at Corneto, including a woman paying the last offices to an old man stretched on a bier, two men drinking and dancing, and men drinking and playing on the double tibia. In the Bronze Room are two paintings of the Etruscan Charon, from the entrances of tombs, with Etruscan inscriptions. Most of our readers are aware that the Etruscan character is of a Greek type, and used in the method originally obtained from Phœnicia, of writing from right to left, instead of the later Greek way of writing from left to right.

The Right Tomb from Vulci is so different in style that we must speak of it separately, but the other tombs may be classed together. There is a smoothness and ease in the style which is particularly remarkable, and great care in the drawing of forms, though there is no attempt at minute anatomical delineation. Whether the figure is draped or naked, the same practice is adhered to of drawing in the outlines of the figure, which, when the figure is draped, are shown under the drapery. This has a singular effect, as however closely or loosely the male or female figure may be clad, the naked body is shown through the clothing, not in the mere pressure of the drapery, but in the exact anatomy, however far the drapery may be distant. Thus, in the figures on the Left Tomb of Tarquinii, where the dancing women are clad in a kind of full-skirted modern petticoat, the whole of the lower limbs are rigidly drawn.

This practice shows how sensitive the artists and the public were to a close and accurate delineation of the human figure, and how very different from our modern artists and public. The frequent exhibition of the naked figure in public games made the Etruscans more critical in human anatomy, and as we have no longer the same opportunities, it is only by a close study of the antique and of the living model that we can hope to make up for our deficiencies. The Etruscan paintings well illustrate the soundness of that law, put forward for all classes of art, from high art to the least mechanical performance, that instruction must rest on the study of the human figure. Schools of design may draw from architectural casts as long as they like, and make as much use as they please of the rule and compasses, but we cannot have artists or an artistic public without the figure. This must be at the beginning of teaching, and it must follow it throughout. This fact was proclaimed ten years ago, and our schools of design will never enable us to compete with foreign manufacturers in works of taste, until we carry it out fully and faithfully.

To make a high artist, all will allow that nature must be studied—but what does this mean? Are we to draw trees and flowers, and to neglect that noblest organization, the human form? The Greeks and the Etruscans walked among trees and flowers as we do, they enjoyed the beauties of the landscape—but they did not thus become artists, nor could they have become artists. A flower is most admirably organised, so is an animal; but the perfection of organization, the adaptation of physical means to intellectual ends, is man. It is in his form, in his structure, that we can study the highest applications of godlike skill,—and to neglect this, is to neglect the greatest and noblest school of art. Anything so perversely blind as English practice on this head cannot be imagined, and it conveys the causes of English failure. In England, the artist is a mechanic in painting, nearly on a footing with a Wolverhampton lockmaker or nailer, who goes on from year to year copying the same article, without reference to any higher principles. The Commissioners of Fine Arts, in fostering good drawing and correct anatomy, do most wisely for the interests of art; and it is to be hoped that all will unite in the same purpose, and that in our academies and schools of design we shall follow the only sound course of teaching and learning. The great end and aim of all teaching is to train the mind to the best habits, whatever may be the end of the learner, whether high or low; and in a right education, the mind of the statesman and the porter, the artist and the workman, will be equally trained in correct thinking, whatever may be the special object of their pursuits.

The Etruscan figures are of two classes, draped and naked; but none of the female figures are wholly naked, though some are naked from the waist upward. The drapery is so various in its structure and adaptation, as to afford much practice to the artist, and he has the whole range from the naked figure to the complex forms of modern female fashion. The garment most used by men and women is an oblong square shawl or mawd, worn in various ways. Sometimes it is a shawl or scarf. Sometimes a cloak, with the men a waistcloth. As a scarf, it is sometimes put on in the usual fashion, and the ends then put through the arms, so as to hang down. As all the garments are of various colours, white, blue, and red, and sometimes with braiding, patterns, and ornaments, the effect is much increased.

Many of the female dresses are very elegant in form and colour, and they are of great variety. We recommend to the ballet masters, who are always searching for something novel, an Etruscan ballet, with some of the picturesque costumes of the Museum. In each subject a different general fashion is observable. In the Right Tomb of Tarquinii, the women have a long and rather close dress, with a shawl; a cap worn in the fashion Parisian women wear a coloured kerchief, with short curls. They have likewise sandals. In the Left Tomb of Tarquinii, the costume is almost modern—a boddice with short sleeves, a short and very full petticoat, boots or sandals, long hair worn with a wreath, earrings, bracelets. The third fashion is in the tomb of Corneto: a boddice, petticoat, pelisse, cloak or shawl, long-toed shoes, the hair worn in long tresses.

As an example of the mode of treatment, we may take the female playing the castanets, in the Left Tomb of Tarquinii. She wears a red boddice, edged with bright blue, short sleeves of the pattern of the skirt, trimmed with blue. The petticoat, short and in full breadths or folds, is of a reddish tinge. The pattern is in red, and consists of three spots divided by horizontal stripes or braid of red, sometimes plain, sometimes dentelated. The pattern of the skirt would do credit to Regent-street, and shows more design than most of the products of the Manchester loom. On her shoulders she wears a blue scarf edged with red, the ends being, as before described, brought through the arms. Her hair is worn long, and around her head she has a blue wreath. Her boots are red. She has bracelets, and in her ears rings with a large round drop.

Besides the practice of showing the outline under the drapery, there is another conventional peculiarity of Etruscan art, which consists in showing all the fingers of the hands, which are arranged in perspective, fan-fashion, but close together.

In the Right Tomb of Tarquinii, in the lower compartment, the chief personages are three men and three women, seated in couples on three couches, which are laid in one row, so that the guests can be fully seen by the spectator. Throughout the subjects we notice that the women, like those of Rome, were treated with great deference and attention, being the companions of their husbands in their feasts and games, and that they held the position of a Germanic rather than of a Greek wife. In the banquets and the games the women are present, seated with the men; and even of the slaves or attendants, none of the women are naked. Two naked boy attendants stand near the couches, and there are small tables, of very elegant design, bearing refreshments: the men and women are drinking. As if for coolness, the men and women are naked from the waist upward.

Under each of the couches is a pair of ducks, painted in blue. Each of the ducks is in a different posture, but each is characteristic, and the artist shows a degree of skill and fancy which a modern rival could not surpass. The six ducks are pictures in themselves. From the introduction of them, it is to be supposed they were pets of the household, though rather strange ones.

It is to be noticed that the Etruscan artists studiously strive to introduce as much variety as possible in the treatment. While a general symmetry of arrangement is preserved, each figure is put in a different dress or attitude. So, too, the details are varied. If one dancer is in blue, another is in red; if one has a shawl, another has a cloak, and so forth. In the Left Tomb of Tarquinii, the figures of the dancers are separated by trees, on which are birds or animals; but there is a different set for each tree.

At one end of the couches is the chief musician, playing on the double tibia or pipes. This seems to have been the great instrument of the Etruscans, as it was afterwards with the Romans. It is introduced, likewise, in the Left Tomb of Tarquinii. The instruments shown are the double tibia, the lyre, and the castanets. In each subject are two players of the double tibia.

On the left hand are three male and three female dancers, and as many on the right hand. One of these latter plays the double pipe. The figures are separated by branches of trees. The men are without shoes, and with no garment but a waistcloth.

On the right-hand side is an elegant table with three white vases and one red one. This is a pleasing furniture group.

The upper compartment of this tomb contains a great number of groups and figures of small size, engaged in public games, and with two stands for spectators. The stand has a platform, on which are the chief personages, men and women. Underneath are some men lying down. The costumes of the spectators show a greater variety of fashions than the banquet; some of the men have beards, and some are without; some of the women are dressed in white.

The games represent leaping, running, chariot races, hurling the discus, boxing, and the armed course, which are painted in a lively manner.

In a kind of pediment above is a large vase, and two persons at an entertainment.

The entrance to this tomb is adorned with two panthers.

The Left Tomb of Tarquinii only includes one subject—a banquet; but the costumes are much richer. To this belongs the female figure already closely described. Here, likewise, the chief personages are three couple seated on couches; but the arrangement is different, one of the couches being turned lengthwise at right angles. This gives the opportunity of seeing the finish of the end—and indeed the design and finish of the couches are well worthy of study, showing fitness, lightness, and elegance. Here are two small tables or stands, exquisitely finished, on which are placed the refreshments. A female attendant is standing. A naked page holds in his hand a percolated vase or wine-strainer. Male and female attendants seem to have been employed at entertainments. Two of the lady guests wear a red veil. The whole of the guests are wreathed either with ivy or laurel. Under the couches is a panther, a cock, and a hen. The cock is a very gay piece of painting, and is another example of the attention to details. The panther seems to have been a great favourite of the Etruscans, and here and elsewhere is frequently introduced. He was of course, tamed. The men in this group wear short beards, whereas, in the other Tarquinian tomb, the guests are beardless. On the left of the couches stands the player of the double tibia.

On the left-hand side are two male and three female dancers. One of the men is playing the lyre. On the right-hand side are likewise two male and three female dancers. One of the men plays the double tibia, and one of the women the castanets, or rather bones. At each end is a man, mounted either on a mule or horse. Each figure of the side groups is separated by a tree, chiefly laurel, having sometimes a flower at the bottom. On the branches, and flying around the trees, are birds of gaudy plumage. On some of the trees beasts are drawn, as the panther, rabbit, and fox. These latter are painted spotted, like the panther. One of the panthers is climbing a tree, like a cat or a monkey. The men dancers wear blue mawds, and the women dancers red mawds. The fancy displayed in the arrangement of all the details is well worthy of note. The drapery is likewise pleasing.

The Left Tomb at Vulci, which has Etruscan inscriptions, is of a more oriental character in the features of the people. There are no women in this subject, and the figures are employed in public games, as leaping, running, horse-racing, &c. Some of the men wear a cap, like that of the women in the Right Tarquinian Tomb. The Vulci Tomb was discovered in 1838.

The Right Tomb at Vulci is different from all the others in subject, style, treatment, and physiognomy. The personages, who are more of a Greek or Pelasgic character, are closely draped in cloaks of one colour, as blue, without ornaments or trimming,—more closely approaching what from our sculptural impressions is conventionally required as antique, than the gay and lively costumes of Tarquinii. This tomb, however, had a chequered ceiling, like those of the Tarquinian tombs. These ceilings are of a peculiar character, and are executed in various colours, showing, as usual, much fancy in the arrangement.

The paintings of the Etruscan Charon are coarse, and seem conventional caricatures or grotesques, quite different from the portrait-like character of the other designs.

The Etruscan paintings will well repay inspection, and are some of the best illustrations we have of ancient manners. The student who wants a comment on Homer will best find it here, and after perusing the book of games, he cannot do better than see them depicted in detail in the Right Tarquinian Tomb or Left Tomb of Vulci. The banquet scenes are fair illustrations of Roman life. Etruscan vases and Etruscan dancers, the double flute and the lyre, were to be seen at Roman banquets, where the guests likewise reclined. What is given merely in form in bas-reliefs is here given in form and colour; and what is in sculpture performed by the artist from imagination, long after the event, is here painted to the life from the men and women as they breathed and moved and dressed. Certainly, the Elgin frieze gives us a tamer idea of Athenian life, though executed under the eye of a Phidias, than the weaker paintings of the Etruscans do of Etruscan life.

In an artistical point of view, there is a benefit in studying the works of a refined people, for so the Etruscans were. They possessed a literature, and inscriptions were common on public works, showing that reading was generally diffused. Their dresses, manners, and games show that they possessed wealth and cultivation, and the works they have left us are ample proofs of their advanced taste and of their love of the pictorial arts. Music and dancing were advanced to the rank of arts. It is always useful to contemplate and analyse the progress of a people who had less advantages than ourselves.

The sculptured tombs in the lower part of the Museum do not show so favourably as the paintings, though they exhibit traces of artistic development. They are generally carved in soft, bad stone, and some are in coarse clay; yet, even in these, there is an attention to anatomy, to drawing, and to drapery, which draws our notice. Some of the reclining figures show considerable care in the arrangement of the muscles of the back. In the paintings, minute anatomical drawing is not attempted, but in the Right Tomb from Vulci the muscles of the abdomen are drawn in the Greek style in the figure of Pluto, which is only half-draped. From their progress in painting, from their sound principles of art, and from the indications in the rude sculptured works we have, we may rest assured that these latter are not fair samples of Etruscan art; and we may expect, that though most of the finer works have perished by the effect of time or by the hands of the Romans, that more favourable specimens will yet be discovered.

The vases commonly called Etruscan, are now brought together in the Etruscan Room, and arranged, which was very needful, for during some years they remained in a deplorable state of confusion, so that it was impossible for the student to get any benefit from them.

The vases are now arranged chronologically and according to the localities in which they are found. They form six groups, besides a collection of terracottas, chiefly Etruscan.

The first group consists of vases of heavy black ware, some with rude figures upon them in low relief, the work of the ancient Etruscans. These are mostly found at Cervetri or Cære.

The second group includes the vases called Nolan-Egyptian or Phœnician, with pale backgrounds and figures in a reddish maroon colour. The figures are chiefly those of animals. These vases are mostly found at Nola.

The third group contains early vases with black figures upon red or orange grounds. These are rich in mythological subjects. These vases are found at Vulci, Canino, and the Ponte della Badia, to the north of Rome.

The fourth group is formed of vases more carefully finished. The districts from which these are obtained are Canino and Nola.

The fifth group is a later class of works, more slovenly painted. The subjects relate chiefly to Bacchus. The vases are got from the province of he Basilicata in Naples, to the south of Rome. Indeed, most of the vases are got over a wide district, far beyond the confines of Etruria Proper.

The sixth group is from the Neapolitan province of Puglia or Apulia. These are much like the vases of Nola, with pale backgrounds and figures of the reddish maroon.

The terracottas are of various origin and require classification, so that the locality may be known. They are chiefly Etruscan. In the centre of this group are various divinities and mythological groups.

Besides the vases included in the Etruscan Room, are others in various parts of the Museum. There is a large collection of vases and terracottas from Athens in the Bronze Room. In the Towneley collection are Roman vases, urns, and terracottas. In the Egyptian Rooms are vases and similar works, of various times and styles.

Altogether, the collection of vases and terracottas in the Museum is copious, but to make it complete it is very necessary that there should be a series of Chinese porcelains. The Museum of Economic Geology contains some specimens of ancient and modern earthenware, but the British Museum must be looked to as the chief school for artists.

(To be continued.)

DESCRIPTION OF A UNIVERSAL TIME TABLE.

By F. Bashforth, Esq.

The calculation of Railway Time Tables is attended with considerable difficulty and liability to error, owing to the various velocities of different classes of trains and the variation of gradients and stations stopped at. The importance of the correctness of these tables, coupled with the difficulty of obtaining that result, have led me to contrive a little instrument which, when the stoppages and the time of starting and arrival are determined, will give the times of arrival at each station exactly as they appear in the bill, regard being had to varying gradients, and consequently varying velocities. There could be no doubt of the perfect success of a mere geometrical contrivance, but to remove any doubt that might be felt, and to explain my notions to my friends, I have constructed a universal time table for the main line of the Manchester and Leeds Railway, which is about 61 miles long, and has 21 stations. The result is perfectly satisfactory. I employ two scales; the vertical is of 40 minutes—the horizontal of 8 miles to the inch, but they might have been respectively 60 and 20. The instrument is arranged on a board 11 inches square.

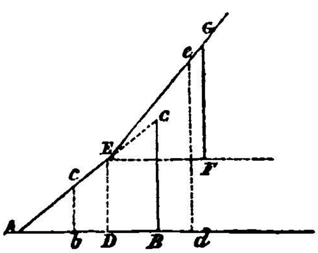


Fig. 1.

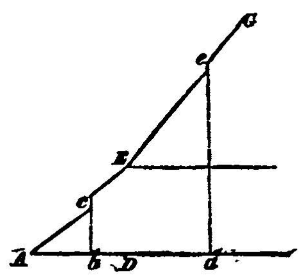


Fig. 2.

Let A B, fig. 1, represent 30 miles, and the perpendicular C B, 60 minutes, and suppose a train to be travelling along A B with a uniform velocity of 30 miles per hour. The time of describing A b will be found by applying the vertical scale to measure the perpendicular $c\,b$; for

$$\frac{\text{Time in A } b}{\text{Time in AB}} = \frac{\text{A } b}{\text{AB}} = \frac{b\ c.}{\text{B C}}$$

But B C represents time in A B, and therefore $b\,c$ represents time in A b; and so on for any other distance.

Suppose, however, that when the train comes to D, the velocity falls from 30 to 20 miles per hour. Draw E F parallel to A B, and cut off E F = 20 miles. Erect the perpendicular F G, and make it 60 minutes by the vertical scale. Join E G. Then the time of arrival at any point d, will be found by applying the vertical scale to the perpendicular $e\,d$, and reading off the minutes; and so on if there be more changes of velocity.

The above is applicable to a train travelling with varying velocities, but without stoppages. If we suppose the train to lose 5 minutes by stopping at a station at b, then this time will never be recovered, and every point in the time line to the right of $b\ c$, must be raised 5 minutes. If there be another loss of 4 minutes at d, every point in the time line to the right of $d\ e$, must be raised through 4 minutes additional; and so on for other stoppages.

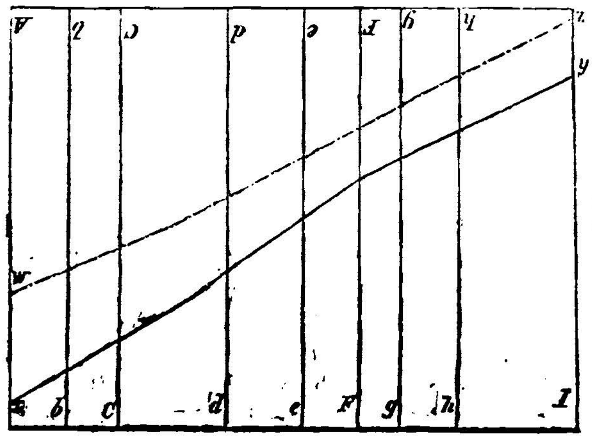


Fig. 3.

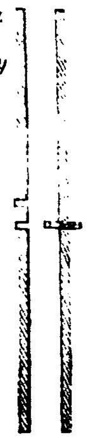


Fig. 6.

Suppose that on a railway there are stations A, b, C, d, e, F, g, h, I where A and I, are the termini, and C, F, first class. A to b, is 3 miles; to C, $2\frac{1}{2}$; C to d, $5\frac{1}{2}$; d to e, 4; e to F, 3; F to g, 2; g to h, 3; and h to I, 6 miles. The first eight miles can be travelled at the rate of 25 miles per hour, the next ten at 20 miles, and the remaining distance at 30 miles per hour. Fig. 3, shows a series of strips of boxwood of equal length and thickness, but whose breadths represent the distances betwixt the stations, measured by the horizontal scale. The section at fig. 6, show the provision made at each division, by a pin and two holes, to allow fo stoppages, as at C and F, fig. 4. The time lines, $x\ y$, $z\ w$, are laid down as in fig. 1. The former is for trains passing from A to I, the latter from I to A.

Fig. 4.

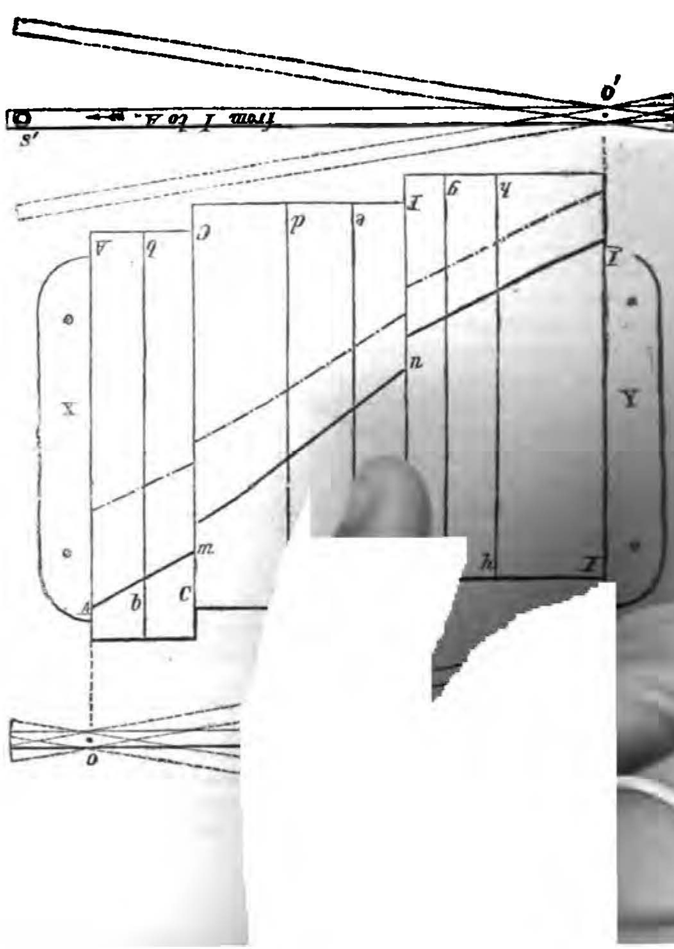


Fig. 3, is placed on a level surface as in fig. 4, and the separate pieces of wood are kept in their places by two fixed pieces X Y, with parallel faces. O S, O′ S′, are two straight bars moveable about O O′, capable of being clamped in any position. Fig. 5, represents the sca le used in reading off the time. The head moves along the bars O S, O′ S like a T-square. The slide carries divisions for every 10 minutes, and the circles on it represent the ivory studs on which any required consecutive hours are written, as it would be inconvenient to have it of sufficient eagth to hold 12 hours.

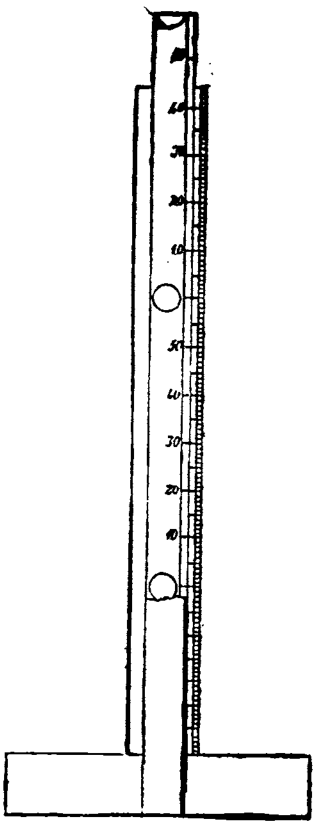


Fig. .

Let it be required to read off the times for a train stopping at C and F. Breaks must be made in the time line at C and F, by the contrivance, fig. 6. Secondly, move the slide and the strips of wood betwixt X and Y, up or down till the time of starting on the scale falls n the end of the time line at A. Thirdly, move O S, about O, till the other extremity of the time line coincides with the required time of arrival, and then clamp the bar. The scale must be applied to show the hour and minute coinciding with the breaks at *m* and *n*, and this time must be registered in the table. For the return train, I to A, the head of the scale slides along O′ S′, and the second and third adjustments have to be made.

Few stations have been supposed for illustration, although the advantage of using this method is not so apparent in such a case. However great the number of stoppages, it is scarcely possible to make a mistake that will not be detected. If any error be made in making the breaks in the time line, the time table will show either the omission or excess, as the time and station must be read off at each break in the time line, and registered in the tan

There is no necessity for having the velocity per hour given for the rate of travelling over each particular part of the line, for the purpose of laying down a time line, as it may be plotted from the observations of the times of arrival at several points of the line of a train travelling without stoppages. Let train be travelling along A D, fig. 7, and let O, B E, C F,

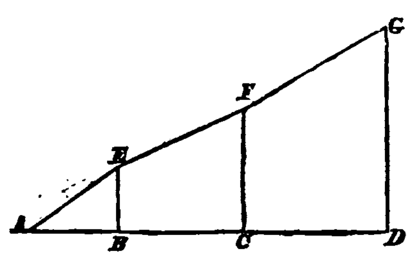


Fig. 7.

and D G, at right angles to A D, represent the times of arrival at A, *b*, C, and D. Join A, E, F, G, which will be the time line. The time allowed for stoppages must include the whole loss consequent on lowering and getting up the speed.

Mr. J. Samuda employed diagrams constructed in a manner similar to figs. 1 and 2, to explain the proposed arrangement of the trains on the London and Croydon, and Croydon and Epsom railways, which are given in the "Minutes of Evidence," printed by order of the House of Commons, June, 1844. I have also seen in the *Builder*, of August 21, 1847, a notice of a new time table, patented in Paris, but the description there given does not enable me to say whether it resembles the one above described. I am not aware that the method of allowing for a stoppage at any given station, for varying the time of performing the journey, or for reading off the times ready for insertion in the time table has ever before been adopted.

ENGINEERING AND RAILWAY MEMBERS OF PARLIAMENT.

A new parliament under usual circumstances is not of much importance to professional men, but for once the case is different. Engineers and surveyors have now much at stake in the measures likely to be subjects of legislation; while the elections have brought forward many men whose opinions on these subjects, or whose connection with our professional pursuits, create much interest. We have been handed over to the mercies of a Board of Trade already, while many measures deeply affecting professional interests are sure to come under discussion, such as the health of towns' bill, a general act for drainage, railway legislation, the survey of London, and steam-engine inspection. How these subjects are likely to be treated is not unnatnrally a matter of anxiety.

The last parliament began the new class of railway directors, for we can hardly consider the election of Mr. Charles Russell, the late member for Reading, and chairman of the Great Western railway, as being of more value than a single and accidental circumstance. It was the return of Mr. Hudson and Mr. Chaplin which constituted the class now so greatly increased by the late elections.

With some it has been a matter of fear that we should have a railway parliament, and it has been put forward, under the authority of Mr. Dodd, that the present parliament contains more railway directors, engineers, retail tradesmen, and political lecturers than any former parliament, and fewer officers in the army and navy, and landed gentry. If a parliament now have railway directors in it, it must have more than in former parliaments, because as it may be said railway directors did not exist as a class in former days. We might as well be told that in the streets of London there are more cabmen and omnibus-drivers than in former days, and that on the river there are more steamboat stokers and fewer watermen. Admitting the fact that there are more railway directors and engineers in the house, we do not therefore see any ground of alarm to the country. As to the retail tradesmen we have little to do with them, except so far as they have been mixed up with railway directors, and insomuch we are bound to say that we put no worth on the increase of retail tradesmen, for we believe that the whole body of retail tradesmen in the House of Commons consists of one or two individuals. The injury to the country cannot at the worst be very great in having Mr. Williams, the haberdasher, instead of Mr. Alderman Waithman, the haberdasher, or Mr. Alderman Sidney instead of Alderman Sir Matthew Wood. We confess likewise to obtuseness as to the injury likely to arise from Mr. Alderman Sidney, Mr. Williams, or anybody else who makes money behind a counter, sitting cheek by jowl with the members for Waterford county, Finsbury, and Wallingford. With regard to the political lecturers, they mean Mr. W. J. Fox, Mr. Feargus O'Connor, Mr. George Thompson, and Mr. Wilson; and even though political lecturing has taken the place of political pamphleteering, it grieves us little that Messrs. Fox and Thompson sit as members of the house to which Burke, Sheridan, O'Connell, Cobbett, and Hunt belonged. We need not enlarge the latter list.

The only fact with which we have to grapple, indeed the head and front of the grievance, is the number of railway personages; though we are bound to say, that when admitting the new classification of railway directors, we must not forget that it strips Mr. Hudson of his quality as a landed proprietor, Mr. Glyn of his title as a banker, and every other individual of his previous description of enrolment. One question therefore is, whether in accepting the new class of railway men, we admit a body less wealthy than officers in the army and navy, government functionaries, or landed gentlemen. We believe that on the whole Mr. Hudson, Mr. Glyn, Mr Robert Stephenson, Mr. Cubitt, Mr. Chaplin, Mr. Parker, Mr. Locke, Mr. Peto, Mr. Waddington, Sir Joshua Walmsley, Mr. Jackson, &c., have not too small a stake in the property of the country to disqualify them from sitting on the same benches with other gentlemen, whose names it is unnecessary to mention, as the state of their finances may be learned of any low bill-broker or sheriff's officer. If we were to give a cool and candid opinion, we should say that the present parliament contains as much wealth, respectability, and intelligence as any parliament which has ever sat within the precincts of St. Stephen's. We are quite ready to believe that there are adventurers in the present house, but we do not believe that there are more than usual in an assembly to which the mode of admission affords no guarantee of moral worth, still less a security against moral corruption.

There is a class of persons in this country and in all others, who so far from allowing that there is nothing new under the sun, can scarcely believe that the night falls and morning breaks day by day, and that the whole scheme of creation, life and death, death and life, rolls on in the course of its accomplishment. For them, everything that is new is a prodigy and an alarm, and they are kept in a perpetual state of worry by the untoward events of their times. No hen was ever more alarmed at seeing ducklings take to the water, no schoolboy was ever more annoyed at a wet holiday when he had nailed the barometer to "set fair," than are the class to whom we have alluded, at the obstinate movement of a state of society which in their mind's eyes they have nailed to stand stock still. For them, the irruption of railway men into the House of Commons is a new cause of wonder, and we shall have a new Sybil or a new Coningsby on a fact which sets itself so audaciously against the middle ages, and which is only a new proof of the material aspect of these degenerate days. Alas! the House of Commons has been always in this state of revolution. It began by admitting the small squirearchy, the manorial lords who rose under the Edwards; it received an accession of traders under the Tudors, of Puritans under the Stuarts, and of army colonels under the Cromwells. Queen Anne's people were taken aback by the admission of stock-jobbers and fundholders, King George's by the strange accummulation of nabobs; then we were frightened by West India planters, by bankers, those who had enriched themselves with government contracts, and by horde upon horde of the *nouveaux riches* who had enriched themselves *tout nouvellement*. The vested interests in the house are all innovations: there were no army officers before there was a standing army, no country bankers within a century, no fundholders before there was a national debt, and the staticians have made no allowance for the decline or extinction of lottery office-keepers, West India planters, government contractors, and nabobs. The accession of railway chairmen and directors is a fact, and "*un fait accompli*," but no more; the House of Lords will not be turned into a first-class train, the House of Commons into a second-class train, nor will Mr. George Hudson be made First Lord of the Treasury, nor Mr. Chaplin Commander-in-Chief. It is a great pity for those who have excited themselves to the pitch, but there will be no railway revolution.

All that it amounts to, and the only real significance is this, that those who were before distributed among the squires, bankers, and merchants are now grouped as railway directors, and that we have admitted a new classification of men of wealth, ability and intelligence. So far as investigation may be entered upon, we are sure that the result will be to show undoubtedly that as a nation we are none the worse off than we were before; though, by conforming with the wants and exigencies of the times, we may be in some degree the better.

Whether we will or no, conform we must to the progress of events; we cannot fasten old habits on to new institutions; there is no travelling outside an express train, nor can it be made to stop for a parcel of game at a hall door,—all that stage-coach system has been done away with. The electric telegraph will not frank ladies' gloves and fans, nor can we give West India pines a hot-house flavour. New establishments create new institutions. Railway companies have created railway directors, and railway directors have become members of parliament;—we must submit, and not be surprised when the next change comes. We may soon have telegraph men as candidates, and the successful management of the correspondence of the country may be a claim for the honours of representation—and why not? What harm is done?

By some the mention of railway members of parliament is met by the counter-cry, "What can the management of switches and sidings have to do with legislation, or why is successful jobbing to be held as a proper training?" Certainly, if England were a country of doctrinaires, which it is not,—or an empire of mandarins, which it is not,—or a Prussian police district, which it is not,—railway directors would as such have no qualification, and they would be bound to prove the extent of their political studies and capacity. We are not aware of any free country being successfully governed by literati or theoretical politicians, and both Rome and England are examples of countries not governed by literati; nor do we think that the latter country is likely to come under the system. We must therefore take it as we find it, and in so doing, it may be worth while to consider how far railway directors as such are likely to prove efficient law-makers and public counsellors.

England is a practical country, and a preference is always given to practical training over theoretical training, and we question whether Englishmen would not any day much sooner elect a good brickmaker than the greatest poet or dramatist on whose fame they ever prided themselves. Give a man a good practical training, and he may set his hand to anything—that is, the English teaching and schooling: and we are none the worse for it. It is perfectly national to see Richard Cobden and George Hudson in their present positions, and it would not be surprising to find them exercising still greater influence. The standing of these two is an exposition of the national sympathies and character—not what some have been pleased to call it, the worship of Mammon, but the result of that innate appreciation which the English have of business habits applied to business purposes. We are very certain that as much would not be done for Charles Dickens, and we are not ashamed of it. Dickens has his reward in another way. We give to a Cobden or a Hudson political power and influence, but we do not award to them the undying esteem of all ages. It is the pride of genius to labour for the applause of posterity; the politician has only a life interest in the present. Whether it be better to become a Shakspeare or a Cobden it lies with the aspirant to judge, but he must not complain if he do not receive the rewards of both. We know that there is a large party who complain that in this country literary and scientific men do not receive political rewards; we cannot see that there is any ground for sympathy with this complaint. We think a successful railway potentate much more fitted for a lawmaker than a proficient poet, physician, or artist. A man who can look well after his own affairs is, in the common acceptation, best fitted to look after the affairs of his neighbours; and railway kings comply much better with this condition than poets, painters, mathematicians, musicians, or actors. The sample we have had of literary men in the House of Commons has not been encouraging enough to induce us to wish for more; and while there is no specific exclusion of them, and while they have the means of purchasing a qualification by the very liberal remuneration of their labours, we are not disheartened nor ashamed that Dickens, Ainsworth, James, Leigh Hunt, and Sheridan Knowles, are not members of the House of Commons. It is quite as open to them as it is to Bulwer, D'Israeli, and Macaulay; and when they can command the political confidence of the public, let them demand political honours.

We consider the training of a railway man as particularly qualifying him for parliamentary duties. He must be a man in whose pecuniary ability and trustworthiness a large number of persons have placed their confidence. He is trained in the habit and feeling of public responsibility and accountability. He must have working habits of business as the member of a board, for without he has adequate command of temper and ability, he cannot continue as the colleague of a dozen or twenty men of standing. The crotchetty, prattling, meddling, or ill-tempered man is either sifted out, or he has his rough points polished off. He acquires a considerable degree of financial and fiscal knowledge in dealing with large sums of money. He is compelled to enter upon the consideration and application of many newly developed principles, which require close discussion and accurate comprehension. He is schooled in meeting the exigencies of new and progressive institutions. He is called upon to conduct important negotiations with able men, and to make arrangements which shall be applicable to circumstances of great difficulty and complexity. This is no exaggeration of the capabilities of a railway man, and we consider it not a bad stock whereon to engraft the responsibilities of a seat in the House of Commons.

Except among our Indian functionaries of the civil service, it will be difficult to find men who have had a wider field of administrative practice than our railway directors. Responsibilities far exceeding those of the finance minister of many an independent nation devolve upon Mr. Glyn, or Mr. Hudson. The yearly expenditure of millions, the management of a floating capital of twenty millions, and of a current revenue perhaps of two millions, with the administrative control of a thousand subordinates, afford a wide field for the attainment and exercise of practical ability,—and we opine that that is what is wanted in the House of Commons. We have speakers enough and writers enough; we want thinkers and doers, and the more of them th better.

A fair examination of the question can only have one result—the recognition of the eligibility of railway men, even if we cannot get so far beyond the fear of ridicule as to allow their superior capacity. We believe the present

House of Commons has been refreshed with new blood, and that Mr. Macgregor, Mr. Fox, and Mr. Wilson will not prove useless members, still less Mr. Glyn, Mr. Hudson, and the many other gentlemen whom we have already enumerated. Before leaving this part of the subject, however, we cannot well refrain from making some remarks on a few of the individuals most prominent in the railway legion.

Mr. George Carr Glyn is the son and grandson of a baronetal family of that name, and a member of the banking firm in which his brother, the present baronet, is a partner. Mr. Glyn made his debut in joint-stock companies during the mania of 1824, at which time, among other such occupations, he was auditor of the Columbian Pearl Fishery company—one not among the brightest enterprises of that speculative period. Of late years he has shown less ardour in his engagements. In the next great period of speculation, we find him chairman of the London and Birmingham, now the London and North Western railway company. For a long time he has been the head, out of parliament, of the railway interest; as much from being put forward by his colleagues, as from being recognised by many of the minor companies. His policy in this capacity is the index of his parliamentary policy, and it has not been that which in our view has been best calculated to promote railway interests. Mr. Glyn has no confidence in independent action, and has always been inclined to lean upon the government. He was the introducer and the chief supporter of the Board of Trade inspection system, and his last public act is a declaration of his adhesion to the same principles, though he has already had reason to regret the exercise of the power which he has entrusted to such hands. Mr. Glyn has no defined views as to the operations of railway capital, the principle of private enterprise in joint-stock companies, or the principle of fares. What convictions he has are opposed to what is assumed to be the best theory and the best practice, and Mr. Glyn only acts in conformity with these latter, when he can no longer withhold his action, though he does not seem to give his acquiescence. With a very distinct delivery, and a seeming logical severity of language, Mr. Glyn is a very indistinct thinker. As a railway chairman, with the prestige of a great reputation, and with a case carefully got up, Mr. Glyn has been an impressive speaker. Whether he will be so successful in the House of Commons, where he will no longer stand alone, but have to contend with other men, remains to be seen. Undoubtedly he has great advantages: a pleasing person, polished language, a confident but inoffensive address, and the assertion of high moral principle, when backed by power and reputation, are calculated to produce a favourable impression on an audience. On some points of religious profession, Mr. Glyn is, we believe, likely to take the same part as his cousin, Mr. Plumptre, whose strong opinions are well known. Success and ill-success have been about equally balanced in Mr. Glyn's career: the resignation of the North Midland chair, defeat by the Great Western, and recriminations with Mr. Moss and Mr. Russell, in which mutual charges of breach of faith have been bandied, have been counterpoised by Mr. Glyn's maintenance of the London and Birmingham chair, and by his amalgamation of the Grand Junction railway, after difficulties which might well have been regarded as insurmountable. Mr. Glyn's maiden session will be anxiously watched by many.

Of Mr. Hudson little need be said. He has successfully passed through an anxious railway session, and the next series of half-yearly meetings can scarcely present anything inauspicious. The prestige of his reputation is untouched, while in the present temper of the Bentinck party, being unshackled in his political movements, and released from his patronage of protectionism, he is likely to exercise great and useful influence in the house. Mr. Hudson is certainly the railway man of the most original powers of thought, of the most advanced mind, and of the most progressive character. More confidence is to be placed in his single defence of the joint stock system, than in that of all the railway members put together.

Mr. Hayter is the representative of the Great Western.

Mr. Chaplin is a man who will hereafter be better understood by the public. A sketch of him in *Fraser's Magazine*, does honour to him and to the writer. Mr. Chaplin is a man who by great prudence has raised himself to a very high position, who undertakes nothing without careful and laborious thought, and who, although often behind hand and not always in the right, commands respect from the known fact that his opinions are the result of a well-studied conviction. Mr. Chaplin, we conceive, is much more likely for the present to follow Mr. Glyn's line of policy than any other; for he is, like Mr. Glyn, only a forced follower—we cannot say convert—of what may be called the railway movement party.

Mr. David Waddington has not hitherto been well known in any independent capacity. His chief claim heretofore has been the unbounded confidence reposed in him by Mr. Hudson, and his administration under Mr. Hudson of the Eastern Counties railway, against the most difficult circumstances.

Mr. Robert Stephenson, the son of the patriarch of the locomotive system, has been less known by the public in his personal capacity than as an engineer. His ability in those gladiatorial combats before parliamentary committees, his practice in negotiation and correspondence, and the confidence reposed in his diplomatic skill by leading railway men, are guarantees of his powers to those who know him. A good figure and pleasing address will help him in making an impression in the House of Commons. He has always been acting in conjunction with Mr. Glyn.

Mr Locke has tried his skill in the same arena of the committee-rooms, and with equal success. Mr. Locke at one time co-operated with the Great Western in their struggle with the London and Birmingham, but still must be ranked among Mr. Glyn's followers.

Mr. Jackson, of Birkenhead, has only a provincial reputation. He is a fluent speaker in the Liverpool style, but is likely to require a long training in the House of Commons before he will have weight. He has no decided views on general principles of railway policy, but is an advocate for non-restriction in currency matters. He has no weight among the railway interest, and will not be admitted by them as an exponent of their views, whatever course he may adopt.

Sir Joshua Walmsley is a Liverpool merchant, a colleague of Mr. Jackson's. He has served the office of mayor of Liverpool, when he was knighted. He is likewise a fluent speaker.

Mr. William Cubitt, the contractor and builder, not the engineer, will not, it is supposed, take any active part in parliamentary proceedings.

Mr. Samuel Morton Peto is considered a man of education, ability, intelligence, and practical business habits. He speaks well, but his railway principles are not known.

Mr. Wyld has never had any intimate connexion with railway management, but is well acquainted with the general policy, and is supposed to be an advocate for non-interference.

Mr. Humphrey Brown was the founder of the Birmingham and Gloucester railway, and afterwards its manager. He enters with very strong feeling into every subject he takes up. He is not so well liked as a speaker out of doors, but in the House of Commons is likely to be well listened to, as he is a well-skilled statician, and can get up his case carefully and studiously. He leans to non-interference in the management of joint-stock enterprise.

There are abundance of railway directors in the house, but very few others who are likely to take part in debates in such capacity beyond those we have named. As the matter stands, we fear the prospects of the railway interests are very uncertain, for in all likelihood the voices and votes of Mr. Glyn, Mr. Hudson, Mr. Chaplin, Mr. Locke, Mr. Stephenson, and Mr. Waddington may all be given for a Board of Trade bill, or for more stringent standing orders to restrict new companies: This, however, is matter of speculation, for Mr. Hudson is far on the way, as already intimated, to repudiation of the Board of Trade, and he last year vehemently condemned their railway bill. If, then, they should bring in some measure trenching too much on the vested interests, they would only have the support of Mr. Glyn and Mr. Robert Stephenson, and the government would find itself attacked by Mr. Hudson, Mr. Chaplin, Mr. Hayter, Mr. Waddington, Mr. Locke, Mr. Peto, Mr. Jackson, Mr. Humphrey Brown, Mr. Wyld, and Sir Joshua Walmsley. This would make a grand railway debate; and a severe defeat of Mr. Strutt might jeopardise the ministry.

We must intreat the railway members carefully to consider the mischiefs which have already accrued from Board-of-Trade interferences, to withstand every new bill, and to repeal or modify all the restrictions which have been placed upon joint-stock enterprise by the standing orders and enactments, such as the length of notices to parliament, the ten per cent. deposit, the limits on the payment of interest on calls, on the amount of dividends and fares, the power of suing for calls, the registration of joint-stock companies, and all the other new-fangled devices for impeding the free progress of railway enterprise. Old companies may be fearful of encouraging competition, but experience must have already pointed out that there is only one sound way of promoting railway enterprise, old and new, and that is by unloosing the fetters. The same argument which authorises the fettering of new schemes, authorises the fettering of the old. What the companies have to fear is not competition from each other but spoliation on the part of the government. As matters are going now, there will at an early period be a demand for a limitation of dividends which is now ten per cent., to eight per cent.; then to seven, then to six, then to five, then the commutation for government stock. Mr. Glyn and his party may think that ten per cent., under the guarantee of the government, is the best thing they can have; but they can never have it, for a government guarantee is worth nothing. It has been shown already; Mr. Hudson has denounced the breach of faith with the companies; but this is in time of peace and a mere ambitious movement on the part of Mr. Strutt; but what will the government guarantee be worth, when the ministry of the day offer, for an election bait, a reduction of railway profits and charges?—which will be an eligible measure, as it will not be at their own expense. An additional 1 per cent. on the income tax may very well be met by a diminished 2 per cent. on railway dividends,—and chancellors of the exchequer are not scrupulous on such points.

The real enemy of railway and engineering interests, and of the public interests in such matters, is the government, and they have shown it. They have ambitious ends to serve, and they do not care how they gain them. They have traded upon the unpopularity of railways, they have created a great patronage and a great influence, but what single good have they done for the public? "They have diminished railway accidents." They have done nothing of the kind. The development of the railway system has diminished accidents; but government inspection has been found to be no safeguard and no remedy: bridges fall down after they are inspected, lines are obliged to be closed, and inspectors make reports after accidents to tell the public what the newspapers tell them much better.—"They have lowered fares and tolls, and obtained better accommodation for third-class passengers." They have done no such thing, for fares are lowered in consequence of the growing conviction that the lower the fares, the larger the traffic and the greater the profits; while, by interfering with third-class accommodation, the Board of Trade has created a prejudice and indisposed the companies from extending accommodation. While the Board of Trade have done no good to the public, they have unsettled railway property; and the first thing for its safeguard is to do away with Board-of-Trade inspection altogether.

THE BLADE PROTRACTOR.

(With an Engraving, Plate XVI.)

Registered by Mr. James Basire, Jun., *of Red Lion Square.*

We have much pleasure in introducing to our readers a new and useful instrument, invented by Mr. Basire, for the purpose of facilitating the plotting of trigonometrical surveys. It is a very important improvement on the protractor, and consists in the addition of a blade fixed to the arm of the instrument, as shown at fig. 1 in the Engraving, and by the aid of which the lines are at once laid off, without the trouble of first pricking off the point, as shown in fig. 2, which in the plotting of some surveys occupies considerable time; besides which, the work is done with much greater accuracy, as it is only necessary to fix the instrument on a meridian and draw the angles at once.

For military and mining surveying, or other work set out by angles, this instrument will be invaluable, and to architects and artists of great service for copying, reducing, or enlarging drawings. In the Engraving an example is given in fig. 3, showing how the instrument is applicable for marine surveys: the blade protractor is first placed on the station A, and all the angles at once drawn off; it is then shifted to the next station B, and the angles laid off bisecting A and C; and so on.

The instruments are got up in German silver, and are furnished with four blades containing various scales, and placed in a neat and compact case, and are to be had of the inventor.

Tunnel across the St. Lawrence.—A project is spoken of in Canada, for connecting the railroad running to the Atlantic, by tunnelling the St. Lawrence, opposite the island of Montreal. The tunnel at its narrowest part, near St. Helen's Island, will be about one-third of a mile from shore to shore, and about one-third the length of the principal tunnels in England. The depth of the water in the river is 48 feet.

Dee Bridge Girders.—One of the girders of this bridge has been tested, to ascertain the breaking weight. The experiment was made on the 8th ult., by the officers of the Chester and Holyhead railway, by gradually placing railway bars over the centre division of the girder, until it reached 38 tons 6 cwt. 2 qrs. 18 lb., which broke it, the fracture commencing at the bottom flange.

SLUICE GATES AND RAILWAY LIFT BRIDGE.

Sir—At page 244 of No. 119 of your excellent *Journal*, is the description (taken from the *Franklin Journal*) of a new sluice gate, invented by F. C. Lowthorp, civil engineer, of Pennsylvania. Allow us to claim the priority of this invention for one of our countrymen, long since deceased, and thus discharge a debt due to the memory of one who directed the first steps of our professional career and who was to us both a friend and a master.

It is now about 30 years since T. Blanken, Inspecteur general du Waterstaat in Holland, well known by his grand Canal of the Helder at Amsterdam, erected in this country the first sluices with what are termed fan-gates (*à eventail, waaijerdeuren*). These gates are precisely similar to those described in your *Journal*, except that their application and the flow of water are arranged in a simpler manner than by the American engineer. The first experiments having perfectly succeeded, the king Louis Napoleon decreed that these sluices should bear the name of the inventor, and gave them the title—*Blankensluizen*.

A large number of the sluices of this country, of which the openings vary from 4 to 12 metres (13 to 39 feet), have been constructed on this principle, and their use has become general among us. M. Wiebeking has given a description of them in his large treatise on hydraulic works.

Permit us, at the same time, to claim the priority of the application of the Railway Lift Bridge, of which you give a description at page 241 of the same number. A moveable bridge, on this principle, was erected last year on the railway from the Hague to Rotterdam.

We trust, Sir, that you will have the goodness to insert this brief explanation, and beg you to receive the assurance of our perfect esteem.

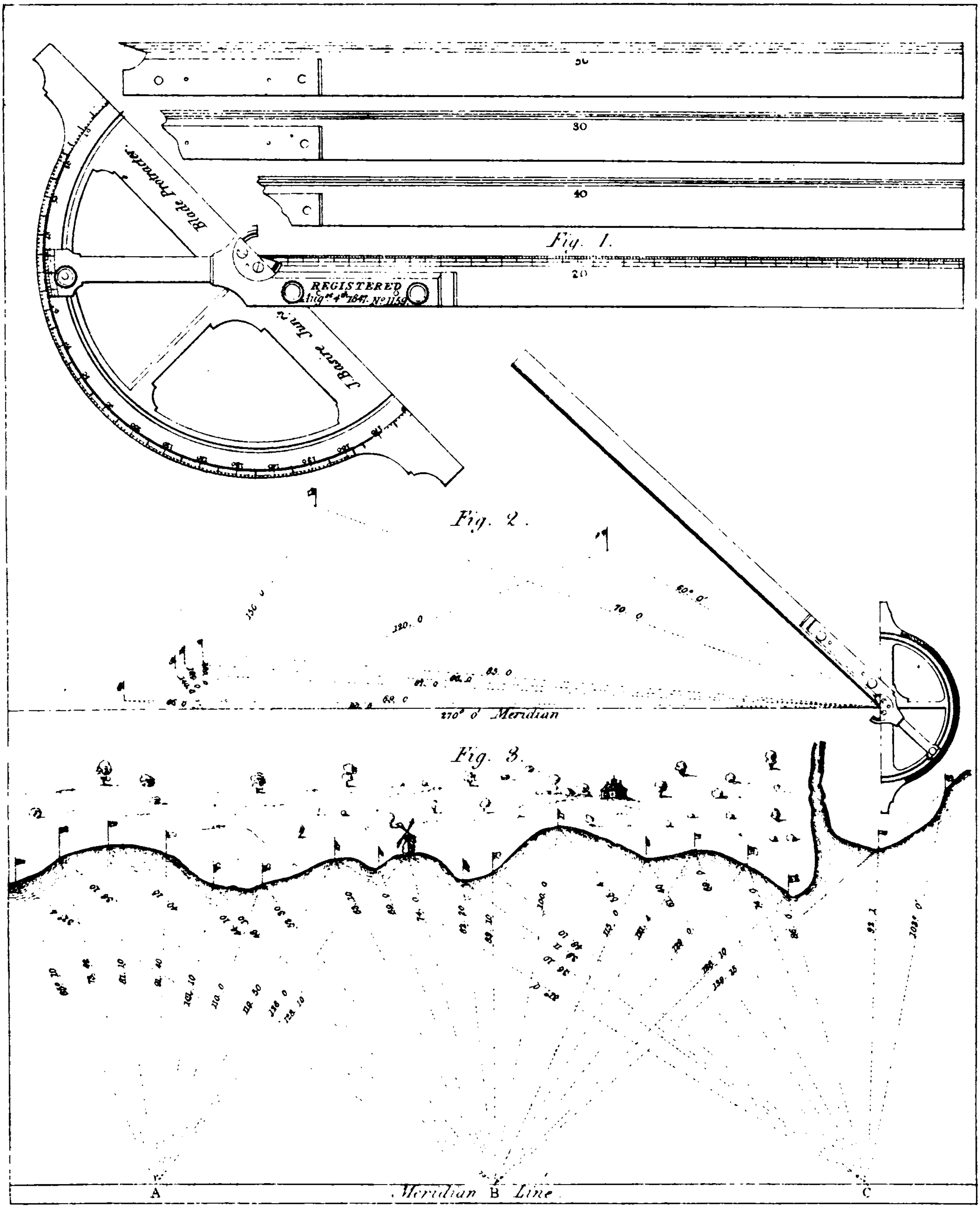
(Signed) F. W. Conrad,
L. J. A. Vander Kun,
Hague, Sept. 13, 1847. (Dutch engineers.)

REVIEWS.

Observations on Lime, Calcareous Cements, Mortars, &c. By Major-General Sir C. W. Pasley, K.C.B. Second Edition, Part I. London: John Weale, 1847. Pp. 209.

Both the engineer and architect are under great obligations to General Pasley for the very elucid manner he has set forth in this treatise the result of many years' laborious researches and experiments on limes, mortars, and cements. When the first edition of this work appeared in 1839, we then perused it with great pleasure, and strongly recommended it to the profession; and as a proof of the correctness of our opinion, the work was very soon out of print, and has been since much sought after, which induced the author to publish a second edition. He may well be gratified to find that his laborious researches have induced several manufacturers under different appellations to manufacture the artificial cement recommended by him. The General observes in his introduction,—

"When he first published his researches on the subject, all the previous attempts to make a good artificial cement in this country had so far failed, that only one sort, that prepared by Mr. Frost, had found its way into the market, which was of inferior quality, owing chiefly to certain defects in the mode of preparing the ingredients, pointed out in the First Edition of this work. At present there are three manufactories of artificial cement in England, which have all been used more or less extensively in works of importance, and have given satisfaction; viz., first, that of Messrs. John B. White and Sons, in the parish of Swanscomb, Kent, the present proprietors of Mr. Frost's works, who, after gradually relinquishing the objectionable parts of his process, have succeeded in making a good artificial cement, which they call their Portland cement, by a mixture of chalk found on their own premises with the blue clay of the Medway; secondly, that of Messrs. Evans and Nicholson, of Manchester, who make an artificial cement, which has been called the patent lithic cement, with the very same ingredients, and in the same proportions nearly, that were used in the Author's experiments, but the most important of which is obtained in a round-about manner from the residual matters or waste of certain chemical works, instead of working with natural substances; thirdly, that of Mr. Richard Greaves, of Stratford-upon-Avon, who makes a powerful water cement, which he calls blue lias cement, by mixing a proportion of indurated clay or shale with the excellent blue lias lime of that neighbourhood, both of which are found in the same quarries; the former being previously broken and ground, and the latter burned and slaked, which is absolutely necessary in making an artificial cement from any of the hard lime stones.


Blade Protractor.
J. Baxter Jun.r
REGISTERED
Aug.st 4th 1847. No 1159.
50
30
40
20
Fig. 1.
Fig. 2.
270° 0' Meridian
Fig. 3.
Meridian B Line
A
C

The success of this process, as a commercial undertaking, though the most expensive of all that were suggested in the First Edition of this work, is therefore peculiarly satisfactory, considering the great importance of good water cement, and the probability of the natural cement stones of this country, which are only found in certain localities, becoming unequal to the demand, or scarcer than they are at present."

We will now proceed to give a few extracts from the treatise, to show its practical character; first, as to the qualities of sand and lime, constituting *Mortar*.

"The sand used in making mortar should be *sharp*, that is, angular, not round, and *clean*, that is, free from all earthy matter, or other than silicious particles. Hence *Road Scrapings* always, as being a mixture of sand and mud, and *Pit Sand* generally, as being scarcely ever without a proportion of clay, should be washed before they are used, which is seldom necessary in river sand, this being cleaned by the force of the current which is the cause of its formation. None but clean sharp sand will ever form good mortar, and the intimate mixture of the sand and lime, which should be done with a moderate quantity of water, is of no less importance.

I have ascertained by repeated experiments, that one cubic foot of well-burned chalk lime, fresh from the kiln, weighing 35 lb., when well mixed with 3½ cubic feet of good river sand, and about 1½ cubic foot of water, produced about 3¼ cubic feet of as good mortar as this kind of lime is capable of forming. Some readers may be surprised that this mortar should occupy rather less space than the sand alone originally did, before the lime and water were added to it. The principal reason is, that dry sand, and all dry loose materials generally, settle into a much smaller space when wetted. Hence the same quantity of sand measured dry, then moist, and afterwards wet, will occupy unequal spaces. The clean sharp river sand, rather moist, used by us, weighed about 87 lb. per cubic foot. On gradually pouring water upon it in the measure it settled down from 12 to 9¼ inches in height, thus occupying only four-fifths of the space, which it had before filled.

Pure lime is so little capable of resisting the action of water, that it is unfit even for the external joints of walls exposed to the common vicissitudes of the atmosphere. For by degrees the beating rains, to which the outside of such walls is subject, will gradually destroy the mortar of all those joints to a certain depth, as may be observed by inspecting old walls built with chalk lime mortar, which have not been meddled with for some years...... Walls built with the water limes settle less, and those built with cement are entirely free from this action, because the cement used in the lower courses sets too soon for the weight of brickwork or masonry added above to make any impression on the joints. Now though the difference of settlement, even between those extremes, may be very small, it does not appear prudent to use more than one species of mortar in the same horizontal joints of a building, especially as it would give trouble to the workmen, and occasion loss of time.

Pure lime mortar has sometimes been used for the backing of wharf walls, the front or facing of which has been protected by water cement, usually to the depth of about 18 inches, or two bricks thick, from the outside of the wall. Even this system, though it does not involve the entire ruin of the wall, is highly to be reprobated. The cement protects the pure lime mortar from the direct action of water in mass, but not against wet or damp, because the moisture penetrates through the pores of the brickwork and of the cement, and although not in sufficient quantity to dissolve the pure lime mortar, it effectually prevents it from setting, so that it always remains in a state of soft pulp, and is of no more use towards the consolidation of the wall than so much moist clay."

The next division of the work treats of *Plaster of Paris*, as it is generally called. To test its quality—

"Mix a small quantity of it with water in the form of a ball, and it will set with moderate heat into a very hard fine white substance, and will even continue setting under water, but being partially soluble in that liquid in process of time, it is not applicable to the purposes of hydraulic architecture."

The division on *Hydraulic Limes* describes the different limes called in London, "stone limes."

"The blue lias lime stones are considered the strongest water limes of this country, and are found on opposite sides of the Bristol Channel, near Watchet in Somersetshire, and Aberthaw in Glamorganshire, and also at Lyme Regis in Dorsetshire. The first of these, mixed with puzzolana, was used by Smeaton in building the Edystone Lighthouse. The Dorking or Merstham lime, and the Halling lime, so termed from a village on the left bank of the Medway above Rochester, but which is also found near Burham on the opposite site of the same river, though not possessing such strong hydraulic properties, are also much esteemed; and these two limes, the former of which is considered rather the best, are more used in the metropolis than the blue lias, probably from the greater proximity of the quarries where they are found, and from very little land carriage being required for either.

All the water lime stones are of a bluish grey or brown colour, which is communicated to them by the oxide of iron. They are usually termed 'stone lime' by the builders of the metropolis, to distinguish them from common chalk lime, but so far improperly, that the Dorking lime stone is not much harder than chalk, and the Halling lime stone is actually a chalk, and not harder than the pure chalk of the same neighbourhood, from which it is only distinguished in appearance by being a little darker.

In fact, all the coloured chalks found in various parts of England, commonly termed *Grey Chalks*, which are the *Lower Chalks* of the geologists, and generally free from flints, are possessed of hydraulic properties more or less powerful."

The chapter on *Concrete* contains some useful directions for mixing the ingredients, which is followed by some observations on "grouting." Among architects and builders there is a difference of opinion as to its advantages; our author's opinion appears to be favourable to its use.

"Upon this subject, I may be permitted to remark, that unless every course be grouted, it appears to me that there is a risk of the grouting not penetrating lower than the single course immediately under it, for the beds of plastic mortar in the next courses below that, have sufficient consistency to intercept the grouting, unless those beds themselves should have been imperfectly laid, which seldom or never happens, even when middling or indifferent bricklayers are employed. For this reason, one can scarcely expect sound brickwork, unless every course be grouted, especially in thick walls, although the more general custom is to work with mortar only. When one of the massy walls of the new British Museum, after being grouted in the manner before described, was cut through for some temporary purpose, it was remarked that the brickwork resisted the tools of the workmen quite as much, and appeared equally firm in the joints, as if the latter had been filled with plastic mortar instead of grouting. The same risk of part of the vertical joints being left dry may occur also in masonry, and there can be no method of guarding against it more effectual than to grout each course."

Water cement, or what is called "Roman cement," comes next. This material, we consider, has been abused in its use more than any other connected with building, and from its repeated failures in exposed situations, and particularly when used near the ground for stucco and on the top of projections, such as cornices, make one doubt its boasted durability for such works; but whether its failure be owing to the improper mixing of too much sand, or the cement being of bad quality, it is difficult to say: we may instance as a failure the balustrade enclosure on the east side of Regent's-park, which has been frequently repaired. In the construction of brick-walls, cement appears to have stood well, and might be advantageously used to a greater extent than what it is; when all circumstances are taken into consideration, the expense is not very much more than lime-mortar. General Pasley observes, that "cement" is always weakened by the addition of sand, whereas every kind of lime is improved by it. For concrete foundations it is requisite to use double the quantity of cement than is required when lime is used, consequently it is not recommended for that purpose; but for the lower parts of a wharf-wall or pier under water, one measure of cement mixed with three, and not more than four, of gravel or sand, may be advantageously used.

The valuable information communicated by the General on the manufacture of *Artificial cement* made from chalk and clay, form the most useful part of the treatise, and deserves the attentive study of all parties connected with building. We will select one or two of the author's successful experiments, detailing the process of making the artificial cement, which we here suggest should be called *Pasley's Cement*, in contra-distinction to the numerous cements which are in the market; none of which, however, appear to be superior, if equal, to the one recommended in this treatise, and which the General found to be the best after a long series of trials and experiments. The first experiment on a large scale is thus described:—

"Having, towards the close of the year 1828 and in the beginning of 1829, tried as many experiments on a small scale as I then considered necessary, I determined to prepare a considerable quantity of artificial cement composed of chalk and blue clay, with a view of applying it on a larger scale, to those purposes for which the natural cements have been used in architecture.

The chalk, after having been broken small and dried in the air, was pounded in small quantities at a time, in iron troughs that had belonged to a forge, with iron rammers made for the purpose, and was passed through sieves with brass wires, having 25 meshes to the inch, being the finest used in the Ordnance gunpowder works. A large mass of dry pulverised chalk being thus provided, 5 cubic feet of it were laid on a wooden platform, and made into a paste with a moderate quantity of water, after which 2 cubic feet of the blue clay were added, and the whole intimately mixed together on the same platform by shovels. When a sufficient quantity was prepared, the mixture was next moulded in the same manner as common bricks, excepting that water was used instead of fine sand to prevent adhesion. After these bricks of raw cement, which were twelve inches long, became drier, they were cut into five equal parts, each forming a cube of rather less than 2½ inches side, this being the average size of the lumps into which chalk is usually broken, before it is burned, in the common open lime-kilns in Kent. I made my moulds exactly 12 inches long, and $2\frac{4}{10}$ inches wide by $2\frac{4}{10}$ inches deep, in order that 25 bricks, or 125 cubes, should be exactly equal to one cubic foot. Thus, by merely counting the number of bricks, we could ascertain the quantity of raw cement made, without the trouble of measuring it."

This experiment not proving so successful as was desired, some experiments were again made on a small scale, and subsequently on a larger scale, in a small lime-kiln about four feet diameter at top, and six feet deep.

"In this little kiln, than which nothing could have answered better, we burned, at four successive periods of the same year, about 140 cubic feet of raw cement. In the first of these batches of artificial cement we used the same mixture as before of 5 measures of chalk, 2 measures of blue clay, and half a measure of coal-dust; and in burning it, after putting in shavings and wood at the bottom of the kiln, we laid half a bushel of coals over the wood, then four bushels of the raw cubes, after which another layer of half a bushel of coals, then four bushels of cubes as before, and thus we continued applying the coals and cement cubes in alternate layers, until the kiln was filled, using one measure of coals to eight measures of raw cement, the former being broken rather small, so that no piece of coal used exceeded an inch in thickness, and both being thrown loosely into the baskets with which we measured them.

In the third and fourth batches of raw cement prepared for burning at the same kiln, we dispensed with the coal-dust altogether, using 5 measures of chalk to 2 of blue clay; and we merely pounded and sifted the chalk, without grinding the powder afterwards in the mill; and in consequence of there being no fuel combined with the raw cement in this mixture, we used one measure of coals to five measures of the raw cement cubes in burning them, which proportion we always adhered to afterwards, as the best for this mixture."

The remainder of the treatise details the numerous experiments made by the General to test the strength of all kinds of cement, to which we must refer our readers.

In conclusion, we confidently recommend an attentive perusal of this treatise to every one who may be desirous of obtaining sound practical information on limes, mortars, and cements.

Weale's Quarterly Papers on Engineering. Part I. Vol. VI. London: John Weale, High Holborn.

The present number of Mr. Weale's journal consists of three papers—I. "On the Principles and Practice of the Application of Water Power," by Robert Mallet, President of the Geological Society of Ireland.—II. "Experiments on Locomotive Engines," by MM. Gouin and Le Chatelier.—III. "Paper on the first Introduction of Steam Engines into Naval Arsenals; and Machinery set in motion thereby," by the widow of the late Sir Samuel Bentham.

The first paper contains an account of the projected Dodder Reservoirs, near Dublin, and of the Bann Reservoirs, now in course of construction. Mr. Mallet has likewise favoured us with a description of his self-regulating syphon weir, which seems to us extremely ingenious, and perfectly correct in principle, whatever it may turn out in practice.

"Over a common weir, or embankment, is thrown a large flat-shaped syphon tube, made of boiler plate, and for stiffness divided into several parallel tubes by vertical plates. One end of this syphon (which may be extended indefinitely along the crest of the weir) dips into the water ponded above the weir, the other end lays open at the lower side of the weir. The under side of the syphon tube reposes upon the crest of the weir, and the *depth of the syphon tube*, or distance vertically *over the crest*, is equal to the *height* to which the rise of water in times of flood may be permitted, (in the instance shown equal to $1\frac{1}{2}$ foot).

At such a level *below* the crest of the weir as it is determined shall be the *lowest* to which the ponded water shall be wasted by the syphon, there is formed a range of air holes, or simple apertures through the upper plate of the syphon tube. The action of this arrangement is now very obvious. Whilever the water above the weir continues at the 'standard level,' none runs over or through the syphon; as its level rises above this, a sheet of water flows over the crest of the weir, and also down through the flat syphon tube, as part of the weir. This continues as the level of the water rises higher and higher, until it reaches that marked as the limit for the 'highest floods,' that is, the level of the upper side of the syphon tube. The moment the water reaches this point, the syphon, being quite full, instantly commences to act as a syphon, and discharges a quantity of water, enormously greater than before—a quantity due, not to the mere *area* of *overflow* through the partially filled syphon, but to the area of the syphon tube, and to the head of water now acting upon it as a syphon. This vastly increased discharge, now more than a match for the supply of the river itself, begins to lower the water above the weir, and its surface continues to fall until it reaches the point marked as the 'lowest level' that it shall attain. Here the range of air holes are situated, and the instant the surface of the falling water reaches these, air enters the syphon, and it directly ceases longer to act as a syphon, and becomes merely a part of the weir conducting the ordinary overflow. This process, the sudden bringing of the syphon into action when the water reaches a given level, and sudden cessation of its action again when it has fallen to a given level, may be endlessly repeated; and the effect of the syphon, when in action and suitably constructed, is in fact very nearly the same as suddenly opening a sluice, equal to its entire area, at the level of the bottom of the weir or dam."

Experiments on the discharge and flow of water from orifices and through tubes are much needed. Eytelwein's formula is generally adopted by engineers, though we much doubt whether it would be found applicable if the height of the head of water were to exceed a certain limit—say 100 or 150 feet.

The second paper—"Experiments on Locomotive Engines"—has rather a formidable appearance; the tables contain as many figures as Mr. Adams employed in the calculation of Neptune's orbit. We noticed an allusion to the fact of the difference of pressure in the cylinder and boiler being a function of the load, as a theory of M. de Pambour;—for this difference and the cause of it, we beg to observe that Nature, and not M. de Pambour, is responsible; although that gentleman, we believe, first correctly interpreted her laws on the subject.

The last paper is a highly-interesting historical summary of the labours of the late Sir Samuel Bentham.

The Indicator and Dynamometer, with their Practical Applications. By Professor Main, of Portsmouth, and Mr. Thomas Brown, Engineer. London: Hebert, 1847.

The object of this work is to explain the use of two valuable instruments for ascertaining the work done by the steam engine. The Indicator is one of the many of Watt's valuable instruments, and on which that great man set high value, on account of its simplicity and importance. By the application of the indicator the working condition of a steam engine is at once tested. The Dynamometer is introduced into screw vessels for ascertaining the amount of pressure given off by the screw shaft, and consequently the force the engine is exerting to propel the ship. The use of both these instruments and their application are very clearly explained in the little work before us.

Letter to Lord John Russell, on the Defence of the Country. By John Weale.

Mr. Weale's object is to train for soldiers all the able-bodied men who may apply for relief at the Union, and he very croakingly points out the great dangers to which England is liable from the sudden invasion of the French. We should be very sorry to see England turned into a country of bayonets; we much prefer the epithet of "a country of shop-keepers." Let men be taught how to avoid war, and not teach them the use of the carbine, to murder and pillage their fellow beings. Knowing Mr. Weale's disposition, we must say that we never suspected hat he would have recommended such a system as he has promulgated in the pamphlet before us.

COLONIAL RAILWAY PROGRESS.

Madras and Arcot Railway.—A company has been started to effect the junction of these two important points in India. The line has been highly recommended by Mr. Simms, the government engineer. Its length is 71 miles, and is nearly a dead level, the average inclination being only 1 in 633 feet; there is no tunneling, nor any cutting of consequence. The proposed line is the first stage out of Madras on the great western line of communication with Bombay and the military stations of Arcot, Bangalore, Hyderabad, Cannanore, and Trichinopoly; and is second in importance to no line in India. It will be constructed at as low a cost as £5,000 a mile.

Australian Railway and Sydney Water-Works Company.—This colony being in such a flourishing condition. It has been determined to introduce railway communication on the same economical system as practised in America. The line is intended to run from the port and town of Sydney to Richmond, passing through Paramatta, Castlereagh, Windsor, and other places of minor importance, with a branch from Paramatta to Liverpool; and it is also intended to supply Sydney with water from the hills. This is of great importance to that town, as it is at present supplied with water from a lagoon, which is almost dry in the summer season. The line is 45 miles in length, and can be constructed remarkably cheap, as government will find land, and the country abounds with a very hard and durable timber, called iron-bark wood, particularly well suited for sleepers and rails, by merely arming the edge with angle iron.

MEASUREMENT OF ANGLES.

A New Method of Measuring the Degrees, Minutes, &c., in any Rectilinear Angle, by Compasses only, without using Scale or Protractor.

By Oliver Byrne.

Let it be required to find the number of degrees, minutes, &c., in the angle A B C = θ (Fig. 1). With any radius, A C, describe a circle: then

Fig. 1.

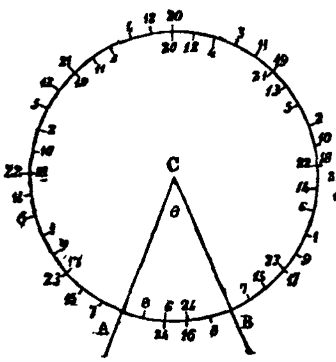
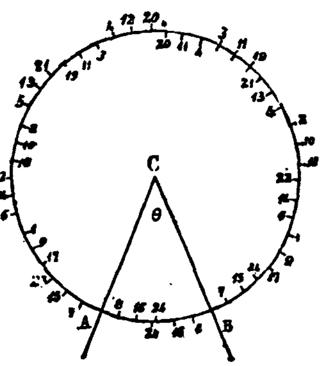


Fig. 2.



take A B in the compasses, and apply it from B to 1; from 1 to 2; from 2 to 3; &c. (the numbers outside the circle are referred to). If, in applying the arc A B, we find that on our return to B, after n applications, we have a coincidence, then it is well known that the number of degrees, &c. will be $= \frac{360}{n}$. But, in the present example, after eight applications the point falls at 8, putting Δ_1 = from 8 to B, continue to apply the same arc or opening of the compasses from 8 to 9; from 9 to 10; from 10 to 11; &c., on to 16. This process is to be continued till we have the half or more than half the arc A B between the last point found and B. In this case 24 is the point. Any error that may be involved in the process will be much neutralised by thus determining the points 8, 16, 24, &c. independently. Theoretically, the arcs B, 8; 8, 16; 16, 24; &c. are all equal, but practically they may imperceptibly differ. We might have taken the arc B, 8, and applied it from 8 to 16; from 16 to 24; &c., but this process would multiply any error that might be involved in B, 8; while the process just described has a correcting tendency. To lessen error further, we are again to begin at A, and apply the arc A B in a contrary direction, from A to 1; from 1 to 2; from 2 to 3; &c. (the numbers inside the circle are in this case referred to). Should the points 24 and 16 coincide, as in fig. 1, then we have

$$8\,\theta + \Delta_1 = 360^\circ; \text{ and } 5\,\Delta_1 = \theta;$$

$$\therefore\ \Delta_1 = 360^\circ - 8\,\theta = \frac{\theta}{5};\quad \therefore\ 1800 - 40\,\theta = \theta;$$

$$\therefore\ \theta = \frac{1800}{41} = 43^\circ\ 54'\ \tfrac{6}{41}.$$

If the points 24, 24, overwrap or fall, as in fig. 2.—Then put Δ_2 = from 24 to 24: this arc will be very small in most cases—in this case it is the 20th part of A B;

$$\therefore\ \theta = 20\,\Delta_2;\quad 8\theta + \Delta_1 = 360^\circ;\quad 6\,\Delta_1 - 2\,\Delta_2 = \theta.$$

From these equations, which involve the unknown quantities θ, Δ_1, Δ_2 θ is readily eliminated.

$$\Delta_1 = 360^\circ - 8\,\theta, \text{ from the second;}$$

$$\text{and } \Delta_1 = \frac{\theta + 2\,\Delta_2}{6}, \text{ from the third.}$$

$$\therefore\ 2160 - 48\,\theta = \theta + 2\,\Delta_2 = \theta + \frac{\theta}{10};\ \text{since } \Delta_2 = \frac{\theta}{20}.$$

$$\therefore\ \theta = \frac{21600}{491} = 43^\circ\ 59'\ \tfrac{31}{491}.$$

If the points 24, 24, do not overwrap, as in fig. 3, and Δ_1 be in excess instead of defect, that is, that some multiple of θ made less by Δ_1 make up the circumference. In this case the three equations will stand thus:—

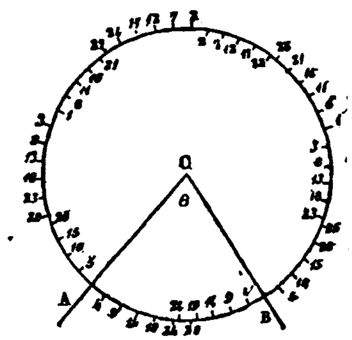
$$5\,\theta - \Delta_1 = 360^\circ;\quad 10\,\Delta_1 + \Delta_2 = \theta;\quad \text{and } 29\,\Delta_2 = \theta.$$

In this example, the distance between 24 and 24, or Δ_2, is found to be the 29th part of the arc A B.

$$\therefore\ \theta = \frac{52200}{711} = 73^\circ\ 25' \text{ nearly.}$$

It is evident that the numbers on these figures may be omitted in practice, as none of them except the first is required; indeed, where the points of the compasses rest need not be noted, except those points that fall inside the points A, B.

Fig. 3.



This method of measuring an angle is more accurate and expeditious than may at first appear from the above lengthened details, and will often be found convenient when compasses only can be obtained. A general rule may be arrived at as follows: Let

$$m\,\theta \pm \Delta_1 = \pi = 360^\circ;\quad n\,\Delta_1 \pm p\,\Delta_2 = \theta;\quad \text{and } q\,\Delta_2 = \theta;$$

be the three equations generally expressed; p being always equal + 1 or − 2.

$$\theta = \frac{n\,q\,\pi}{m\,n\,q \pm q \pm p}. \qquad \text{(Q)}$$

In example, fig. 2, this expression becomes

$$\theta = \frac{6 \times 20 \times 360}{8 \times 6 \times 20 + 20 - 2} = 43^\circ\ 59'\tfrac{1}{3}.$$

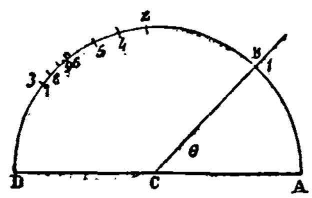
In example, fig. 3,

$$\theta = \frac{10 \times 29 \times 360}{5 \times 10 \times 29 - 29 + 1} = 73^\circ\ 25'.$$

The only thing to be observed in (Q) is the sign of q. In examples like the latter it is to be minus, but in those like the former plus.

This method of measuring angles will be found more correct than the ingenious one proposed by M. De Lagny, which consists in measuring angles with a pair of compasses, and that too without any scale whatever, except an undivided semicircle. Having any angle drawn upon paper, to measure it: produce one of the sides of the angle backwards behind the angular point; then with a pair of fine compasses describe a pretty large semicircle from the angular point as centre, cutting the sides of the proposed angle, which will intercept a part of the semicircle. Then take this intercepted part very exactly between the points of the compasses, and turn them successively over upon the arc of the semicircle, to find how often it is contained in it, after which there is commonly some remainder; then take this remainder in the compasses, and in like manner find how often it is contained in the last of the integral parts of the first arc, which will again most likely give some remainder; find in like manner how often this last remainder is contained in the former; and so on continually, till the remainder becomes too small to be taken and applied as a measure. By this means M. De Lagny obtained a series of quotients, or fractional parts one of another, which being properly reduced into one fraction, give the ratio of the first arc to that of a semicircle; or the ratio of the proposed angle to two right angles or 180 degrees, and consequently the degrees and minutes of the angle itself becomes known.

Fig. 4.



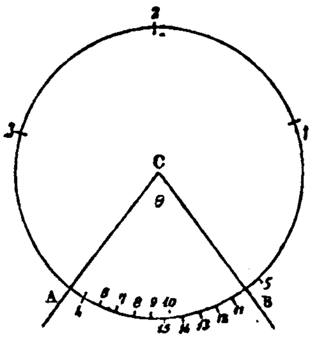
Suppose the angle A C B (fig. 4) be proposed to be measured. Produce A C towards D; and from the centre C, describe the semicircle A B D, on which A B is the measure of the proposed angle. Take A B in the compasses, and apply it three times on the semicircle, at 1, 2, and 3; then take the remainder D, 3, and apply it back upon 3, 2, which is but once, namely, at 4; again, take the remainder 4, 2, and apply it three times on 4, 3, at 5, 6, and 7; then take 3, 7, and apply it twice on 7, 6, at 8, and 9; lastly, take the remainder 9, 6, and it will be found to be contained just five times, in 8, 9. Hence the series of quotients in this particular example is 3, 1, 3, 2, 5, which give the continued fraction,

$$\frac{1}{3} + \frac{1}{1} + \frac{1}{3} + \frac{1}{2} + \frac{1}{5},$$ which, when properly reduced,

gives vulgar fraction $\frac{49}{185}$, and $\frac{49}{185}$ of 180° = 47° 44′ nearly.

To those acquainted with the doctrine of continued fractions this method of De Lagny is easy enough, and very accurate considering the means employed. If great accuracy be not required, our method may be much contracted, by only applying the arc once round the circle, and then using $\triangle_1$ to find all the other required numbers. Taking the same angle as the one

Fig. 5.



measured in example 3, apply A B (fig. 5), from B to 1; from 1 to 2; from 2 to 3; from 3 to 4; from 4 to 5. Then take B, 5, in the compasses, and apply it from B to 11; from 11 to 12; from 12 to 13; from 13 to 14; and from 14 to 15, near the middle of the arc A B. With the same opening B, 5, or A, 4, or $\triangle_1$, as we have termed it, lay off, 4, 6; 6, 7; 7, 8; 8, 9; and 9, 10. Then the arc between the points 15 and 10 is found to be contained 33 times in the arc A B; but before it was contained 29 times, for 29 $\triangle_2$ was found equal to θ. But by this latter contracted process we find that 33 $\triangle_2$ is equal ϱ. Our object is to show that this discrepancy will not alter in any great amount the result or measure of the angle in degrees, minutes, &c. From (Q) we have

$$\theta = \frac{n\,q\,\pi}{m\,n\,q \pm q \pm p} = \frac{10 \times 33 \times 360}{5 \times 10 \times 33 - 33 + 1} = 73^\circ\ 25'\ [illegible].$$

This result was 73° 25′ $\frac{6}{19}$, when q was 29.

To obtain the divisor of (Q), the three numbers m, n, q, have to be multiplied together; to their product q is to added if m be too small, but subtracted if too great; to this sum or difference we must add one if n be too great, but subtract two if n be too small. In the latter case, (Q) becomes $\frac{10 \times 33 \times 360}{5 \times 10 \times 33 - 33 - 2} = 73^\circ\ 33'$ nearly, a result which differs from the former results only by 6 or 7 minutes. This circumstance points out the great value of the rule, for it is evident that the result remains nearly the same, whatever be the positions of the points between A and B. Or in other words, the carelessness of the operator does not much affect the result, for in all cases it comes nearly right. I must digress, and add,—what a pity that our statesmen, architects, engineers, &c., cannot discover a few rules of this kind.

A new Life boat was recently tried at Cowes, in the presence of several officers in the navy. The boat was built by Messrs. White and Sons, of Cowes; it is 30 feet long, 9 feet beam, has double sides, and air-tight ends. 135 men were placed in her, and she took in all the water that she could gunwale under, and when she righted gave a fifteen-inch side; in fact, it was found impossible to sink her. She sails very fast, stays in thirty-two seconds, and weighs only seventeen hundred weight. She will carry in her lockers a month's provision for fifty men. The novelty is principally in her form.

ON HERALDRY.

A paper "*On Heraldry*," by Mr. Partridge, read at a meeting of the Decorative Society.

Heraldry was explained to be an organization of emblems and devices, which, undoubtedly, must have existed from the earliest establishment of order and civilization among the human race; and various passages containing records of, and allusions to, its symbols were quoted from Biblical history, showing that it was the medium adopted for distinguishing friends from foes, nation from nation, and tribes and families from each other. Mr. Partridge also referred to, and quoted passages in, Homer, Hesiod, and others, describing the shields of their heroes; adding, that the shields of Achilles, Æneas, and Hercules had, in his opinion, been described with poetical license, but, nevertheless, supplied evidence of the custom of ornamenting shields in the richest manner of the arts of that period. He likewise considered as fabulous the descriptions given by the Jewish rabbi of the standards pitched by the Ten Tribes of Israel. Some references to the subject during the Roman era were followed by observations upon the great change made in the institutions of this country by William the Norman; who modelled his court, as far as practicable, after that of Normandy, and who, therefore, introduced the very remarkable officers whose duties were strictly heraldic.—The Great Constable, whose authority in matters of war and chivalry, both in France and England, during the Norman and Plantagenet reigns, was little less than that of the monarch. The Great Marshal was an important dignitary, whose influence was at its zenith at the time of the Conquest; and the office still remains, through all the changes of legislation and government, one of great power and influence. The third office, being, perhaps, the most singular of any adopted by the Conqueror, was that of Champion. Mr. Partridge traced the hereditary descent of the championship from Marmyon, who received his appointment, with the manor of Scrivelsby, from William; and quoted verses from an ancient poem in which the changes in the families of Marmyon, Ludlow, and Dymoke, the present champion, are set forth. He then referred to Camden, Guillim, Sir Henry Spelman, and other eminent authorities, showing that although many of our noble families can prove their descent from before the time of the Crusades, yet their arms or heraldic bearings had not become hereditary. After the crusades it was accounted honourable to display those ensigns which had been borne in the Holy Wars; and hence the descendants treasured them as their hereditary arms, and the opinion of Lord Chief Justice Coke was quoted showing that he considered this as one of the strongest proofs of a noble and worthy origin.

Mr. Partridge then recited the Roll of Carlaverock—a record in old Norman-French of the names and arms of the leaders who served under King Edward I. at the siege of Carlaverock Castle, Scotland, in 1300; and explained that at that time heraldry was embodied as a science as nearly as possible to its form at the present day. Tournaments were alluded to as an important means in sustaining the dignified bearing and accurate transmission of armorial bearings down to the time of Elizabeth, —when the establishment of the College of Heraldry and the visitations made under its direction created a broad distinctive line between the ancient families and those who have risen to greatness by the increase of civilization and wealth since that period.

Mr. Partridge next drew attention to those arms and mottos which from their relation to names have been ordinarily considered and termed "punning arms,"—but which he said had been practised in remote antiquity, when names had a symbolical source and meaning. He mentioned several names derived from important official duties, such as Usher, Butler, Stewart, &c., in which cases the previous family-name had been disused,—as also that of Godolphin, in accordance with the signification of which a white eagle is adopted as the crest by that family: and this was followed by notices of others of a similar nature.

The lecturer then proceeded to show that the great poets of modern Europe have fully appreciated the value of heraldic distinctions; and said that in the descriptions of their heroes they are usually as heraldically correct as they are poetically beautiful. He referred to and quoted parts from Tasso's "Jerusalem," Shakspeare's "Wars of the Roses," &c. Important allusions in many family mottos, &c., were illustrated: and then he brought the subject to a general summary by maintaining that the detractors of heraldic science are bound to admit one of these two things,— either to prove that all the honours and distinctions which the sovereign of this or any other European state can bestow on eminent men are utter trash, or else to admit that heraldry is one of the important institutions of civilised Europe, as being the recognised medium by which the sovereign —the fountain of honour—bestows that honour on men who have deserved well of their country. This part of the paper was concluded by remarks upon the shield of Baron Napier, and the heraldic honours which he quarters by his descent from Scott of Thirlestane, who received them from King James for his services at the battle of Falkirk in 1298; and the verses by Sir Walter Scott were recited as affording the most eloquent and perfect illustration. Heraldry, he observed, would be found intimately blended with the general history of the middle ages—with the biography of eminent persons and families—with manners and customs—with poetry and polite literature;—and, moreover, it affords a key capable of explaining correctly the meaning of many mysterious and important forms prevalent in embellishments during the feudal period. He alluded to several points of interesting and somewhat romantic research, showing heraldry to be chiefly a symbolical art.

Mr. Partridge then directed attention to those heraldic figures called "supporters"—such as the lion and unicorn of the royal arms; and he subsequently noticed the analogy existing between heraldic and natural forms. Supporters, it was said, came into use when tournaments and feudal chivalry assumed a scale of splendour requiring a system of distinctions; and it became a practice for the nobles and knights each to hang his helmet and shield, richly emblazoned with heraldic insignia, on the front of his tent when in the field. Two attendants or esquires, dressed in armour, or in a fanciful costume imitative of certain characteristic animated beings, were placed to guard or support them, and also to receive challenges when they arrived. Under such circumstances, it was argued, it is absurd to represent supporters as lying down, walking away, or half asleep, while the heraldic attitude *rampant* should be invariably maintained. Mr. Partridge observed that frequent instances may be seen in St. James's Street and Pall-Mall, and even in the *Gazette* and the *Times*, in which the supporters of the royal arms are represented as crawling in mean-spirited positions, instead of "*rampant, guardant, &c.*"—as set forth in the blazonry. Mr. Partridge remarked that he had not been able to detect an abuse of this kind occurring before about the commencement of the present century; and the supporters were never found in any other position than rampant either in architectural remains or in old works on heraldry. He attributed this infraction in a considerable degree to a volume of Peers' Arms, with supporters, by Mr. Catton, R.A.; who, being a skilful painter of animals, but quite ignorant of the science of heraldry (many of the arms, it was said, are incorrectly given), gave the supporters every variety of attitude, so as to contribute to a novel and pleasing pictorial effect. This course was much calculated to mislead many who possessed some knowledge of drawing, but were ignorantly indifferent to the correct heraldic expression and meaning. Mr. Partridge contended that, if one person may change the attitude of supporters for the sake of pictorial effect, another would be equally justified in changing colours, or in making still greater deviations. Heraldry, he asserted, mainly consists of imitations of natural forms, but which are nearly always made amenable to symbolic and conventional treatment. In cases such as a stag, horse, or eagle "proper," nature may be in many respects faithfully copied from natural bodies; but it will be found that each of these is frequently placed with a symbolic form, such as a dragon, which must be depicted according to the regulations of heraldry. Instances in illustration of these views were offered. The Duke of Devonshire has for supporters "two stags proper," in which case colour and form must be true to nature, but the attitude remains heraldic. The Duke of Northumberland has one gold and one blue lion—which, if painted green, belong to the Earl of Roseberry, or if red, to the Duke of Bedford. Several similar cases were cited. A regard to proportion or relative size of the objects, the lecturer observed, would also tend to produce absurdities; and this went far to prove that they were never intended as pictures for natural history, but as symbolical distinctions treasured by their possessors from feelings of high honour. Examples were adduced of beings of unequal sizes which are often brought together side by side in arms—as a falcon and an elephant—a lion and a cock, for supporters; and similar ones were given applying to crests, quarterings, &c. It was explained that supporters are attached to all arms of peers; and that, with a few exceptions, they do not pertain to those of commoners.

Mr. Partridge then noticed the opinion sometimes held that the extravagant forms of animals used in architectural decoration, as well as in heraldry, are the efforts during a barbarous period, when the people employed could do no better—and therefore ought not to be followed in the present advanced state of manipulative skill. But he argued that this is an erroneous view; and that the human figure and animals were depicted with great fidelity *together with no small show of symbolic art* upon ancient embroidered vestments, stained glass, and in illuminated missals. He considered that the apparent eccentricity proceeded partly from causes not unfelt at the present day; and that many forms were devised to be repulsive of evil spirits and demoniacal influences. The form and size of shields and some other features in heraldry were pointed out for the purpose of illustrating its importance historically,—referring to Winchester School, Eton College, and other buildings—as well as to stained glass windows at Chenies, Bolsover, and St. George's Chapel, Windsor. As an example of family history executed in the present century, a view of the Duke of Bedford's Dining-room was exhibited; in which Mr. Partridge decorated the panelling with shields bearing arms descriptive of all the marriages in the Russell family. He also mentioned that he had been employed by Mr. Macready to emblazon correctly the arms of each personage in Shakspeare's play of "King John."

The paper concluded with some suggestions for the appropriate introduction of heraldic ornament:—and it was stated that before now a shield bearing the proper arms placed on the frame to a portrait had formed an important link in establishing a complete chain of legal evidence.

NEW ARMAMENT FOR THE ROYAL NAVY.

Report of the New Armament which the Board of Admiralty has ordered to be prepared for the Ships of War of all classes in the Royal Navy. The Return includes the new Complements of Men ordered for each class of Ships, and directs the manner in which the Guns are to be Mounted:

First-Rates.

120 Guns.—Britannia, Caledonia, Howe, Nelson, Neptune, Royal Albert, Royal George, Royal William, St. George, St. Vincent, Trafalgar, and Waterloo; total 12; complement, 1,000 men; lower deck, four 8-inch guns of 65 cwt., 9 feet; twenty-eight 32-pounder guns of 65 cwt., 9 feet 6 inches; middle deck, two 8-inch guns of 65 cwt., 9 feet; thirty-two 32-pounders of 50 cwt., 9 feet; main deck, thirty-four 32-pounders of 42 cwt., 8 feet; quarter deck and forecastle, six 32-pounders of 45 cwt., 8 feet 6 inches; fourteen 32-pounder carronades* of 17 cwt.; total, 120 guns.†

110 Guns.—Marlborough, Prince of Wales, Queen, Royal Frederick, Royal Sovereign, Victoria, and Windsor Castle; total, 7; complement, 950 men; lower deck, six 8-inch guns, twenty-four 32-pounders; middle deck, four 8-inch guns, twenty-six 32-pounders; main deck, thirty 32-pounders (3); quarter deck and forecastle, six 32-pounders (2); and fourteen 32-pounders of 25 cwt. 6 feet.

Total number of first-rates 19, mounting 2,210 guns.

Second-Rates.

104 Guns.—Camperdown, Hibernia, Impregnable, Princess Charlotte, Queen Charlotte, and Royal Adelaide; total, 6; complement, 850 men; lower deck, four 8-inch guns, twenty-four 32-pounders; middle deck, two 8-inch guns, twenty-eight 32-pounders of 48 cwt. 8 ft.; main deck, thirty 32-pounders of 32 cwt. 6 ft. 6 in., on compressor carriages; quarter deck and forecastle, six 32-pounders (2), and ten 32-pounder carronades of 17 cwt.

92 Guns.—London, Nile, Prince Regent, and Rodney; total, 4; complement, 820 men; lower deck, eighteen 8-inch guns, fourteen 32-pounders; main deck, six 8-inch guns, twenty-eight 32-pounders; quarter deck and forecastle, two 8-inch guns of 52 cwt. 8 feet, and twenty-four 32-pounders (3).

90 Guns.—Albion, Aboukir, Algiers, Exmouth, Hannibal, Princess Royal, and St. Jean d'Acre; total, 7; complement, 820 men. The armament of this class is precisely the same as that of the preceding, with the exception of there being only twenty-six 32-pounders on the main deck, instead of twenty-eight.

84 Guns.—Agamemnon, Asia, Bombay, Calcutta, Canopus, Clarence, Cressy, Formidable, Ganges, Monarch, Powerful, Sans Pareil, Thunderer, and Vengeance; total, 14; complement, 750 men; lower deck, six 8-inch guns, twenty-four 32-pounders; main deck, two 8-inch guns, thirty 32-pounders of 48 cwt. 8 feet; quarter deck and forecastle, six 32-pounders (3), and sixteen 32-pounder carronades of 17 cwt.

80 Guns.—Brunswick, Centurion, Collingwood, Colossus, Goliath, Irresistible, Lion, Majestic, Mars, Meeanee, Superb, and Vanguard; total, 12; complement, 720 men; lower deck, eight 8-inch guns, twenty 32-pounders; main deck, four 8-inch guns, twenty-four 32-pounders (1); quarter deck and forecastle, twenty-four 32-pounder guns (3).

Total number of second rates, 43, mounting 3,758 guns.

Third Rates.

78 Guns.—Achille, Bellerophon, Cambridge, Foudroyant, Hindostan, Indus, Kent, and Revenge; total, 8; complement, 650 men; lower deck, four 8-inch guns, twenty-six 32-pounders; main deck, two 8-inch guns, thirty 32-pounders (2); quarter deck and forecastle, six 32-pounders (3), ten 32-pounder carronades.

72 Guns.—Agincourt, Armada, Belleisle, Black Prince, Carnatic, Cornwallis, Egmont, Hastings, Hawke, Hercules, Illustrious, Implacable, Invincible, Malabar, Medway, Melville, Pembroke, Pitt, Russell, Sultan, Wellesley, and Wellington; total, 22; complement, 600 men; lower deck, four 8-inch guns, twenty-four 32-pounders; main deck, twenty-eight 32-pounders (3); quarter deck and forecastle, four 32-pounders (3) and twelve 32-pounder carronades.

70 Guns.—Boscawen, Cumberland; total, 2; complement, 600 men; lower deck, four 8-inch guns, twenty-two 32-pounders; main deck, two 8-inch guns, twenty-six 32-pounders (1); quarter deck and forecastle, sixteen 32-pounders (3).

Total number of third-rates, 32, mounting 2,348 guns.

Fourth-Rates.

56 Guns.—Ajax, Blenheim, Edinburgh, and La Hogue; total, 4; complement, 500 men; lower deck, twenty-six 42-pounders, of 66 cwt., 9 feet 6 inches; main deck, twenty-two 32-pounders (3); quarter deck and forecastle, four 56-pounders, of 87 cwt., 10 feet, and four 10-inch guns, of 86 cwt., 9 feet 4 inches.

50 Guns.—Alfred, America, Arethusa, Benbow, Conquestador, Con-

* All the carronades are to be mounted on Sir Thos. Hardy's compressor carriages.

† As the weight and length of the guns will always be regulated with strict uniformity, it will be unnecessary to repeat these items in each class. As, however, there are several classes of thirty-two-pounder guns to be used in the navy the figure (1) annexed will show the gun to be one of 50 cwt. 9 feet; (2), one of 45 cwt. 8 ft. 6 inch.; and (3), one of 42 cwt. 8 feet. Where this rule is departed from, the exact length and weight are given. The 32-pounder without any such distinguishing mark is that of 56 cwt. 9 ft. 6 in.

stance, Cornwall, Devonshire, Dublin, Eagle, Gloucester, Grampus, Indefatigable, Leander, Liffey, Nankin, Octavia, Phaeton, Raleigh, Severn, Shannon, Sutlej, Vernon, Vindictive, and Warspite; total, 25; complement, 500 men; main deck, six 8-inch guns; twenty-two 32-pounders; quarter deck and forecastle, four 8-inch guns and eighteen 32-pounders (2).

50 Guns (second class).—Chichester, Java, Lancaster, Portland, President, Southampton, Winchester, and Worcester; total, 8; complement, 450 men; main deck, four 8-inch guns, twenty-six 32-pounders, of 50 cwt., 8 feet; quarter deck and forecastle, four 32-pounders (2), and sixteen 32-pounders, of 26 cwt., 6 feet.

46 Guns.—Arrogant; total, 1; complement, 450 men; main deck, six 8-inch guns, twenty-two 32-pounders; quarter deck and forecastle, two 68-pounders, of 95 cwt., 10 feet, and sixteen 32-pounders, of 32 cwt., 6 feet 6 inches.

Total number of fourth-rates, 38, mounting 1,920 guns.

FIFTH-RATES.

40 Guns.—Active, Cambrian, Chesapeake, Flora, Pique, Sybille, and Thetis; total, 7; complement, 350 men; main deck, six 8-inch guns of 60 cwt., 8 feet 10 inches, eighteen 32-pounders; quarter deck and forecastle, sixteen 32-pounders (3).

44 Guns.—Africaine, Andromeda, Druid, Endymion, Hotspur, Isis, Leda, Madagascar, Meander, Nemesis, and Stag; total, 11; complement, 320 men; main deck, two 8-inch guns of 60 cwt., 8 feet 10 inches, twenty-six 32-pounders of 40 cwt., 7 feet 6 inches; quarter deck and forecastle, four 32-pounder guns (2), and twelve 32-pounder carronades. Note.—Endymion is to carry twenty-four 32-pounders of 40 cwt. on main deck, and fourteen 32-pounder carronades on her quarter deck and forecastle.

42 Guns.—Æolus, Blonde, Boadicea, Cerberus, Circe, Clyde, Diana, Fisgard, Fox, Hamadryad, Latona, Laurel, Leonidas, Melampus, Mercury, Mermaid, Minerva, Naiad, Proserpine, Resistance, Seringapatam, Sirius, Thalia, Thisbe, Undaunted, Unicorn, Venus; total, 27; complement, 310 men; main deck, two 8-inch guns of 52 cwt., 8 feet, twenty-two 32-pounders of 39 cwt., 7 feet 6 inches; quarter deck and forecastle, four 32-pounders (2), four 32-pounders of 39 cwt., 7 feet 6 inches, and ten 32-pounder carronades.

36 Guns.—Castor and Inconstant; total, 2; complement, 330 men; main deck, four 8-inch guns of 60 cwt., 8 feet 10 inches, eighteen 32-pounders; quarter deck and forecastle, two 32-pounders (1), and twelve 32-pounders of 25 cwt., 6 feet.

30 Guns.—Amphion; total, 1; complement, 330 men; main deck six 8-inch guns, fourteen 32-pounders; quarter deck and forecastle, two 68-pounders of 95 cwt., 10 feet, eight 32-pounders of 25 cwt., 6 feet.

24 Guns.—Eurotas, Forth, Horatio, and Seahorse; total, 4; complement, 320 men; main deck, twenty 42-pounders of 66 cwt., 9 feet 6 inches, on common carriages; quarter deck and forecastle, two 56-pounders of 85 cwt., 10 feet, on pivot slides and carriages, and two 10-inch guns of 86 cwt., 9 feet 4 inches, on slides and carriages.

Total number of fifth-rates, 52; mounting 2,096 guns.

SIXTH-RATES.

CLASS I. 26 Guns.—Alarm, Amethyst, Carysfort, Cleopatra, Creole, Diamond, Eurydice, Iris, Juno, Malacca, Niobe, Spartan, and Vestal; total, 13; complement, 240 men; main deck, two 8 inch guns of 52 cwt., 8 feet, sixteen 32-pounders of 40 cwt., 7 feet 6 inches; quarter deck and forecastle, two 32-pounders (3), and six 32-pounders of 25 cwt., 6 feet.

24 Guns.—Amphitrite and Trincomalee; total, 2; complement, 240 men; main deck, eight 32-pounders, ten 8-inch guns; quarter deck and forecastle, four 32-pounders of 25 cwt., 6 feet, and two 56-pounders of 85 cwt., 10 feet.

26 Guns.—Amazon; total, 1; complement, 240 men; main deck, twenty-six 32-pounders (1)

24 Guns.—Aigle and Curaçoa; total, 2; complement, 230 men; main deck, twenty 32-pounders of 40 cwt., 7 feet 6 inches; two 32-pounders (1); quarter deck and forecastle, two 8-inch guns of 52 cwt., 8 feet.

20 Guns.—Brilliant; total, 1; complement, 230 men; main deck, ten 32-pounders (1); six 8-inch guns of 52 cwt., 8 feet; quarter deck and forecastle, two 56-pounders of 85 cwt., 10 feet, and two 32-pounders of 25 cwt., 6 feet.

19 Guns.—Havannah; total, 1; complement, 230 men; main deck, ten 32-pounders (1), six 8-inch guns, of 52 cwt., 8 feet; quarter deck and forecastle, one 56-pounder, of 85 cwt., 10 feet, and two 32-pounders (1).

19 Guns.—Dædalus; total, 1; complement, 230 men; main deck, twelve 32-pounders (1), six 8-inch guns, of 52 cwt., 8 feet; quarter deck and forecastle, one 56-pounder, of 85 cwt., 10 feet.

CLASS II. 26 Guns.—Actæon, Andromache, Calliope, and Conway; total, 4; complement, 195 men; main deck, two 8-inch guns, of 36 cwt., 5 feet 4 inches, sixteen 32-pounders, of 25 cwt., 6 feet; quarter deck and forecastle, two 32-pounders (2), and six 32-pounder carronades.

18 Guns.—Calypso and Coquette; total, 2; complement, 195 men; main deck, two 8-inch guns, of 52 cwt., 8 feet, fourteen 32-pounders, of 40 cwt., 7 feet 6 inches; quarter deck and forecastle, two 32-pounders (2), on slides and carriages, to pivot.

18 Guns.—Daphne, and Dido; total, 2; complement, 175 men; main deck, two 8-inch guns, of 52 cwt., 8 feet, fourteen 32-pounders (3); quarter deck and forecastle, two 32-pounders (3).

22 Guns.—Herald, North Star, Samarang, Talbot, Tyne, and Volage; total, 6; complement, 175 men; main deck, two 32-pounders, of 39 cwt., 7 feet 6 inches, sixteen 32-pounder carronades; quarter deck and forecastle, four 32-pounder carronades.

Total number of sixth-rates, 35, mounting 826 guns.

SLOOPS.

18 Guns.—Arachne, Modeste, Narcissus, Nimrod, Pearl, Tweed, and Terpsichore; total, 7; complement, 145 men; two 32-pounders of 39 cwt., 7 feet 6 inches, and sixteen 32-pounders of 25 cwt., 6 feet, all on slides and carriages.

16 Guns.—Atalanta, Camilla, Frolic, Helena, Siren, and Zebra; total, 6; complement, 130 men; the armament of this class is precisely the same as the last, with the exception of there being only fourteen 32-pounders instead of sixteen.

14 Guns.—Champion, Comus, Electra, Favourite, Hazard, Hyacinth, Larne, Orestes, Racehorse, Rose, Satellite, Scout, and Wolf; total, 13; complement, 130 men; armament similar to that of the first class, but the number of 32-pounders reduced to twelve.

12 Guns.—Acorn, Albatross, Arab, Bittern, Columbine, Contest, Daring, Dispatch, Elk, Espiègle, Fantôme, Flying Fish, Goshawk, Grecian, Heron, Kangaroo, Kingfisher, Mariner, Martin, Mutine, Persian, Pilot, and Recruit; total, 23; complement, 130 men; armament the same as the first class, but the number of 32-pounders reduced to ten.

12 Guns.—Childers, Cruizer, Harlequin, Liberty, Lily, Pelican, Racer, Ringdove, Sappho, Serpent, Snake, Sparrowhawk, Squirrel, Wanderer, Wasp, and Wolverene; total, 16; complement, 130 men; two 32-pounders of 32 cwt., 6 feet 6 inches, and ten 32-pounders of 25 cwt., 6 feet.

8 Guns.—Cygnet, Ferret, Heroine, Hound, and Philomel; total, 5; complement, 80 men; armament as in the last class, but the number of 32-pounders reduced to six.

8 Guns.—Alert, Linnet, Ranger, and Star; total, 4; complement, 80 men; two 32-pounders of 32 cwt., 6 feet 6 inches, and six 32-pounder carronades.

8 Guns.—Britomart, Pantaloon, Rapid, Sealark, and Waterwitch; total, 5; complement, 80 men; two 18-pounders of 20 cwt., 6 feet, and six 18-pounders of 15 cwt., 5 feet 6 inches.

Total number of sloops, 79, mounting 984 guns.

BRIGS.

6 Guns.—Camelion, Curlew, Espoir, Nautilus, Rolla, Royalist, Saracen, Savage, Scorpion, and Wizard; total, 10; complement, 65 men; two 32-pounders of 32 cwt., 6 feet 6 inches; and four 18-pounder carronades of 10 cwt.

3 Guns.—Bonetta, Dart, Dolphin, and Spy; total, 4; complement, 65 men; one 32-pounder of 39 cwt., 7 feet 6 inches, and two 32-pounders of 32 cwt., 6 feet 6 inches.

3 Guns.—Griffin, and Lynx; total, 2; complement, 60 men; one 32-pounder of 39 cwt., 7 feet 6 inches, and two 24-pounder carronades of 13 cwt.

Total number of brigs, 16, mounting 78 guns.

SUMMARY.

			Guns.	Men.
19 first-rates, mounting		....	2,210	18,650
43 second-rates	"	....	3.758	33.260
32 third-rates	"	....	2,348	19 600
38 fourth-rates	"	....	1.920	18,550
52 fifth-rates	"	....	2,096	16,610
35 sixth-rates	"	....	826	7,470
79 sloops	"	....	984	9,675
16 brigs	"	....	78	1,030
Grand total, 314 ships of war	"		14,220	124,845

STEAM VESSELS PROPELLED BY SCREWS.

The return published in the *Journal* for May last, of the armament of the screw steam vessels remains unaltered under the present return, the only difference being that the name of the Pegasus is now altered to that of the Greenock. The complement of men has, however, since been fixed, as follows:—Simoon and Vulcan, 300 men; Termagant, Dauntless, Euphrates, and Vigilant, 250 men; Megæra and Greenock, 200 men; Conflict, Basilisk, Desperate, Enchantress, Falcon, Florentia, Niger, Encounter, and Harrier, 140 men; Rattler and Phœnix, 120 men; Archer, Cossack, Parthian, Rifleman, Sepoy, and Sharpshooter, 80 men; Biter, Boxer, Minx, and Teazer, 30 men.

The steam frigates with auxiliary power, and the steam guard ships, have been taken out of the catalogue of the steam navy, and placed with the sailing vessels.

STEAM VESSELS PROPELLED BY PADDLES.

Some slight alterations have been made in the classification of the steam-vessels propelled by paddles; but the armament being for each class substantially the same as given before, the following arrangements of the vessels, and their complements is all that it will be necessary to give: Terrible, 16 guns, 300 men; Penelope, 16 guns, 270 men; Odin, Leopard, and Sidon, 12 guns, 270 men; Avenger, Birkenhead, and Retribution, 6 guns, 250 men; Centaur, Cyclops, Dragon, Firebrand, Gladiator, Sampson, and Vulture, 6 guns, 195 men; Scourge, 2 guns, 160 men; Bulldog, Cormorant, Devastation, Driver, Eclair, Fury, Geyser, Gorgon, Growler, Inflexible, Sphynx, Spiteful, Styx, Stromboli, Thunderbolt, Vesuvius, Virago, and Vixen, 6 guns, 160 men; Hecate, Hecla, Hermes, Hydra, Medea, Salamander, and Trident, 6 guns, 135 men; Ardent, Alecto, Polyphemus, and Prometheus, 3 guns, 100 men; Janus, 2 guns, 100 men; Acheron, Antelope, Columbia, Grappler, Oberon, Pluto, Triton, and Volcano, 3 guns, 60 men; Blazer, Firefly, Flamer, and Tartarus, 3 guns, 55 men; Avon, Cornet, Gleaner, Kite, Lucifer, Lightning, Meteor, Porcupine, and Shearwater, 3 guns, 40 men; Alban, Dee, and Rhadamanthus, 4 guns, 60 men.

ENGINEERING EVIDENCE.

Extracts from Unpublished Evidence given by MR. R. STEPHENSON *before the House of Commons' Stour Valley Committee.* [Reported in the *Railway Chronicle*.]

ON SPEED—COMPETITION—THE FOUR-RAIL SYSTEM—THE TRUE PRINCIPLES OF GOODS AND COAL TRAFFIC, &c.

The Four-rail System—Economy.—In consequence of our fixed establishment we shall be able to carry the additional traffic we obtain cheaper than any other company can do. At present, as you converge towards London, the trains become more numerous, and when any of them are not in time they give rise to great disorder; not because the railway is incapable of carrying them when they keep their time regularly—for the London and Birmingham are capable of accommodating three times the amount of their present traffic, provided absolute punctuality is insured. More towards London the value of punctuality begins to tell most, and we want more lines. A loop line from Tring to Banbury [the Buckinghamshire, since passed] would accommodate local traffic, and could also be made subservient to heavy traffic moving at slow rates. Four lines of rails from London to Tring would receive and divide the great tide of traffic flowing toward the metropolis (at present flowing on two lines of rail only), and by enabling us to serve the public better attract more traffic to us.

Competition.—Looking at the past, we may expect for some time to come that the hostile companies will go on devouring each other, though I hold the opinion very strongly that permanent competition is impossible. The object of companies who are in competition in laying out lines is generally for the purpose of maintaining the ground, in order that when the time does arrive for adjusting their differences they may not be trampled on by their neighbours. I have the strongest possible opinion that perpetual competition is impossible, and that after the country is occupied there will be an adjustment. The Great Western are great preachers of competition, yet it is within my own knowledge that treaties have been going on between them and the London and South-Western, of which a territorial division has been the basis.

Quick and Slow Traffic (London and North-Western).—At present we are obliged to force on our goods trains to make room for our passenger trains. The cost of conveying goods is augmented in consequence of that speed. The public will never get the full advantage of railways until they can separate the slow traffic more or less from the quick traffic. Up to a certain extent the mixture does not add to the expense of conveyance, but when the mixture becomes very great, or the income of the railway is derived as much from goods as from passengers, then, in order to convey goods most economically, it becomes desirable to convey them at a speed of, say, from 15 to 18 miles an hour, coals at a speed not exceeding 15 miles an hour, for it is impossible to convey them at 1*d.* or ½*d.* per ton per mile if they are to be hurried along at 25 or 30 miles an hour; the cost and the wear and tear are too great, besides coal is damaged very much by velocity. The clogging of the London and Birmingham line referred to has arisen from the tolls having been very much lowered. Many persons thought that the reduction of tolls would not increase our traffic. Now, I held a different opinion. I always thought that by reducing fares on railways, especially the charges on goods, they would become great instruments of conveyance for the heavy class of articles: and so it turned out, so that a great increase came upon us suddenly, without our having either wagons or engines adequate for the increase.

Wear and Tear on Broad and Narrow Gauge.—Q. Is there no difference of pressure on the same weight of engine at the same speed on the broad and narrow gauge?—*A.* None; the crushing effect is precisely the same, or rather the crushing effect of the wide gauge is greater at the curves than on the narrow gauge. If there was any difference in the tendency of the heavy weights to crush the rails, it would tell against the wide gauge at curves, because the wheels are keyed on the axle, and they consequently move round with the same velocity, and when the engine is going round a sharp curve there is a greater distance to go round upon the outside, so the inside wheel has to slide a little back and the outside wheel has to slide a little forward; and, inasmuch as the difference of gauge increases the amount of sliding, the heavy weights will crush the rails more in the one case than in the other, but in a perfectly straight line the crushing is equal.—Q. Is the rail stronger on the broad or the narrow? —*A.* The rails are laid by Mr. Brunel on longitudinal timbers. He takes the strength of the timber as well as the iron. In the usual mode of constructing the narrow gauge you do not use the longitudinal timber, but you lay heavier rails instead. You get the bearing strength entirely on the rails in the one case, and in the other case partly on the timber.

Speed.—We are now in possession of speed that no permanent way in existence, broad or narrow, will be able to stand long. The wear and tear of the rails has been, in my opinion, nearly as the square of the speed. If it were perfect machinery in every respect, the wear and tear arising from concussions, ought to be exactly as the square of the speed, and I presume it ought to be directly as an engine weighing double the number of tons would cause double the amount of crushing. Indeed, I know that speed is the great trial of our present permanent roads. The proof is that we have been obliged to strengthen them about 16 or 18 lb. per yard, and now there are some of about 90 lb. This increase of speed, the weight remaining the same, is a direct and large sacrifice of the profits of the company, which has operated and is now operating with the London and Birmingham, and has led them to consider the propriety of duplicating the lines where they are compelled to run the heavy trains so quickly—that is between Tring and London. The interest of the capital they are about to expend to duplicate the line will be about 40,000*l.* a-year, the cost will be about 780,000*l.*

The origin of the Oxford, Worcester, and Wolverhampton.—Q. Is it a fact that this district applied to the London and Birmingham for accommodation and was refused, and was it in consequence of that refusal that the Oxford, Worcester, and Wolverhampton line was originally projected?—*A.* That, perhaps, is a rather harsh mode of representing it. But some of the London and Birmingham Board entertained a notion at that time that railways were not really fitted for the conveyance of heavy goods, and they did not seek to obtain the traffic which the country demanded; and then again their accounts were kept in such a way as to make it appear that they lost money by the conveyance of goods. This was done by charging the goods with a portion of fixed expenses, which would have been necessary under any circumstances even for conveying passengers. Therefore, when you debit the goods department with its proportion of the fixed establishment of the railway, then it does appear a loss to carry goods. There may be one or two of the Board now left who entertain their old opinions, but I know the management and system has undergone a complete revolution in that respect. I have always entertained the opinion that they ought to come down with their fares and carry heavy goods, and have urged it on the Board. But I do not move out of the engineering department of the company. I think that railways as instruments for the carriage of heavy goods, have not reached half their perfection or extent, and will not until we are permitted to separate the fast and slow trains. If we convey heavy goods at 15 miles an hour, I believe it will reduce the cost of conveyance to considerably lower than one half of what it is now; so that a large quantity of coal may come to London from the Midland districts. At present it costs us three farthings per ton per mile. In the North at Stockton and Darlington, where they convey the coal at 9 miles an hour, every charge is included, and they carry it at one halfpenny per ton per mile. The breakage of coal is so much increased by rapidity of movement, that it becomes impossible to move ordinary coal wagons when they are on any of the main lines without springs. The speed breaks the coal all to pieces. Experience has shown that the multiplication of railroads facilitates and creates much greater traffic than was anticipated. They reach on each other. That is one of the most remarkable features in the extension of the railroad system—the extraordinary reciprocation of traffic. If by the multiplication of railroads, and the adoption of economical modes of transit, you can reduce the price of coal, the demand for the article in London would be most prodigious, and in the country it would be very large. There are many agricultural counties where they do not know what coal is now.

REGISTER OF NEW PATENTS.

AMERICAN PATENTS.

PNEUMATIC HYDRAULIC ENGINE.

Specification of a Patent for "an Improvement in the hydraulic ram, called 'Strode's pneumatic hydraulic engine;'" granted to JOSEPH C. STRODE, *of East Bradford township, Chester county, State of Pennsylvania, March* 27, 1847. [Reported in the *Franklin Journal.*]

The nature of the invention and improvement consists in making use of a column of condensed air between the propelling fluid and the fluid that is to be raised; said air being condensed in a pyramidal-shaped chamber, by means of the momentum of a descending column of water; said chamber having a communication, by a small opening at its top, with another chamber, into which the spring water or fluid to be raised is introduced, called the spring water chamber, and upon which the condensed air in the first-named chamber is made to act, causing said fluid to rise through a tube placed in the spring water chamber (open at its lower end, and closed alternately at its upper end by means of a valve), into a large air vessel, or receiver, of the usual form and construction, being conducted thence to its place of destination by pipes, or hose, in the usual manner.

Similar letters in the several figures refer to corresponding parts.

A is the main pipe for conducting the propelling water from the head, or reservoir, to the pyramidal air chamber. This pipe descends

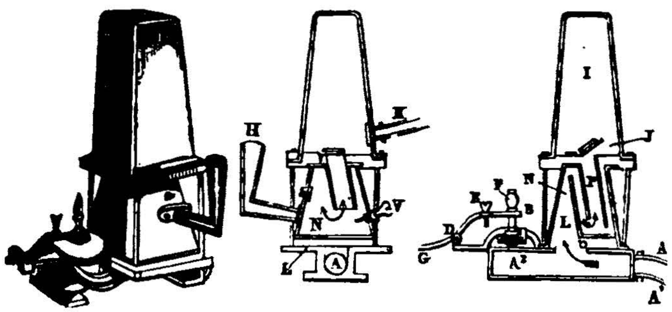


Fig. 3. Perspective view. Fig. 2. Transverse section. Fig. 1. Longitudinal section.

below the level of that portion of it which connects with the air chamber just before it reaches the said chamber, and then ascends, in a curved line to it, forming a curved bend in the pipe, as at A^1, for the purpose of preventing the air received at the valve B, during the time in which the vacuum is produced in the air and water chamber, as hereafter described, from filling the pipe A, as the air will not descend at said bend in the tube, so that the surplus of said air, after having filled the condensing chamber L, may be carried off, by the current of water, through the valve B.

The pipe A is enlarged below the air chamber L, as at A^2, and has an opening O into the air chamber S, through which the water passes when the valve B is closed.

B is a valve attached to a curved, vibrating lever C, turning on gudgeons D, in boxes, as its fulcrum, having a set screw E, for regulating the descent of the valve, and a counter-balance F, for adjusting the valve. When this valve B is down, as shown in fig. 3, the water from the head flows through the opening, which it closes; when it is up, as shown in fig. 1, the water rises into the pyramidal chamber L, through the opening O, and condenses the air therein.

H is a pipe for conveying the spring water to the spring water chamber. I is the air chamber into which the water is forced. J is the valve for holding it. K is a pipe or hose, for conveying the water to its place of destination. The above-named parts, lettered from A to K, inclusive, are made and operated in the usual manner. The improvements are as follows:

L is a pyramidal chamber into which air is admitted through the valve B, when it descends by the pressure of the external air, to supply the partial vacuum created in the pipe A, and chambers L and N.

This pyramidal chamber has a communication, by a small opening M at the top, with another chamber N, called the spring or pure water chamber; through which opening M, the air, so condensed, is forced, and presses on the spring or other water, introduced into the same through the pipe H, by which pressure, the water in the spring water chamber is forced upward through a tube P, reaching to near the bottom of the chamber N, through the valve J, into the air chamber I; said valve being represented as open in fig. 1, and as closed in fig. 2.

To raise water with this machine, open the valve B, and let the water flow out; then, by closing the valve B, the water, which is now in motion in the pipe A, will pass through the opening O, into the pyramidal condensing chamber L, and condense the air the same as before; the condensed air will force the spring water up the tube P, (which had entered through the pipe H during the continuance of the partial vacuum above spoken of), into the chamber I, and condense the air therein, until its density is equal to that in the condensing chambers L, and N, below; at this time the spring water will cease to flow into the air chamber I, the valve J closes, and the air in the chambers I, L, and N, commences expanding, that in the lower chambers, L and N, giving motion to the propelling fluid and driving backward, producing a partial vacuum in the machine, and the air in the upper chamber I, forcing the spring water to its place of destination.

The said partial vacuum in the machine, caused by the reaction of the machine, as aforesaid, and the pressure of the exteral atmosphere on the valve B, will cause it to open again. The water from the head then flows through this valve with an accelerating movement, until it has acquired that degree of velocity as to cause the valve to close. The water having no longer any vent through the valve B, passes through the opening O, into the pyramidal chamber L, and repeats the operation above mentioned successively.

In this manner the operation will continue as long as the machine remains in order and there is a head of water to propel it. The valve V is for the purpose of supplying the chamber I with air, by admitting the air into the tube P. The said air is admitted during the time that the partial vacuum above mentioned takes place. The air thus introduced into the tube P ascends to the top of the same, and is forced into the chamber I at the next stroke of the machine; said valve V is represented open in fig. 2, and may be closed, or regulated, by screwing the thumb-screw V.

The principal advantages this machine possesses over other machines are,

1st. In case of forcing up pure water by the propelling power of a running stream of water less pure, there is no possibility of the impure water mixing with the pure, there being at that time a column of condensed air between the two waters.

2nd. The water being forced into the upper chamber I, by the condensation of air in the lower chamber, the valve J opens more slowly than when water alone is made the propelling medium, and also shuts more slowly, thereby preventing the water from escaping back through the valve J after it is forced up—the valve J being nearly closed when the water ceases to flow upward into the chamber L. This advantage upon trial is found to be of considerable importance, enabling the machine, thus operated, to force, with a given quantity of water, several barrels more of water per day than it would otherwise do.

3rd. There being no valve between the condensed air in the lower chamber and the driving water, or at the opening O, the said air is permitted to act a longer time in forcing back the driving water, and thereby making a more complete vacuum than in other machines, and rendering useless the spring for opening the outlet valve B, as used in several machines.

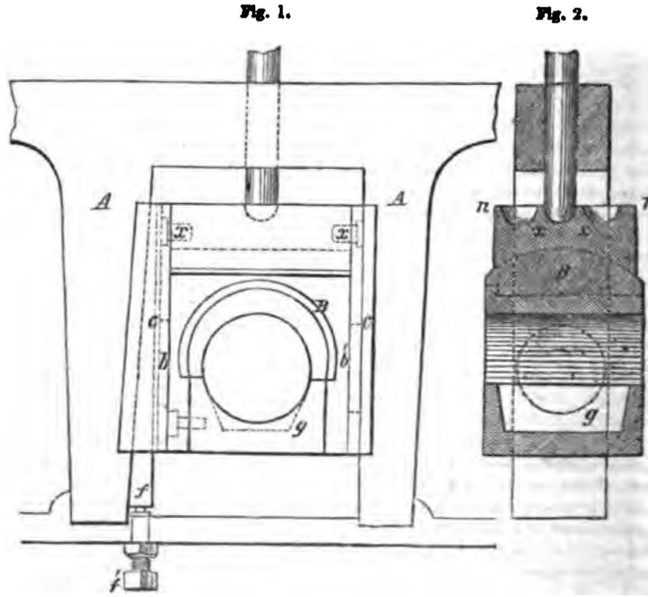
It is not necessary that the spring water chamber N, and the air chamber L, should be enclosed by the same envelope, but they may form separate chambers, and they may be arranged in any convenient way or manner most acceptable to the constructor, provided that the capacity of the air chamber does not exceed a due ratio between the propelling power and the water to be raised.

LOCOMOTIVE AXLE BOX.

Description of *"a vibrating box for locomotive axles,"* by Norris and Tull, of Philadelphia, U.S., June, 1846.

The arrangement of this box allows it to revolve in a vertical plane, at the same time that it floats up and down, the journals of the drivers having, at all times, their full bearing upon the box; let the axle assume any position from a horizontal line caused by inequalities of the road, or the consequent raising of the outer rail, in passing curves, which must necessarily reduce friction in a great degree, and insure the more perfect working of the engine, without producing any undue strain in its several parts, and has only to overcome the friction which

Fig. 1. Fig. 2.



is due to the surfaces upon which it works. This evil has always been overlooked in the construction of locomotives, and which must occur when a box floats vertically in a pedestal. Fig. 1, elevation of pedestal with vibrating box; fig. 2, cross section of the same; fig. 3, horizontal plan; fig. 4, vibrating box; fig. 5, bearing of vibrating box.

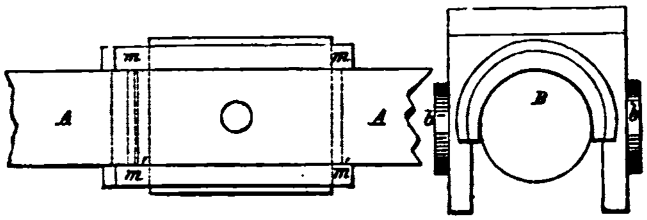
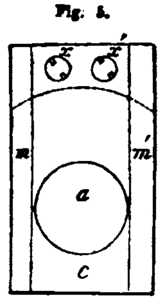


Fig. 2. Fig. 4.

A, A, pedestal forming part of the wrought iron frame. B, vibrating box resting with the two pivots *b*, *b'*, which are firmly attached to it in openings of the two sliding pieces, *c*, *c'*. Fig. 5, shows an end view of one of the latter, with its flanges, *m*, *m'*, and the hole, *a*, which is to receive the pivot, *b*. These sliding-pieces are connected, by means of screws, *x*, *x'*, with the cross-piece, *d*, the lower surface of which is cylindrical, and forms a bearing for the upper convex surface, *n*, *n'*, of the box, B. *f*, wedge, kept by the set-screw, *f'*, in a position which allows the box to slide in the pedestal, without being too loose or too firm. *g*, oil-box. In fig. 4, this oil-box is omitted. The same parts are marked by the same letters in the different views.—*Franklin Journal.*

Fig. 5.



ENGLISH PATENTS.

LOCOMOTIVE ENGINES.

George Fossick, engine-builder, Thomas Hackworth, engine-builder, and Thomas Elliott, superintendent of locomotives, all of Stockton-upon-Tees, for "*certain Improvements in locomotive and other boilers.*"—Granted March 3; Enrolled Sept. 3, 1847. [Reported in the *Patent Journal.*]

The improvements here specified relate, first, to the form or shape of the fire-box of locomotive and other tubular boilers; secondly, to the arrangement of the tubes; thirdly, dividing, in boilers of large diameter, the fire-box into two portions, by means of a vertical division.

The patentees in the specification of their first improvement state: we make the fire-box of a semi-cylindrical shape, corresponding in form to the cylindrical shell of the boiler, the top or roof of the fire-box being slightly curved; this roof is to be supported and sustained by the addition of wrought-iron stays, placed across the upper side of the roof and rivetted thereto; as with fire-boxes of the usual construction, the end of the fire-box is closed by a thick flat plate, generally termed the tube-plate, through which the tubes pass as usual. The outer or open end of the fire-box is closed by double or treble plates, having a door formed of double or treble plates made therein, and an opening to the ashpit beneath the said door; a bridge is placed, as usual, transversely in the fire-box, and the fire-bars are properly supported by bearing-bars, at a suitable height in the fire-box, as is usual in boilers with tubular or enclosed fire-places; the shell or case of the boiler is stated and represented by the patentees as cylindrical the whole length of the boiler.

The patentees state their second improvement to be the arrangement of the horizontal tubes through the boiler from the fire-box to the smoke-box; these tubes the patentees place in vertical rows, and not, as they are usually arranged, in diagonal or horizontal rows; this arrangement of vertical rows allows a free space between each row of tubes, thereby allowing a free and uninterrupted passage for the escape of the steam, generated by the lower tubes: the patentees also state the facility this improved arrangement possesses of allowing the cleansing of the tubes from incrustation and sediment from the water, by a proper scraper or cleaner, being passed down the opening between the vertical rows of tubes, and thereby removing any sediment or incrustation from them.

The patentees state their third improvement to be the employment or introduction of a vertical division of water space, placed within the semi-cylindrical fire-box, and thereby dividing the said fire-box into two separate compartments; this arrangement the patentees propose adopting when boilers of increased diameter are required.

The patentees after describing the above improvements claim, first, the forming the fire-box of locomotive and other boilers of a semi-cylindrical shape, but slightly curved upon the upper side, and carrying the tubes from the said semi-cylindrical fire-box in such manner as agreeing with the general form of such fire-box, as hereinbefore described. Secondly, the patentees claim the arranging the tubes in locomotive and other boilers known as tubular boilers, in vertical rows, whereby a free and uninterrupted passage is obtained between such vertical rows from bottom to top, as hereinbefore described. Thirdly, the patentees claim the use and arrangement of vertical divisions, within the fire-box, of boilers, dividing such fire-boxes into separate compartments or fire-places, as hereinbefore described.

IMPROVEMENTS IN FURNACES.

George Grundy, of Manchester, in the county of Lancaster, manager, for "*certain Improvements in furnaces, and in the flues and tiles used in the construction thereof.*"—Granted February 8; Enrolled Aug. 8, 1847.

This invention relates to a novel arrangement of the flues and other parts of a furnace, whereby the heat is more effectually applied; and also in certain tiles to be used in the construction of the furnace. The annexed engravings show a furnace, constructed according to this invention, containing four fire-clay or tile cylinders or retorts, for generating coal gas.

Fig. 1. Fig. 2.

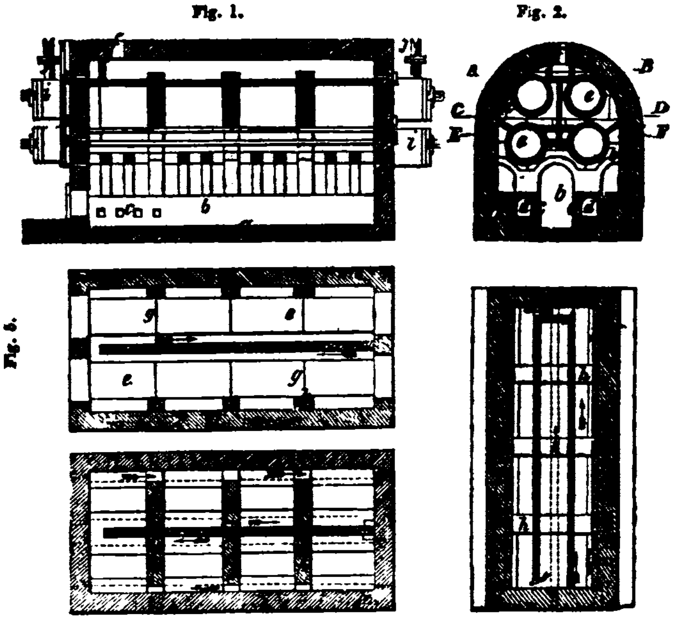


Fig. 5. Fig. 4. Fig. 3.

Fig. 1 is a longitudinal vertical section of the furnace; fig. 2 is a transverse vertical section thereof; fig. 3 is a horizontal section, taken on the line A B of fig. 2; fig. 4 is a similar section, on the line C D; and fig. 5 is a section on the line E F. *a* is the brickwork of the furnace. *b* is the fire-place or chamber, wherein the fuel (which in this case is coal-tar, but other fuel may be used) is introduced; it extends the whole length of the furnace, and is supplied with air through the openings *c*, from two parallel flues *d*, which extend from one end of the furnace to the other, and are furnished with doors at each end to regulate the supply of air. The oven, in which the tile or fire-clay cylinders or retorts *e* are fixed, is of the ordinary shape; and the course of the flame and heated gases, generated below, is indicated by the arrows in the horizontal sections, figs. 3, 4, 5, which are taken at different levels, in order to show the continuous traverse of the heated gases from end to end, or from end to centre of the retorts *e*, until they escape through the opening *f*, in the crown of the oven. The cylinders or retorts are made of tile or fire-clay, and may be strengthened, if considered requisite, by imbedding metal hoops in the clay. Each cylinder is open at both ends, and consists of several pieces, which are jointed together, as seen at *g*, fig. 5; the joints being made good with fire-clay, and supported by the fire-clay tiles *h*. The number of joints in each retort will depend upon its length; but this may greatly exceed the length of ordinary retorts, on account of the facility of working at both ends, which the patentee considers an important feature of his invention. The retorts have caps *i*, fitted on each end, furnished with exit-pipes *j*, for the gas. Any accumulation of coal-tar is removed from the retort, by partially opening one end of the retort, and applying an extra pipe to the opposite end; which pipe then acts as a flue, and the draft of air through the heated retort completely removes the carbonaceous deposit.

The patentee states, that the description of the manner of applying his improvements to a furnace for generating gas will enable a person to apply such improvements to furnaces for other purposes. He claims the general arrangement of the furnace and flues as described, which consists in a continuous fire-place from one end to the other, supplied with air from parallel air-flues—thus allowing the heat to be conducted from end to end, or from end to centre repeatedly; together with the peculiar form and construction of tile or fire-clay tubes, and the tiles forming the joints, as above described.

COOLING COKE OVENS.

Frederick Ransome, of Ipswich, Suffolk, for "*Improvements in working coke and other kilns or ovens.*"—Granted Feb. 24; Enrolled Aug. 24, 1847.

This invention consists of improvements in cooling coke and other kilns or ovens, by causing air to circulate by mechanical apparatus through the cooling flues or passages.

In the working of coke ovens the cooling has been extensively done by having air passages arranged so as to allow air freely to circulate in contact with the inner lining of the oven, the air not coming in contact with the charge, such circulation being caused by the rarefaction of the air by the heat of the flues. Such mode of working coke ovens is according to a patent granted to Jabez Church, December 20, 1845. This mode of making coke is very superior to the old mode where the charge is drawn when hot, and cooled down by water. In working of such coke ovens, it has been found that the time of cooling an oven is very uncertain, depending on the state of the outer atmosphere, and that it is important to cool down the charge as quickly as possible, so long as the atmosphere is excluded from the charge. In coke ovens constructed according to Church's patent, the air after passing through the flues simply rises through a short pipe into the air by its levity, the pipe having little, if any effect, in causing the circulation or passage of the air through the flues. But it has been found that by hastening the draft in ovens arranged with flues, the cooling process may be materially quickened. And this the patentee prefers to do by connecting the cooling flues with a rotatory fan, in such manner as to continuously withdraw the air from such flues, by which means the external air will rush into the flues or passages, and thus cool the same quickly, and by these means the charge in the oven will also be quickly cooled.

The patentee does not confine himself to the fan, as other known arrangements of blowing and exhausting apparatus may be employed, or in place thereof the air or cooling flues or passages, or the pipe thereof, may be conducted into a high shaft or chimney; thus adding additional power of exhaustion to that which results from the heat of the passages or flues.

CAOUTCHOUC.

Stephen Moulton, Esq., of Norfolk-street, Strand, Middlesex, gentleman, for "*Improvements in treating caoutchouc with other materials, to produce elastic and impermeable compounds.*"—Granted Feb. 8; Enrolled Aug. 8, 1847.

This invention consists in treating caoutchouc by combining therewith calcined and carbonate of magnesia and hyposulphate of lead and the artificial sulphuret of lead, and submitting the combined compound to heat, which process dispenses with the use of solvents. After the caoutchouc has been cut and cleansed, one or more pounds weight, as can be conveniently ground or mixed at a time, is put between two revolving iron rollers, heated internally by steam, when it presents a rough, uniform sheet, and is then ready for the mixing it with the following ingredients.

If the goods are intended to be elastic, and to be unaffected by heat or cold, mix in with 1 lb. of caoutchouc, from 1 to 8 oz. of the hyposulphate of lead and the artificial sulphuret of lead, both or either, but the patentee prefers them in equal proportions; but if they are used separately, then the whole quantity mentioned will be used. If the goods are intended to be hard, of greater tenacity, and of less elasticity, mix in from 2 to 8 oz. of the calcined or carbonate of magnesia with 1 lb. of caoutchouc, and then add both the hyposulphate of lead and the artificial sulphuret of lead, or either, in like manner and proportions, as used for elastic goods.

The materials above-mentioned and the caoutchouc having been passed repeatedly between the mixing rollers, so that the whole compound may be well combined, it is then removed to another pair of rollers denominated the grinding rollers, and treated in like manner, which rollers are placed nearer to each other than the mixing rollers, in order that by these rollers a more perfect mixture of the compound may be effected. After this second process, the compound is again removed to the third pair of rollers, also heated by steam, denominated the softening rollers, and again ground or mixed thereby, when it soon becomes fit for its removal to the spreading machine.

The spreading machine comprises two or more iron cylinders, which are heated internally by steam (the machine preferred consists of three rollers one above the other), and of a smoother and finer surface than that of the rollers before-mentioned. The compound is placed between the upper rollers and passes to the lower one, upon which the cloth for its reception passes round, and thus receives on its surface the different coatings of the compound required. If sheet rubber is desired, the compound is placed in like manner, dispensing with the use of the cloth, and the sheet taken from the lower roller. Both the coated cloth and the sheet rubber in passing off the lower roller are rolled up in dry cloth to keep the surfaces apart, and is then fit for making up into such goods as may be required. In manufacturing goods from the compounds thus prepared, when manufactured, they are dusted over with purified pipe or other clay of similar quality finely powdered, to prevent the surfaces from adhering together; but they are as yet still liable to the action of all the solvents and other influences which act upon caoutchouc, and would accordingly become rigid in cold, and soft and sticky in warm weather; to free the caoutchouc therefore from these, its natural characteristics, it has been combined with the salts of lead above-mentioned, and the goods manufactured from this compound have now to be subjected to heat in a suitable chamber or cylinder, and heated either by steam or dry heat (the former is preferred) of from 220° to 280° or 300°, according to the quantity of the goods heated at one time, and also as to the thickness of the compound put into the sheets or upon the cloth.

The time required for heating goods will likewise vary according to the circumstances last mentioned. Some heats may require three hours, and some five hours or thereabouts, and which is easily determined by any practical man acquainted with the business. After the goods have been heated, as last mentioned, they become elastic and impermeable, as set forth in the title above recited.

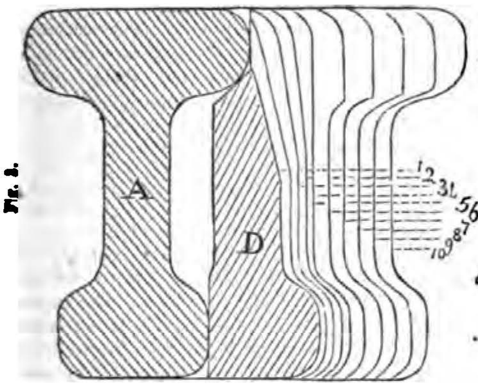
RAILWAY SWITCHES AND TURN-TABLES.

Charles Heard Wild, of Mortimer-street, Cavendish-square, civil engineer, for "*Improvements in constructing parts of railways,*" —Granted Feb. 24; Enrolled Aug. 24, 1847. [Reported in the *Patent Journal.*]

The improvements here specified relate severally to the form of the points of the moveable tongue rails of railway switches, and to the construction and application of certain mechanism to turn-tables, to facilitate their action. The object of the patentee being to remove, by the first of his improvements (namely, that improvement relating to railway switches) the objections attendant upon switches of the usual construction. These objections being, as stated by the patentee, of two kinds,—one of which as an alternative it has hitherto been necessary to adopt, as follows,—When the point of the moveable tongue rail has been made sufficiently broad and strong to support the weight of the wheel and the load of the carriage, it became necessary to have a notch in the fixed rail to allow the inner edge of the point of the tongue rail to coincide with the inner edge of the fixed rail, so that there might be no impediment or interruption to the flange of the wheel upon passing the point, while the switch is closed; thus far, *while the switch is closed*, no important objection exists, as usually constructed, as they present an unbroken surface of rail to the passage of the carriage wheels; but the contrary is the case, when the switch is opened: the notch now presents its objections and disadvantages to action, the carriage wheels in passing striking against the side of the notch. The alternative of this objection is, making the depth of the notch much less; but to allow this, it is necessary to reduce the thickness of the point of the tongue rail, thereby rendering it too thin and weak to support the passing weight. These objections and disadvantages the patentee proposes to remove by the improvements in question, and which consist in cutting away so much from the upper table, and from the outer side of the middle webb of the moveable tongue rail, at the immediate point or extremity of such moveable tongue rail, as to enable the end of the same to pass under, and be housed beneath, the upper table of the side rail of the main line of rails, when the switch is closed. The wheels of the carriages in passing along the switch will not press vertically upon the moveable tongue rail in consequence of the end of the tongue being below and beneath the upper table of the side rail; but the flange of the wheel will press laterally against the side of the tongue rail; the wheel will pass a considerable distance along from the end of the tongue rail before it commences pressing upon it vertically, the upper table of the tongue rail being gradually developed as it recedes from the side rail, till, at a considerable distance from its point, it is of sufficient bulk and strength to receive the vertical pressure of the wheel without injury. The tongue rail still continues to develope itself for a further distance, where it is of the usual and proper form.

By these improvements, the patentee obviates the necessity of having a notch cut in the upper table of the side rail for the reception of the point or end of the moveable tongue rail, or the alternative of having the point or end of the tongue rail cut so thin, and thus so reduced in strength, as to be unable to support the pressure of the wheels and load when passing over it. Fig. 1 is a plan of a railway switch, made according to the most approved construction usually used, but with the points of the moveable tongue rails, D and D', made according to the patentee's method; A, A', the rails forming the main or through line of rails; B, B', the rails forming the branch line or siding; C, C, the chairs supporting the same; D and D', the two moveable tongue rails jointed to the jaw chairs, E, and sliding or moving laterally upon the table chairs, F, as usual; G, a rod or bar connecting together the two moveable tongue rails, and connected with any apparatus for the purpose of opening or closing the switch

Fig. 3.



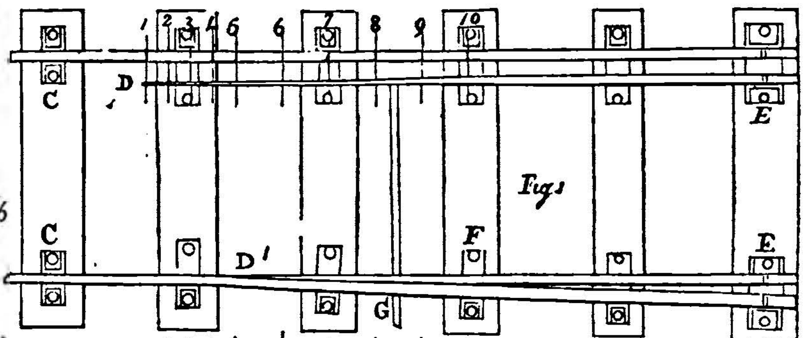
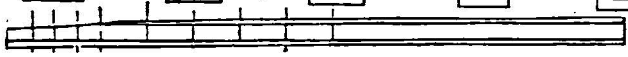


Fig.2



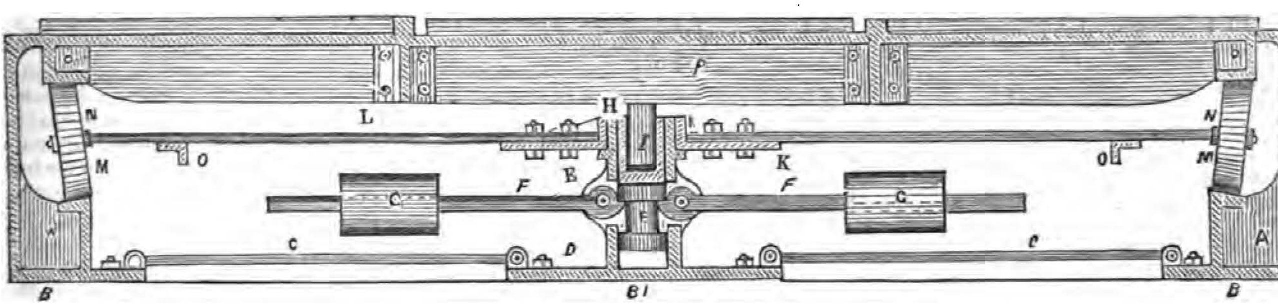


Fig. 4.

in the usual manner. The ends or points of the moveable tongue rails, D and D', being made and constructed, as represented by the dotted lines, in addition to the full lines in the plan, fig. 1, and also by figs. 2 and 3; fig. 2 being an elevation of the tongue rail D, showing the inclination of the top surface of the upper table of the tongue rail, D; fig. 3, a diagram upon an enlarged scale, representing, as will be hereafter explained, the contour or form of the tongue rail, by the sections represented, as taken at the points shown by the numbers 1, 2, 3, &c. By reference to the above, and the following description thereof, the form or contour of the moveable tongue rail will be at once apparent. 1, 2, 3, &c. (fig. 3), represent the point or end; and the sections of the tongue rail, D, figs. 1 and 2, taken respectively at the corresponding numbers thereon; thus describing and showing the form or contour of the said tongue rail, D, from the point or end of the same to No. 10, where it is the full size of the general body of the rail. The right-hand tongue rail, D', is precisely of the same shape or form as the rail D, but reversed, to suit the opposite side rail, A', of the line; should, however, the thickness of the upper table, or the breadth of the lower table, of the side rail, A, or A, exceed, or fall short of, or otherwise vary from the dimensions or proportions shown in the patentee's drawings, the patentee directs the moveable tongue rail to be made to conform to the form or contour of such side rail by cutting away more or less from the upper or lower table of the said tongue rail, so as to allow the point or end of the said tongue rail to pass under, and be housed beneath, the upper table of the said side rail; or a portion may be cut away from the under side of the upper table of the side rail, if sufficiently thick to allow this reduction, for the same object, without unnecessarily reducing the strength of the tongue rail.

The second improvement of the patentee relates to supporting and balancing the upper or moveable portion of turn-tables, and thereby lessening the bearing weight, and consequently the friction upon the moving parts; and it also relates to the position of the friction rollers or wheels placed beneath the outer edge of the revolving table or plate, by arranging them in such a position that the upper edge of the rollers shall be in one horizontal plane, or plane at the right angles to the centre line of the axles of the turn-table. Fig. 4, a sectional elevation of the turn-table; A, the lower or outer curb firmly bolted to the foundation, B, and fastened by the radial bars, C, to the centre plate, D; also firmly secured to the foundation B'; E, a block of metal moving freely within the centre plate, D, and acted upon on the under side by the inner ends of the levers, F, F, of which there are two; the other end of the levers, F, F, carrying the counter-balance weights, G, G, adjustable upon the levers, F, F; upon the block, E, within the centre-piece E, rests the brass step, H, in which works the centre axes, I, of the turn-table; upon the exterior of the centre-piece, E, revolves loosely the disc, K, to which are bolted the radial arms or axes, L, L, carrying at their extremities the friction rollers or wheels, M; N, N, washers placed upon the axes, L, L, for adjusting the position of the friction wheels or rollers, M, thereon; these friction wheels or rollers revolve upon the raised portion of the curb, A, and carry the outer edge of the revolving table or plate, P; O is an iron ring bolted to and connecting the radial arms or axes L, together; the counter-balance weights, G, G, acting through the levers, F, F, upon the toe of the axes, I, of the revolving turn-table, P, relieve the friction rollers or wheels, M, from a very considerable portion of the weight of the revolving turn-table: thereby the friction is considerably lessened, and the turn-table moved with greater facility than by the usual methods; the upper edge of the periphery of the friction rollers or wheels, M, being, the whole of them, in the same horizontal plane. The object of the arrangement and invention the patentee states to be, to allow any lateral motion of the upper or revolving plate of the turn-table to take place, without in any way affecting the pressure or position of the said revolving plate upon the friction rollers or wheels.

The patentee also states, the third part of his improvements to be, the arrangement of the rails upon the turn-plates, and the arrangement of turn-plates upon parallel lines of railway, to facilitate the removal or transit of carriages from one rail to another. This improvement simply consists in placing the turn-plates in such a position that a line passing through the centres of such turn-plates shall be at such an angle as shall divide the circle. The patentee giving two examples, thus: one in which the line passing through the centre of the turn-plate is at an angle of 60° to the line of rails; by their being placed in this position the patentee fixes upon the turn-table three lines of rails, and a carriage placed thereon has to be moved twice through 60° only, or one-sixth of a circle, instead of by the usual arrangement 90° or one-fourth of a circle. In the other example of the patentee's, the said lines passing through the said centre of the turn-plates are placed at an angle of 45°: in this example the patentee arranges upon the turn-plates four lines of rails; and a carriage requires to be moved through one-eighth of a circle, or 45°, twice, to place it upon another and parallel line of rails. By these arrangements, the patentee states, the turn-table is in a position to receive a carriage upon it, whether from the inclined line between the parallel or main lines, or from the main or parallel lines themselves.

The patentee, after specifying and describing his invention and improvements, states his claim to be; 1st. The construction and application of moveable tongue rails of railway switches, as hereinbefore described. 2nd. The construction and arrangement of railway turn-tables, by which the upper edges of the peripheries of all the revolving friction rollers or wheels are in one and the same plane, that plane being horizontal, or at right angles, to the centre line of the axes of motion of the upper or moveable plate of the turn-table, and thereby allowing lateral motion of the said upper or moveable plate upon the said revolving friction rollers or wheels, without injuriously affecting or deranging the perfect action of the said arrangement and apparatus. And the patentee also claims the construction and application of the lever balancing apparatus to the said turn-tables, as hereinbefore described. 3rd. The arranging and fixing the rails upon turn-tables, and the arrangement of the relative positions of the said turn-tables to facilitate the removal of carriages from one to another line of rails, as hereinbefore described.

HIGH-PRESSURE MARINE BOILERS.

The explosion of the boiler of the Cricket steamboat has given prominence to the question, whether high-pressure steam can be used with safety for the purpose of navigation. In considering the subject, however, at such a time, there is some danger that the judgment may be prejudiced, and a too-hasty decision given against the principle, when only the mode of carrying it into practice has been defective. It is most desirable to view the matter as freely as possible from the influence which such a disaster is calculated to produce, and to consider all the circumstances attending it, for the purpose of ascertaining whether they disclose any inherent danger in the use of high-pressure steam that no precaution can remove, or whether the accident was the result of recklessness on the part of those employed, or of want of care in the manufacturing engineer;—casualties altogether independent of the safety of high-pressure steam. We will in the first place compile a brief narrative of the event, collected from the evidence of those who witnessed the explosion.

The Cricket was one of three steamboats built on the same principle, and employed in conveying passengers to and from the Adelphi-pier and London-bridge, at the low fare of one halfpenny. On the morning of the 27th of August, the Cricket was at the Adelphi-pier, waiting for passengers. She had been waiting for ten minutes after having come from London-bridge, with the steam up; yet, during that time, nearly all the witnesses declare that there was no steam blowing off. The captain had gone ashore, and the person in whose charge the engine was for the day—not the regular engineer—was standing on deck near the funnel talking to the stoker. The call-boy was in the after-cabin, and not one of the persons belonging to the boat was in the engine-room. The number of passengers on board is variously stated at from 100 to 200. Suddenly a loud noise was heard, which is described by some of the passengers to have resembled the sound of rushing steam and rending iron, rather than a sudden explosion; others, indeed, compare the noise to the discharge of a cannon. The boiler casing was projected with great force through the after-part of the boat, which was completely destroyed. The whole flooring of the deck was blown up, the cabin was stripped bare, and the iron sides of the vessel, where it narrowed at the run, were laid flat, and the boiler casing was carried into the water. The steam chest was projected upwards, carrying with it the funnel and the outer case of the boiler, and shattering the bridge which connected the two paddle-boxes. The front plate of the boiler and the tubes were driven against the frame of the engine, which was much injured, but it fortunately arrested the progress of that portion of the boiler, and thus preserved the fore part of the boat.

An explosion attended with such destruction on the vessel must, of necessity, have told with disastrous effect on the numerous passengers. Those on the after deck were blown into the air: some fell into the water, and others descended among the ruins of the vessel. The number killed, however, is wonderfully small considering the destructive effects of the explosion. The lives lost were only five, and among them was the call-boy, who was boiling coffee in the after-cabin when the boiler casing swept through it. Even he, continued to live sometime after the explosion. It is a remarkable circumstance, also, to which we shall subsequently direct attention, that not one of those who were killed had been injured by scalding, and among the many who have sustained injuries by the explosion, very few have been scalded, and none of them seriously.

The foregoing is a brief *resumé* of the principal facts given in evidence before the coroner, respecting the explosion of the boiler and its effects; we have now to inquire for the cause of the disaster. The engine was constructed in accordance with a plan (patented by Mr. Smith, one of the proprietors of the boat,) in which the principles of high-pressure and of condensing engines are combined, and the result is reported to have been a great saving of fuel. The engines were made by Mr. Joyce. The boilers were tubular, having the fire contained in a tube three feet diameter within them. The boiler casing, which was cylindrical, was about five feet diameter and six feet long, with a hemispherical end at the after part, and it was made of ⅜-inch iron. The steam-chest was cylindrical, with a hemispherical top, and was composed of iron $\frac{5}{16}$ths of an inch thick. There were 66 tubes of 2¼ inches diameter inside and 4 ft. 9 in. long. The safety-valves were $2\frac{5}{16}$ inches in diameter, being flat and resting on flat seats. The length of the levers was 27 inches, and the fulcrum 2¾ inches. Of these valves there was one on each of the two boilers, which freely communicated by steam and water passages; and besides these lever-valves, each boiler had a Salter's spring-valve supposed to indicate 45 lb. on the index: there was also a mercurial gauge, for the additional guidance of the engineer as to the pressure of the steam. Neither of the boilers had any stays above the tubes, nor in the steam chest. With respect to the boat itself, the following specification for its construction, as agreed between Mr. Smith and Mr. Joyce, shows that it was intended to be put together in the best manner:—

"*Specification of an Iron Steamboat.*

Length on deck	. .	126 feet
Breadth of beam	. .	13 feet
Depth of hold	. .	7 feet

Draft of water 2 ft. 6 in., with machinery and coals on board. Is to be built of the best plates, flush jointed, and countersunk rivetted.

Plating of bottom lower streak, one-fourth thick;
Second, third, and fourth streaks, three-sixteenths thick;
Fifth streak, one-eighth full; sixth streak, one-eighth.

Angle iron frames 2 in. by 2 in., and 18 inches apart in centre of vessel, and towards the ends the angle iron to be lighter, and 24 inches apart.

Sleepers about 12 inches deep and one quarter thick, and of sufficient length to distribute the weight of engines and boiler over 30 feet length of vessel.

Keel and stems 6 inches by ½-inch.

Bulkheads and coal bunkers ¼ full, ¼ bare.

Suitable half-round iron all round that portion of the boat designated the plank shear or gunwale streak, including sponsons.

Wood Work.

Shelf piece of best red pine	. .	5 in.	by	2½ in.
Beams, 24 inches apart	. . .	3½	"	2½
Plankshear of Quebec oak	. .	7	"	2½
Deck, best yellow pine	. . .	5	"	1½
Shear streak of best red pine	. .	8	"	1½

Paddle beams, spring beams, and rim pieces of Quebec oak.

Cabin floors of good yellow battens, one inch thick, on suitable bearers of red pine.

Cabins to be fitted up similar to the Ant and Bee, and the joiners' work and fittings, skylights and companions, to be equal and similar to those vessels.

Glazing of the best character (with best bull's eye scuttles).

The whole of the wood and iron work to have three good coats of paint.

This vessel is to be fitted with a pair of engines of 16-horse power, each similar in principle to those on board the Ant and Bee, with a much improved and very powerful boiler. A good cabin stove in the after cabin.

And to be equipped with anchor, ropes, and everything for her station. A small winch at the head for her anchor, and all necessary fittings complete to go upon her station for work, and to include an extra donkey-pump, steam pressure gauge, vacuum gauge, and a Salter's balance on one safety-valve; the other safety-valve to have a weight in the usual way, and all necessary fire irons and spanners.

Speed to be equal to the fastest of the above bridge boats; consumption of fuel not to exceed 4½ lb. of good Welsh coals per indicator horse-power of (66,000) per hour.

Time of completion—All, May 1846.

I, William Joyce, do hereby undertake to make, construct, finish, and supply you with the whole of the before-mentioned works, viz., the iron steamer complete, with her engines, boiler, and fittings, in all respects ready to go to work upon her station, of the very best quality, best of materials and workmanship, and without any extra charge whatever beyond the sum now agreed upon, viz., Two thousand five hundred and fifty pounds sterling."

[The periods at which the money was to be paid having been specified, the agreement concludes as follows]:—

"In consideration of receiving the above order upon the terms specified, I also agree to put the engines and boiler which I have already been paid for into the new steamboat building by Messrs. Ditchburn and Co., called the Cricket, and to complete the same engine and boiler in every respect fit for work upon her station (with the exception of half the cost of a donkey pump, pressure gauge, and Salter's balance, which has been settled at £12), before the expiration of the present month.

Signed by both of us upon the 11th day of February, 1846. } O. H. Smith, W. Joyce.

Witness to the above signature, Bn. Nash."

The agreement, it will be observed, stipulates for one boiler only, but Mr. Joyce afterwards undertook to put in two smaller boilers instead of it, as he considered they would be safer. Mr. Smith, when examined before the coroner, said he had every reason to believe that Mr. Joyce had adhered strictly to the terms of the contract, and that the boat and the engines were constructed according to the specification. It appears, however, from the terms of the agreement, that nothing was specified as to the form or strength of the boilers, which were left entirely to Mr. Joyce, under the stipulation that the engines were to be of 16-horse power each, "with a much-improved and very powerful boiler," and to work with a given quantity of fuel. Whether Mr. Joyce took any and what precautions to test the strength of the boilers before he put them into the boats, has not at the time we are writing been given in evidence; but the lever-valves were weighted to rise at a pressure of 40 lb. to the square inch, and the spring-valves were screwed down to 45 lb. During the whole examinations not one witness has spoken to having seen the steam blowing off at the spring-valves.

The circumstances that have been elicited during the investigation tend strongly to throw the blame of the accident on the gross mismanagement of those who had the charge of the boat. More careless and reckless conduct was scarcely ever disclosed, and the surprise is, not that the boiler burst on the 27th of August last, but that it did not burst at any time during the last six months. Clark, the engine-driver, who was appointed to the Cricket at Easter last, appears almost from the first to have pursued the plan of tying down the lever safety-valves when the boat was in motion, and the fact seems to have been so notorious that many persons avoided going on the boat, and a "blow up" was spoken of as an occurrence to be daily expected. Notwithstanding the notoriety of the fact among the persons connected with the Cricket boats, that Clark was in the habit of tying down the valves, the managing proprietor seems to have been so blinded by the plausibility of that man's statements, and by confidence in his veracity, that he dismissed Edwards, the stoker, who had complained to the captain of the danger of the practice, without any inquiry. There is indeed an attempt to deny, on the part of some of Clark's friends, that the valves were tied down; but the evidence of the fact is too strong to be doubted. Among others who deposed to having seen the levers tied down, was Mr. Meachem, the foreman of Mr. Joyce, who was driving the engine one day in the absence of Clark, and when he found the levers tied he instantly cut the strings, remarking at the time that he knew what the boilers would bear better than Clark. The boat seems to have been frequently entrusted to the care of persons quite incompetent to the duties of managing the engine, and among others to whom the charge was committed was a man who six months before had been the porter at a seed warehouse.

The evidence of the stoker who succeeded Edwards made the case still stronger against Clark than his predecessor. He said that he had regularly tied the valves down by the order of Clark when the boat got underway; that the pressure indicated by the gauge was sometimes 80, and that the boiler and condenser often became so hot that the steam would not condense, and the engine-room became filled with steam. All parts of the boat became hot in consequence, and it was no uncommon thing at such times for the people on deck to call out, "All hot, all hot!" He further stated, in confirmation of the preceding evidence of Clark's recklessness, that he would sometimes start the boat before the water in the boiler was up to the bottom cock, and that on Sundays, when the boat was most crowded, he would have friends drinking with him in the engine-room, and "practising driving engines." As an instance of the strains the boiler sustained by the extreme pressure caused by tying down the valves, this witness said that,—

"On one morning, about three weeks after he had been on the boat, on proceeding to light his fires, he found the water all gone out of the boiler below the first row of tubes; in fact, below the lower cock. The water escaped through a tube which was split the previous day by a pressure of steam. On observing the want of water he began pumping, and pumped an hour and a half, when he found the water continued to run out as fast as he pumped it in. He did not notice anything particular the previous day. The valves were tied that day under the general orders. That was one Sunday morning. Clark had not arrived at the time he found the defect in the tube, having gone down to Greenwich the previous evening. Witness went on board the Bee, and told Mr. Buttriss of the split in the tube, and while Mr. Buttriss was looking at it Mr. Clark arrived, who proposed to caulk the tube, but Mr. Buttriss said that as the pressure would be the same as on the boiler, it would not answer the purpose, and proposed that it should be repaired by an iron bolt and washers. That plan was adopted. A round iron bar as thick as his finger, was placed through the tube—a washer placed on each end, and a joint made between the washer and the boiler. Witness pumped the engines to fill the boiler after that, when it leaked a little at first, but when they were running and the water got hot, it did not leak at all. Four days or a week after that occasion, he found the water leaked from a joint of another tube, where it was made fast to the boiler. There was no split in the tube. After pumping an hour, Mr. Buttriss came on board, and with the assistance of Mr. Ball, the mate, the danger was repaired, so that they could run. He believed it was hammered round."

In addition to the wanton sporting with human life on the part of the engine-driver, which the evidence discloses, there appears also to have been culpable misconduct by the persons employed to manage the affairs of the company. The engineers and stokers are represented to have been kept at work from five in the morning till twelve at night, being exposed during a portion of the time to a temperature of 100°. The incessant working of the three boats belonging to the company caused also greater difficulty with the boilers, there not being time to blow out the water and examine the boilers, as in other steam vessels; and the dismissal of Edwards, without inquiry, for complaining of the conduct of Clark, seemed effectually to prevent other complaints from being made.

It will be observed from the summary of the evidence we have given relating to the cause of the accident, that the question of the comparative safety of high-pressure and low-pressure engines is in reality scarcely involved by the explosion of the boiler of the Cricket. By tying down the safety-valves any boiler might be burst, and a low-pressure boiler would have the less chance of escape under such treatment. We have as yet no minute description of the construction of the Cricket's boilers, as Mr. Lloyd, the engineer appointed by the Board of Trade to investigate the matter, has not at the time we write made his report; but from the account given by Mr. Galloway and others, there appears to have been a want of proper stays in the steam chest and boiler casing. The safety of tubular boilers arises from the comparative weakness of the tube fastenings, by which when the pressure becomes dangerous the steam escapes through some small rent, and the pressure is relieved by the escape of steam. This principle might be still further applied, so as to render an explosion, in the ordinary meaning of the word, next to impossible.

There is one point that especially deserves notice with respect to high-pressure steam, which renders it in some respects a much safer force than steam of low pressure. *High-pressure steam does not scald.* Among the deaths and serious injuries inflicted by the explosion of the Cricket's boiler, we do not find that any one has been seriously scalded. One person who was blown from the deck, says, that he felt himself struck on the head by the steam, but he experienced no sensation of heat. We are acquainted, by experience, with the fact that there is no heat given out by high-pressure steam when escaping into the air, having often held our hand in a jet of steam issuing from a pressure of 100 lb. to the square inch. It is only when such steam regurgitates, if we may so express it, that it gives out heat and scalds. When, for example, a jet of steam strikes against a solid body, and its issuing force is arrested, then it scalds; but when it has free room to expand, the sensation produced is that of cold, and not of burning. It may be remembered that when by the separation of the pipe of the boiler in an engine constructed by Messrs. Samuda, at Blackwall, several persons were killed, they all lost their lives by the scalding of the low-pressure steam. The high-pressure steam of the Cricket's boiler, on the contrary, did not seriously injure a single individual. This extraordinary property of high-pressure steam should form an important consideration in determining the comparative safety of the two kinds of engines, yet it has hitherto been disregarded.

Since the foregoing remarks were written, the evidence of Mr. Lloyd, chief engineer and inspector of machinery of the Royal Navy, has been given at the adjourned inquest, held on the 22nd September, and we subjoin the greater portion of it, divested of the repetitions consequent on examination by different counsel. Some parts of his statements relative to the construction of the boiler and the pressure borne on different parts are not very clear or comprehensible, but his evidence proves that the boiler, however defective, was capable of bearing a pressure twice as great as that which would have lifted the weighted valves, if they had not stuck or been tied down. The corresponding boiler of the Cricket gave way under a pressure of 136 lb. to the square inch, but it had previously suffered a great strain by the pressure which caused the explosion, and therefore its strength at the time must have been much greater. Mr. Lloyd is of opinion that the other boiler must have had a pressure of at least 136 lb. to the square inch before it exploded.

Clark, the engineer, was examined after Mr. Lloyd, and he declared that the statements of the other witnesses against him were false, and that he never gave directions to Edwards nor to any one to tie down the valves. He seems to make a nice distinction between tying them down and twisting the end of the string fastened to the lever round a nail. He denied, however, that the string was ever tight, and he said that the object of twisting the ends round the nail was to prevent them from dangling and being in the way.

Mr. Lloyd's evidence was to the following effect:—

The Engines.—"With regard to the engines themselves, I do not think many observations necessary. They are high-pressure engines, on the principle well known as Wolfe's. Each engine has two cylinders; in one the steam is used at a high-pressure, and, instead of passing into the open air, as in an ordinary high-pressure engine, it passes into the second and larger cylinder, whence it passes into the condenser, and is there condensed in the ordinary way. The object of this arrangement is of course the saving of fuel, by effecting a saving of steam, and, therefore, of fuel. So far as I saw, the materials and workmanship of the engines were good. As compared with high-pressure engines, there is nothing objectionable in these engines, in point of danger—nothing but the ordinary construction. There were attached to the engines two pumps for feeding the boilers; another pump was worked by an auxiliary engine, which was commonly called the 'donkey;' and there was a fourth pump, to be worked by the hand, for feeding the boilers. These appeared to be all that was necessary.

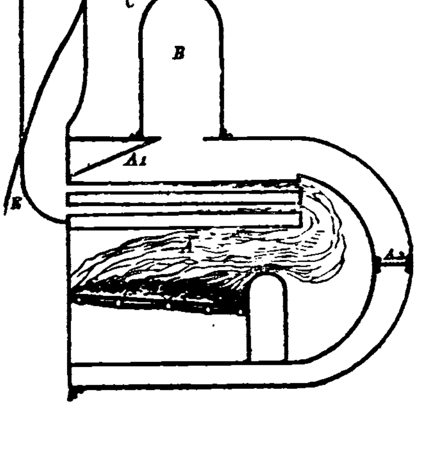
*The Boilers.**—There were two boilers, consisting of an external cylinder, five feet in diameter, having a hemispherical end at the back, and the front being composed of a flat plate. To this flat plate are fixed a cylinder, forming the furnace, and all the small tubes through which the products of combustion pass. The internal part of the boiler, consisting of the furnace, the fire-box, and the small tubes, were secured to the shell by the rivetting round the circumference of the front plate, and by two stays, one fixed between the end of the fire-box and the end of the boiler, and the other fixed obliquely between the top of the front and the upper part of the shell. A steel dome was also rivetted to the top of each boiler, on each of which were two safety-valves, pressed down by levers, one lever having a weight at its end, and the other a spring-balance—Salter's balance. The thickness of the tube plates was $\frac{3}{4}$ inch; of the front-plates, those on the top and bottom of the tube-plates, $\frac{1}{2}$ inch; the shell $\frac{3}{8}$ inch. The front of the boiler consisted of three plates, one of these being the tube-plate, and the others the plates above described. The steam-dome is $\frac{5}{16}$ inch; the angle-iron round the front of the boiler is 3 inches by $\frac{1}{2}$ inch. All the other angle-iron is $2\frac{1}{2}$ by $\frac{3}{8}$ inch. The rivets in the boiler are $\frac{3}{4}$ inch diameter, and the rivets in the steam-dome rather smaller. That includes the rivets in the shell; all the rivets of any importance are $\frac{3}{4}$ inch. Assuming each boiler to be of the power of 16 horses, the total heating surface in the boiler is 14·8 square feet per horse power. The area of the fire-grate is 55-100ths of a foot per horse power. There is nothing objectionable in these proportions, either in the amount of area of fire-grate or of heating surface. The quantity of water in the boiler up to the middle gauge-cock is about 38·1 cubic feet per horse power; and the steam-room about $1\frac{1}{2}$ foot per horse power; that is including the dome and the other part of the boiler.

The Valves and Pressure.—I have calculated the pressure upon the safety-valves, supposing the weight to be at the extremity of the lever, at very nearly 66 lb. per square inch. Taking the spring-balance as it was when I saw it, the pressure per square inch when the valve was just about to open, would be 40 lb. per square inch; but if the valve were as wide open as it could be, this spring-balance would produce a pressure of about 170 lb. per square inch. Both valves are lever valves; one is pulled down at the end by the spring-balance, the steel-yard, the other is operated on by a weight. As the lever of the spring-balance rises, by the valve opening, the pressure on the valve increases, and rises to 170 lb. at the highest. One pound on the spring-balance produces a pressure on the valve of nearly two pounds. These valves operate jointly on the boiler, both serving to empty it of steam; but they operate separately from each other. I think if they had all been properly in operation, the steam could not have accumulated in the boiler to any dangerous extent—that is, supposing them not to have been overloaded. I do not approve, certainly, of the arrangement of this spring-balance valve; it is objectionable because, when the valve has been raised to such a height as to relieve the boiler considerably, the pressure brought upon it is very greatly increased, the power of the lever being nearly as 10 to 1. This is not the usual way in which spring-balances are used, so far as I know. I think the principle wrong, on account of the pressure being increased when the valve opens. I think it wrong in principle to put a spring-balance at the end of a long lever. I altogether object to valves being in the power of the engineer to load at his pleasure, especially the high-pressure ones; but it is only fair to say that this is too commonly the case. It can scarcely be a matter of opinion that this is wrong in principle. Nothing in the weighted valves called for observation, except that if it had not been intended to work these boilers at a pressure of 66 lb. to the square inch, such a weight as that ought never to have been put upon the lever. The same remark applies to the spring-balance valve, because it can be screwed down or up to any extent. The weight being upon the lever was objectionable, as it would be an indication to the engineer that he might use it in any way he thought fit, so as to obtain that pressure, namely, 66 lb.

Opinion on the Strength of the Boiler.—As to the construction of the boiler, I may say that, in my opinion, it is dangerous to be used as a high-pressure boiler. The whole of the pressure of the steam within the boiler is brought, either directly or indirectly, upon this flat plate in the front. I find, when the pressure of steam is 66 lb. on the square inch, the direct pressure on this plate is 83 tons, which is withstood entirely by the stiffness of the plate itself, with the small addition of the two stays before-mentioned. I do not believe that 66 lb. on the inch would have burst the boiler at present, though it might have done so when the boiler was somewhat older. The objections which naturally lie against a flat plate of this kind are these: In the first place, you cannot calculate what it ought to bear; the pressure on the inside of it tends to produce three different effects. First, there is a strain brought upon it at right angles to the surface, and, if the plate were perfectly rigid, there would be no other effect; this not being the case, an enormous pressure is brought upon it in its own plane, which may be illustrated by considering the effect produced on a musical string when pressed sideways, the force brought to bear upon it lengthways being far greater than when stretched in that direction. A third action is produced by the bending of the plate, the outer circumference remaining nearly

---

* [The annexed diagram, from the "Mining Journal," is a section of the boiler show-



ing the position of the two stays, the only ones in the boiler. A 1, is the stay at the front, leading from the front plate, in a diagonal direction, towards the steam dome; this stay being formed out of $1\frac{1}{2}$ inch square bar-iron, flattened out at the end with an inch hole, and supported by a pin passing through two $2\frac{1}{2}$-inch angle irons. A 2, represents the other stay, leading from the back of the boiler to the end of the flue, which communicates with the tubes. A, the furnace, about 3 feet in diameter. B, the steam dome, to which two safety-valves were affixed. C, steam-pipe, leading from the box of the safety valve to the funnel D. E, represents the spun-yarn, with which it is supposed the valves were made fast.]—Ed.

in the same plane, and the inner part being considerably bulged. From the best examination I can give the subject, I have come to the conclusion that the strength of this front plate, aided by the two very imperfect stays which were put in the boiler, was not sufficient to bear, for a length of time—that is, during the usual time a boiler may be supposed to last—a pressure of steam of 60 lb. on the square inch. At present it would bear it, no doubt; there is no question of that. If any person wished to tie down the weighted valves he would, most likely, prevent the spring-balance valves from working, which he might easily do by putting in a piece of wood.

I have calculated, in a rough way, what would be the effect of keeping all the valves tied for five minutes. Supposing no steam were permitted to escape, and the pressure was 60 lb., at the end of five minutes it would increase to more than 90 lb.; and, at the end of ten minutes, be between 130 lb. and 140 lb.; in a quarter of an hour, at least 180 lb. That is, supposing no steam escaped, that the fires were burning briskly, and the boiler in full operation. I cannot conceive four valves getting out of order, or sticking, at the same time. One valve, supposing the other three to be fast, would not relieve the boiler of steam as fast as the steam was generated, looking at the size of the steam-pipe. If two were in operation, one of Salter's, and one of the others, they ought to relieve the boiler; but the area of the steam valve is larger than that of the waste steam-pipe, which is not a good arrangement. The area of the former is nearly five inches, of the latter, only 2·7 inches. If the two weight-valves were tied, and the spring-balances free, I think a dangerous pressure would be brought upon the boiler.

Test of the Tenacity of the Plates of the Boilers.—After making an examination of the boiler, I thought it proper to test the goodness of the materials; for which purpose I took pieces of the plates of the boiler which had been rent by the explosion. These plates, as I said before, are ⅜ inch in thickness. I cut strips of two inches in width from them, both with and against the grain, and tore them asunder by a machine for that purpose at Woolwich. Four of the pieces produced are four of the strips of the boiler; two torn with, and two against the grain; the other four pieces are good metal from Woolwich, with which I compared the former. The former, are, in fact, part of the plates which were rent in the explosion. Without troubling you with the details of the experiments, I may mention that the average tensile force per square inch of these plates was 17 tons, that of plates of the same thickness, of the best kind, which I tried at the same time, was 21⅜ tons. Specimens of those are also produced. They are Low Moor plates, of the same thickness, but of a very superior quality. The plates of the Cricket are very much laminated or shelly, not only in one part but all that I saw. This is owing to the bad quality of the metal. It will happen sometimes in plates of the best quality, but it is very much to be avoided. This piece exhibits the fracture actually made by the explosion, the appearance of which proves it to have been bad iron—that is, for the purpose to which it was applied, to a high-pressure boiler, and considering that it was employed in the part which was most likely to break. I tried also some common Staffordshire plates at Woolwich, and found their strength nearly the same as that of the Cricket's plates. They bore 16⅜ tons on the average, which is very low.

I do not consider the workmanship of the boiler to have been such as it ought to have been in a boiler of this kind. The rivets generally did not fill the holes, and they were generally not sufficiently long to make a good rivet. The boiler does not appear to be seriously deteriorated by wear, except at the lower part of the front, and possibly the bottom too may be so; but I do not attribute the explosion to that. The part which exploded was the whole of the front, which was torn out bodily. Of course the part was weaker than when quite new, but not materially so. The experiments I have mentioned are not tests of the pressure of steam on the plates. All we can is, that a pressure of 60 lb. ought not to be permanently put upon them, say for three years. From these experiments, and another of bending the iron, I should say that the metal was not such as ought to have been employed. It was good common metal, such as is usually employed in the boilers of the navy for parts where there is no great strain; but not such as ought to have been put in the front of the boiler. The plate was torn where it was weakest, and in the stronger part it was torn from its fastenings

By consent of Mr. Smith, Mr. Joyce, and other parties interested, who have afforded me every facility, I have made experiments on the unexploded boiler. I brought on it a pressure of 136 lb. to the square inch, showing that the other must have been subjected to a very severe pressure. In the unexploded boiler both the stays were separated, and a part of the angle-iron, which unites the front to the shell of the boiler, was cracked. Upon this boiler I brought a pressure of water of 136 lb. on the square inch, and then the boiler leaked to so great an extent that a greater pressure could not be obtained. My opinion is, that the pressure of steam which caused the explosion could not have been less than 136 lb. to the square inch. That is, of course, a matter of opinion; but it is the conclusion to which I have come. I should not have expected it to burst with a less pressure; but, as I said before, it is utterly impossible to calculate it. You can calculate perfectly well what the shell of the boiler ought to bear. I should say it was not less than 136 lb.; how much more I cannot say. I do not believe there is any reason to suppose that there was any deficiency of water in the boiler. It is called a tubular boiler, from the circumstance of a number of small tubes being introduced, for the purpose of absorbing the heat. We consider them rather a safe boiler. The business of one or two of these tubes is a matter of no importance. The tubes seemed to be all perfectly good. Two or three of them were bent, but the cause of that was very evident from striking against the inside. My great objection to the boiler is its form, the front being flat, without proper staying; and, in a far less degree, the quality of the materials and the workmanship.

Cause of the Explosion.—There can be no doubt as to the cause of the explosion—namely, the improper increase of the pressure of the steam shortly before and at the time of the explosion. If the pressure was gradually increased, say from 60 lb. to 130 lb. or 140 lb. in the course of ten minutes, that would be enough to account for it—certainly, if the pressure rose to 150 lb.; but that is a mere matter of opinion. That the boiler had never before been subject to such an extreme pressure is evident from the fact that the other boiler leaked considerably at almost no pressure at all: and I consider that it had been rendered thus leaky by the extreme pressure on the day of the explosion. The boilers are connected in the water spaces and in the upper part of the steam, so that the pressure on both would be the same at the same time. If only one valve was in operation on one boiler, the pressure on both would be the same; and even if both valves of one boiler were secured so as not to work. To show the great pressure brought on the unexploded boiler, I may mention that the flat plate in front was bulged to the extent of 1⅜ inches before I commenced my experiments. After it had been subjected to the water-pressure of 136 lb. on the square inch, the bulging of that plate increased to 2·16 inches; and the lower front plate of the boiler began to break exactly like the one that was broken in the exploded boiler. Had all the four valves been at liberty, it appears to me impossible that the pressure of steam could have so increased as to cause the explosion. Had both the balance-valves been open, I think they would hardly have saved it; they might have deferred the time, and prolonged it from ten to perhaps twenty minutes. I think the valves must have been closed, or open only to a small extent, when the explosion occurred. [Here Mr. Lloyd exhibited a plan of the vessel and boiler, and explained to the jury how he conceived the explosion to have occurred.] When the front began to bulge the stays would be the first to go; the plate would then bulge more and more, and the moment the separation took place the inside of the boiler would be projected in one direction, and the shell in another. The former was driven against the engine, which resisted it, and to this the people in the fore part of the vessel owed their safety. The shell of the boiler was carried in the other direction, and tore away everything in the stern part of the vessel. Assuming the actual gross pressure at 180 tons, and adding a ton and a half for the weight of the shell, it would give a force a hundred times greater than that of gravity, which will account for the enormous power exerted in a comparatively short space of time.

You can always raise a valve in a well constructed boiler, but not pull it down. The engineers in the Royal Navy have not access to the valves; in locomotives the engineers have access to the safety-valves. I found the spring of the unexploded boiler correct; as nearly as can be calculated, it was about 40 lb. per square inch when the valve was shut, but as the valve opened the pressure increased. For anything I can tell, the safety-valve was not permitted to rise in the unexploded boiler. If both the Salter's balance-valves had been in a fit state, a longer time would have been necessary to get up the steam to the bursting pressure. I cannot tell whether they would have opened sufficiently to let out the steam of themselves; I doubt very much whether they would. The waste pipe of the Cricket is small, and is a bent pipe, and all that impedes the passage of the steam into the chimney, but to what extent it is impossible to say. The noise would have been very great if any of the valves had been acting, and the steam had been 5 lb. above 40°. There were two stays to the unexploded boiler; both had been separated. Either sudden or gradual pressure would have accounted for that separation. The stays themselves were strong enough; it was the fastenings that had given way. If the valves were closed at 60°, the pressure would in five minutes have got up to 90°. I know very few engineers who understand these matters thoroughly. I wish we could get people who did understand them; but no man is allowed to drive an engine in the Royal Navy who has not undergone such an examination as may from time to time be considered necessary. I think that you ought to get the best men that can be got as engineers, and the only course to pursue is to increase the wages, if any difficulty arises in obtaining qualified men.

In the dockyards some high-pressure engines are used for particular purposes. I should prefer low-pressure engines, if they were suitable for those purposes. I should say the boiler that exploded must have been weaker than the one that remains, because the pressure would be alike upon both. The boiler that I tested did not stand a very severe test for a high-pressure boiler. We tried it without the ordinary stays; and it was then bulged in consequence of a previous strain. The maker of a boiler ought to allow for any weakness that may be caused by corrosion. I have been told the boilers were proved before they were put in the Cricket. Mr. Joyce, and everybody connected with the vessel, afforded me every facility. Low Moor iron is some of the best iron that can be got. It is not used much for the boilers of commercial steamers; but it ought to be used for high-pressure boilers. I think the pressure a steam boiler ought to be worked at should not exceed one-tenth of its calculated strength, supposing it to be made of the very best materials and workmanship.* Almost all tubular boilers have flat plates in front. If I used a flat plate, I should construct it in such a manner that the stays themselves might sustain the entire pressure. If the valves were tied down and the boiler was subjected to a strain of considerably above 66 lb., the effect would be gradually to weaken the boiler. All the parts of the boiler made to resist the straining would be acted upon by such a constant pressure. The dome would not be affected by the pressure of 136 lb., which I applied to the unexploded boiler. The vulnerable part of the boiler is the bad plate in front."

The inquest was again adjourned, and was resumed on the 24th, when several additional facts were elicited. Heasman, the person who acted as engineer on the day of the explosion, denied positively that the valves were tied down, and he said that only a minute before the explosion the gauge indicated a pressure of but 38 lb. to the square inch, and the steam was blowing off slightly from the loaded valve. He was equally positive that there was no string whatever attached to the lever of the larboard boiler at the time, as it had been shaken off on the Sunday morning previously, and had not been replaced. Mr. Lloyd was again called, for the purpose of explaining a few points of his former evidence. He stated, in confirmation of his opinion that the pressure at the time of the explosion must have been at least 136 lb. to the inch, that the companion boiler had been so much strained at the same time, that it could not have worked afterwards, owing to the leakage; and yet, in this weakened condition, it bore a pressure of 136 lb. to the inch before it gave way. Mr. Joyce and his foreman, Mr. Meacham, gave evidence. The latter states that when the boilers were delivered from Mr. Trotman's, of Whitecross-street, Borough, they were proved to a pressure of 150 lb. to the square inch. The boiler was again proved to a pressure of 150 lb. on the 3rd of August, when the tubes were repaired. That pressure was not observed to make any impression on the boiler. When he visited the boat on the 23rd of August, he ordered the strings on the levers to be cut away, as there had been a talk about Clark having tied down the valves; but, having himself confidence in Clark, he did not believe that he "had ever done so wicked a thing." Had any one of the four valves been in operation, he was of opinion it would have been enough to relieve the boiler from dangerous pressure. The weight on the lever would be equivalent, as stated by Mr. Lloyd, to a pressure of 66 lb., if placed at the end of the lever; but it never could be brought within three inches of the end, owing to the waste steam-pipe, and the pressure could not then exceed 56 lb. or 57 lb., or, with the lever and valve, 59 lb. Mr. Lloyd's proof was made after the boiler had lost its stays. Had it been made when the boiler was new, and with the stays in, he believed it would have supported a pressure of 250 lb.

Mr. Joyce said that Mr. Trotman had his own price for the boilers, and he had reason to believe they were quite sound. In reference to Mr. Lloyd's opinion, that boilers ought to be proved to ten times the working pressure, Mr. Joyce observed that he never knew a boiler that would stand such a test. The front plate of the Cricket's boiler was made of B. B. H. iron, which is of very good average quality. The boilers of the Ant and Bee are of good Staffordshire iron, and the tube plates are not so thick as those of the Cricket.

Mr. Trotman, the maker of the boilers, gave the following evidence:—

"I have been a boiler-maker from my youth. I furnished the boilers of the Cricket. Mr. Joyce said they were to work from 40 lb. to 50 lb., but never to exceed 50 lb. I proposed to prove them to 100 lb., and Mr. Joyce said he should be very well satisfied. When they were done, he offered to prove them himself, after they were delivered, and I consented. I filled them with water, to discover any leaks, but did not prove their strength. I saw the exploded boiler the Sunday after the accident. I concluded there had been some unfair work. I don't think that any ordinary pressure could have bent the plate and torn the angle-iron, which was very strong. I had the iron from Messrs. Moser, in the Borough: I paid 15*l.* a ton for the tight iron, and 20*l.* a ton for that of the two plates. I have worked tons of the B. B. H. iron, and consider it next to the Low Moor. The engineers fix on the safety valves. With fair pressure and fair work, those boilers would have worked for years. They have been known to work at 80 lb., and that is much more than I was told would be required, I have never known a boiler so strong as to resist a pressure ten times the ordinary amount. This accident must have been occasioned by pressure, which must have been excessive to send part of the boiler, weighing perhaps a ton and a half, through the stern of the boat, and about forty yards through the water."

Mr. Robert Rettie, of Ham, civil engineer, though he admitted he had never seen the valves nor the boiler, spoke confidently that the cause of the explosion was the overheating of the flues, that the stoppage of the valves was quite inadequate to account for the explosion, and that the pressure must have been nearer 300 lb. than 150.

The evidence having been concluded, the coroner (Mr. Bedford) summed up, and the jury, after deliberating for an hour and fifty minutes, delivered the following verdict:—

"We find that Thomas Shed, John Blunt, John Littleton, George Shute, and John Buckley came to their deaths by the bursting of the boiler of the Cricket steamboat, on the 27th of August, 1847. We find a verdict of *manslaughter against Henry Heasman*, the engineer on that day. We consider Clark highly culpable, and unfit to hold the situation of engineer. We likewise consider Mr. Smith's conduct shamefully neglectful in not properly investigating the complaint made against Clark."

The foreman stated that they were unanimous in their verdict. The inquisition was then signed by the jurors, and the coroner made out his warrant for the commitment of Heasman.

Thus has terminated this important inquiry, which lasted seven days, and on the last occasion the jury sat from ten in the morning till ten at night. In an engineering point of view it possesses great interest, and the evidence given respecting the explosion, and the experience gained by it, will, we trust, operate in giving additional protection to the public against such disasters in future.

* [We think Mr. Lloyd must here allude to low-pressure boilers, where the steam is rarely generated at a higher pressure than 10 lb. or 12 lb.]—Editor.

CONSTRUCTION OF PENITENTIARIES.

The following propositions on the construction of prisons were discussed at a meeting of delegates from the different European Governments, met last month at Brussels, to take into consideration Penitentiary discipline. The meeting was attended by Major Jebb, sent over by our Government, Mr. Rotch, and Mr. Pearson, from England:—

"The buildings should be disposed in such manner as to facilitate the various duties, without any confusion. To that effect it is indispensable to separate the prison, properly so called, from the accessory localities destined for the directors and other persons employed. The external communications may be maintained without exercising any influence on the preservation of order within. With that view messengers, purveyors, &c., should never come into contact with the prisoners. Each branch of the service should be carried on in some respects in an independent manner, with reference, however, to the principal direction from which it receives its impulse.

Central Observatory.—The various parts of the building should be connected with a central point of inspection, from which the head of the establishment may inspect, without being under the necessity of moving, all the essential branches of the service. Regard must be had to the internal distribution of the localities, to the arrangement of the galleries, and to the choice of the materials of construction, in order that no material obstacle may thwart that inspection.

Cells.—In the disposition and arrangement of the cells, regard must be had to the following conditions:—1st. The cells must be large enough to allow of the prisoners' taking exercise, carrying on trades, and enjoying sufficient space and air for the preservation of their health. The space should vary from 28 to 35 cubic metres. 2nd. They should be lighted up, ventilated, and heated in a suitable manner. 3rd. Their construction should be such as to allow of no communication between their inmates. 4th. They should be furnished with bed and bedding, with a fixed wash-hand basin with a tap, with a water-closet and with other necessary articles. The prisoners should also have the means of giving the alarm to the attendants in case of illness or accident, or under any circumstance in which their presence might be necessary. 5th. The prisoners should be subject to an easy but unperceived inspection.

Special Cells.—In penal prisons it is necessary to have a certain number of special cells for the infirmary, for special punishments, for the different callings, and for prisoners on their first arrival. The cells for infirmaries, chiefly reserved for patients who cannot be suitably attended to in the ordinary cells, should be more spacious than the former, and should be disposed in such a manner as to allow of the free access of the attendants. One cell of that kind for every 40 or 50 prisoners would possibly be sufficient. Cells for punishment should be stronger than others, and should be built in such a manner as to be easily darkened, if necessary. One such cell would be sufficient for about 100 prisoners. The dimensions of the cells for the exercise of certain trades should correspond with the use to which they are to be put. They should be situated in preference on the lower stories, and their number must depend on the nature of the trades carried on in the prison. In prisons where prisoners are constantly arriving, a certain number of cells should be made in which each prisoner may be placed temporarily, previous to being seen by the surgeon, and such cells might be of smaller dimensions than others.

Heating and Ventilation.—Whatever the system of ventilating by heating may be, its results should be the following:—A sufficiency to each cell of fresh air, or, if necessary, of air tempered for each prisoner, without the inconvenience of draughts. The extraction from each cell of a quantity of foul air equivalent to the quantity of pure air introduced; and the carrying on of the heating and ventilation without facilitating the means of communication, whether of sound or otherwise, between the different cells."

IRON VESSELS.

The following report of a survey for the purpose of ascertaining the injuries sustained by the *Great Britain*, has been delivered to Captain Claxton. It clearly shows the superiority of iron over wood for constructing sea-going vessels.

"We, the undersigned, certify that we have at your request this day been on board the steamer, Great Britain, now lying on the gridiron in the Prince's Dock Basin, and both inside and out have examined the means adopted by the foreman boiler maker, Mr. John Crew, for stopping the leaks in the bottom of the vessel whilst lying in Dundrum Bay. We find the principal holes to have been six in number, varying in dimensions from 2 ft. by 12 in. to 5 ft. 9 in. by 16 in.; and there are other formidable holes and cracks of smaller dimensions. From their size and position, under the keel of the ship, we are of opinion that it must have been a work of extreme difficulty to make them in any degree water-tight. We are informed that, besides the water in which the ship lay, there was never less than 2½ or 3 feet of water and sand in her hold after the damage she sustained from the gales in the early part of the winter; and taking this fact into consideration, with the other difficulties that had to be encountered, we are of opinion that the greatest ingenuity and perseverance must have been exercised to stop the holes in such a manner as to enable the vessel to float. The method adopted by Mr. Crew for this purpose was as follows:—A plate of sufficient size was passed edgeways through each hole from the inside, having a screwed bolt attached to it as nearly in the centre as possible. This plate was then adapted to cover the hole on the outside, and was drawn tight up by a screwed nut and crossbar from the inside, being packed with felt to prevent leakage as much as possible. On the whole, as boiler-makers' or iron ship-builders' work, we consider it to be a most extraordinary performance, which, regarded from before-hand, must have appeared of almost hopeless execution, and must have been one of the greatest amongst the numerous difficulties over which the energy and determination of the rescuers of this vessel have ultimately triumphed. We do not conceive that it would have been possible, under similar circumstances, to stop holes of the size mentioned in the bottom of a wooden vessel; and we may further remark, that the iron of which the frames and plates are made must have been of most excellent quality.

FAWCETT, PRESTON, and Co.
E. ROSS, engineer.
T. BAKER, engineer.
E. PARGETER, foreman boiler-maker.
N. FURLONG, engineer.
W. B. M'ALLISTER, foreman boiler-maker.

Liverpool, Sept. 2, 1847.

ARTIFICIAL MINERALS.

The experiments of M. Ebelmen, to produce minerals artificially, communicated to the Academy of Sciences, Paris, are thus given in *L'Institut*: the immediate subject being chiefly the varieties of the ruby.

"The method I adopted to crystallise these compounds, depended upon the property of boracic acid to dissolve all the metallic oxides, and upon the great volatility of this acid at a high temperature. I thought that by dissolving, in melted boracic acid, alumina and magnesia, mixed in the proportions that constitute the spinel, and by exposing this borate in open vessels to the high temperature of the porcelain kiln, the affinity of alumina for magnesia would determine the separation of a crystallised aluminate, and the complete expulsion of the boracic acid. In short, I employed boracic acid, at a high temperature, as water is used at ordinary temperatures, to obtain crystallised salts by evaporation alone. The proportions were about one part of melted boracic acid to two parts of alumina and magnesia, mixed synthetically to constitute the compound, Al^2O^3, MgO; with the addition of a small quantity of the bi-chromate of potash. These materials, well mixed, were put on a platinum leaf, in a biscuit-cup, and exposed to the heat of a porcelain biscuit-kiln. I obtained a surface covered with crystalline facets, presenting in their interior reticulated cavities, the form of which was easily distinguished with the lens. These crystals were rose-coloured, transparent, readily scratching quartz, and presenting the form of regular octohedrons without any modification. They are quite infusible in the blow-pipe. These characters, joined to the composition of the crystals, synthetically ascertained, appear sufficiently conclusive to establish their identity with the spinel.

"By substituting for the magnesia its equivalent of the pretoxide of manganese, a crystallised product is obtained in large laminæ, in the form of equilateral triangles, or of regular hexagons. These crystals, also, readily scratch quartz. I consider them to be the manganesiferous spinel $Al^2O^3 MnO$, which has not yet been met with in the mineral kingdom.

"Oxide of cobalt, substituted for the magnesia, equivalent for equivalent, gave bluish black crystals, regular octohedrons. They again scratch quartz, but with more difficulty than the preceding."

In employing alumina and glucine in the proportions that constitute cymophane or chrysoberyl, $Al^2O^3 GlO$, a bristling mass of crystalline asperities of great brilliancy is obtained. This product readily cuts quartz, and very cleanly topaz. It presents then a hardness comparable to the crystallised cymophane.

Certain silicates, infusible at the temperature of our furnaces, appear capable of being reproduced by the same process. Thus, in melting the elements of the emerald with half their weight of boracic acid, at the same temperature as in the preceding experiments, a substance is obtained, which easily scratches quartz, and the surface of which presents a great number of facets having the form of regular hexagons.

"I content myself," M. Ebelmen adds, in conclusion, "with submitting to-day these first indications, hoping, however, soon to present to the Academy a more detailed and more complete work. But I am convinced, at present, that it is possible to produce, at temperatures below those of our iron smelting furnaces, diaphanous crystals the hardness and external characters of which are analogous to those of precious stones. It is probable that in repeating these experiments in apparatus of certain dimensions, like reverberating furnaces, by operating on large quantities of materials, and continuing the application of heat sufficiently long, much larger crystals may be produced than those I have obtained, working with a few grammes only. Another conclusion to be drawn from the preceding facts is, that many species of minerals have the power to produce themselves and crystallise at temperatures much below those necessary to melt them."

Specimens of the products mentioned in the communication were submitted to the Academy.—*Literary Gazette.*

NOTES OF THE MONTH.

French Proof Engravings.—At a recent meeting of the Royal College of Chemistry, Prof. Taylor explained the manner in which French printsellers are enabled to increase the number of proof copies, to the great detriment of the purchasers. He showed that they had adopted the system of giving the paper a slight coating of carbonate of lead, which rendered the impression more perfect after the plate had become deteriorated; but that this was very soon converted into sulphide by the action of sulphuretted hydrogen constantly floating in the atmosphere of large towns, and by which interchange the print was destroyed. The presence of lead on this paper was showed by experiment. Prof. Taylor then stated that the brown colour of Valenciennes lace was due to a similar cause; the manufacturers sprinkling it with carbonate of lead, to make it look clear,—which being changed into sulphide on exposure to the air, gave the lace the dingy appearance so much prized by ladies.

Test for distinguishing Iron from Steel.—To distinguish iron from steel by a chemical process, take pure nitric acid, dilute it with so much water that it will only feebly act upon the blade of a common table knife. If a drop of the acid thus diluted be suffered to fall upon steel, and allowed to remain upon it for a few minutes, and then washed off with water, it will leave behind a black spot. But if a drop of this acid be suffered to act upon iron in the same manner, the spot will not be black, but of a whitish-grey colour. The black stain is owing to the conversion of the carbon of the steel into charcoal, which thus becomes predominant; and iron being nearly free from carbon, can produce only a grey stain. The utility of this test is not confined to finished articles manufactured of steel, but its application enables the workman in iron and steel to ascertain also the quantity and uniformity of texture of unfinished articles.

Sheathing for French Vessels.—The Minister of Marine has given orders that several experiments shall be made to test the quality of copper sheathing employed in England and France, for the coppering of vessels, as that at present used in the French Navy and merchant service soon corrodes, as has been proved by the recent report on the state of the bottoms of the steamers, frigates, and other ships of war, where French copper has been employed instead of British, as hitherto, and will have to be recoppered as soon as the superiority of the one over the other is fully proved. The copper manufactured in France is of a very soft nature, very corrosive, and but little adapted, either for marine purposes, boilers, or steam-engines, if not mixed with English metal.

Stagnant Water.—M. Fleurian de Bellevue states, as the result of his observations and inquiries on the effects arising from stagnant water, that in marsh lands which are covered with water to a considerable depth during the great heats of summer, the inhabitants of the localities in which they exist are not more unhealthy than in other localities; but that where the stagnant water is of slight depth the decomposition is attended with frightful consequences, and the mortality is great. He recommends that in all low lands where there is water during the summer of so slight a depth as to render decomposition certain, the inhabitants should form one general reservoir into which the different masses of water may be conveyed by means of channels of communication.

Fusion of Mercury.—The result of M. Person's experiments on the congelation of mercury, and the latent heat of fusion, is that the heat requisite for the fusion of mercury is about eight times that required to change the temperature of water one degree. M. Person observes that the quantity of heat necessary for the fusion of metals is according to the order of their tenacity.

Steam Power.—It appears from a recent official return that the total number of steam engines in France in 1845 was 207; in 1840, it was only 109. Another return respecting the produce of the iron mines states that in 1845 the quantity of iron cast was 439,000 tons, whereas in 1825 the quantity was only 190,000. The price of bar iron, which in 1825 was 48f. the 100 kilogrammes, was in 1845 only 34f.

Removing useless Fences.—The following remarks are from a correspondent of the *Salisbury Journal*:—"I contend that thousands of sacks of corn may be grown annually in this country more than at present, were land-owners and tenant-farmers to turn their attention more than many of them do to the removal of useless fences. I am of opinion that many of the landowners have imbibed the notion that farmers are anxious to tear up their fences for the purpose of destroying game; but this is very far from being the greatest evil arising from having too many fences, hedge-rows, &c. By allowing too many of these nuisances (for I know no better term for them) to remain on your farm, you not only lose the crop the land which they occupy would bear, but also the produce of several yards of land on each side of the same. One farmer has a field of 40 acres to get sown to wheat; another has the same quantity of land, but in four or five different fields. They both begin sowing on the same day, and follow the work till it is completed; and while the one is ploughing his head-pieces, and turning about his horses so many times, the other completes the work; and the farmer who has his 40 acres in so many fields is a day and a half or two days later than the other. This is another very great advantage arising from having fields large. Some landlords will say, if they allow their tenants to break up so many of their fences, they shall have no cover for their game. I would say to every landowner throughout the kingdom, get your tenants out of the detestable practice, which many of them have got into, of sowing barley after wheat, or any sort of straw crop, in two succeeding years. Let them keep their farms well filled with turnips and every other sort of green crops, and this will make plenty of cover for game, and be the means of keeping the land in a fit state to sow corn on. I would again reiterate the cry throughout the land, 'Down with all unnecessary fences,' as it will ultimately prove a very great benefit to the landlord as well as the tenant. And where fences are really necessary on arable lands, let them be kept neatly shorn down, so that they may not shade the ground on either side, nor prove a harbour to sparrows, linnets, and many other destructive birds, which destroy annually in this country hundreds, and I think I should not be going too far if I were to say thousands, of sacks of corn."

Free Trade.—Among the importations from Antwerp lately, was a cargo of roofing tiles. This is understood to have been the first imported from abroad, and it appears to be the commencement of a new trade, as it is said there is another vessel on its way, and that a large quantity is still ready for shipment.

Irish Institute of Architects.—A deputation of the members of this body waited on his Excellency, the Lord Lieutenant of Ireland, headed by Sir Richard Morrison, with an address in which they deplore the condition of Irish architecture. His Excellency, in reply, said:—"It is not for me, gentlemen, to analyse the causes which may have led to the state of things of which you naturally complain, however strange it must appear to me that architecture should not be duly esteemed in Dublin, one of the most picturesque cities in her Majesty's dominions, and adorned as it is by so many noble public edifices, or in a country where such magnificent mansions exist, where genius is not rare, and taste and talent abound; but if happier days, as I venture to hope, are in store for Ireland, they must bring with them that encouragement of art and science which always marks a nation's progress, and they will strengthen a conviction, now on all sides manifesting itself, that the social condition of her people must be elevated. Towards carrying out this pressing and national object, the Royal Institute of the architects of Ireland may, as it seems to me, powerfully co-operate; for when it is considered how much requires to be done towards the improvement of towns, and thereby ameliorating the sanitary condition of the people, and how little care has hitherto been bestowed upon the dwellings of the humbler classes of our fellow-subjects, that the places of religious worship, schools, hospitals, and asylums, are insufficient for the wants of the country, a wide sphere of usefulness is manifestly open to a scientific and practical body such as yours; and I feel sure that the architects of Ireland, like the most eminent men of their profession in every country, will at all times be found ready and anxious to aid the great work of social improvement."

Military Cemetery.—It is stated that the Duke of Wellington, as Commander-in-Chief, has given his sanction to the formation of a grand cemetery and mausoleum on Shooter's Hill, for the officers of the British army and navy, as well as those in the East India Company's Service. The mausoleum will rise in the centre of the ground, on the spot where Severndroog Castle now stands. It is to be raised in a series of terraces—the substruction of which will afford space for ten thousand catacombs.

Great Nassau Tunnel.—The great tunnel through the mountain on which stands the town of Weilburg, in the Duchy of Nassau, formed for improving the bed of the Lahn, has just been terminated after five years' continuous labour. The waters of the Lahn were to be let into the tunnel on the 12th, and 2,000 gas lamps were to be lighted, and always kept burning. The formal inauguration of the gigantic work is to take place on Oct. 15.

The Fortifications of Sheerness, says the *Kent Observer*, are fast approaching completion. With the exception of a few yards towards the sea the whole line is finished, the gun-carriages fixed, all the smaller guns mounted, and several of the larger ones are to be seen peeping over the parapet. Last week excavations were commenced in the open space opposite the dockyard chapel, preparatory to laying the foundation for an extensive range of barracks, and the road between Mile Town and Blue Town has been closed for five or six weeks past, a temporary road having been made round by the beach, whilst two new drawbridges, with bastion and other defences, are being constructed.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM SEPTEMBER 2, TO SEPTEMBER 23, 1847.

Six Months allowed for Enrolment, unless otherwise expressed.

Henry Davy, of Ottery, St. Mary, Devon, gentleman, for "Improvements for separating copper and other metals from their ores."—Sealed September 2.

Robert Oxland, of Plymouth, chemist, for "Improvements in dyeing, parts of which improvements are applicable to the manufacture of metallic alloys."—Sept. 2.

Richard Madigan, of Haverstock-Hill, Middlesex, civil engineer, for "Improvements in railway turn tables."—Sept. 2.

Charles Chabot, of Skinner-street, Snow-hill, City, zincographer and engraver, for "Improvements in railway carriages, and in the buffers and other apparatus connected with such carriages."—September 2.

Sykes Ward, of Leeds, for "Improvements in communicating motive power which are applicable to working of breaks on railways; and also improvements in communicating intelligence signals and motive power by the agency of voltaic agency."—Sept. 2.

Thomas Foster, of Streatham, Surrey, manufacturer, for "Improvements in machinery for cutting india-rubber, in rendering fabrics waterproof, and in making articles from fabrics so rendered, waterproof, and in dissolving india-rubber and other gums."—September 2.

John Mitchell Rose, of the firm of Rudall and Rose, of Tavistock-street, Covent-garden, musical instrument makers, for "certain Improvements in flutes, clarionets, and other similar wind-instruments." (A communication.)—September 6.

Henry Vint, of St. Mary's Lodge, Colchester, gentleman, for "Improvements in propelling ships, and other vessels."—September 6.

John Barke Gustavus Ferryman, of Cheltenham, gentleman, for "certain Improvements in handles to be applied to various articles for containing liquids or other matters liable to be spilt."—September 6.

James Leadbetter, of Over Darwen, in the county of Lancaster, brazier, and William Pierce, of the same place, mechanic, for "certain Improvements in machinery or apparatus for raising water and other fluids."—September 6.

Thomas Marsden, of Salford, in the county of Lancaster, machine-maker, for "Improvements in machinery for dressing or combing flax, wool, and other fibrous substances."—September 6.

Joseph Clinton Robertson, of Fleet-street, London, for "certain Improvements in the manufacture of metals from their ores." (A communication.)—September 9.

James Sims, of Redruth, in the county of Cornwall, civil engineer, for "certain Improvements in steam-engines."—September 9.

William Gibbons, of Corbyn's Hall, near Dudley, Worcester, for "certain Improvements in trussing beams and girders."—September 9.

Thomas Battye, Woburn-place, Middlesex, gentleman, for "an Improved mode of retaining the waist of the human body in a desirable form, without producing the inconvenience resulting from too tight-lacing of stays or corsets, or buckling of belts, waist-bands, or girdles."—September 9.

John Blyth, and Alfred Blyth, both of St. Ann's, Limehouse, engineers, and John M'Culloch, of Masemore-cottages, Old Kent Road, Surrey, chemist, for "certain Improvements in apparatus for distilling and rectifying."—September 9.

Frederick Steiner, of Hyndburn-cottage, Lancaster, for "Improvements in the manufacture of sugar."—September 9.

Connor William O'Leary, of Tralee, in the county of Kerry, Ireland, for "certain Improvements in the methods of producing power for the discharge of weapons and missiles, and other purposes."—September 9.

William Brockedon, of Devonshire-street, Queen's Square, for "Improvements in heating rooms or apartments."—September 9.

Clarence Augustus Kurtz, of Manchester, for "certain Improvements in the mode of preparing and using indigo in the dyeing and printing of woollen, cotton, and other fabrics."—September 9.

James Pitt, of Cheyne-walk, Chelsea, gentleman, for "Improvements in apparatus for holding down trowsers."—September 9.

David Morgan, of Morriston, in the county of Glamorgan, coppersmith, and John Borlax Jenkins, of Middle Bank, same county, copper agent, for "certain Improvements in the manufacture of copper and other metal cylinders or rollers for the printing of silks and other fabrics, and for other similar purposes, and in casting copper and other metal cylinders, tubes, or rollers, hollow and free from air bubbles."—September 9.

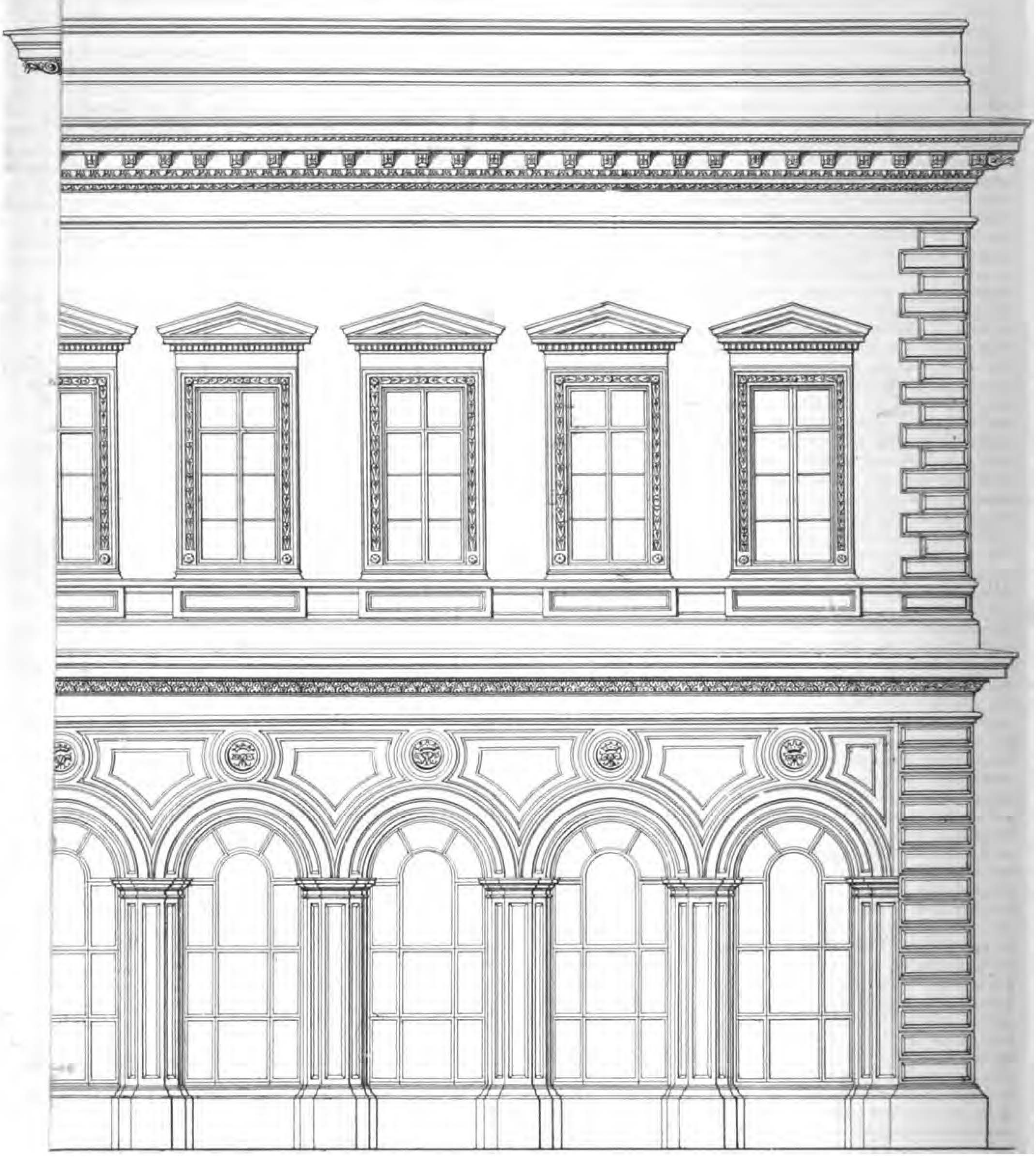
William Hancock, of Pentonville, gentleman, for "certain Improvements in bolts, locks, and other fastenings."—September 16.

George Bell, of the city of Dublin, merchant, for "Improvements in gas tar, by means of which improvements it may be used as a substitute for oil paint, which he intends to designate as patent mineral paint."—September 23.

John Dickinson, of 65, Old Bailey, stationer, for "certain Improvements in the manufacture of paper."—September 23.

Arthur Harry Johnson, of Gresham-street, city, assayer, for "Improvements in refining silver lead by effecting a saving in one of the materials used."—September 23.

Henry Newton, of Lisson Mill, Derby, cotton-spinner, for "Improvements in spinning and doubling cotton and other fibrous substances."—September 23.



ELEVATION IN PICCADILLY.

50 Feet.

THE MUSEUM OF ECONOMIC GEOLOGY.

(With Two Elevations, Plate XVII.)

That species of astylar composition which is now generally qualified as the Italian "palazzo" mode, admits of very great variety and freedom of design, and of no less diversity of character in regard to the degree of finish and decoration bestowed upon it; which latter may be carried if required to the point of the most intense richness. Unfortunately, however, variety of design in regard to minor features and detail,—which constitutes almost the only species of variety a mere *plane* street-façade admits of,—seems rather to have been shunned than aimed at; it has been so either without due study or else too timidly. The new Museum we are now noticing has, therefore, caused us somewhat of an agreeable surprise, there being much in it that is quite out of the beaten track. In one respect, it certainly performs more than was to be looked for, since it gives us two totally distinct pieces of architecture, its two façades contributing a very marked architectural feature to separate streets—viz., to both Jermyn-street and Piccadilly. That neither front bespeaks the actual purpose of the building at all distinctly must be admitted, for there is more of Club-house physiognomy, especially in the Jermyn-street front, than of what expresses such a public institution as a Museum. It will besides be objected perhaps by some, that the Piccadilly front is defective as a front, there being there neither entrance nor the appearance of any, but the entrance must be sought for in another and far less public street. Another circumstance, which, if not exactly a fault, is not in accordance with the laws of composition for what shows itself as a distinct façade, is that the Piccadilly front having an even number of apertures (six) on a floor, presents no central feature. Still there is merit enough to counterbalance, or more than counterbalance, what only very rigorous criticism indeed is likely to take exception to.

To begin with the Jermyn-street front, as the entrance one, although the design consists of what seem, when described in words alone, very commonplace features and arrangement, it exhibits a far greater than usual degree of artistic treatment. In fact, the door, or we should term it portal, is almost an unique example here,—noble and even imposing for its amplitude, and though simple in its general composition, singularly rich in design. An example of the kind was much wanted among us, the entrance doorways and doors, even in our principal public buildings, being, if not all of them exactly insignificant, deficient in grandeur. Even the best of our club-houses are not distinguished by any excellence in regard to such feature; in some of them, on the contrary, the entrance doors are altogether of the most ordinary character. Mr. Pennethorne, then, has taken an equally decided and happy step forwards in astylar composition, by making his door the focus of it as it were,—the principal feature in it of all, on which the eye rests with contentment and satisfaction, it finding there sufficient to interest and detain it. In addition to richness of the architectural dressing, the doors themselves will be decorated by elaborately carved panelling; wherefore we purpose showing them and the doorway, together with some other details, drawn on a larger scale. The opening of the door measures 6 feet 6 inches, by 16 feet high, and the entire composition 11 feet by 28 feet, which proportions are as remarkable as the dimensions are unusual,—that is, except in one or two buildings where a single large doorway, or else a central one accompanied by two lesser ones, is placed within a portico or other columnar composition. There is, as far as we are aware, but one other astylar façade which is at all remarkable for the importance given to the door, namely, the Hall of Commerce, in Threadneedle-street, unless the large door in the west front of the Bank may also be quoted as an instance; although with regard to the latter, it should be observed, it belongs to what, if in that part of it it may be termed astylar piece of architecture, is not a fenestrated one. Both those examples, however, are of very plain design, more especially with regard to the doors themselves. Exquisite taste of embellishment, together with perfect completeness of decoration, is to be found in the doors within the portico of St. Pancras' Church, which ought to have led not, indeed, to direct imitation—and they themselves are only direct imitations—but to similar laudable ambition on other occasions.

Perhaps it will be thought that we dwell, if not too long, too exclusively upon that single feature in the Jerymn-street front of the building; yet hardly can its value be too forcibly insisted upon, more especially as there is nothing in the mere name of "door," as in that of "portico," to characterise or appear to characterise a design when merely spoken of. Yet we would readily give half-a-dozen of our usual Doric or Ionic porticoes for one such a portal as that we are noticing. It gives a decided physiognomy to the whole façade; which, if that were taken away, becomes comparatively tame and uninteresting. This last remark may seem to imply something like an unfavourable opinion as to the general design, taken independently of that single feature. Yet it ought not to do so, seeing how many buildings we have whose sole merit—or we should rather say whose architectural pretension altogether—consists in its having a few columns put up against it for a portico, and without which there would frequently be nothing whatever at all answering to even the most ordinary notions of design. There are, besides, many Gothic buildings whose fronts would be almost vacant and featureless were it not for a doorway or portal which imparts interest, and sometimes a very peculiar and piquant charm to the whole. For making this observation we are not to be understood as intending to insinuate that it so far holds good here, that, with the exception of the door, the other features possess very little value or interest. Many of them, on the contrary, afford evidence of laudable study of detail, and highly commendable attention to those minuter but not least precious touches in design, which bespeak the artist.

The Piccadilly façade—but no, we will reserve that till our next number, when we hope to be able to enter into some description of the designs for the interior also.

HISTORY OF ARCHITECTURE IN GREAT BRITAIN.

A Brief Sketch or Epitome of the Rise and Progress of Architecture in Great Britain. By James Elmes.

"Epitomes are helpful to the memory, and of good private use."
Sir Henry Wotton.

(Continued from page 302.)

About the same time that James Wyatt flourished under the patronage of George III. and the leading aristocracy of England, the leash of architectural brothers, the Adelphi Adams, arose and took their ground on the architectural battle-field, with distinguished success. They have recorded their relationship in the Anglo-Hellenic term of the Adelphi buildings, between the Strand and the Thames; and their names by Robert, James, John, and Adam streets, Adelphi. One of these, the author and delineator of "Dioclesian's Palace at Spalatro," had travelled to, and enriched his country's literature by his description of that once gorgeous assemblage of architecture, sculpture, and painting. Like Wyatt, he endeavoured to introduce a new style, but it was not derived from so pure a source. Neither of these able men were imbued with so manly a taste as Jones, Wren, Lord Burlington, and Kent; the latter of whom has been before noticed in connection, as an artist, draughtsman and painter, with Lord Burlington. In fact, he was not solely an architect, but the able and not always tasteful assistant to his noble patron. As a painter, he may be classed with the Verrio, La Guerre, Thornhill, and Kneller schools. He was considered a man of taste, was an able landscape gardener, and was much consulted as such by the nobility and gentry of his time. As editor of Jones's architectural works, and joint editor with Ripley and Ware of "Sir Robert Walpole's seat at Houghton, in Norfolk," he showed great industry and talent, particularly in the correct way in which he delineated the ornamental details. From his intimacy with Lord Burlington and other distinguished men, he was often consulted by the fashionable world upon affairs of art; and is said to have sent a lady to court in a brocaded silk dress of his design, upon which were wrought temples, statues, fountains, triumphal arches, in all the glories of the five orders of architecture; making the lady a walking Palladio in petticoats, and her hooped rotunda a veritable temple of the Cytherean goddess. He was also occasionally employed as an illustrator of books, among which was Tonson's edition of "Gay's Fables." In these his professional knowledge is shown to advantage in his interior of the theatre which forms the head-piece to the fable of the two monkeys; who, gravely seated in one of the stage boxes, are criticising the efforts of the rope-dancer on the stage to imitate their agility, asking—

"How can these clumsy things, like me,
Fly with a bound from tree to tree?"

The interior of the library wherein are the learned elephant and the bookseller, the sick man's chamber, and the court of Death, exhibit his architectural knowledge; whilst the decorated gardens in which are the poet and the rose (said to be a portrait of Gay), and the gardener and the hog, show him as a designer of gardens.

Wyatt, as before remarked, was an architect; so was originally Robert Adam; but the firm of "Adam brothers" were speculative builders. The district called by them the Adelphi, is the greatest of their works in this department; and their overgrown speculations in Edinburgh left the modern Athens for many years almost as much a heap of architectural ruins as was its ancient namesake.

The style of architecture aimed at by the brothers in their Adelphi buildings was the pseudo-Grecian used in the decline of art by the emperor Dioclesian and his artists. The great difference of level between the high street of the Strand and the left bank of the Thames, upon which they erected these buildings, was filled up by a range of warehouses and wharfs covered by arches, which formed the basement of the terrace and dwelling houses above. The range of houses built upon the terrace facing the Thames is planned with great skill for domestic use and comfort.* So are the two streets at the eastern and western extremities, which form detached wings and connect the series of dwellings into a whole as a composition. The street which runs from east to west on the northern side of the main building, and carried on by a range of similar design into the Strand, contains the mansion, museum, and great room belonging to the Society for the Encouragement of Arts, Manufactures, and Commerce, and some houses of a larger size than those which face the river, used as private hotels, offices, and chambers for professional men. The leading decorations are a series of very narrow pilasters between the windows, supporting cornices of no precise order, but all profusely enriched with foliage and arabesques in low relief, of the Dioclesian style. The most striking defect of this design, considered as an architectural composition, is a lack of boldness in projection and recession, which causes an uninteresting flatness, for want of a due proportion of light and shade, that mars the whole design. The projections of the pilasters are too small, and the reveals of the windows too shallow, to produce that artist-like effect which could alone give its author the name of architect. The whole mass bears more the appearance of a building speculation than the work of an architect who sought for an enduring name. These defects are the more to be lamented, as they occupy the finest situation on the north bank of the metropolitan part of the Thames. The buildings not only appear fragile, but are actually so, and exhibit many symptoms not only of decay, but of unscientific construction and ill-selected materials. The plain and ornamental stucco work that embellished the exterior of these houses, formed of lime mixed with oil (the original of Hamelin's mastic), dignified by royal letters patent and the sounding name of Adam's cement, has failed in many places, and been replaced by plain pilasters, unornamented capitals, and flat surfaces of Roman cement. The endeavour to give an architectural character to the shop fronts, by substituting termini, busts, and semi-caryatides, instead of the common stall-board and story-posts of their London predecessors, not only deserves praise, but followers.

The south front of the edifice belonging to the Society for the Encouragement of Arts, &c., is in a more manly and architectural style than any other on the Adelphi estate. The principal or one-pair story consists of a tetrastyle attached portico of three-quarter columns, supported by an appropriate ground story. The columns are of the Ionic order, rather too slender in proportion for the intermediate character of the order, which should bear a just medium between the robust Doric and the delicate Corinthian. They support an entablature and pediment, which being carried into the two flat wings of the adjoining portions of the building, possess no artistical meaning, and are a mere ornamental appendage stuck on to the plain front of a large house consisting of windows and piers only.

Brother Robert designed and executed many buildings of a similar character in Scotland, and published a volume illustrative of their details in 1764; and also a folio volume, marked with industry, pains-taking research, and graphic correctness, of the ruins of Dioclesian's palace at Spalatro. He was patronised by the Earl of Bute, through whose influence he was appointed architect to the king for Scotland; and was for some time superintendent of the works at the Royal-hospital, Greenwich, and erected a pavilion in the Dioclesian style at each end of the terrace, one inscribed with the name of George III., and the other Queen Charlotte.

The brothers Robert and James published their joint architectural works in three volumes folio, of which the first two were published in 1764, and the third in 1822. Of brother John we have no literary records but that of his name at the corner of one of his streets in the Adelphi.

Among the best works of the Adams in the metropolis are a mansion in the north-west corner of St. James's-square, much resembling the stuck-on pseudo portico of the Society of Arts; Lansdowne-house, on the south side of Berkeley-square, a large and commodious mansion with a body and two wings, the former decorated with the same lank and meagre attached columns of the Ionic order that disfigure all the works of the Adams. The spacious court-yard in front left ample room for a real portico, but they did not avail themselves of the opportunity. This mansion was celebrated in the lifetime of the late marquis, by whom it was built, for that collection of ancient statues, busts, and reliefs, known by the name of Lansdowne marbles. The Royal Academy, about fifty years ago, thought the principal elevation of this structure to be of sufficient importance to form a study for its architectural students, and gave a silver medal for the best geometrical elevation, tinted and shaded, with a duplicate in outline, correctly finished from actual measurement. The Adams also erected the street-front of Drapers'-hall, in Throgmorton-street; some well-built houses opposite, whose interiors bear marks of a better architectural character than most others of their period; and the street-front of Skinners'-hall, on Dowgate-hill, in the City, marked by a similar tameness of character as the before-mentioned works in the Adelphi.

If the Adams left no followers of their vitiated Spalatro style of decoration, they have been followed in their pseudo-Greek, which, like the lady Anglo-Gallic of the circulating libraries, has invaded our national cockneyisms. Some learned Thebans at Waterford, who built a large warehouse-like row of houses on the right bank of the beautiful river Suir, have named it, after the mode of the Adams, the *Adelphi*-terrace; so also did two comedians, who agreed like anything but brothers, alter the name of the Sanspareil to that of the *Adelphi* theatre; and a widow, not to be outdone in Greek by her neighbours, named her stall the *Adelphi* oyster-rooms; and a classical gin-shop on the other side has assumed the name of the *Adelphi* wine-vaults, by an only brother.

James Stuart, who received the honourable addition of "Athenian" prefixed to his name, returned to England about the time that the Adams were flourishing in Dioclesian glory. This eminent man was more of an artist than a practical architect, although he delineated the geometrical details of the art with mathematical precision, and drew the human figure and sculptural embellishments with correctness and taste.

The first accurate knowledge which the people of Europe received of the Athenian antiquities was given by the publication of Dr. Spon and Sir George Wheler, who both fortunately travelled before the Venetian siege. Travels and descriptions of that part of Greece afterwards became more numerous and more sought for. In 1751 Stuart, assisted by Pars, a painter, and Revett, an excellent geometrician, employed three years in measuring and delineating the principal antiquities in Athens and its vicinity. In 1764 the London Dilettanti Society commissioned Dr. Chandler, a learned and investigating man, to examine and report upon these unedited antiquities. Le Roi, a French artist of some ability, visited Athens about the same time as Stuart, and foisted erroneous accounts and delineations of them upon the public.

The drawings and delineations of Stuart and his companions soon became known among the higher and learned classes of England, who duly appreciated the high taste of refinement and purity exhibited in this grand style of art, now known to them for the first time. Preparations were made for their publication with such rapidity, the progress of which was much assisted by the perfect state in which these artists brought over the drawings, that in 1768 they were presented to the public under the title of "The Antiquities of Athens, measured and delineated, by James Stuart, F.R.S., F.S.A., and Nicholas Revett, painters and architects," 4 vols. fol. 1768.

On the occurrence of a vacancy he was appointed by George III. to the office of architect and surveyor of buildings to Greenwich-hospital, which afforded a comfortable leisure to the industrious Athenian traveller. During the time of his holding this office, the chapel and a great part of its bell-tower were consumed by fire, and Stuart designed and superintended their restoration. The whole of its exterior he rebuilt, with due regard to the honoured name of Wren, precisely in the manner in which that great architect left them; but the interior he remodelled after the Athenian style, which is scarcely so suitable for such an interior as was the bolder and more decided style of Wren. It is, however, to be admired as the first actual execution of Attic detail in England, as well as for the chastened purity which pervades the whole design. Benjamin West, then a young

* This terrace is celebrated as being selected by Garrick as a residence wherein to pass the evening of his days. On an occasional visit, Foote asked him whether he had a yard behind his house, the tragedian replied, "I do not know, but I will measure," and on his return said, "I have not, for it is only two feet eleven inches."

man, whose powers as an historical painter were soon perceived by the king, painted a large picture for its altar-piece; the subject selected by his majesty was St. Paul's escape after his shipwreck on the island of Malta, and his miraculous shaking off the viper that had fastened upon his hand, without injury. This picture is generally esteemed to be one of West's master-pieces; another being the stoning of St. Stephen in Wren's neglected gem of art, the church of St. Stephen, Walbrook. The chapel of Greenwich-hospital also shows West to advantage as a sculptor, in some low reliefs of the history of St. Paul in the panels of the polpit.

No event that ever occurred in the history of architecture in England, and thence throughout all Europe, produced so sudden, decided, and beneficial an effect as did the works of James Stuart. It surprised and delighted the learned and admirers of art; the majestic grandeur and simplicity of form exhibited in the general outline of its beautiful temples, and the exquisite purity and elegance of detail shown in all the profiles of his mouldings, fascinated the eye of taste. The natural form, in which everything was subservient to utility, proved how pure was the taste of the elegant Athenians. Nor did the contrast between the works of these ancient architects and their successors and self-called followers strike the mind with less force. Unlike the Romans, there were no pediments under pediments, or under porticoes, or in the interior of buildings,—to which absurdities the Romans were so partial, as to draw down the rebuke of Cicero, that his countrymen were so fond of pediments, that if they had to erect a temple in Olympus to the "Jupiter Impluvius," they would cover it with a roof and decorate it with pediments.

Nor was the contrast greater in the details of their mouldings; those of the Romans being all subservient to the circle and its parts, whilst those of the Greeks defied the mechanical slavery of the carpenter's compasses. Ellipses, parabolas, and other elegant sections of the cone, are the elements of all their curves, and their Ionic volutes bid proud defiance to the compasses of Batty Langley and the ingenious mode of striking the Ionic volute invented by those eminent Italian architects, Scamozzi, Vignola, and Andrea Palladio. Let the eye of taste decide between the echinus of Athenian architecture and the ovolo of the Roman; the cymatium of the Greek and the ogee (what a name!) of the Roman; the bold, manly, and elegant curvature, amenable to no compasses but those which the artist carries in his eye, of that type of the Ionic order in the temple on the Ilissus, or the more beautiful complicated sweeps that form the elegant curvatures of those of Minerva Polias, one of which is in the British Museum, with any Roman or Italian example that ever existed in type or in book, from Vitruvius to Borromini.

It has been the fashion of late with certain sciolists to decry Greek architecture as a heresy, a mere ephemeral fashion, a style of bygone times not worth reviving; and among others, calling themselves architects, that it is good for its remote antiquity, but has been greatly improved by the Romans and Italians. Have we not, say they, added two orders, the Tuscan and the Composite, to the original three? Fluted and cabled and pearled and olived and bedizened the Corinthian, making it as fine as a May-day queen? Angularized or Scamozzied the volutes, lengthened the shafts, bolstered the frieze like the side of a Dutch cheese, and modillionized its cornice, that Ictinus would not know his own invention; added ogees and annulets and colarinos to the unfinished capital of Minerva Parthenon; and a handsome base to its shaft, like a buckled shoe to a naked foot,—and call you not these improvements and additions to the bald Greek style?—Bald it is, indeed, as used by some of modern times; making a miniature model of the majestic temple of Minerva an entrance stuck upon the flank of a huge dead wall, or,

"To what vile uses may we come, Horatio,"

to serve as the passage to a stinking stable-yard. To transform the beautiful style of the temple of Bacchus at Teos—the god who rivalled Apollo in youth and beauty, and shared with him the attentions of the muses and the graces—to the embellishments of gourmandising eating-houses, or to the still more debased temples of intemperance, the Bacchus of the gin-shop; the god to whom Gay in his fable of the "Court of Death," gave the wand of pre-eminence before all his other faithful subjects, saying emphatically,

"He shares their mirth, their social joys,
And as a courted guest, destroys;
The charge on him must justly fall,
Who finds employment for you all."

Fuseli, on being asked whether there was not much breadth of style in one of these Anglo-Greco plagiaries, replied, "that if baldness was breadth, it was broad enough in all conscience."

See, say the Romanists to the Grecians, how gaily we have dressed your naked Venus—how nobly we have attired your slim Apollo—how we have fed and fructified your barren Teïan god?—You have, indeed, sighs a venerable Greek, clothed the Venus of Praxiteles with a head-dress of wool and powder, like Ramsay's portrait of good Queen Charlotte; given her a boddice, hoop, and farthingale, with high-heeled pointed-toed shoes, like Bird's statue of Queen Anne in St. Paul's churchyard; transformed the Hyperean curls of the Delphic god into a periwig of George the Second; cut and concealed the rest of the manly beauties of the son of Latona in attire, like one of Hogarth's coxcombs; and fructified the Grecian Bacchus into a genuine city Silenus, bursting with dropsy, gout, and apoplexy.

Greek art may be reviled, but let its revilers equal it if they can,—to surpass it is beyond their powers: hence the cause why they traduce what they cannot understand. Samuel Johnson, on finding a Greek quotation amidst some modern trash, like "a green Oasis in a desert world," exclaimed, "So much Greek, so much gold." So does the man of true taste on viewing the architecture and sculpture of the godlike Greeks.

About the same period with Chambers, Wyatt, and the Adams, flourished other architectural stars of lesser brilliancy. Ware, who assisted Kent and Ripley in the delineations of Walpole's mansion at Houghton, and known by his ponderous folio, "A Complete Body of Architecture," published in 1768,—as bulky and as little read as the statutes at large in an alderman's library. Brettingham, the architect of Holkham, in Norfolk, the plans, elevations, and sections of which, together with a description of the statues, pictures, and drawings, he published in a folio volume in 1773. He also designed and executed the handsome mansion near the south-west angle of St. James's-square, London, now the town residence of the Bishops of Winchester; and a few other works of less importance, but none marked by any distinctive character.

Among the architectural publications of this period, useful alike to the student and amateur, may be enumerated the works of the collected designs of Inigo Jones, Palladio, Scamozzi, Perrault, &c., by Kent, Lord Burlington, Leoni, James, and Ware, which were, however, for a time swallowed up by the magic wand of Stuart, as that of Moses did those of the Egyptians before Pharoah.

James also flourished about this period, and is best known to architectural critics by his Hawksmoorian churches of Greenwich and Deptford; the former of which was judiciously selected, a few years since, by the Royal Academy, as an architectural competition for its silver medal students.

Paine also enjoyed a portion of the royal and noble patronage of the country in the same era; he built the pretty bridge over the Thames at Richmond, and made some pleasing additions, in the Elizabethan style, to his own residence at Addlestone, near Chertsey, Surrey, which was for many years the hospitable residence of the late Sir Charles Wetherell, of legal and facetious memory. Paine was one of the attached surveyors of the crown in the Land-revenue department, and had considerable practice as an architect among the nobility. None of his works, however, entitle him to the name of a master in his art, nor have distinguished him from the herd of servile imitators of the Italian school. The plans are all well arranged and commodious, sound in construction, and well built; but as meagre in originality of style as the most servile copyist of the common-place school to which he belonged. He did that which it would be well if better architects would imitate—namely, published his works; one entitled "Plans, Elevations, and Sections of Noblemen's and Gentlemen's Houses, &c. &c., executed in various parts of England," 2 vols. folio, 1767, 1783; and the other, "Plans, Elevations, Sections, and Ornaments of the Mansion-House of Doncaster," folio, 1751.

The early part of the reign of George III., so prolific in works on art, produced Cameron's elaborate treatise, "On the Baths of the Romans," in which he successfully explained and improved the "Restorations" of Palladio. It was published in 1772. Colin Campbell also published his very useful work, the "Vitruvius Britannicus," in four consecutive volumes, between the years 1715 and 1771; to which Woolf and Gandon respectively added supplementary volumes, of equal skill and correctness. More recently, Richardson added another volume, so much inferior to its predecessors, that the work was discontinued.

The latter part of this fertile period produced Robert Milne, a pupil, I believe, of Robert Adam; at all events, he was of the same country and school. Like Wren, he exhibited precocious talents; for scarcely at the age of manhood, he triumphantly bore away the first prize in the first class of architecture at Rome, and had the honour of being the first Briton who obtained a premium for art in that city. He was not only a Protestant—and consequently a heretic, in the estimation of the professors of the primitive faith—but was also of that anti-Papistical sect, a Scotch Calvinist. The superabundant ceremonials of the church of Rome which he witnessed in this very heart of popery, the profligate manners and lives of its professors, and the unceremonious style of worship of his own church, perhaps led to that contempt which Milne always impatiently exhibited, even at the decent ceremonies and more simple garb of the church of England. Before he had completed his studies in Rome, he sent over in competition, and conquered all his opponents, for his Blackfriars'-bridge, a work of skill and some originality. Milne's style was too decidedly Roman for the day; but, to his honour be it spoken, his love and affection for our great metropolitan structure, St. Paul's, of which he long held the place of surveyor, was such, that he never would see it defaced or altered, or spoiled in any way; and scarcely a week of his long life passed without him giving it a personal survey.

Milne never did anything better than his Roman design, which was in every way worthy of one of the best disciples of one of the best architectural schools the world has ever produced. It formed a becoming ornament of his study or *sanctum sanctorum*, at his residence at the New River head, Clerkenwell. I have often admired it in my youthful days, with its Italian inscription—"*Primo premio Roberto Milne, Scozzese, Roma*," with its date and something else which I have forgotten, or perhaps never understood,—Italian being in those days as great a stumbling-block to me as St. Paul's doctrine was to the Greeks; and I feared even to ask this architectural Aristarchus anything more than the mere subject before us. He was a man of austere manners, of violent temper, and appeared to have a contempt for every art but his own and for every person but himself. In some of his ebullitions of temper, he has been known to kick the clothes and tools of workmen, who have dared to reply to him, out of windows and into holes in the streets, and has been obliged to fly from the effects of their excited wrath. One of these, an Irishman, said that "Mr. Millen," as he called him, "was a rale jintleman, but as hot as pepper and as proud as *a* Lucifer." Peace be to his remains, which quietly repose by the side of his great predecessor, in that noble cathedral which was built by the one and sustained by the other.

This architect is not known for many other works than his Blackfriars'-bridge; a few bridges, and perhaps one or two mansions, in Scotland; the buildings and machinery of the New River company; and a very commonplace elevation to the east front of Stationers'-hall, Ludgate-hill. The principal employment of his latter years was that of architectural curator to St. Paul's cathedral, architect and surveyor of buildings to the Stationers' company, and engineer to the New River company; dividing his time between his two official residences at either end of that river—its spring or source at Amwell, near Ware, in Hertfordshire, and its other end at Clerkenwell, erroneously called the New River head,—it being the reservoir which supplies, by steam machinery, such parts of the metropolis that are served by the company.

Sir Robert Taylor, a man of great capacity, occupied a distinguished station in Tertio-Georgian era. He was one of the chief architects to the crown, and architect to that opulent body the Governor and Company of the Bank of England, when it began to expand its buildings to the right and to the left of that comparatively small edifice which was more than adequate to its necessities on its establishment in the reign of William III. He had much private practice, and was known for three-fourths of a century to every architect, surveyor, builder, and lawyer in the metropolis, for his celebrated, incomprehensible, and contradictory Building Act, which is only surpassed in litigious absurdities by its successor. He educated many pupils, to whom he gave either districts under the Building Act, or appointments in the office of the Board of Works. It is true, that none of them proved to be men of taste; but they were all thoroughly men of business, high honour, and ntegrity. It is probable that he intended his son to be a great artist, for he gave him the powerful name of Michael Angelo; as did another more recent architect name his scion Christopher Wren. Poor little Christopher, however, died young, and destroyed all hopes of his rivalling his namesake: but Michael Angelo Taylor lived to be a respectable whig member of parliament —the best tempered whig that perhaps ever lived, and the giver of the best dinners that ever did honour to Spring-gardens.

The style of Sir Robert Taylor was founded upon the best Roman examples, resembling in its finest points those of his cotemporary, Sir William Chambers; but he far excelled him in scientific construction and sound building. He found a pretty design for a tetrastyle portico and pediment, with lateral columns of a very elegantly-proportioned Corinthian order raised upon pedestals, in Chambers's work on "Civil Architecture," confessedly borrowed from an anonymous Italian architect. These he repeated on either side of the coarse Ionic centre of the Bank of England in a very pretty but unconnected manner. The whole of this front, which extended from the corner of Princes-street to Bartholomew-lane, has been replaced by the massive and masterly composition of Soane, of which more will be said hereafter. In another part of this building is a quadrangle on the western side, which is still preserved in almost its original freshness, a very choice example of Taylor's skilful adaptation of this tasteful precedent of the Corinthian order. In the centre is a pleasant city garden, with a few verdant lime trees that give variety to the picture. The former façade, next Threadneedle street, being a screen wall to the internal edifices, had no apertures, and was more a copy from Chambers's work than the one in question; which, being an interior court, and giving light to the directors' parlour and other important rooms in that edifice, is decorated by a series of exquisitely-proportioned Venetian windows, which adds a charm to the composition that the original design is much in want of. There is not an executed building of the decorative Greco-Romano style in Europe, that more deserves the titles of tasteful and elegant than does this pretty composition of Sir Robert Taylor.

The two islands of houses that stood between Threadneedle-street and Cornhill, called Bank-buildings, that were taken down to make way for the Royal Exchange and the open area on its western front, and which were occupied by some banking-houses and insurance companies, were a masterpiece of street architecture, putting situation aside, not surpassed by any in Europe. Upon a massive stylovate, that gave height and light to the basement stories, was raised an attached colonnade of as elegant a Roman-Doric as ever emanated from the pencil of a modern architect. The intercolumniations were filled with doors and windows as necessity and internal convenience required, deeply recessed and with bold reveals that served for every purpose of office or shop. The upper part consisted of a lofty elevation of well-proportioned windows with architectural stone dressings, with that breadth between them which characterise all this architect's works. This peculiar characteristic is particularly noticeable in the lofty mansion on the western side of Tower-hill, in which the proportions of the windows show the loftiness of the stories within. This character, which gives such harmony and grandeur to the elevations of Sir Robert Taylor, was so perplexing to the architect (?) of Phillimore-place, Kensington, that he filled the interval between the one and two-pair stories windows with little panels, which, if left open, might have intimated that they were windows to that bungling Italian contrivance, a mezzanine story; but which he rather chose to fill with ornaments (!) of sculptured swags, representing wet cloths hung upon pegs;—he would doubtlessly have filled Sir Robert's broad spaces with similar imitations. King George the Third, who often passed through Kensington in his route from London to Windsor, named that specimen of Kensingtonian architecture, Dishclout-row.

Another fine specimen of Sir Robert's tasteful design is almost lost in the narrow but wealthy way of Lombard-street. It was originally erected for a banking-house, but is now occupied by the Pelican Life Assurance company, and is situated on the north side of the street, nearly opposite Abchurch-lane. The basement story is formed of a solid stylovate, which serves for a base to the Doric order of the lofty ground story. It is of the same classical Roman-Doric that he used in the Bank-buildings. The one-pair story is lighted by three well-proportioned semicircular-headed windows; and above, a row of attic windows, at such a distance from those below them as would have induced the Kensington architect to have hung out his flags of distress. Every admirer of architecture should take a view of this excellent design, before the genius of wide streets takes it away. The well designed group of sculpture by De Veare, which designates the nature of the office, and disfigures the design, must not be taken into consideration in the estimation of the architectural beauties of the edifice, to which it does not belong, and can only be considered as a good thing ill applied.

A smaller, but not less tasteful, example of this architect's peculiar skill is to be found in the pretty villa which he erected for Sir Charles Asgill, on the margin of the Thames at Richmond. Without a column, without a pilaster, without anything appertaining to the five orders,—with nothing that can be strictly called architectural but the cantalived cornice, such as used by Inigo Jones in Covent-garden church—he has composed an edifice so picturesque in form, and playful in light and shade, that may defy competition from such simple materials. The centre stands forward and rises higher than the two attached wings; a three-windowed bow projects from the centre and rises the entire height; the ground story is rusticated and surmounted by a stringcourse and dadoed moulding, upon which rests the windows of the one-pair story; square attic windows mark the upper story of the centre, and the projecting cornice crowns it in front and sides; the wings form semi-pediments, resting against the flanks and centre, looking like contreforts or buttresses to the main building. The eastern and western fronts—for there are no flank walls—have similar bows to the ground story, only the upper parts of which form balconies to the superior story.

Looking at this villa from the opposite side of the river, or from the river itself, the pyramidal form of the composition, aided by the beautiful trees and scenery which surround it, give it an indescribable grace of picturesque beauty, that must find value in a painter's eye. Had the architect separated the villa from the road by a parapet-wall or balustrade, half its picturesque beauty would have been lost. Instead of which, he has enclosed its lawn by a mere protective row of iron rails, which makes the river appear to be part and parcel of the design. Nor is its appearance from the east or the west, on the Richmond side of the river, less perfect or beautiful, showing that the architect must have designed it *en masse* and in perspective, like a painter; and not on the drawing-board, with a T-square and compasses, like a carpenter.

Surely Sir Robert Taylor must take his place among the greatest of English architects.

(To be continued.)

CANDIDUS'S NOTE-BOOK.
FASCICULUS LXXV.

> "I must have liberty
> Withal, as large a charter as the winds,
> To blow on whom I please."

I. Now that *Punch* has pounced upon the palace, people will, perhaps, begin to open their eyes to that architectural enormity, and also to open their mouths pretty freely on the subject. At least so it is to be hoped, since it is only by clamouring, and clamouring very loudly indeed, that we can hope to put a stop to similar delinquencies against taste, and similar mismanagement for the future. One would have thought that just after the outcry about the "Arch and Statue," all those who were in any way concerned with the projected alteration of the Palace, would have exercised a little discretion, and paid some little show of deference to public feeling. Instead of which, the only caution taken was the most unhappy one, as it now proves, of precipitating the business in the most hurried manner,—not altogether without reason, though a very bad one, for never would the public voice have sanctioned such a design for the occasion as that which received the *imprimatur* of parliament. It may be questioned if any one individual—even any one of those who affixed their signatures to the designs presented "to both Houses"—bestowed any sort of examination upon them. If they really did do so, what is to be thought of their judgment? Or was it taken for granted that the designs had been duly examined and fully considered by some responsible authority? Where responsibility for the choice actually lies, it is easier to guess than it may be exactly decorous to say. Assuredly not with the architect himself, for his incapacity would have been harmless, had it not been for the incapacity of judgment or careless indiscretion which suffered him to be employed. The lady who can dismiss a minister from her council board, can surely dismiss an architect from her service. At any rate there was no necessity for her employing that particular architect on an occasion that did not fall within the course of his usual official duties.

II. Buckingham Palace looks if not exactly more insignificant in style, of far more plebeian quality than before, and is, besides, greatly worse than ever as an architectural composition, the addition to it forming a lumpish mass, which, owing to its jutting out abruptly from the two low wings which are left standing, seems to encroach upon and disfigure the Park. Previous to the alteration, the principal mass of building had at any rate an architectural framing to it, whereas the present "façade" has none. Not only do the above-mentioned portions not belong to it, but they cause it to appear more lumpish—more of an excrescence than it otherwise might do.—Were royal palaces erected every day, we could tolerate a few blunders now and then, in the hope of obtaining something very much better the next time; but such not being the case, the utmost ought to be made of the opportunity which actually occurs; every possible precaution ought to be taken to insure not a merely good, but a very superior design; and Mr. Blore's most assuredly does not answer to such character, since apart from all its other numerous deficiencies, it does not exhibit a single touch of imagination, or fancy, or artistic feeling. In sad and sober truth, the design is nothing more or less than the production of a Pecksniffian drawing-board. Altogether of the most ordinary quality, it manifests impotence of conception, and total want of imagination and fancy, whether as regards the whole or the separate parts. Yet, as the building stood before it was begun to be *doctored*, there was much in it to prompt contrivance, since it held out many tolerably obvious hints for improvement, all which have now been overlooked. As far as the public are concerned with it, the Palace is worse than ever—a more decidedly offensive architectural object than before, and the very reverse of any improvement to the Park. And what renders the matter all the more provokingly vexatious is that not the slightest pains were taken to endeavour to satisfy the public. Vast indeed must have been the opinion of, and the confidence in, Mr. Blore's talent, to abide by such a "Hobson's choice," without letting there be even so much as a chance for anything more worthy the occasion being produced. One thing at least ought to have been seriously considered, namely, that little less than assured certainty of success warranted the risking such a decisive step as the one taken,—one that only the most complete success could justify. Had we been taken by an agreeable surprise,—had—after all the misgivings and apprehensions excited by very suspicious mysteriousness—the new façade burst upon us arrayed in beauty and magnificence, there could then have been no question as to the propriety of a mode of procedure that might up to that time have appeared both arbitrary and injudicious, both of which, we conceive, it will be considered now. As the patron of the Institute of British Architects, her Majesty might surely have afforded those whom she so royally and graciously countenances, the opportunity of exerting their talents on an occasion that ought to have inspirited and inspired them. There are persons in the world who are so exceedingly clever and Machiavellian that they over-reach and cheat themselves; who has done so in this particular instance, we will not say; nor should we so much care, were it not that John Bull pays for all in more ways than one,—not in pocket merely, but in reputation also. Foreigners will now have fresh cause to sneer at his taste, or the taste foisted upon him. They—happy dogs! may grin, while we can only groan. As to Mr. Blore, he may console himself one way, since he may now truly remark with Byron, that he got up one morning and found himself famous—his name in everybody's mouth, from north to south,—his fame (not quite the best) spreading wide from east to west, or what's the same, spreading at least from west to east. Still no one cries encore! to the achievements of the far-famed Blore.

III. Should the Architectural Association act up to its professions and intentions, much benefit may be anticipated from it. It promises to call the attention of the student to what is so greatly neglected, or rather altogether overlooked, in his ordinary professional education—namely, artistic apprehension of architecture, as distinct from mere building, in its quality of fine art. The Association consists chiefly of juniors,—and it is to the juniors and the rising generation in the profession, that we must look forward for more liberal, enlarged, and worthy notions than those which have hitherto prevailed in these latter times, when the art has degenerated into what is little more than empirical routine on the one hand, and twaddling pedantry on the other. Since they seem so disposed, let the seniors in the profession go comfortably to sleep, provided the juniors are awake, and awake a better state of things. Let them boldly break the trammels in which their art has so long been confined,—fetters of unbending iron to the timid and the weak, but feeble as cobwebs to the firm and the resolute,—the mere flimsy spider-spinnings of pedantic brains.

IV. The nation is, it seems—at least, according to some people's fancies—very much richer than it was a short time ago, in consequence of the prodigiously valuable acquisition of Shakspeare's House—the only house, by the by, that can be called his, be being now ejected and kicked out from his legitimate dramatic domicile—the theatre. Shakspeare's House! what an immense quantity of drivelling sentiment was poured out just before the time of the sale of that rubbishly old tenement! Yet we laugh and sneer at, and ridicule the reverence of Roman Catholics for relics as besotted superstition,—our own Protestant superstitions being at the same time not a whit less absurd and crazy. However others may be affected at the sight of them, I know not; but such vulgar objects as Wilkie's palette, in the pedestal of his statue at the National Gallery, and Nelson's coat, in the Painted-hall at Greenwich, only excite my thorough contempt, as the veriest buffoonery aping reverential admiration and affection. This species of superstition becomes little less than downright imbecility, when the objects of it are absolutely insignificant and uninteresting in themselves, and have no other value than their very problematical genuineness,—as is the case with the two reliques afore-named, it being just as likely as not that that identical palette was never in Wilkie's hands, or that identical coat upon Nelson's back. Again, as to Shakspeare's House, it is quite certain that no such inviolable precautions were taken to preserve it for ever and a day intact, as were taken by Soane to maintain his domicile in all its pristine excellence.

V. That our late Greekomania should now be greatly chilled, is no wonder, for our Grecianism had fairly worn itself out. It was in a manner starved to death, owing to its not having received the slightest nourishment from any new ideas infused into it. Nothing more was made of it than just what it was at first. Instead of attempting to treat it with free artistic gusto, to mould it according to actual circumstances, and also to keep up consistently, through every part of a building, the style so dictated, we contented ourselves with little more than copying in the most humdrum manner the fronts of ancient temples for classical porticoes, with no other variations than Doric, Ionic, and Corinthian—tetrastyle, hexastyle, and octastyle. Nearly one and all were the merest mechanical copies; and precisely the same examples were repeated over and over again, in the most wearisome manner. It seemed as if we were ambitious of rendering the scanty resources of design afforded by Grecian architecture, even when availed of to its fullest extent, still more scanty, by exploding all but one or two of the most familiar examples. Nor was penury of ideas and inventive taste all, there being also, for the most part, great penuriousness in the general design of the buildings themselves and their execution. In many instances, even the ordinary decencies of design were wholly disregarded,—wherefore, in spite of their Greek columns, the would-be classical structures proclaimed themselves to be arrant Cockneyism, and that of the very worst and most vulgar kind of all, because accompanied by despicably paltry affectations. Nevertheless, such things were admired,—were complimented in newspapers, and extolled in guide-books, which exultingly called the attention of visitors to what they described as "a great ornament to our town."—In a word, we had, by the unhappy use we made of it, converted Greek architecture into the most humdrum sort of design. Nay, it seems to have paralysed our powers of design and composition altogether, so that the only alternative left us was to escape from it by plunging *headlong* into the Gothic and Italian styles.

VI. No one can say that I do not encore Buckingham Palace, after one fashion at least; for my pen is itching to twitch at it again—*le voici!*

> One vast difference, I ween,
> Little Florence between
> And our huge overgrown city,
> Is—to speak more in grief than in malice—
> The first has the palace whose name is the Pitti,
> We, a petty and pitiful palace.

We groan, we grin by turns at it, nor groan the less when we consider what our neighbours have lately made of their—not royal, but municipal palace, the Hotel de Ville at Paris, whose Grand Gallery, or banquetting-room, quite eclipses our House of Peers, and all else that is contemplated for the interior of the Palace of Westminster.

VII. A Real Architectural Dictionary is a desideratum not likely to be speedily supplied. By *real* is to be understood one which treats of *things;* one therefore, which, instead of confining itself—if not exactly to mere definitions, to a very brief account of the respective matters, should enter fully into the subjects connected with the terms explained, and supposing a work to be executed satisfactorily, some of the articles would require to be of considerable length. And to be well executed, it ought to be exclusively architectural, otherwise it would exceed all convenient bounds, there being a very great deal, hitherto scarcely touched at all in any shape, that would come under cognizance in such a work. In fact, as compared with its mass and the number of publications belonging to it, architectural literature is remarkably meagre as to substance, and in regard to information to be derived from it. The greater portion consists of what is very little more than repetition, and that mere compilation, with scarcely so much as a fresh thought or remark infused into it. What work can we find which goes into the subject—and a very important and highly interesting one it is—of architectural Composition? In fact, the term itself is altogether ignored in dictionaries calling themselves architectural ones, although it would afford matter not merely for pages, but for entire volumes. Nevertheless, not so much as a single one on it has been produced. "Effect"—which, by the by, belongs to and is included in Composition—is another term that would form an article of some length in a dictionary of the kind in question. A great number of other terms, expressive of different qualities and characters, but now rendered almost unmeaning by the indiscriminate and ignorant manner in which they are applied—often at mere random—would require to be introduced, and to be most carefully analysed and explained,—explained moreover by copious instances and examples; because, without such express elucidation, criticism becomes mere fumbling in the dark, whereas in architecture it cannot possibly be rendered too definite and exact. Take "Simplicity,"—ask any man supposed to be tolerably *au fait* in architecture what he understands by it, and instead of an intelligible reply you will get a vast deal of hemming and ha' ing, and perhaps at last the very profound information that Simplicity is—Simplicity; and so throughout the entire list. Not least strange of all is it, that in dictionaries, glossaries, or whatever else they are styled, of the class alluded to, no notice is taken of such exceedingly obvious terms as Cinque-cento, Renaissance, Rococo, Louis Quatorze mode, or Italian style generally, with the Florentine and Venetian in particular. What exemplary attention Nicholson bestowed on his Architectural Dictionary may be conceived from the almost incredible fact of his omitting, *inter alia*, the term "Spire;" one which, if properly drawn up, would have brought together some account and description of all the principal structures of that class. Both "Campanile" and "Belvedere Tower" might also be made to furnish very interesting articles. There are besides a prodigious number of similar matters and terms, which, if not exactly passed over altogether, have hitherto been dismissed with exceedingly *jejune* notices of them. As far as it goes, Parker's Glossary is the best work we have of the kind, is economical in form and admirable in some of its wood-cut illustrations; but it is so exclusively mediæval, that it would have been better had it confined itself entirely to the architecture of that period, without pretending to embrace "Grecian, Roman, and Italian," which are treated so very begrudgingly as to be made to appear comparatively quite secondary, if not actually unworthy; whereas, in a work of the kind, whatever is introduced at all, ought to obtain due and impartial attention. Had the last-mentioned styles been omitted by Parker, as not coming within his plan, there would then have been an opening for a similar illustrated "Glossary," exclusively devoted in turn to them.

VENICE; AND HER ARTS.

By Frederick Lush.

> O Italy, the fallen! once thy soul
> Of high and noble impulses was full,
> And in its lofty might could spurn control,
> And find a place for all things beautiful.
> Noble and lovely in thy pride thou wert;—
> O wherefore could'st thou bear to stoop so low?
> Better have died thy freedom to assert,
> Than tamely crouch 'neath the degrading blow!
> But the vast Knowledge which o'er earth's wide plains,
> Is sweeping like a mighty rushing wind,
> Has reach'd e'en thee, and in thy languid veins
> The pulse is quick'ning—to thyself be kind,
> Call back the old high feelings to thine heart,
> And let it glow once more with Freedom, Truth, and Art!
>
> Anne A. Fremont.

A city, like Venice, so extraordinary in its position; rising out of the sea as if by enchantment; presenting so many picturesque appearances; and unfolding in the pages of its history so much of the fairy-tale and romance, cannot but be beheld with emotions the most lively and enthusiastic. In many respects, she is not unlike what we conceive from description ancient Tyre to have been, and fully deserves the eulogium that was passed upon that celebrated capital:—"Thou art a merchant of the people for many isles..... thy borders are in the midst of the seas, thy builders have perfected thy beauty.... princes were thy merchants, and occupied in thy fairs; and chief of all spices, with all precious stones and gold and chests of rich apparel, were amongst thy merchandise.... thou wast replenished and made very glorious in the midst of the seas."*

The sensations which Venice produces are the more powerfully preserved, from the fact that the spot, which has witnessed some of the most interesting events that have occurred in Europe, and which displays some of the most wonderful and curious creations of the ingenuity of man, receives a considerable degree of its splendour and attraction from the beautiful climate and glowing sun of the Adriatic, in which it was cradled. Viewed when her spires, her cupolas, and palaces are suffused with the

* Ezekiel, chap. 27.

ruby rays of the setting sun, or repose in the silvery moonlight; at Ave Maria, when the bells proclaim the hour of prayer, or music sends forth its streams of harmony from the crowded Piazza; or at midnight, when the impassioned notes of some gondolier's song or lover's serenade alone break the prevailing tranquillity;—the sounds and the emotions which are then heard and experienced—the purity and intensity of which are increased by a profound silence and a still atmosphere—impress this city of poetry and song for ever upon our recollection.

Venice is proverbial, even in Italy, for the beauty of her sunsets, and it will not be a matter of surprise to those who consider the influence of external objects over the feelings and imagination, why the Venetian painters—Giorgione, Titian, Tintoretto, &c.—acquired such perfection of colouring, and warmed the subjects depicted on their canvas with the resplendent hues of their native skies. A clear perception of the beautiful in nature; a lively fancy easily captivated by the charms of that colour which surrounded them, joined to a power of imitation which enabled them to express it in their productions, making their pictures look as though the sun shed its dyes of gold, vermilion, and purple upon them,—stamped the golden period of the Venetian school of painting with a magical brilliancy and splendour of colouring, which, as it sprung out of natural feelings, and was grounded on the most poetical associations, so it was the beautiful and striking feature that characterized this school; a palm of merit which none other has been able to dispute with them. Although belonging to the ornamental style—placed by Reynolds in the second rank next to the grand style, and considered inferior to the Roman—yet "the national genius," as Lanzi says, "always lively and joyous, sought to develope itself in more brilliant colours than those of any other school;" and we trace this feeling not only in their architecture and in the architectural accessories of their pictures, but find it entering into every thing they undertake, and investing with greater show and pomp their favourite festivals, their regattas, processions, and all their public exhibitions. Besides, the climate and scenery of Venice—without even referring to those popular games and festivals, which were so many theatres for poetry and opportunities for displaying the artistic talent of the people—demanded from the arts a degree of splendour which in other places would have been deemed superfluous and ostentatious. Those arts, moreover, in contributing to the scenery, were in return heightened by the climate; all received additional lustre from the pure light under which they were exhibited. It is this which so strongly augments the effect of every feature of the landscape; and, at the same time, leaves such vivid impressions on the spectator: which makes the foliage of the trees glow like emerald; and the islands and gardens seem as though they floated in a sea of sapphire.

It is this climate—the luminous, phosphoric haze that warms and gilds and shines upon Venice—as well as the oriental aspect of the city—which the traveller gazing upon knows to be the chosen abode of the genius of the arts and poetry; and as such, although the hackneyed sounds of the world are removed from it—though it never hears the tramp of horse or the "car rattling o'er the stony street"—yet he will not experience the melancholy and depression that is engendered beneath the gloom of the lengthened arcades of Bologna, or the solitary, deserted streets of Ferrara.

The poet or artist, yielding to the charms which are scattered over Venice in such profusion; looking upon the pearls and precious stones which shine in the crown of the Queen of the Adriatic; the dazzling robe in which she is arrayed, as she sits "enthroned on her hundred isles;" as he listens to the tones of sweetest melody, and catches the perfume of delicious fragrance as he glides over canals meandering

"———— by many a dome
Mosque-like, and many a stately portico,
The statues rang'd along an azure sky;
By many a pile in more than Eastern pride,
Of old the residence of merchant-kings;
The fronts of some, tho' Time had shatter'd them,
Still glowing with the richest hues of art,
As tho' the wealth within them had run o'er;"*

will feel that this city, selected as it was for enacting, as it must have enhanced, those pageantries and ceremonials for which it was renowned in the days of its republic, must suggest to the Venetians of the present day, when thinking of its faded glories, the lamentation, so applicable to many other cities of the past—*Venezia! Venezia! Venezia! Venezia, non è più com' era prima!*

* Rogers's poem of "Italy."

It cannot be unprofitable or uninteresting to allude to some of the arts which adorn this beautiful city,—arts of which it has been miserably despoiled by wars; yet of which, sufficient remains to convince us that they were cultivated and brought by the Venetians to a very high degree of splendour. Sansovino, their historian, acquaints us, that in the most flourishing period of Venice, there was not a city in the world which possessed so many works collected from antiquity, or could boast of such large galleries of pictures, statues, bassi-relievi, bronzes, engraved stones and metals, mosaics, tapestries, and all kinds of inlaid work; and that the opulent citizens and wealthy patricians, ambitious to amass everything that was a token of wealth, indication of commerce, or evidence of refinement, endeavoured to outvie each other in the number and beauty of these productions. But these were acquired, perhaps, more from foreign, than from the sources of their own country: and the slightest investigation into the history of this city, and the causes of its greatness and wealth, soon lays open to us the beneficial tendency of commerce upon the arts—and through this channel, a way to their increase and prosperity. The enterprising and "devoted hands of patriots," who, driven by Attila, set to work, like beavers, and built Venice on wooden piles in the ebbing and flowing tide, would not be wanting, nor their sons neither, in their command over the riches of the East, &c., by ploughing the ocean and navigating along the ancient seats of the fine arts upon the Asiatic and Grecian coasts, the shores of the tropical peninsulas, and the islands which stud the Archipelago, for the purpose of there founding colonies and emporiums of commerce—by means of intercourse with which, their first city would grow rich, beautiful, and prosperous. And such was the case. The treasures of art and the relics of antiquity, accumulated from foreign countries, were contributed towards the adorning of churches and public edifices; were the cause of that ornamental character, yet heterogeneous mixture, which we see in many of the buildings; and many of them enriched, and still exist in, the galleries of the old palaces of the Pisani, Contarini, Cornari, Grimani, and of other ancient patrician families;—each of which, whilst displaying an example of curious and beautiful architecture in itself, contains also a museum for the study and admiration of the antique.

The influence of commerce over the fine arts of Venice was great; and although the state could not boast of much extent of territory, nor a large amount of population—yet, by extending their commercial relations with other countries, and imitating as it were the example of ancient Tyre or Carthage, their fame and their sovereignty was conspicuous, and excited the envy of many a cotemporary republic. The skilled pilots who trafficked in the marts of the Levant, and brought home cunning artificers from Arabia, and Grecian artists from the Lower Empire, were the true pioneers of civilization. To the labours of these foreigners, Venice and the Venetians are greatly indebted,—not only for the Byzantine architecture of St. Mark (of which they are so justly proud), and of many other of the earlier edifices in this style, but likewise to the curious art of mosaic and various tesselated work with which it abounds. These picture-like representations, so particularly appropriate to the decorations of either Gothic or Byzantine churches, possess distinguished advantages over frescoes, in point of permanency of colour. Many very ancient specimens still remain—even such as have been exposed to the action of the open air, although their durability is seldom put to this trial; yet, in the case of fresco-paintings which have been exposed to the sirocco and the sea-breezes, the vividness of their original tints has entirely faded away,—the subject, under such influences, being sometimes scarcely discernible.

The early mosaics extant in Venice are considered by some writers as being the first essays of the art of painting in that city; but, as Lanzi remarks, in his account of the Venetian painters—"the artificers, however rude, must have been acquainted, in some degree, with the art of painting; none being enabled to work in mosaic who had not previously designed and coloured, upon pasteboard or cartoon, the composition they intended to execute."*

The same author mentions some mosaics of Grado, wrought in the sixth century (a century or more after the foundation of Venice, which was about A.D. 451), those of Torcello, and a few other specimens that appeared in Venice, in the islands, and in Terra Firma, produced at periods subsequent to the increase of the grandeur of the Venetian state, which attained its climax soon after the taking of Constantinople, in 1204. About the

* Roscoe's Translation.

year 1070, the Doge Selvo invited mosaic-workers from the capital of Byzantium, to adorn the basilica of St. Mark, for in that the Venetians were desirous to emulate or surpass the church of S. Sophia. Andrea Tafi, a Florentine, cotemporary with Cimabue, studied under those Grecian artists; from whom he obtained the materials of that fame which he afterwards acquired in the mosaics executed by him in the baptistery of his native city: and hence it is the opinion of Flaxman,* that the elements, as well as the perfection of the arts, have always been received, either immediately or intermediately, from the Greeks, by Western Europe; although, he adds, this has been denied by Vasari—and, as far as concerns the Greek Christian paintings, does not seem to have been even suspected by Winckelmann.

There are two sorts of mosaics, as they are also referable to two different epochs. The most ancient belong to the foundation of the basilica of St. Mark (at the close of the tenth century), and to the first introduction of this art into Italy from the Byzantines. The famous *Pala d'Oro* was executed by the mosaicisti of the first period, and which, entirely composed of plates and figures of gold and silver upon enamel, offers a beautiful example of the rich and elaborate workmanship of the Greeks of the Lower Empire. The mosaics which for contra-distinction we might call modern, were commenced in the latter years of the fifteenth century, and are attributed chiefly to the two brothers Zuccati, Francesco and Valerio, sons of the painter Sebastiano Zuccati, of Trevisa, who instructed Titian in the elementary lessons of drawing. The Zuccati executed these mosaics by means of cartoons, drawn by the best artists of the time, and from copies furnished by Titian or Tintoretto. The subjects are generally conceived from the descriptions of the Old and New Testaments.†

What, even at the present day, is so rich and splendid in St. Mark's, are the vaults of burnished gold; and it is these, with the sheen of various metals, bronze, silver, and sparkling stones—vieing with the most brilliantly-painted ornaments, Moorish and Byzantine—which give such a strong oriental character to this singular and interesting pile. The inlaying of figures in coloured pieces of stone on a surface of gold, perfectly corresponds with, and is analogous in effect to, the pictures of the Greeks, which were invariably painted on a golden background. Covering wood and other substances with this valuable material was common among the Egyptians, and was extensively practised by all the nations of antiquity. Vestiges of gold leaves and gilded ornaments are still traceable in the ruins of many ancient edifices in Greece, Persia, Arabia, Italy, and other countries; and are often found in a high state of preservation. Although the golden vaults of San Marco may be tarnished by time, still it is easy to imagine how very beautiful must have been their appearance in by-gone days. The early Venetian painters used gold in their pictures, as if they thought it indispensable to the due representation of the gorgeous *fêtes* which were celebrated in their city: Gentile Bellini may be mentioned as an instance, in his painting of the religious ceremony of *Corpus Domini*, in the Piazza di San Marco. For a long time afterwards, the Italians employed gold for the glories of their saints, and the fringes and ornaments of their costume.

Painting on glass and in enamel, another art in which the Venetians excelled, was also in ancient times carried to a very great extent. The glass-houses at Alexandria were celebrated for the skill and ingenuity of the workmen. The Alexandrines were fond of exhibiting glass cups, which sparkled with colours of every kind, at their grand festivals. This art was thence imported into Venice, and down to the present moment has had a great deal of attention devoted to it; for none can be insensible to the magical brilliancy reflected from the ancient windows of foreign or British cathedrals. When it was but little known, a transparent marble or alabaster of beautiful colours, called *lapis specularis*, was sometimes as a substitute introduced for effect in the windows of churches; as we see, for one, in San Miniato at Florence.

The Saracens introduced into Venice tapestries from Cairo, as that city was famous for the manufacture of them; and the processions which conveyed thence to Mecca the most beautiful hangings which Cairo could produce, was quite a religious affair, and was got up entirely regardless of expense. This ceremony is described by bishop Pococke in his "Travels in the East."

Tapestries were and are at this day the great ornament of churches in Italy and all Roman catholic countries, the finest being copies of celebrated pictures, sometimes issued from the Gobelin manufactory, and are exhibited to the public on the occasion of any great festival; and none so fond of doing so as the Venetians.

In Venice, and in all other states—especially in the early periods of their history and civilisation—those artists and artificers were at a high premium who excelled in mosaic, in gilding, in the working of different metals, in weaving cloths and silks, in colouring glass, or in painting on walls; and these arts, valued on account of their curious and elaborate execution, which far surpassed the material, as well as for the effect which they imparted to civil and religious edifices, obtained the universal and lasting favour of all civilised and enlightened countries: the knowledge of the principles and processes employed in them spread rapidly throughout the whole of Europe; the moderns contributed to their perfection; and they were most assiduously cultivated by the monks during the middle ages. The greatest artists have not disdained to make researches into these subjects, being sensible of their utility in point of decoration, and as being auxiliaries to more noble arts: Michael Angelo turned his attention this way; and Ciampini, in his "*Vetera Monumenta*," prefaces his history of the ancient basilicas with an enquiry, illustrated by plates, into the antiquity of mosaics, attributing their invention to the Greeks of the Lower Empire.

We have above alluded to some of the arts which originally belonged to, and were introduced into Venice from, the Asiatic and Arab countries, because of the oriental physiognomy which she first assumed from this connexion and influence; and pursuing this track, we shall now mention the vestiges of Saracenic architecture which she presents, together with its characteristics,—before speaking of Venice after the Italian invasion of the new but beautiful style of the *cinque-cento*.

St. Mark's deserves our first consideration, being the most oriental of all the edifices in Venice, and the most remarkable in Christendom. Combining, as it were, the mosque or Mahommedan house of prayer with the Christian temple—loaded alike with the productions of art and the trophies of conquest—there is probably no other edifice in the world which appeals to the spectator by so many powerful associations, or is suggestive of such extraordinary reflections, as St. Mark's. It is the primary and principal object which excites the curiosity and fills the imagination of the traveller in Venice: let him have visited what wonders he may, its strange but beautiful façade will strike him as something that has no parallel. Although there are mingled together details the most heterogeneous and strangely sorted, still the effect of its colours and proportions enchant, as if the beautiful Byzantine and Arabic styles compensated for and concealed the boldness of a work which was produced in contradiction to the severe rules of art. Then, singular enough, although the Venetians can boast of no hippodrome, neither indulge in horsemanship or steeple-chases, yet they can point with national pride to the four bronze steeds over the central porch of their cathedral,*—for they are monuments of their former greatness, though not, unfortunately, works of a first-rate character.

The exterior of St. Mark's, with its domes and minarets, its height from the ground, and its profusion of ornament, resembles a mosque of the Saracens; whilst within, it is more like a Mussulman than a Christian temple. There its narrow naves, instead of terminating in light and lofty arches, are confined and roofed-in by low, heavy vaults. Yet these vaults, covered over with gold, are supported by upwards of five hundred columns of precious marble, veined, black, and white; alabaster, bronze, serpentine, and verdo-antico; and the tesselated pavement is formed of most exquisite jasper and porphyry. The arabesques, chisellings, bas-reliefs, and statuary—the works severally, of antiquity, of the Byzantine artists, and of artists of a subsequent age—here appear as if in competition of their respective merits; whilst those portions of the walls and the vaultings which do not glitter with burnished gold or precious stones, contain the mosaics (already mentioned) of two separate epochs—those attributable to the Greeks, and those produced by the Italians.

With all that has been said in praise of St. Mark's, much has been said in censure, and we can imagine such would be the case. There are some objects so entirely out of the sphere of the usual routine and exercise of the understanding and taste, that the mind, occupied and absorbed with others more congenial to its inclinations or habits, feels for the former no

* "Lectures on Sculpture."

† Of the capability of mosaic to produce all the tones and gradations of light and shade equally with the brush, we have convincing proofs in the copy of Raphael's "Transfiguration," in St. Peter's, Rome; which is a close resemblance of, and assimilation in effect to, the original

* "It is astonishing," wrote Haydon, "that the great principles of nature should have been so nea ly lost in the time between Phidias and Lysippus. Compare these two heads [the Elgin head and that by Lysippus]. The Elgin head is all truth: the other all manner. In the Lysippus' head, the great characteristics of nature are violated for the sake of an artificial effect; in the former head, the great and inherent characteristics of nature are elevated without violation. Inasmuch as the Elgin horse's head differs from and is superior to the head by Lysippus, so do the rest of the Elgin marbles differ from and are superior to all other statues of this and every subsequent age."

interest or concern; rejects them, perhaps, with indifference and contempt; pronounces them as useless or absurd; or, at least, does not receive them as fit and welcome objects for its study and contemplation. Even the educated eye and cultivated taste of the real connoisseur before St. Mark's, may fail to see and discern its beauties, and may err in the judgment and opinion he forms of it, by a mind unfavourably disposed towards it; incapable, from its condition, of becoming the recipient of, or yielding assent to, its peculiar merits; and alike incapacitated to understand and enjoy them. Instead of testing a work and the qualities associated with it by the particular frame and constitution of our own minds, and some standard of our own therein set up, it is essential in all criticism of fine art, to feel as the author or artist felt, to know with what idea and intention he was animated and possessed, and to judge according to the circumstances of the age in which it emanated,—if we would renounce partiality and avoid misinterpretation. Hence, Schlegel said: "No man has so deeply penetrated into the innermost spirit of Grecian art as Winckelmann; he transformed himself completely into an ancient, and seemingly lived in his own country, unmoved by its spirit and influences."*

Admitting all the faults of St. Mark's; admitting that semi-barbaric character impressed upon it by the extravagant use of costly materials,—we must, at the same time, confess that to our eyes this very wildness and exuberance caused much of the pleasing emotion we experienced. We thought that its architectonic forms and ornaments (faulty as they are often considered to be by many Europeans) were extremely effective; and, although the boldest that the hand of man ever ventured to employ, that they were as appropriate and significant to the intentions and purposes of St. Mark's as could possibly be conceived. Long familiarity with its peculiarities only deepened this conviction. Long familiarity did not make it look ordinary or tame. But long, frequent, and intense contemplation only developed its beauties, and manifested its deep symbolical significance.

It is difficult, if not impossible, to do anything like justice to St. Mark's with the pen; nor is it intended to offer a complete description;—pictures and dioramas can alone convey an adequate representation of its splendour: to these we refer the reader, and we think that he will therein see a corroboration of our remarks—namely, that its architecture is in admirable keeping with the buildings which surround it; and that its effect, in its place and in relation to its scenery, is everything that could be desired, and the principal ornament and attraction of the great Square in which it is erected.

(To be continued.)

* Lectures on Dramatic Art and Literature.

MUNICH IN 1847.

Somewhat extraordinary it undeniably is that no English artist or publisher should have thought it worth while to give us any illustrations of the capital of Bavaria, for besides that no engravings of the kind—that is, views of the modern, especially the recent structures at Munich, have been brought out in Germany, they would have a chance of being very much better executed here, there being in Germany itself no medium, apparently, between very expensive and large-sized works—consequently the very reverse of popular in price or shape, and the most paltry productions conceiveable—the very doggrel of the pencil. Munich, as it now presents itself, has been styled the Paradise of Architects,—perhaps somewhat incorrectly, at least as far as English architects are concerned, since it must excite in them sundry very unpalatable comparisons with not buildings alone, but the general system of architectural management here at home—that is, if what seems to be conducted upon no systematic scheme of management at all, can so be termed. What has been achieved of late years at Munich with comparatively limited means is almost incomprehensible to Englishmen; but the great secret is, that if the means have been limited, the intelligence and the will that directed them have been great and energetic. We, on the contrary—but comparisons are odorous, as Mrs. Malaprop says, therefore, perhaps, we had better drop them altogether, and forego any allusions to royal taste and royal sympathy with Art, here at home.

Among the more recent and as yet incomplete works at Munich is the "Wittelsbacher Palast," in a style partaking of our own later mediæval architecture. The edifice is described as a quadrangular pile with four octangular towers rising at its corners, and with a projecting pavilion in the centre of the principal façade. The whole is partly of a warm red and partly of a decidedly yellow tint, wherefore the building shows very forcibly against a clear blue sky. Another building designed by the same architect (the late Professor Gärtner) is the Neue Friedhof or Cemetery, forming a quadrangular inclosure or Campo Santo, with forty-three arches on each of its longer, and forty on each of its shorter sides, consequently nearly a square in its plan. All the arches are thirteen feet in width, semicircular, or, to speak accurately, something more, the curve being just returned below the chord, whereby a peculiar expression and lightness are imparted to the arches, which rest upon octangular pillars. In the spandrel surface between the arches is a medallion, and the elevations are finished by a console cornice. Internally, these arcades or cloisters have rich open-work timber ceilings, and their walls afford adequate spaces for both pictorial and sculpturesque decoration. How vastly superior, we may remark, such a well disposed *ensemble* to the paltry higgledy-piggledy appearance presented by our own modern cemeteries—that of Kensal Green especially, with its atrociously vulgar, not to call them profane monuments, recording such worthies as Pill-Morrison, St. John Long, and Ducrow the equestrian—company in which no one would care to be buried, lest—the readers will supply the hiatus.

Not the least important building of all now in progress at Munich is the Neue Pinakothek, which is intended for the reception of productions in porcelain and glass-painting in the ground-floor rooms, and for pictures by modern artists in the upper ones. This second Pinakothek, the architect of which is Professor Voit, will not be so extensive an edifice as the first one, its length not exceeding 368 feet, while that of the other is 520. In regard to style and general form, also the arrangement of its plan, it will be somewhat similar, but in the physiognomy of its principal façade will be almost unique; it being intended to decorate the whole of that its south-side, above the ground-floor, with mural painting. That surface, about 360 feet in length, by 26 feet in height, will be divided longitudinally into compartments, so as to form a series of historical compositions, the cartoons for which have been already prepared by Kaulbach. The entrance is in the east front, and beyond the vestibule will be a double staircase—that is, two ascents, one on each side, conducting to the upper floor, first into five spacious exhibition rooms, with as many smaller ones on the south side, all of which will be lighted entirely from above. On the north side of the middle suite of rooms, will be fourteen cabinets, each having a side light, and these will, of course, be accordingly appropriated to pictures of cabinet size. On this floor the western end of the plan will be occupied by a single room upwards of 90 by 50 feet. It is intended exclusively for the reception of a series of landscapes by Rottmann,—a set of views in Greece, which he was commissioned to paint for the king. And that Rottmann's-Saal, as it is to be named, will be so peculiar in character—so unlike all other picture-galleries or exhibition rooms, as to deserve here such an account as we can at present give of it. It will be divided by columns into twenty-four intercolumns or compartments around its sides, and of those compartments—which, we presume, will form distinct recesses, after the manner of those in the Glyptotheca of the Colosseum here in London,—twenty-three will be occupied by as many landscapes; and besides that such uniform architectural arrangement is altogether uncommon in a gallery of the kind, the effect will be extraordinarily enhanced by the entirely novel mode of lighting adopted for it,—one that will realise an idea which we ourselves have ere now entertained. No light will be admitted directly into the centre space or room itself, but only upon the walls within the compartments, so that while the space in which the spectator stands will be in *demi-jour*, the light will be thrown upon the paintings, each of which will be completely framed in, as a separate view, by the two columns between which it will be seen, whereby a considerable degree of illusion can hardly fail to be produced. Here then is an idea that might be turned to excellent account for a Panorama, since it would undoubtedly be an improvement were the "platform" at such place of exhibition enclosed by columns or pillars of some kind supporting its roof.

The Rottmann's Saal, and the five-rooms in the south-side of the building, as also the cabinets on the north-side, will be 26 feet high, but the five rooms in the centre of the plan will be about 50 feet high to the summit of their sky-lights, wherefore that portion of the structure will form a lofty mass towering above the rest of it. Besides what is going on in public works, a fresh field for their talent is now opening itself to the Munich architects, several of whom, including Metzger, Bürklein, Braunmühl, Moninger, and Kreuter, have erected various private mansions that deserve to be accounted among the embellishments of the Bavarian capital.

Would that we could look to Sir Edward Lytton Bulwer and some of the other English visitors who are now there, for their bringing home with them a little of the cordial love of architecture which there prevails.

THE BRITISH MUSEUM.
No. IV.

The collection of Greek and Roman domestic antiquities in what is called the Bronze Room, is at present in confusion and unlabelled, so that the examination is not very easy.

Such a collection is particularly useful to the student, as it enables him to get better ideas of the domestic life of the Greeks and Romans than he can from books and artistic works, and to correct his ideas as to their state of social advancement. The progress of the fine arts and of the mechanic arts is not necessarily correspondent; and we may find a people producing the most beautiful sculpture and painting who want common comforts, or another whose painting is barbarous, but whose domestic arts are well cultivated, as for instance in the case of the Chinese. While the Athenians made a great stride in sculpture between the time of the Egina marbles and of Phidias, it may be taken for granted that the progress of the useful arts was not so great. The invention of a new machine would have been needful to effect any great change. While we look to the cultivation of the fine arts, as having an equivalent effect on the manners of the people and in the advancement of artistic manufactures, it is evidently unequal to the production of mechanic skill; and we must be careful not to rely too much upon artistic instruction, nor to push it too far. The existence in a country of a general and refined taste is not inconsistent with the promotion of mechanical pursuits, and is favourable to them, but we must not try to give an artistic bias in education. At present our people get a good mechanical training, which makes them the best workmen in the world, and in trying to do more we must not lose this.

One reason why the flourishing state of the fine arts is no index of the state of the mechanical arts is, that the former are chiefly handmaids to wealth, and are employed either by a rich state, or by a few rich men, and are little enjoyed by the people individually. While the Athenians were raising the Parthenon and pouring out upon it all the riches of art, they themselves were living in wretched huts, which had no share in the largess. While the head men of Rome were filling their palaces with the greatest works of old and new art, the people were as ill-lodged as when Romulus and Remus began the town. The mechanical arts cannot, however, be pursued without all getting a share in their works. Sawed timber and wrought iron were luxuries among the ancients; when towns were taken by the Greeks, the planks and beams, the hinges and the nails, were carried off as the worthiest part of the plunder, but as the stock got bigger all classes were able to get a share. The husbandman willingly gave food for a plough, an axe, a bolt, a kettle, or a pan; but he would unwillingly have given food for a carving or a painting, from which he could have got nothing back. The fine arts became the servants of the rich, the mechanical arts the servants of the poor.

The fine arts are but one page in the history of civilization; the Egyptians could raise pyramids, the Russians have built a city of palaces, and have filled them with the choicest works of the west; but as in the former the people were wretched serfs, so they are in the latter. The state of the mechanical arts and their employment by all classes is a far better index of the condition of the people. Where the mechanical arts are degraded, as among the Romans, a slave-class must exist, and the free-class must be paupers, for idleness will do its work on all. In Ireland, if we have not slavery in the name of the law, yet slavery and pauperism are the lot of the people, and neglect of the mechanical arts may be reckoned among the concurring causes. Where so many hundreds of thousands of beggars are fed by the pauper-people, carpenters, smiths, quarrymen, masons, brickmakers, potters, bricklayers, and weavers might be as well fed. The English beggar-class are the hand-loom weavers, the lace makers, and straw plaiters: those kept at the common charge break stones, grind bones, pick oakum, make and mend the roads. In Ireland the beggar-class do nothing to keep up the common stock.

So far as words go, freedom and the fine arts may be spoken of in wider terms at Athens or at Corinth, than in London or in New York; but to judge we want something better than words. When we look at the handiwork of the Egyptians, Greeks, or Romans, although we may acknowledge in some things very fair workmanship, yet on the whole we cannot but feel that the people could not have had the same comfort, and therefore not the same health and length of life as ourselves. The bearing upon the man is the measure of civilization, words do not give it. There is the same air, the same soil, and the same law in Ireland, as in England; and yet the former is as well known for its beggary, as the latter for its wealth.

The reader of Thucydides, of Livy, and of Tacitus, may find in a hinge or a staple, a great commentary on the text of his author. He may see how painfully and how clumsily the commonest hardware was wrought, and he may learn with what toil, with what time, and with what cost an army or a fleet was fitted up, and how great was the wreck when it was lost. It was shameful to lose a shield, because it took more to buy a shield than a man; the warrior who lost his armour, lost, like a knight of the middle ages, what it would take many rich fields to buy again. A part of such spoil was hallowed in the temples, an offering as rich as gold and silver. With us gold and brass are not linked together, for they are as the top and the bottom wide apart; with Homer, gold, bronze, silver and tin rank as costly metals, for the workmanship of all being alike, the disproportion of the price of the material was less. To burn the town was to ruin the commonwealth which held it, for the mason's and carpenter's tools were costly, the work was slow, and an unsheltered people could not raise another town. Hence we find towns, once powerful and thickly peopled, which never rose from the wreck which had been made of them; and others were only able to do so because the walls were readily patched up, or because the foe had gone away by sea. It is for such reason that we have Cyclopean cities left to us as relics, which had been ruined in remote ages.

The best beginning for a sound knowledge of history and the progress of civilization is to be laid down by carefully reading the works of Homer and Hesiod; not the smoothed down Louis Quatorze Iliad of Pope, but the rough and rugged originals. From their works we get a knowledge of a people, afterwards highly polished, who beginning as wild robbers were then going through the first steps towards civilization. Not merely are the manners drawn, but the houses, the fields, the tools. We see the king, the warrior, the priest, the soothsayer, the husbandman, the brass-smith, the potter, the housewife, the Phœnician trader, and the sea-rover; but we see moreover the rough tillage of the field, the early seeds of art, the beginning of wealth. We have a lively painting of the dawn of civilization, such as Cook saw it in Tahiti or Hawaii. In the British Museum we have the tools of the Maori and the paper-cloth of the Tahitian; but we have likewise such weapons and such ornaments as the Phœnician merchant sold to the Homeric-Greeks. Those who well study the Iliad, acknowledge a truthfulness in its drawings, which is the best seal of its antiquity, an antiquity not forged by Pisistratus, or in any later times. Those may who like believe there never was a Homer, or that there were many, but that the Iliad is a work of the time it holds forth to be, no well-thinking man will deny. To be able to feel this it is not enough to read the text—it is useless to read the Byzantine commentators or the scholastic commentators of these later times: what we have to study is the remains of ancient art and the relics of modern discovery, and not less those written records we have of those who, in our own day, have been eye-witnesses of all the phases of civilization.

The lump of iron which Achilles gave as a prize in the death-games of his friend, would be of little worth now, though the giver boasted of it as enough to find all the iron a husbandman might want in a long life. In the Museum we have spike nails, so highly thought of, that they are stamped by the maker; some with writing at a great length. A bronze tripod vase or brass kettle given by the same hero, raised the mirth of Voltaire. Such vessels in the Museum show that with the rough tools of the workmen they must have been made with great labour. We must not look through the spectacles of a Voltaire, neither is there any reason why we should read with less interest what Homer has sung of king Agamemnon or Achilles, than what Cook has written of king Terreoboo or of Omai. In the latter case we have the record not a century old, in the former a quarter of a hundred centuries old; yet both are equally fresh, truthful, and pleasing to a healthy mind.

To understand the state of handicrafts among the Greeks and Romans, is to understand the political and social condition of the middle ages, and of those nations which in the present day are most behindhand. In the overflowing of our material wealth we are not ready to conceive how much the commonest institutions among ourselves are hindered in their progress among people less favoured. The wisdom of those missionaries who teach their people the arts of life first, and religion afterwards, is approved by the evidence of experience. When a great change has been made in the social condition, habits and thoughts of a people by material improvements, they are prepared to receive a great religious change. The old French lady who saw a balloon rise in the air for the first time, sorrowed that she should die before the art of living for ever would be found out. It is the nature of the human mind when struck by one wonder, to look out for others, and to give trust to the powers of him who has created the wonder. It has, however, been well observed that the Christian missionary in the Pacific, beginning in the wrong way, shakes the faith of the islanders in their old worship, without giving them faith in a new worship. A Dædalus, a Cecrops, or a Cadmus, who taught the Greeks a new art, might give them a new belief, or even teach them to worship himself. Among a rough people, little better than wild men in a wilderness, the clever workman became a lawgiver and a god; the use of a saw, the forging of a breast-plate, the weaving of a sail, were means of wealth and power where all others were without skill.

When robbers overran the land and sea, a well hammered helmet, breast-plate, and spear, were among the best goods of every man; the king and the warrior were stronger in their armour than their courage; they trusted more to the dread they raised in their ill-armed foeman, more to the boast of power than the thrust of the sword. When one of Homer's kings fights among the crowd he slays his many, but when king meets king the war becomes a war of words; Hector and Achilles strive which can outboast and frighten the other, and they only meet hand to hand when they cannot help it. The deeds in the Iliad do not come up to the words, and fall far short of our measure of heroism, but they are quite in keeping, and Homer is none the less a true painter of men and manners.

In Case 45 are several helmets, some of which are Greek, made to cover the face, with a nose-piece and slits for the eyes. These are made in one piece without joint, and some of them seem to be cast. The metal is bronze, and the workmanship is good. A phalanx so well armed and thoroughly trained must have formed a powerful force, well able to achieve the battles of Alexander. The work is among the best there is, and it hardly seems as if the light bronze swords could break through the thickness. This gives a reason why the soldiery trusted to the heavy spear and javelin. One of the helmets has a sheath to hold a nodding crest, and others are slightly ornamented. When polished these helmets must have shone brightly in the battle-field, as the poet tells us. There would be no harm in polishing one to show the effect.

In No. 46 are two helmets and a shield, very richly embossed. They might stand in the Tower Museum without being outdone by the finest Milanese workmanship.

In Nos. 42 and 43 are spear-heads, maces, swords, daggers, knives, and arrowheads. From the confusion, it is impossible to separate Greek work from Roman,—though this is not of so much moment, as whatever the Greeks could do the Romans had the advantage of. Rome had all the resources of Egyptian and Greek skill; yet how far was it behind the Rome of these days.

In No. 46 are Roman weights, mostly of a solid bell-shape, with a ring or handle at the top. Some of them are large. There is nothing noticeable in them. There are likewise scales of two kinds, the scalebeam and the pair of scales. The workmanship is good. The remains of Pompeii show that the Roman tradesmen were as well supplied with scales and weights as ours. The Roman weights have enabled antiquaries to ascertain the Roman pound, which is the original of the modern system of weights. Here are some large adze-heads of fair work.

A tripod stand of bronze, in No. 49, is a large and good piece of brass work. It is 2½ feet high. Another is about 2 feet high, and of smaller proportions.

The high tripod stand in No. 50, is a light and pretty design. A frame rests on three sphynxes, each upheld by a caryatid, ending in the curved leg.

The chandelier in No. 51, is a large piece of work. It is for twelve lights, made to hang up in a hall or large room. The trimming of such lights must have been very troublesome. A hook, jointed on to a staple made to fix in a wall, is a good piece of smith's work. The joint is well made. Lamps were hung up against walls by such hooks.

In Nos. 52 and 53 are candelabra and stands. Some of these stands end in hooks, and are made to hold lamps, sauce ladles, &c. They may be called Roman *épergnes*.

In Nos. 54 and 55 are candelabra with flat tops, some 4 or 5 feet high, made to stand on the ground; and others a foot high or so, to stand on the table. The small earthenware and bronze lamps were put on the top of these candelabra. The lamp of the well-known shape, turned in our potteries into a milk jug, could be carried about in the hand, or be used on a candelabrum upon a table, for reading. For carrying about, they are much more convenient than our candlesticks or oil-lamps, which are cumbersome. Unless, however, there were some catch on the top of the candelabrum, to hold the lamp, there must have been fear of its being upset. The short candelabrum and lamp are elegant, and might be imitated.

The bronze lamps are in Nos. 56 and 57, the earthenware lamps in the middle of the room. The bronze lamps are many of them well finished Some of them have lamps by which they can be hung up, either in the middle of a room or on a hook against a wall. The latter seems to have been preferred, as Roman walls were better than roofs. Many of the lamps are table lamps, made to stand flat or on a candelabrum. In these cases are two chandeliers or lamps with eight lights, and one with seven lights. With these chandeliers of seven, eight, and twelve lights, the Romans had full means of lighting large rooms.

The most noticeable article in No. 58 is a bronze cullender or strainer, of seven inches diameter, very well finished, and with the holes cleanly drilled.

No. 59 contains some large copper kettles and basins, some of which are two feet across. Here are many bronze handles, some of handsome design: two of them have a man's head and a woman's head, beautifully chased. A swinging handle is cleverly wrought. There are some small tripod stands, well finished.

In No. 60 are several saucepans of a modern shape, some finished by turning, and some by the hammer. The smith's work is generally not well finished unless turned. This seems to be for want of good files. Where the surface is ornamental the fault is not seen; but a plain surface commonly looks clumsy, like Chinese work.

There are likewise bronze stewpans and fryingpans with handles in No. 61: also pots.

In Nos. 62, 63, and 64, are bronze jugs of various sizes; some of these are engraved, and some ornamented in relief. There are many 18 inches high; some neatly finished, but mostly rough. They are not equal to the pottery. Although the saucepans in No. 60 are finished inside by turning, the lathe does not seem to have been used to the outsides of the jugs; yet it seems quite as easy to have made a chuck for one as the other, and the Roman lathes could take a large and heavy article.

There is some ornamental chainwork in No. 80, much of which is elaborate, but seldom well finished. A large piece of double-linked cable chain, of a watchguard size, is the best. There is likewise a square chain, seemingly plaited with wire. Some of the lamp chain, in Nos. 56 and 57, is also very good. There is not much fancy in the patterns of chainwork. A favourite pattern is a piece laid *wavy*, with a round coil at each end, the *waves* being linked to the corresponding parts of other pieces. This makes a flat chain, used for belts and other purposes. In this case is the rowel of a spur, rather large, but a very good piece of workmanship.

The case No. 98 contains mixed Greek and Roman articles: some of the former from the tomb of a warrior at Athens. There are knucklebones or astragals of various sizes, in glass, metal, and iron, for playing the favourite game of the ancients. There are counters and medals of ivory and bone, but the engraving and finish are not good, except in some of the plain turned ones. The assortment of dice is numerous; they are of glass, metal, wood, and stone; a variety with the corners cut off, and one set with pentagonal faces. Some of these are very large. In this case are likewise counters and ornaments of cut glass. The glass is clear, well and sharply cut.

In Nos. 99 and 100, the articles are likewise Greek and Roman mixed. Here are bone spoons, like common salt-spoons. Bodkins, needles, pins, and hair-pins of ivory and bone, and likewise of metal, are numerous. The eyes of the bodkins and needles are long and well cut, but otherwise they are not neatly finished. The smallest needle is two inches long, and thicker than a darning needle. In metal needles, the eye seems to be made by splitting the head and then welding the ends together, so as to leave a slit for the eye. It seems likely that finer needles were made, but they must have been very dear. They were perhaps made in a soft state. In this case are small jugs, phials, and vases of coloured glass, made for toilet use. Likewise earthenware imitations, painted or enamelled. The pattern is chiefly a wavy line, each line of a different colour. One phial is to be noticed an inch long, but thick, and of a brown colour with white streaks. It is a very pretty toy. The glass blowing and cutting are good, but do not seem to have been carried out on such a large scale as among the moderns. The specimens in Case 40, found in England, are very good.

The case No. 93, gives some very interesting specimens of Greek wood work, a lyre and two flutes from a tomb at Athens. Each flute has a mouth hole and four finger holes. One flute is of a single piece, about a foot long, and the thickness of a piccolo flute; the other is rather longer. The outside is smoothly turned, and the holes are cleanly bored, seemingly with an auger of the same size. The lyre is much broken.

The contents of Case 86 are mostly Greek. They are small bullæ or balls of glass and stone, chiefly blue. There are some bone bodkins, large but well finished.

In No. 104 are small metal ladles, scoops, spoons, and spatulæ. Here are also a small pair of pincers or tweezers, jointed like scissors, and a fish-hook.

In No. 105 are several pairs of compasses; among them a small pair of carpenter's compasses, four inches long; a pair eight inches long, with jointed legs; and a pair of double compasses. These instruments are not so well finished as in these days, but the joints and workmanship are good. A large assortment of Roman stamps and brands is of various goodness; some very neatly cut. Here are some spike nails, well forged. The staples are good. The hinges are among the most interesting specimens of Roman smith's work. Some are as well finished as can be desired, particularly a large and heavy pair made with a double joint. There are some strong door sockets.

In No. 106 are locks and keys. The keys are very clumsy.

No. 112 contains a variety of signet rings, some with stones set. These are mostly common things, not equal to the jewellery of gold and silver in other cases. A chain or necklace, enamelled gold and blue, is one of the neatest pieces of work in the whole collection. Every piece is of the same pattern, and well linked together.

The assortment of buckles is large. They of all shapes and sizes—square, oblong, round, oval, and horse-shoe among others; some few ornamented, one with two rams' heads. Many are embossed, but badly. A ring buckle, of the size of a shilling, is neatly wrought. The tongue of the buckle is often made of a bit of wire, with the head twisted round. The rivetting is often clumsy. There are buckles made to sew on; one like a good stock buckle. There are many brooches with a spring catch; some very large and clumsy, as if made by common smiths.

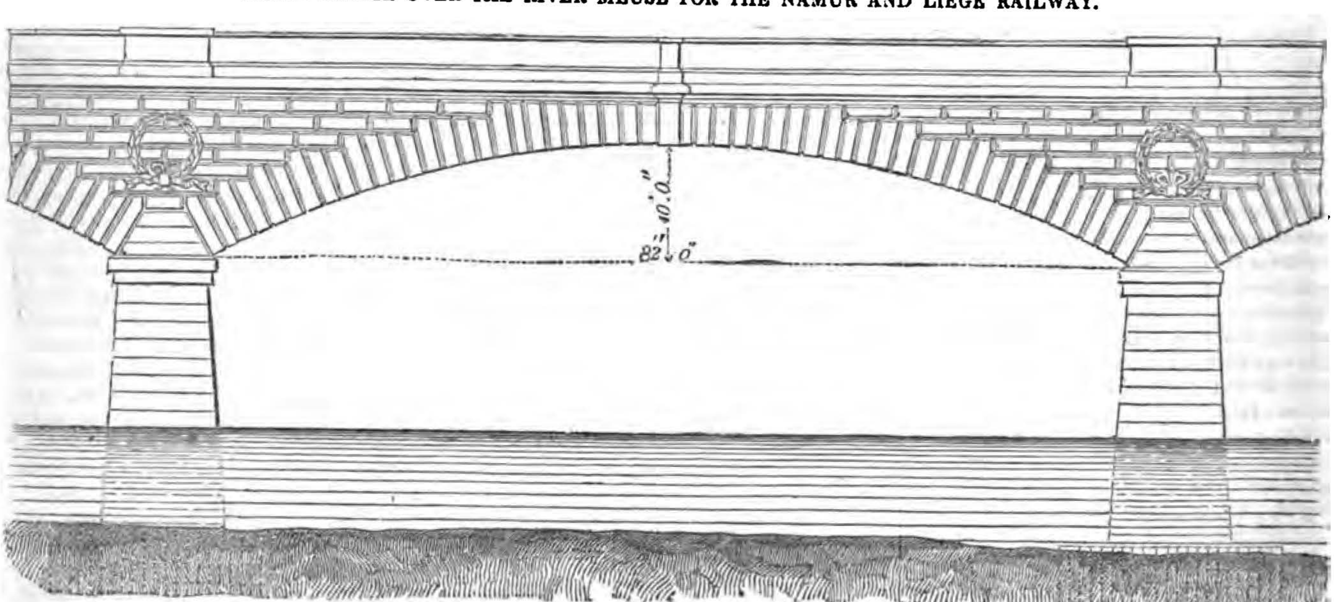
The collection of metallic mirrors and mirror-cases fills several cases. The mirrors are from three to eight inches diameter, and cleanly turned. It is a pity that some of them are not polished, to show the use of them, for most of them are dull and rusty enough now. All the mirrors are made with a handle to hold by, so that some look like fryingpans. Some have their faces and cases engraved, sometimes done in the lathe and sometimes with the graver. The cases are often beautifully embossed or engraved, though some are very common. In No. 74 is a mirror-case of bronze, found at Toscanella. It is nine inches across, and delicately chased in very high relief. Two women are sitting opposite to each other. They are dressed like Pallas Athene, with a Medusa's head and snakes on the breastplate, and a snake on the shield. This case is much damaged. Another case, also found at Toscanella, is five inches across. The subject is Bacchus and Ariadne. Both are naked, Ariadne with her back turned clasping Bacchus round the neck. He holds in his left hand a large wine jar. A panther is behind him. There are several cases engraved in the style of the vases, some with Etruscan countenances. The engraving is mostly a bad attempt at anatomical drawing. In No. 75 all the engraved cases show bad drawing. Here is one mirror-case seemingly cast, which is a piece of beautiful workmanship. It represents Hercules and Omphale, in the early Greek style. The drapery and details are highly finished.

In No. 90 are mirrors from Athens and Ithaca, all of them small.

The above remarks, though they embrace only an imperfect view of the collections in the Museum, may still give some idea of ancient workmanship. It will be seen that they were acquainted with hammering, forging, turning, filing, casting, boring, drilling, rivetting, polishing, tempering, die-sinking, glass blowing and cutting, and enamelling. In many of these they had made much progress. It is impossible to avoid reflecting how much the work of the ancients was limited by their want of power. The difference is great between the mechanical resources of the Romans and what the steam-engine has done for us in the forge-hammer, the saw, the boring, the planing, and the rivetting machines. We cannot, however, help admiring how much they did with small means.

(To be continued.)

STONE BRIDGE OVER THE RIVER MEUSE FOR THE NAMUR AND LIEGE RAILWAY.



The above engraving is the centre arch of a handsome stone bridge now in course of being constructed on the Namur and Liege Railway, over the River Meuse, in France, from the designs of George Rennie, Esq. The bridge consists of five arches, 82 feet span, with a rise of 10 feet; the piers are 8 feet thick at top and 11 feet at bottom, and 24 feet high from the top of the footings to the springing of the arch. The roadway is 26 feet wide to the outside of parapets, and will carry two pairs of rails.

THE GOVERNMENT AND THE RAILWAYS.

Not a month passes but we are urged to take notice of the unfair way in which civil engineers are treated by the government, in the preference given to military engineers in civil employments. We have professed often enough our esteem and regard for our military brethren in their military capacity; but we cannot withhold our belief that they are not the best fitted for civil office. Whether we go by theory or whether by facts, we come to the same end,—that as civil engineers the military have not shone, neither are they likely to do so.

We may be told that the Royal Engineers have the guarantee of a good collegiate education—nay, further, that they are the picked men of a large body of students, of whom the least endowed are left for the Royal Artillery. This may seem a guarantee of qualifications, as against a profession, that of the civil engineer, which is an open one and subject to no examination. It is tolerably certain that there are very many civil engineers far below members of the Royal Engineers in knowledge;—but here we come to a stop, because we do not get the converse of this proposition. We have no hesitation in saying—nay, in laying down a challenge, that the body of civil engineers has exhibited a much greater degree of knowledge and of talent than that of the Royal Engineers. A preliminary examination might keep out many men of inferior attainment; but with the civil engineers it would have this disadvantage, that it would keep out many men of superior attainment. Being an open profession, civil engineering is always receiving the accession of large numbers of men, whose general proficiency and abilities make them valuable associates; but who might be either unable or unwilling to pass a schoolboy examination. These recruits include many men of middle age, or of mature age, who have already gained reputation in their previous career, and who bring it for the enhancement of their new profession. If others, either from sheer impudence or from an over-estimate of their own qualifications, likewise dub themselves civil engineers, it does not matter; for neither will professional men give them countenance, nor the public give them employment. This is the real censorship of the engineering profession, and it is one much better than a scholastic examination, which at the best can be got through by a short grinding, and the matter of which is, in all likelihood, forgotten everafter.

Subject civil engineers to a preliminary examination, as many in their zeal have proposed, and what must be the consequence? We should lose all those men who are most valuable, and on whom we most pride ourselves. We shall first exclude those most practical men, who begin their career as mechanics, and who so often rise to the highest distinction. The workshop will at once be closed as a nursery for engineering. We shall likewise lose those who being engaged in mining, in draining, in shipbuilding, and in factories, have enlarged their sphere of operations by enlarging their experience. We should lose all those men of active mind, whose inventive genius is our great glory. We might, perhaps, keep those who have begun as mathematicians; but, in keeping one branch of science, we should lose all others. We need not begin a list of those who, if a system of examination had been adopted, would now be lost to the profession: the acquaintance of every one will furnish him with a long list, and there would be more difficulty in deciding who would remain, than in deciding who would be struck out. What the engineering profession would be under such circumstances we leave the public to imagine; but we believe it would be filtered of its knowledge, its talent, and its reputation. All this would be done needlessly, because the exclusion of those who cannot or will not pass the scholastic examination, comes to this—it excludes persons not incompetent for the exercise of their profession, and who in the pursuit of it acquire, if they have not already done so, all such scholastic knowledge as is necessary for them, in the same way that they acquire so much other knowledge, which can never be made the subject of scholastic education or examination.

On whatever point, except that of military engineering, on which the Royal Engineers can challenge their brethren the civilians, the latter can outmatch them. The mathematical sieve through which the Royal Engineers have to pass, has not been very successful in making great mathematicians or philosophers; and if it came to a contest on this point, we can supply the military with plenty of champions well able to contend with them. Messrs. George Rennie, Eaton Hodgkinson, John Scott Russell, Robert Stephenson, Isambard Brunel, George Parker Bidder, Wyndham Harding, and Joseph Samuda, are well able to compete as philosophers or mathematicians; and here we have only put down such names as most readily occurred to us, without taking the trouble to choose the most proficient, or even to put down all those who are well deserving of being named in such an enumeration.

If attainments are to be known and shown by their exercise, an advocate for the Royal Engineers would have little to show for them. The civil engineers have been greater contributors to the cause of science, as much as they have been greater contributors to professional literature. The works on professional subjects by officers of the Royal Engineers, who have the best means, are few; and even the volume of "Transactions of the Corps of Royal Engineers" is eked out by civil contributions.

The examination is no guarantee of the superiority of the Royal Engineers, for it is no guarantee against mediocrity in that body. If the practice of their profession be a claim of the Royal Engineers as against civil engineers, we ask what are their works? We know what civil engineers have done; but neither the public nor ourselves know what the Royal Engineers have done, unless it be the Rideau Canal, which cannot be considered as the most flattering testimonial of success. We can show too that their recent career in connexion with the Board of Trade has not been such as to raise them in the eyes of the public.

Before saying more on this latter point, we are tempted to enquire on what grounds military engineers should be at all employed in a civil capacity. We know of no reason why civil engineers should not be so employed. When the two bodies are considered in connexion, all impartial persons will acknowledge that civil engineers are far superior in knowledge, talent, and reputation, as much as in the works they have executed. Indeed, nothing can be said in favour of the military engineers. The government, however, have tried civil engineers, and have not found them wanting. If our dockyards are examined, we shall vainly seek for proofs of the capacity of the military engineers. The works and machinery, on the other hand, give ample proof of skill and ingenuity other than military. Whether breakwater or block machine, whether steam engine or lathe—whatever is best, whatever is cleverest, is by other hands than those of the military.

When civil engineers are sent on missions of enquiry by the government, we are sure they have not been behind their military brethren. No one, we believe, will deny that Mr. James Walker, Mr. William Cubitt, and Mr. Hodges have proved quite as good commissioners as Sir Charles Pasley, Sir Frederick Smith, and Captain Coddington; although the latter have rarely acted out of harness, or without Mr. Airy, Professor Barlow, Mr. Amsinck, or somebody else, being attached to them, to help them through their work.

Why a military engineer should be employed at all in a civil capacity we cannot comprehend: the public never think of so employing them until they have had a good civil training; and we know of no reason why the government should do so. We cannot believe that it is on the ground of cheapness, for we do not consider the Royal Engineers as cheap—we think they are a heavy drag on the country. At any rate, the government does not always find civil engineers so dear, inasmuch as they are able sometimes to employ them. When Royal Engineers are employed as railway commissioners, or for other civil purposes, they are paid salaries, but which do not represent the burthen on the nation. There is the cost of their education, of their training as juniors, of their sick-pay, half-pay, retiring pensions, and widows' pensions, besides the cost of colleges, houses, barracks, and many other items of considerable expense, the mode of charging which cannot be readily ascertained. Taken altogether, the Royal Engineers are a very expensive body, while the outlay, instead of going, as in the case of civil engineering, to reward talent, goes only to foster mediocrity. Stephenson and Jack Noakes, Brunel and Tom Styles, are put on a par under the system of military engineering; and the Royal Engineers are more to be praised for such abilities as they have shown under such an unfavourable *régime*, than blamed for their inferiority. This, however, is only so far as it concerns themselves, for it does not acquit the government of blame in employing them on occasions when they can avail themselves of the superior services of civilians. We believe no one out of a government office deludes himself with the belief that the employment of General Pasley was any financial benefit to the country; it was only an encouragement of a system under which men of ability, or of no ability, are brought up to be made Inspectors-General of Railways, and then shelved off on half-pay, at length to be pensioned off. Whenever Sir Charles Pasley or Sir Frederick Smith is paid one thousand a-year, it must be always worth while to pay a competent civilian two thousand a-year, for money would thereby be saved.

At whatever class of works we look—railways, canals, harbours, docks, or bridges; at whatever class of machinery, we find all constructed by civil engineers—no one class claimed by military engineers, and no one great work which bears their name. Assuredly, therefore, the standard of qualification belonging to the Royal Engineers cannot be a material one; we have shown that it cannot be on their scientific or literary attainments; and we do not know, in fact, upon what it rests.

The employment of military men in civil affairs is usually held to be ill-advised, because from their training they are not suited for such pursuits. From the peculiar nature of their employment and associations, they do not acquire business habits or ideas, and we have always esteemed it unfortunate when they were placed in civil positions, because they have been utterly unable to respond to the call made upon them. The removal of Major-General Pasley from the office of Inspector-General of Railways, is one objected to by himself, and on which he has pursued the extraordinary course of appealing to the public. It shows that there is no sympathy between him and the government. The employment of military engineers brings them in comparison with their civil brethren, who are particularly well trained in matters of business, and who hold their ground among the acutest men of business in the country. The most important and complicated affairs are left to the negotiation or arbitration of Mr. Robert Stephenson, M.P., Mr. Brunel, or Mr. Locke, M.P., by capitalists fully capable of appreciating their practical abilities. It will be found that the engineers have taken as great a part as any class in the organization and development of the railway system and its administration.

So far from exhibiting any such public proof of their capacity, military men are well known to be unfitted for the understanding of business matters. A lad is taken from school, sent to Woolwich, gets a commission, is employed at home or in the colonies, and at length is made a railway inspector, without knowing as much of business as any young man in the city of London. He can give orders to sergeants and corporals, build barracks in places where he has it all his own way; but as to any useful intercourse with society, it is perfectly out of the question. He has not, in most cases, that association with professional and practical men, which might put him in the way of acquiring a proper degree of professional experience. A pupil in Mr. Stephenson's office knows very much more.

It would be very hard for the Board of Trade to furnish the public with any sufficient justification for appointing aged or middle-aged gentlemen, tricked out in blue, gold, and scarlet, as inspectors of railways, of which the inspectors know nothing. It may very well happen that an officer, who has spent his time in New Zealand, or the Isle of Ascension, or in the backwoods of Canada, building barracks and convict jails, may be perfectly guiltless of knowing what a railway is; and it is no reflection upon the unfortunate individual who is made a railway inspector, that he should know nothing about them. Major-General Pasley has the rare merit among military engineers of having written on several professional subjects; but no one ever thought of his knowing anything of railways, until he was brought forward to be the arbiter between Stephenson, Brunel, Locke, and Cubitt, as Inspector-General of Railways. General Pasley could scarcely refuse accepting the appointment, though it put him in the very painful position of interfering with the master-minds of the world in matters of which he knew nothing at all. This position must have been one very painful to Sir Charles Pasley's feelings, and every one will sympathise with him, for his own merits and his gentlemanly conduct have secured for him much good will. The government cannot, however, be pardoned for putting him in a false position. The same is to said of the other gentlemen, who were similarly ill-used.

The appointment of raw soldiers to inspect railways made engineers and directors familiar with their ignorance and incompetency. As they did not understand anything about railways, they had to be taught. Some of them were conscious of their ignorance, very willing to learn, and taking much trouble to learn; others, in the supercilious arrogance and self-conceit engendered in the atmosphere of a barrack-room, have rendered themselves ridiculous by the exhibition of their ignorance on points of which they supposed themselves well informed. How many of our readers have been witnesses of their follies, and have laughed at the presumptuous incapacity of the Mentors set over them by government! Not even an engine-driver can be brought to hold a favourable opinion of men, of whose emptiness he is well aware. The visit of a government inspector is a joke, which nothing but the prudence or good sense of the railway authorities prevents from being made sensible in a manner very undignified. The public, too, and the public press want faith in government inspectors, and the *Times* and *Punch*, the two magnates of the pen, have held them up to well-deserved ridicule.

The officers of the Royal Engineers, and other parties employed by government for railway purposes, use the employment for their own convenience; and if they happen to learn anything, turn their knowledge to account by going into the service of the railway companies. So long as they are worth nothing, the government is at the cost of keeping them, and has to pay for their blundering out of the public purse, and to encounter the ridicule of their incompetency; but when the officers are worth anything, they sell their knowledge in the best market.

Anything so unsatisfactory as the position of the railway officers of the Board of Trade, and their relations with railway companies, can scarcely be imagined. Some needy son of patronage, who has scraped through his examination at Woolwich, and who is always more of a dandy than a gentleman, and more of a schoolboy than an engineer, gets into the railway department. He is dependent upon the chairmen, secretaries, superintendents, and engineers not to expose his ignorance, and to give him the information he wants. He gets very sociable in his intercourse, and very familiar—for many of his associates are much better gentlemen than himself, and none is ready to give way to assumptions of barrack superiority. On being brought in contact with the world, free from the hallucinations of mess pomp and self-conceit, he finds out his own true position, apart from his butterfly livery, that he is a nobody, and rather a poor one. He wants the means to keep up his own dandyism and his wife's millinery, and he wants places for his sons and portions for his daughters. The ambition to live a useful life comes upon him, and he cannot resist the temptation of asking for the first railway appointment which comes in his way.

Some very honourable men may do their best to withstand corrupt action; but at any rate the government officer is placed in a false position, and cannot give satisfaction to his employers. Some, it may be, give way to positive corruption—nay, suggest and carry it out; and at any rate, those who do not give way lie open to the imputation of it. The events of 1845, and the parliamentary discussions on the conduct of the Board of Trade, will occur to every reader, and the result of them cannot by any means be considered as satisfactory.

For a public officer to be suspected is always bad, because when honest it trammels his own mode of action, and the jealous public will never be satisfied of the independence of the officer, when they know how readily he may turn his trust to his own private purposes. The communication of valuable information may so easily be made a matter of profitable barter and speculation, that the public can never be satisfied it is not done, and unfortunately before now circumstances strongly corroborative of suspicion have occurred. The public have every regard for the honourable character of military men; but it does not esteem the character of one profession, or of one body of gentlemen, as higher than another; and at any rate it does not judge very favourably of human nature when exposed to temptation.

The Board of Trade officer, when once determined to place himself out, has the means of preparing the way by rendering such services to his future employers as may well be considered the price of his employment. How easy it is for one so determined to make such arrangements for the favoured line, and to make such reports upon it, as may be very valuable to the company, and in the end very valuable to himself, but which cannot in any way be held as the best means of forwarding the public interests. This is certainly a possibility—nay more, it has a probability, and there are those who believe that it really has occurred, while there is no guarantee that it may not occur over and over again.

The temptation to companies of using parties connected with the Board of Trade is very strong, as they not only get an immediate service done, but they also have the means of communication whenever they may want it.

Often as the Board of Trade have been subjected to public censure, we are not aware of any defence which has been made for them—we might say of any defence which can be made. The railway department is utterly useless for the purposes intended; its inspection is a joke, which is now so well known, that it ceases to tranquillise the public mind; and it is only operative for mischief. The department is an incubus on the railway interest, which does not give patronage enough to a government to justify its continuance, and which is well calculated to bring a ministry into jeopardy. In the first session of a parliament in which a railway interest will be combined, Mr. Strutt is pledged to bring forward a bill, which has been denounced as an aggression on a vast amount of private property; and this railway directors have determined to resist to the utmost. With the number of new and hostile members in the house, the defeat of Mr. Strutt by the railway interest, assisted by the opponents of the ministry, is one among the disasters of the next year which appears most likely to be accomplished, and which will greatly aggravate the difficulties with which the administration of Lord John Russell is already threatened. A blow once given, we hope the railway interest will not rest till they have swept away every vestige of interference.

TEMPERATURE OF STEAM.

Sir—The following empirical formula for determining the temperature of steam is new, accurate, and may be interesting to some of your readers.

If n = the number of atmospheres, then

$212 + \frac{72}{2} + \frac{72}{3} + \frac{72}{4}$, &c., till $\frac{72}{n}$ = the temperature in degrees of Fahrenheit. Thus, for

Atmospheres.

$$2 = 212^\circ + \tfrac{72}{2} = 248$$
$$3 = 212^\circ + \tfrac{72}{2} + \tfrac{72}{3} = 272 \text{ or } = 248 + \tfrac{72}{3}$$
$$4 = 212^\circ + \tfrac{72}{2} + \tfrac{72}{3} + \tfrac{72}{4} = 290$$
$$5 = 290^\circ + \tfrac{72}{5} = 304{\cdot}4$$
$$6 = 304^\circ{\cdot}4 + \tfrac{72}{6} = 316{\cdot}4$$
$$7 = 316^\circ{\cdot}4 + \tfrac{72}{7} = 326{\cdot}7$$

The following are the results of Dr. Ure's experiments, and those of the Franklin Institute, as far as ten atmospheres, contrasted with the results obtained by this method of calculation:—

No. of Atmosphere.	Calculated Temperature.	Dr. Ure's Calculation	Mean of Temperature obtained by Franklin Institute.
1	212°	212°	212
2	248	248	250
3	272	272	275
4	290	290	291·5
5	304·4	305	304·5
6	316·4		315·5
7	326·7		326
8	335·7		336
9	343·7		345
10	351		352·5
11	357·5		
12	363·5		
13	369		
14	374		
15	379		
16	383·5		
17	388		
18	392		
19	395·5		
20	399		

I am, Sir,
Your obedient servant,
William T Matier,
Civil Engineer.

Dublin, October 16, 1847.

MEASUREMENT OF ANGLES.

How to lay off an Angle of any number of Degrees, Minutes, &c., with Compasses only, without the use of Scale or Protractor.

By Oliver Byrne.

First allow me to correct a trifling mistake involved in the solution of the converse of this proposition, published in the *Journal* of last month. Page 313, col. 2, line 10, for " + 1 or − 2," read " + 1 or − 1;" and the expression (Q) becomes

$$\theta = \frac{n q \pi}{m n q \pm q \pm 1}.$$

The same correction must be made at page 314.

Let it be required to lay off an angle of 36° 40′ = β.—Take any small opening of the compasses less than one-tenth of the radius, and lay off any number of equal small arcs, from A to 1; from 1 to 2; from 2 to 3; &c. (fig. 1), until we have laid off an arc, A B, greater than the one required.

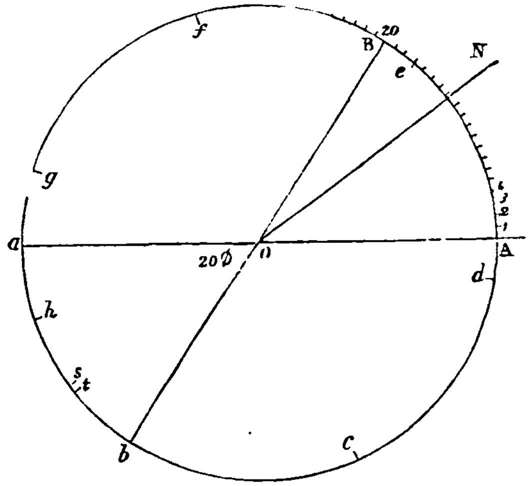


Fig. 1.

Draw B b through the centre O, then will the arc $a b$ = arc A B, which we shall put = 20 ϕ in this example, and proceed to measure $a b$ as in example fig. 5, page 314. Lay off $a b$ from b to c; from c to d; from d to e; from e to f; from f to g. Putting $g a = \Delta_1$, then

$$6 \times 20\phi + \Delta_1 = 360^\circ = \frac{108}{11}\beta; \text{ because}$$

$$\frac{360^\circ}{36^\circ 40'} = \frac{21600}{2200} = \frac{108}{11}.$$

Lay off, as before directed, $g a$, = Δ_1, from a to h, from h to s, and b to t; then calling $s t$, Δ_2, we have

$$3\Delta_1 + \Delta_2 = 20\phi;$$

and we find that $s t$ is contained 28 times in the arc $a b$;

$$\therefore\ 120\phi + \Delta_1 = \frac{108}{11}\beta;\ 3\Delta_1 + \Delta_2 = 20\phi;\ \text{and } 28\Delta_2 = 20\phi.$$

Eliminating Δ_1 and Δ_2, we find

$$\beta = \frac{29205}{2268}\phi = 12{\cdot}9 \text{ times } \phi \text{ nearly;}$$

$\therefore$ 36° 40′ = $\angle$ A O N is laid off with as much ease and certainty as by a protractor.

As a second example, let it be required to lay off an angle of 132° 27′.—From 180° 0′ take 132° 27′ = 47° 33′, which put = β.

$$\frac{360^\circ}{47^\circ 33'} = \frac{2400}{317} \text{ when put } = \frac{\nu}{\delta}, \text{ then } \frac{\nu}{\delta}\beta = 360^\circ = \pi.$$

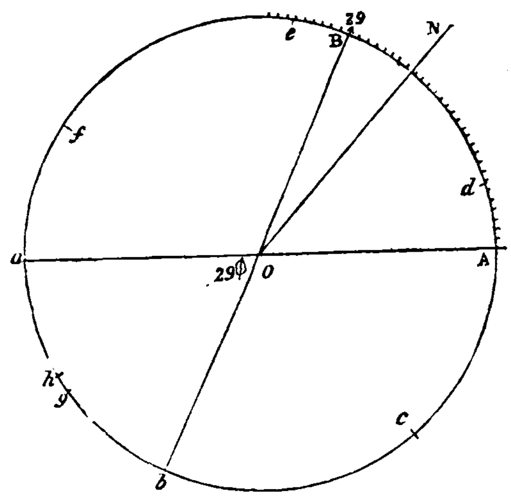


Fig. 2.

Referring to fig. 2, we have laid off 29 small arcs from A to 29 = e. A B = $a b$ = $b c$ = $c d$ = $d e$ = $e f$. And $a g$ = $b h$ = $a f$ = Δ_1; $h g$ = Δ_2.

$$\therefore\ 5 \times 29\varphi + \Delta_1 = 360^\circ = \frac{\nu}{\delta}\beta = m\epsilon\varphi \pm \Delta_1 \qquad (1)$$

$$2\Delta_1 - \Delta_2 = 29\phi,\ \text{or}\ n\Delta_1 \pm \Delta_2 = \epsilon\varphi \qquad (2)$$

$$13\Delta_2 = 29\phi,\quad \text{or}\quad q\Delta_2 = \epsilon\varphi \qquad (3)$$

Eliminating Δ_1 and Δ_2, we have

$$\beta = \frac{\{mnq \pm (q \mp 1)\}\epsilon\delta}{\nu n q}\phi = \frac{\{5.2.13 + (13+1)\}\ 29.317}{2400.2.13}\varphi = \frac{1323792}{62400}\varphi = 21\tfrac{1}{4}$$ times ϕ very nearly. Hence the line O N determines the angle a O N = 132° 27′.

In the expression

$$\beta = \frac{\{mnq \pm (q \mp 1)\}\epsilon\delta}{\nu n q} \qquad (R)$$

substituting the numerals of the first example, then

$$\beta = \frac{\{6.3.28 + (28-1)\}\ 20.11}{108.3.28}\phi = \frac{29205}{2268}\varphi = 12{\cdot}9$$ times ϕ nearly, the result before obtained.

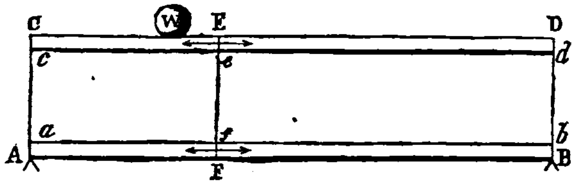
The ambiguous signs of (R) cannot be mistaken or lead to error, if the manner in which it is deduced from (1), (2), (3), be attended to. From (3) $\Delta_2 = \frac{\epsilon\varphi}{q}$; substituting this value of Δ_2 in (2),

$$\Delta_1 = \epsilon\phi \mp \Delta_2 = \epsilon\phi \mp \frac{\epsilon\phi}{q};$$ which, when substituted for Δ_1 in (1), gives

$$\frac{\nu}{\delta}\beta \quad m\epsilon\phi \pm \left(\epsilon\phi \mp \frac{\epsilon\varphi}{q}\right);$$ from which (R) is easily found.

ON MODEL EXPERIMENTS.

Until this present era of the "railway and the steam-ship and the thoughts that shake mankind," the studies of the engineer, like those of the lawyer, were confined to the acquiring of details of precedent, while the knowledge of the scientific principles of his profession was neglected as of comparatively little importance. Thus, although the recognised modes of construction were numerous, the laws of structural equilibrium were few and but imperfectly developed; the builder was satisfied if the edifice he was about to raise were similar in character and magnitude to others which had been raised before;—this fact at least he knew—they had been found to stand, perhaps for ages; and the most ordinary, *pariter paribus*, style of reasoning might be sufficient to assure him that his own work would be no exception to the general rule. But with the railway arose a new epoch in the history of engineering: works were required to be constructed of unprecedented magnitude and solidity, and for the execution of which a higher amount of mechanical science and a wider range of experience were required. To supply the latter of these two desiderata, numerous experiments have been conducted of late years on the strength of materials, and on models of the whole or most important component parts of proposed structures. It is to these last class of experiments we would now direct the reader's attention, particularly with reference to the difference of amount of thrusts and strains in the model and its original. We shall first consider the case of a simple horizontal girder, composed of a web and an upper and lower flange, and loaded with a given weight;—to this case may be referred almost all the cast iron railway bridges now completed, as well as the proposed tubular Menai Bridge.



Let A B be the girder, supported at A and B, and composed of the lower flange A B ab, the upper flange C D cd, and the web $cabd$. Let A B = au; A C = bu; A a = cu; C c = du; C w = hu.

Let the weight at $w = wu^3$ (because the weight varies as the cube of the scale u); the weight of beam and girder $= w'u^3$; C E = lu; R and R′ the reactions at A and B.

Then first considering the equilibrium of the whole girder, we shall have

$$R + R' = (w + w').u^3$$

$$R'.au = \left(whu + \frac{w'au}{2}\right).u^3;$$ the girder being supposed uniform and symmetrical throughout its mass.

$$\therefore\ R = \left\{w\left(\frac{a-h}{a}\right) + \frac{w'}{2}\right\}.u^3.$$

For the equilibrium of the portion C F, if T be the tension and thrust of the lower and upper flanges, Y the vertical force at F, z the distance between the points of application of the thrust and tension, we have

$$T = T;\quad Y + R = \left(w + \frac{l}{a}w'\right).u^3;\quad \text{and}$$

$$Ylu = \left(whu + \frac{w'.l^2u}{2a}\right).u^3 - Tz.$$

$$\text{Whence}\ Tz = \left\{\left(\frac{a-l}{a}\right).hw + \left(\frac{a-l}{2a}\right).lw'\right\}.u^4.$$

Now, in applying the results of experiments upon a model girder to its original, all we have to do is to vary the scale u from the scale of the model to the scale of the original. Consequently, we find that Tz varies as the fourth power of the scale or dimensions of the girder. If the web of the girder be very thin compared with the breadth of the flanges and their vertical depth,—and if their vertical depth, uc, ud, be small compared with ub,—and if uk, uk' be the width of the upper and lower flanges respectively,—t and t' their thrusts and tensions per square inch respectively—then we shall have

$$T = tkcu^2 = t'k'du^2 \text{ nearly};\quad \text{and } z = au \text{ nearly}.$$

$$\therefore\ Tz = takcu^3 = t'k'adu^3 \text{ nearly}.$$

$\therefore$ t and t' both vary as u nearly; that is, approximately, *the tension per square inch on the lower flange, and the thrust per square inch on the upper flange, of all similar and similarly loaded girders varies as their scale of linear dimension.* This we consider so important a fact, that we shall endeavour to give a proof of it in popular language.

Suppose a vertical section made of a loaded girder at E F; then supposing F the fulcrum about which the mass A E is turned,—A E will be prevented from turning about F by the opposite action of the tension at F and reaction at A, and the weight w and thrust at E, and the weight of A E collected at the centre of gravity of C F. Now the weight w, the weight of C F, and the reaction at A, will all vary as the cube of the dimensions of the girder, if we suppose the girder loaded proportionally to its mass. And the leverage of these forces varies as the linear dimensions of the girder; consequently, their moment about F varies as the fourth power of the dimensions of the girder; therefore, the moments of the tension and thrust at F and E, vary as the fourth power of the dimensions of the girder; therefore, if we suppose A a and C c small, the tension and thrust vary as the cube of the scale; but as the tension and thrust are composed of the sum of all the tensions and thrusts per square inch at a vertical section of the flanges, and as the area of this vertical section varies as the square of the scale,—in order to make up the fourth power, we must have the tension per square inch varying as the scale u.

We next propose to determine the amount of the load Vu^3 which can be supported at the centre of a girder of the dimensions u, in order that t and t' at the centre may be the same as in a girder of the dimensions $u = 1$ supporting a load w at its centre. We have proved $Tz = Ctu^3$, where C is some constant independent of u.

Making $l = h = \frac{a}{2}$ we have, therefore,

$$Ctu^3 = \left(\frac{Va}{2} + \frac{w'a}{4}\right)u^4;$$

$$\text{and } Ct = \left(\frac{wa}{2} + \frac{w'a}{4}\right);$$

$$\therefore\ \frac{wa}{2} + \frac{w'a}{4} = \left(\frac{Va}{2} + \frac{w'a}{4}\right)u$$

$$\therefore\ 2V = \frac{2w - (u-1).w'}{w}$$

$$\therefore\ 2Vu^3 = \left(2w - (u-1).w'\right).u^2.$$

If $(n-1)\,w'$ = or exceed $2\,w$, it follows that the girder in scale n will not be able to support any weight at its centre, without the tension and thrust per square inch being increased.

Example.—A model girder, length 80 feet, weight 10 tons, breaks with a weight of 30 tons in the middle: what weight will break a similar girder 480 feet long?

$$V n^2 = \frac{(2w-(n-1)\,w')\,n^2}{2} = \frac{(60-50).36}{2} = 180 \text{ tons. } \textit{Ans.}$$

We have been especially induced to call our readers' attention to the subject of model experiments, from the fact that the proposed tubular bridge over the Menai Straits is to be constructed, as to its dimensions, according to laws developed in a series of experiments, conducted by Mr. Hodgkinson at Blackwall. We much fear that the enormous width to be crossed without a support will prove too much even for the known ingenuity of Mr. Stephenson. If, however, the talents of that illustrious engineer should prove equal to the magnitude of his conception, none will feel more satisfaction than ourselves at his success; and with mingled wonder and pleasure shall we witness—at a respectful distance—his aerial tunnel quivering and bending beneath a load of "moral agents," happily unconscious of the laws of equilibrium and of the depth of the cold dark waters above which they are being whirled.

(To be continued.)

REGISTER OF NEW PATENTS.

NASMYTH'S PATENT SCREW COCKS.

The accompanying engravings show an important improvement in sluice cocks, as patented by Mr. Nasmyth, of the Bridgewater Foundry, near Manchester. In consequence of the facility with which they are manufactured, the cost of them is considerably less than that of the ordinary sluice cocks, and at the same time they appear to us far more effective; but the following testimonials, coming as they do from gentlemen well known as practical hydraulic engineers, will show the value of the cock far better than anything we can write.

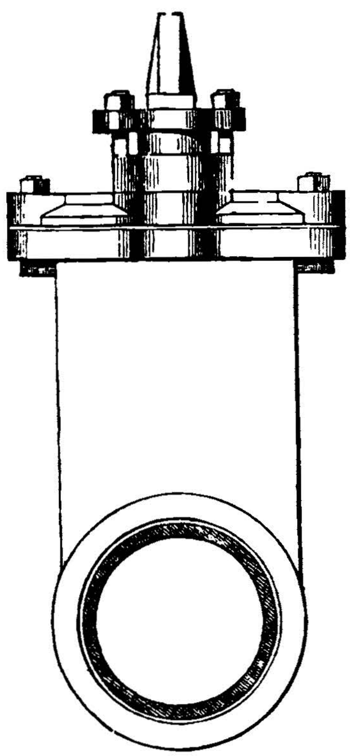
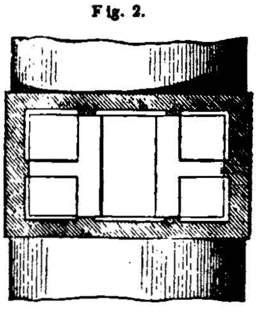


Fig. 1.

Fig. 2.



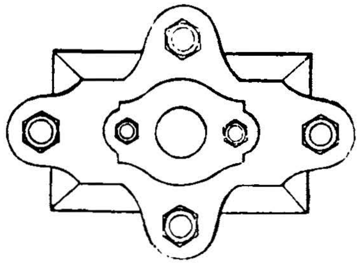


Fig. 3.

Fig. 1 is a side view of one of the cocks; fig. 2, plan above the level of the pipe; fig. 3, plan of cover; fig. 4, a transverse view; and fig. 5, a sectional elevation of a cock fully open,—the dotted lines show the position of the valve when closed.

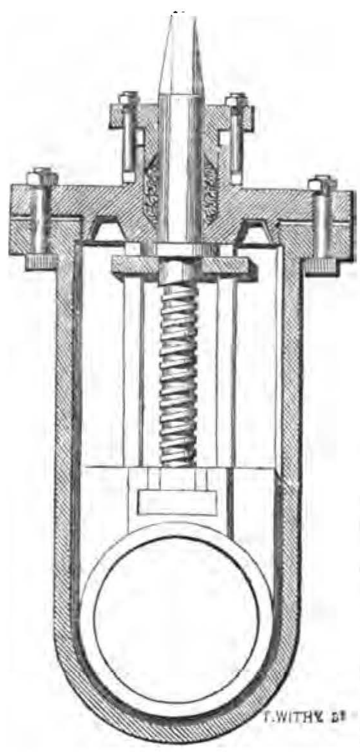


Fig. 4.

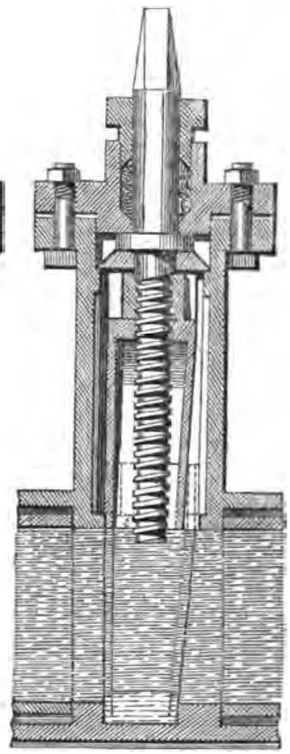


Fig. 5.

Mr. Nasmyth claims as new—1st. The valves being formed with double faces; 2ndly. The screw passing down through the valve; and 3rdly. The casting of the cock in one piece.

(To Messrs. Nasmyth, Gaskell, and Co.)

Gentlemen,—I have great pleasure in complying with your request, to give an opinion upon Mr. Nasmyth's Screw Cock for Water Works. I have examined and proved two of the cocks, and am quite satisfied that they will answer, in an efficient manner, all the purposes for which this kind of Cock is intended.

One important feature in your Cocks, as distinguished from those ordinarily used, is, that they are *all* double-faced, and therefore, there is no occasion to have two sets, one single-faced, and one double-faced, and the cost is considerably less than that of the ordinary single-faced Cocks, which are cheaper than the double-faced.

Screw Cocks form no inconsiderable item in the first and annual expenditure of a Water Works, and not unfrequently a single-faced Cock is introduced, on account of its cheapness, where a double-faced would otherwise be preferable.

A comparision between the cost of your Cocks, and of ordinary, single, and double-faced Cocks, in equal proportions, should be made in order to show the superiority of yours in a commercial point of view, which, after all, is the most important view to be taken in the introduction of improvements.

The value of Seven single-faced Cocks, of the ordinary constructions, and of the following sizes, viz.—3, 4, 5, 6, 7, 8, and 9 inches, will be	£43	18	0
The value of the same number, and of the same sizes, of double-faced Cocks, of the ordinary construction, will be	48	13	6
The mean cost of the two classes	46	5	9
The cost of the same number and of the same sizes of your improved Cocks, which are all double-faced, and therefore will answer the purpose of single or double faced, will be	31	15	0
Difference in favour of your Cocks	14	10	9

Thus it appears that your Cocks are 30 per cent. cheaper than the ordinary Screw Cocks, and equally efficient. I have therefore great pleasure in recommending their use.

I understand, that if a contract is entered into by you, for the supply of these Cocks, that you undertake to guarantee them for twelve months after they have been placed in the ground, and to take upon yourselves the responsibility of all costs and charges which may be incurred should any of them prove defective during that period, and further, that your prices include also the cost of delivery upon the Companies' Works. These conditions I always introduce into my specifications.

You may make any use you please of this letter, my object being in this, as in all other instances, the introduction of an article cheaper than those ordinarily in use, and equally efficient; and thus to reduce the expenditure in Water Works' Establishments.

I am, &c.,
THOMAS WICKSTEED,
Engineer.

Engineers' Office, Old Ford,
Nov. 18, 1843.

(To Messrs. Nasmyth, Gaskell, and Co.)

Gentlemen,—In reply to your request, I will gladly bear testimony to the superiority of your Wedge Cocks over any other form with which I am acquainted; and I think they might be employed with advantage not only for Water Works, but also for many other purposes. As you desire it, I beg to offer the following observations in support of my opinion.

1st. Your Cocks cost considerably less than the common single-faced Cocks.

2nd. The form insures both strength and durability.

3rd. They are tight, and as the attrition or wear is equal at every part of the faces, I think they will remain so.

4th. Being double-faced, they will stop the water either way, which is a great advantage.

5th. The stuffing-box may be packed without shutting off the water, or emptying the mains.

6th. If, as I suggested, they should now be made with a simple Nut, instead of the Gland, the packing in the stuffing-box can be screwed up at any time, without opening the ground.

7th. The ordinary sizes employed for Service Cocks, even under a pressure of 150 feet, are very easily opened and shut; after the first few turns they may be moved without the aid of a bar, but simply by applying the hand to the key; should the pressure be great, it may be partly balanced by causing the water to act against the taper side of the slide.

8th. As a consequence, the keys carried by the Turncocks may be made much lighter than they generally are.

9th. As we can at all times depend upon your Cocks, being assured they will not allow the water to pass, I can rely, with confidence, upon the indication of my Instrument for discovering faults in the Pipes.

I may mention, finally, that your Cocks also possess the advantages common to some others, such as a free uninterrupted Water-Way; opening and shutting gently and gradually; standing low, so that they may be employed even where the Pipes are near the surface; &c.

It appears to me that there is but one objection which may be urged against them, which is the probability of the faces rusting or corroding. If they were seldom opened or shut such an effect might take place, but if used frequently I consider there is no risk. I have this day examined a Cock put down in August, 1845, and I found it in excellent condition, with no appearance of injurious corrosion.

I will but add, that you are at liberty to make any use you please of this communication.

I remain, &c.,
MICHAEL SCOTT,
Engineer.

Liverpool Water Works,
February 4, 1847.

PIGMENTS OR PAINTS.

JAMES MURDOCK, of Staple-inn, Middlesex, for *"an improved mode of preparing and employing certain colours and materials for painting."* (A communication.)—Granted March 10; Enrolled September 10, 1847. [Reported in the *Patent Journal.*]

This invention has for its object the substitution of certain substances unacted upon by sulphuretted hydrogen, instead of the compounds of lead and copper at present in use, as pigments or paints, particularly with reference to the greens, yellows, and reds. The patentee describes his invention under different heads, as follows:—1st. In a certain process for the manufacturing, upon a large scale, of zinc yellow (chromate of zinc); barytes yellow, antimony red (sulphuret of antimony), and zinc green. 2nd. The employment of these colours for painting, in general, upon cloth, wood, walls, paper, &c. 3rd. In the mixture of these colours with others, unaffected by sulphuretted hydrogen. 4th. In mixing the oxide of zinc with other unalterable colours. 5th. The manufacture of a new dryer, in which certain peroxides act the same part as litharge in the common process. 6th. A process of polishing painting with oxide of zinc and unalterable colours, combined with the dryer above mentioned. 7. The application of the above-mentioned colours and oxide of zinc in printing and colouring paper-hangings. The patentee then proceeds to describe his processes; and, in the first place, his zinc yellows. This process is divided into three parts. By the first he obtains what he calls marigold yellow. For this purpose he mixes in a boiler 120 lb. of bichromate of potass with from 700 to 800 lb. of water, and 60 lb. of "zinc white." The boiling is continued for from 24 to 36 hours. The precipitate is then separated and washed, and the first washings added to the solution from which it was precipitated. When perfectly washed the precipitate is dried, and either reduced to powder or made up into cakes. By the second he obtains lemon yellow, by adding to the solution which remains from the first process, together with the washings which were added to it, sulphate of zinc, formed by adding to 75 lb. of oxide of zinc, 45 lb. of sulphuric acid of commerce, of specific gravity 63¼°. This is to be boiled as in the first process, and the precipitate separated, washed, and dried. To the solution remaining from this last process, together with the first washings of the precipitate, he adds sulphate of zinc, formed by adding to 15 lb. of oxide of zinc 7 lb. of sulphuric acid of commerce. This is to be boiled as before, and the precipitate washed and dried. This gives a pale yellow, of a tint between the marigold and citron tint above described. The baryta yellow is formed by adding to a solution containing 100 lb. of chloride of barium, 84 lb. of the double neutral chromate of potass and soda, boiling these together, then separating, washing, and drying the precipitate. From these yellows the patentee says he can obtain any shade of yellow required by adding, if necessary, raw terra sienna, or the antimony red hereafter described. And greens in the same manner may be obtained of any shade, by adding to the yellows a blue, unacted upon by sulphuretted hydrogen. The antimony red, or orange red, is made by dissolving the native sulphuret of antimony in hydro-chloric acid, in such proportion that it will just dissolve the whole of the sulphuret; this proportion the patentee finds to be about 6 of acid to 1 of the native sulphuret. The solution is then filtered, and water or acid is added to it until its specific gravity is between 13° and 17° of the French ariometre. The patentee prefers 15°, but claims all degrees between 13° and 17°. When the solution has been brought to the above density, it is placed in a suitable vessel, and sulphuretted hydrogen passed through it. The sulphuretted hydrogen may be that evolved in forming a second solution of the native sulphuret. The tube by which the gas is conducted into the solution should be of glass, and wide enough to prevent its clogging; the vessel should be covered, and the gas made to pass through a series of vessels, and at last conducted into a vessel of milk of lime; during the process the solution should be stirred occasionally with a wooden spatula. The precipitate is to be washed thoroughly, and dried at a temperature of from 100° to 120°; at a higher temperature than this the hydrated sulphuret would lose its combined water, and become black. To form the zinc green, the patentee dissolves in hot water 49 lb. of pure dry sulphate of cobalt, and to this adds 255 lb. of oxide of zinc slaked with a little water; the whole is then boiled to dryness, and heated red-hot in a muffle. The calcined mass must then be cooled and thrown into water, thoroughly washed and dried. The patentee claims this his process of neutralising the sulphate of cobalt with oxide of zinc. The patentee next describes the process for making a dryer, or drying oil, by boiling for 6 or 8 hours 200 gallons of purified linseed oil, and then adding to this 10 lb. of peroxide of manganese in fine powder. The mixture is to be boiled for 5 or 6 hours, and filtered when cool. Peroxide of iron will answer the purpose, but it is not so effective as peroxide of manganese. If desired, the protoxide, sulphate, acetate, or carbonate of manganese may be used. This dryer may be mixed with the paint in the proportion of 1-10th to 1-20th. Instead of the dryer above described, the peroxide of manganese may be ground up with the paint in the same manner that litharge is now employed. It should, in such case, be used in the proportion of 1-10th to 1-25th. In applying his patent colours for the purpose of polished painting, the patentee lays on, first, several coats of zinc white, and when dry the surface is rubbed down with pumice till it is brought to a dead polish. The colours, whether for marbling, graining, &c., previously mixed with the dryer are then laid on, and when dry will not require varnish. In applying these colours to paper-hangings no alteration whatever is required to be made in the common process, and for the purpose of satining or watering paper, or enamelled cards, the zinc white is employed instead of the white lead now commonly used. The patentee claims:—1. The particular mode of manufacturing zinc yellow, baryta yellow, orange red (sulphuret of antimony) and zinc green. 2. The application of the above colours to painting pictures, buildings, and other objects, upon stone, wood, plaster, canvas, paper, &c. 3. The manufacture of compound colours made of zinc yellow, antimony red, baryta yellow, "zinc white." 4. Compounding the above colours with linseed or other oils, and the dryer above described. 5. The mixture of the dryer above described with unalterable colours, whether those above mentioned, or others containing neither lead nor copper, or compounds containing those colours above described, and other unalterable colours. 6. The application of the above-described colours to the process of painting and printing on paper-hangings. 7. The application of the above-described colours and dryer to the process of polished painting. 8. The mixture of the above colours with other unalterable colours, with or without the dryer, for the purpose of obtaining any desired shade of colour.

JAPANNING METALS.

Frederick Walton, of Wolverhampton, Staffordshire, japanner and tin-plate worker, for *"an Improved mode of coating or covering, or of coating, covering, and ornamenting the surfaces of articles which are or may be made of wrought iron, or of other metal or metals; which improved mode may be used in substitution of japanning, tinning, or other modes, now in common use, of coating, covering, or of coating, covering, and ornamenting such articles."*—Granted February 24; Enrolled Aug. 24, 1847.—[Reported in *Newton's London Journal.*]

This invention relates to coating the surfaces of wrought iron, or other malleable metal that will bear a strong red heat without injury (such as brass or copper), so as to form a glazed enamelled surface either plain or ornamented.

The first preparation is to clean the surfaces of the articles, by first subjecting them to a red heat in an annealing oven, or in a muffle, according to their size, for about half an hour, to dissipate all liquid or greasy matter, and oxidate the surfaces. The oxide is removed by rubbing with sand-stone, or scrapers. When cleaned, the articles are to receive a first coat of partially vitrifiable materials, which is poured in a semi-liquid state over the surface of the article, and distributed evenly; the article is then placed in an ordinary japanner's stove, heated to 180°, and left therein until all moisture is gradually dried away, leaving the same in a state of dry whitish composition, which will adhere to the article, without it is roughly touched with the fingers.

The composition for the first coating is prepared as follows:—6 parts, by weight, of flint-glass, broken into small fragments, 3 parts of borax, 1 part of red lead, and 1 part of oxide of tin, are to be well mixed, by pounding in an iron mortar, and "fritted" in the same manner as is usually done with the materials for making glass. 1 part, by weight, of the "fritt," so made, is to be mixed with two parts of calcined bone, ground to powder; and the mixture of fritt and bone is then to be ground with water in a "porcelain mill," until a semi-liquid, of the same consistence and appearance as thick cream, is produced, which, after being passed through sieves of fine lawn, is ready to be applied to the articles, as above mentioned.

When the first coating is dry, the articles are ready for firing, in order so far to vitrify the materials, as to harden the coating, and fasten it on the surfaces of the articles. The firing is performed in a furnace of the kind used by painters in enamel. The muffle having been brought to a full red heat, the articles are introduced, and are left therein until the earthy composition has undergone so much of the commencement of fusion, or partial semi-vitrification, as to render the earthy particles of the coating firmly adherent to one another, and to the surface of the articles, which are then to be withdrawn from the muffle, and laid on a flat iron bench to cool; when cold, those parts of the surface which have been coated, present a dead whitish appearance, resembling earthenware in the state of "biscuit:" the time that the articles must remain in the muffle, varies from a few minutes to half an hour, according to the heat of the muffle, the size of the articles, and the number of articles in the muffle at the same time. After the articles have become cool, the coating is wetted with water, and a second coat is then applied over the first coat, and dried thereon in the japanner's stove; it is then fired in the muffle in the same manner as the first coat. The composition for the second coat is prepared as follows:—A thick paste is made, by mixing 32 parts, by weight, of calcined bone, ground to fine powder, 16 parts of china-clay, 14 parts of Cornwall stone, in fine powder, and 8 parts of carbonate of potash, the latter being dissolved in water; the mixture is fritted for two or three hours in a reverberatory furnace, until it assumes the appearance of biscuit-china; and then it is to be reduced to powder. 5½ parts, by weight, of this powder, are mixed with 16 parts of flint-glass, broken small, 5½ parts of ground calcined bone, and 3 parts of ground calcined flint; and the mixture is reduced to the consistence of cream, by grinding in a porcelain mill, in the manner described for the first composition. In firing the second coating, care must be taken that the heat of the muffle is sufficient, and that the articles are kept in long enough to effect the thorough incorporation of the second coat with the first, and to harden both coats. After the second coating, the articles will have a stronger and whiter colour, and bear a more decided resemblance to articles of good earthenware in a state of biscuit; but in case it is desired to give a very white colour to the second coating, in order that it may resemble the finest earthenware in the state of biscuit, then, in place of the 16 parts of flint-glass, last mentioned, the patentee substitutes a like quantity of a composition, formed by mixing 4 parts, by weight, of pulverized felspar, 4 parts of white sand, 4 parts of carbonate of potash, 1 part of arsenic, 6 parts of borax, 1 part of oxide of tin, 1 part of nitre, and 1 part of whiting, fritting the mixture, and then reducing it to powder.

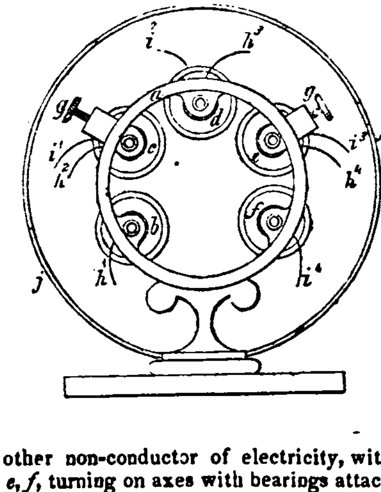
When the articles have become cool, after receiving the second coat, this coat is wetted with water, and a third coat is applied, and fired in a similar manner; and, when cool, the article will present the appearance of glazed earthenware of good quality, or of the best quality, in case the composition, last mentioned, has been substituted for the flint-glass amongst the materials for the second coat. The materials used for forming the third coat or glaze are, 12 parts, by weight, of pulverized felspar, 4½ parts of china-clay, 18 parts of borax, 3 parts of nitre, 1½ parts of carbonate of potash, and 1½ parts of oxide of tin: these ingredients are treated in the same manner as those for making the second coat. Instead of the materials and proportions just mentioned, the following may be used:—9 parts, by weight, of pulverized felspar, 2 parts of china-clay, 9 parts of borax, 2 parts of nitre, 3 parts of carbonate of soda, and ½ part of arsenic. In case there are any imperfections in the glaze, after it has been fired, then, when the articles are cold, another coat of the glaze may be applied, in a semi-liquid state, and dried in the japanner's stove, and fired in the muffle in the same manner as the first glaze: in like manner, a third coating of the glaze may be applied, if requisite.

The articles that have been coated on one side, may have the opposite side coated with black glaze, applied with a sponge when in a semi-liquid state, dried on in the japanner's stove, and then fired in the muffle. The black glaze may be composed of the same materials as either of the compositions, before described, for the third coat or glaze, with the addition of 2 parts, by weight, of oxide of manganese, and 1 part of cobalt; which materials are to be added to the other ingredients, previous to the mixture being fritted. If a deep blue glaze is preferred to black, then the oxide of manganese may be diminished or omitted; and so much as is omitted may be replaced, weight for weight, by cobalt, in addition to the quantity of cobalt above mentioned. Or, instead of the back or under side of the article being coated with black or blue glaze, it may be finished by japanning, according to the method usually adopted by japanners.

ELECTRIC LIGHT.

Thomas Wright, of Cooper's-hill, Thames Ditton, Surrey, Esq., for *"Improvements in apparatus for the production and diffusion of light."*—Granted March 9; Enrolled Sept. 9, 1845.

This invention consists in producing a permanent light, by presenting one or more fresh points or surfaces of carbon, or other suitable material, continually to the path of an electric current, by an apparatus similar to the annexed engraving. *a*, is a double annular frame



of wood, or other non-conductor of electricity, with five (or more) discs *b, c, d, e, f,* turning on axes with bearings attached to the frame *a.* The discs consist of two circular plates of brass, or other metal, with a disc of plumbago or carbon (the latter being preferred), between them, somewhat larger in diameter than the brass plates, about one-fourth of an inch thick, and having an angular or V-shaped edge. The axes of two of the discs *c, e,* are mounted in sliding carriages, and can be moved backwards and forwards by the screws *g, g*. The discs are made to rotate slowly by means of an endless band, with pulleys and wheelwork, actuated by a weight or other prime mover; a current of electricity being then passed through the series of discs, a brilliant light will be produced at those edges of the discs that are adjacent to each other. A current of electricity may be caused to pass through the discs, by connecting one wire of a galvanic battery with the axis of the disc *b*, and the other wire with the axis of the disc *f*; but, in order to economize the power, the patentee prefers to separate the battery into four parts, and transmit a separate and distinct current to each pair of discs, by means of the wires h^1, h^2, h^3, h^4, and i^1, i^2, i^3, i^4. In order to produce the desired effect, the discs *c, e*, are to be brought into contact with the discs *b, d, f*, by turning the screws *g, g*; and as soon as the electric current is established, and the points of contact sufficiently ignited, the discs *c, e*, are to be moved out of contact with the other discs, when a brilliant and permanent light will continue to be evolved at the adjacent parts of the discs, so long as the discs are kept rotating, and the electric current continues to pass. In order that the electric light may be uniformly diffused, the apparatus is enclosed in a ground glass globe *j*.

SLUB CHAINS.

William Baylis, of Bilston, Stafford, chain-maker, for "*a machine for flattening and turning iron links for flat-wood slub-chains.*"—Granted February 20; Enrolled August 20, 1847.

In forming the links of flat-wood or slub-chains the sides are flattened while the ends at the connexion of the adjoining links are cylindrical. Such formation has hitherto been accomplished by hand forging. In order to the well working of such chains, it is necessary that considerable uniformity should exist between the separate links, which require much skill and consequent expense in their manufacture.

Now the object of the present invention is to produce the required flattening to parts of lengths of iron, and partial bending of the same by mechanical means, so as to facilitate the formation of the links, and lessen the cost of the manufacture.

The annexed engravings show a machine for making the links. Fig. 1, is a side view; fig. 2, a plan; and fig. 3, an end view. *a*, the framing of the machine; *b*, the driving axis, to which motion is

Fig. 1.

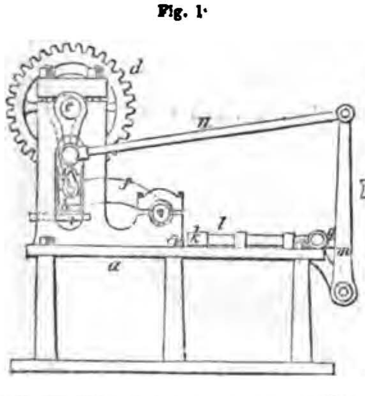
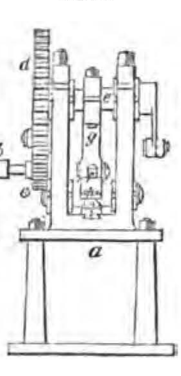


Fig. 3.



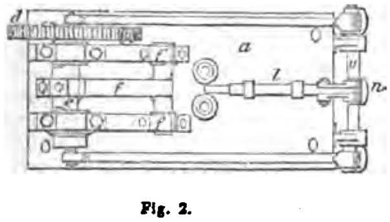
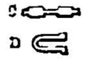


Fig. 2.



given by a steam engine or other power; on the axis *b*, is a pinion *c*, which takes into and drives the cog-wheel *d*, on the crank axis, *e*, and gives motion to the arm *f*, by the link *g*, and carrying the upper face plate *h*. *i*, is the lower face plate, upon which a length of iron A, for the intended link and heated to a moderate heat, is to be held so as that by the descent of the arm *f*, a flattened part, as shown at B, is produced, and then the length of metal A, is to be put end to end, so as to produce another flattened part B, as shown at B, C. The lengths thus formed are then to be placed against the rollers *k*, when by the coming forward of the forcer, *l*, they will be bent into the shape shown at D. Motion is given to the forcer, *l*, in the following manner: *m, m*, are arms which at the upper ends are connected to the connecting-rods, *n, n*, which receive a to and fro motion from the shaft; the lower ends of the arms, *m, m*, are affixed to the shaft, to which is also affixed the arm, *p*, which by means of a link gives motion to the forcer, *l*. The links produced, as shown at D, are afterwards to be welded together in the ordinary way.

STEAM ENGINE IMPROVEMENTS.

William Knowelden, of Great Guildford-street, Southwark, engineer, for "*improvements in steam engines.*"—Granted December 31, 1846; Enrolled June 30, 1847.

This invention relates to obtaining two revolutions of a shaft of a reciprocating steam-engine for each complete stroke of the piston.

Figs. 1 and 2, are an elevation and a plan of a reciprocating steam-

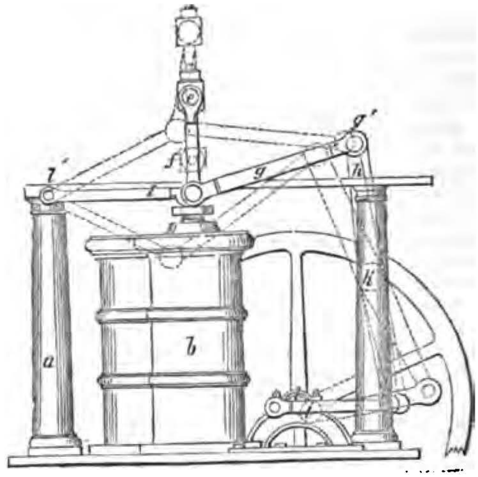


Fig. 1.

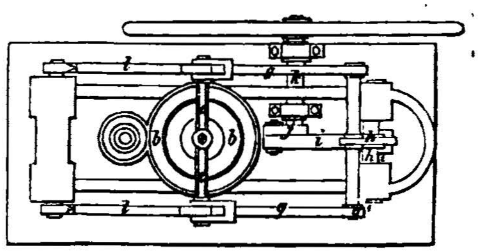


Fig. 2.

engine, showing the improvements. *a, a*, is the framing. *b*, the steam cylinder. *c*, the piston rod. *e*, the cross head; and *f*, the side connecting rods which are at one end in connexion with the cross head *e*, and at the other end in connexion with the connecting rod *g*, which is forked so as partly to embrace the cylinder and to allow of its being in connexion with both of the rods *f*, and this connecting rod is at the end, *g'*, in connexion with the beam or lever *g*, moving on an axis in the centre, by which the end, *g'*, of the lever, *g*, is controlled to move to and fro in nearly a straight line, which is one peculiarity of the invention, and such beam or lever at one end moves on an axis at *g'*, its other end by a connecting rod, *i*, gives motion to the crank, *j*, on the main shaft *k*, of the engine; thus will the crank shaft be caused to make a complete revolution each time the piston moves from end to end of the cylinder, and therefore two revolutions for each complete stroke of the piston. *l, l*, are two arms from the axis, *l'*, one on each side of the cylinder, in order that they may be in connexion with the two side connecting rods, *f*. These arms are for the purpose of controlling the working of the parts, and to ensure the end *g'*, of the connecting rod *g*, making a uniform to and fro movement each time the piston passes from one end to the other of the cylinder; but it is obvious that the same result would be obtained if the ends of the rods, *f, g*, were controlled by guides to move in the same direction.

The claim is for combining the parts *f, g, i*, with a crank shaft or axis so as to obtain two revolutions of such shaft or axis for each complete stroke of a reciprocating steam-engine.

SMELTING COPPER.

James Napier, of Shacklewell-lane, Middlesex, operative chemist, for "*Improvements in smelting copper or other ores.*"—Granted March 2; Enrolled September 2, 1847.—[Reported in *Newton's London Journal.*]

This invention consists in improvements in smelting copper ores, by treating them with fluxes, consisting of common salt, lime, and carbonaceous matters; and also in improvements in smelting ores, containing silver, or gold, or both those metals, by the addition of alkaline substances, coal, iron, and galena.

The first object is to facilitate the separation of the earth from the copper; and to effect this, when several ores of different descriptions are to be operated upon, the patentee mixes them in such proportions, in relation to the earthy matters or gangue they contain, as will cause the earths to unite in the furnace and form glass: the ores have been mixed in suitable proportions, when the silica in the mixture ranges from 50 to 75 per cent., in relation to the other earthy matters, which are generally mixtures of alumina, lime, baryta, fluor-spar, &c.,—the presence of oxide of iron greatly facilitates the fusion of the ores. Should the mixture (or the ore, when only one description of ore is being treated) not contain silica in the above proportion, the deficiency is to be supplied by the addition of sand; or, if the silica exceeds the above proportion, lime or fluor-spar is to be added.

After the above preparatory process, the operation is conducted in the following manner:—If the ore or ores should contain not less than 1 part of iron and 1 part of sulphur, to 2 parts of copper, an addition is made to every ton of ore, of 56 lb. of common salt, 40 lb. of slaked lime, and 100 lb. of coal, and the whole is fused in a melting furnace. When fused, the slag or scoria is skimmed off, and the furnace is tapped into sand moulds: the ingots or pigs, thus produced, are treated as hereinafter described. If the ore or ores should contain less than 1 part of iron to 2 parts of copper, the deficiency is to be supplied by the addition of sulphuret of iron; or the ore is to be treated as before mentioned (omitting the coal); and after the fused mass has been skimmed, 30 lb. of scrap-iron are to be dispersed over the surface thereof, as equally as possible, and the door of the furnace is closed until the scrap-iron is melted; the furnace is then to be tapped into sand moulds. When the ingots, obtained in the above manner, are set, they are thrown into water, whereby they become disintegrated and fall into a fine powder; this powder is thrown into a heap, and allowed to remain for forty-eight hours; after which, it is removed to a calcining furnace, and treated in the manner described in the specification of a patent obtained by the present patentee, July 20, 1846. The addition of black oxide of manganese, instead of iron, has been found to produce a similar effect, but not with equal advantage.

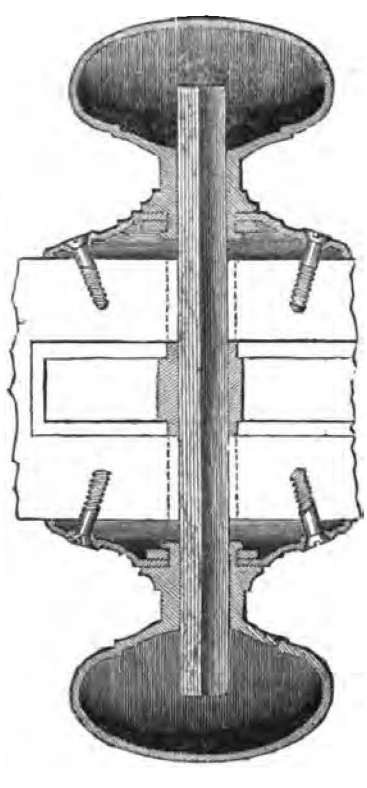
When ores containing little or no sulphur are operated upon, the above-mentioned processes of disintegration and calcination are omitted. The patentee commences, in this case, by mixing the ores, in relation to their earthy matters, so as to form glass, as above described (the ores, when containing no iron, might with advantage have a small quantity of oxide or carbonate of iron added); and then 80 lb. common salt, 50 lb. slaked lime, and 100 lb. anthracite coal, finely pulverized, are added to each ton of ore containing 10 per cent. of copper. If the ore should be richer in copper, a smaller proportion of salt and lime will suffice, and a greater proportion of anthracite of coal will be required: the patentee says, he has found, that for an ore containing 25 per cent. of copper, 56 lb. common salt, 50 lb. slaked lime, and 150 lb. anthracite coal will answer well. The mixture of ore and other materials is fused in a melting furnace, which, for a charge of 25 cwt. of ore, will take from five to six hours; and then the fused mass is tapped into sand moulds: the copper, thus obtained, will generally be ready for the refining operation; but should a portion of the produce be regulus, it is to be roasted, and afterwards refined. Soda and several of its salts may be used instead of common salts; and so likewise may potash and several of its salts, or mixtures of these, free from sulphur.

Sulphuretted ores of copper, containing silver, or gold, or both these metals, are treated in the following manner:—The ore is first calcined and fused, as in the ordinary smelting process, so as to produce a regulus, containing about 50 per cent. of copper; with every ton of this regulus, 56 lb. soda-ash, 40 lb. slaked lime, 1 cwt. coal, 1½ cwt. iron in scraps, and 4 cwt. galena (sulphuret of lead) are mixed, and the mixture is fused in a fusing furnace until the iron disappears; the fused mass is then well rabbled and tapped into sand moulds. The lead will be found reduced at the bottom of the first and second ingots, and will contain all, or the greater part, of the silver, or gold, or both, which the ore previously contained; these metals are afterwards separated from the lead by the ordinary methods of separating silver and gold from lead. The copper is treated in the ordinary manner, or as described in the specification of the patent before alluded to. Instead of galena, the oxide of lead may be employed; in which case the iron is dispensed with; but the patentee prefers to use galena.

When treating ores of silver, or gold, or both, which do not contain copper, or which do not contain it in the state of a sulphuret, the patentee adds copper pyrites thereto, in the proportion of 4 cwt. of the latter to 16 cwt. of ore, and then proceeds in the manner above described, viz., bringing the material into a state of regulus, and fusing it with soda-ash, lime, coal, iron, and galena.

In conclusion, the patentee says, that he does not confine himself to the precise details, or proportions of the ingredients used, so long as the peculiar character of the invention be retained.

LOCK FURNITURE AND SPINDLES.



Mr. Pitt has obtained a patent for an ingenious improvement in the mode of fixing the furniture on locks and shutter knobs, as shown in the annexed engraving; by which, it will be seen that the spindle is not fastened to the knob, but is merely let into the socket. This method obviates the necessity of driving on the handle with a mallet, which frequently mutilates the furniture. Another improvement is the doing away with the small screw in the neck; instead of which, the spindle is first placed in the follower of the lock, and then the knob put upon it, which has connected with it the brass plate of the rose; this plate is firmly fixed to the door by small screws, over which there is a cover rose furnished with a collar with a female screw, and which is fastened by two or three turns on to a screw round the neck of the brass plate: thus the screws and brass plate are completely concealed. The improved furniture is manufactured by Messrs. Hart and Sons, ironmongers, of Wych-street, Strand, and may be had either in glass, china, ebony, ivory, or other fancy fittings.

KING'S COLLEGE, LONDON.

Introductory Address; read to the Students in the Department of the Applied Sciences, at the commencement of the Session, on Tuesday, October 5th, 1847, by D. T. Ansted, Esq., M.A. F.R.S., Professor of Geology to the College, and Dean of the Department.

Gentlemen—Occupying, as I have the honour to do, the office of Dean of the department of the Applied Sciences for the ensuing year, I have thought it expedient, following the example of another department of our College, to open the business of the academical year by an address, in which I shall endeavour to explain to you briefly some of the objects, peculiarities, and benefits of the education which is here offered, and of which, it is to be hoped, you will take every advantage.

The object of this department of the Applied Sciences is to give *general* education, as distinguished from *professional* education We wish to give this general education, however, in such a manner and to such an extent, that special education in engineering, architecture, and some other very important professional pursuits, may rise naturally from it and be intimately connected with it. It has been endeavoured so to arrange the course, that the required practical knowledge and manual dexterity for such pursuits shall be connected with and arise from the sound educational principles inculcated in the lecture-room.

Education is, in one very important sense, the serious occupation of every thinking and acting man. It commences with our entrance into the world; it is carried on, whether for good or evil results, with great energy and incessantly, through early childhood and youth; it is continued, also, whether we will or not, as we advance into manhood; and so long as we remain on this side the grave, so long do we continue to learn,—to acquire new habits, new thoughts, new ideas, and to exercise some influence over our fellow-men. It is only the idiot who can escape—although it is the privilege of the idle and the inactive to approach in the nearest degree to this lowest condition of our human nature.

But although education—or the training of the human intellect to accomplish the purposes of man's nature—is thus a process constantly going on, there is a particular period of life when the faculties are in their early vigour and the physical powers as yet unworn by the pressure of mental excitement; when the memory is fresh and not burdened with the experiences of a life; when the light amusements of childhood pall upon the senses, and thought begins to take the place of simple, unthinking observation;—there is this period in the life of every one, in which it is possible to sketch in simple outline some truthful delineation of the future, and when, therefore, it becomes of the most earnest importance that the sketch should correspond with the intellectual and mental peculiarities of the individual. This is the time when school gives place to college; when mere routine, imposed from without, is to a certain extent changed to voluntary, and in many cases more severe, mental exercise; when new, powerful, and lasting impressions are made; when new associations are formed, which will probably long influence the habits and the character; and when, in a word, what there is of intellectual and moral in the character begins to expand, becomes less dependent on circumstances, and takes some special direction which is rarely afterwards changed.

In the great majority of cases, the part in active life that is to be taken by every individual is determined for him by external circumstances, over which he has little control. In such instances, it is however not unusual that, in addition to and beside the direct occupation or business of an educated and intelligent man, there is some one subject or department of knowledge pursued quietly and as an amusement, to the infinite advantage of himself and his family, and by no means to the detriment of his business. In other and rarer cases, the occupation is at the same time the amusement. Both of these cases may be greatly affected by the education of the youth, as he is passing into manhood. Both therefore should enter into every scheme of education; for, however we may conclude from philosophical speculation, no one accustomed to observe will doubt that there are certain tendencies that are peculiar to the individual; and that as no one man so accurately resembles another, that we cannot determine some point of difference, so no one intellect is without its individuality—capable of being directed more easily in one path than in any other.

Thus, as there are different objects to be attained, and human intellects differently constituted to attain them; as society requires all powers to be developed, and needs the exertions of all her members, it is only just and reasonable that in that transition state of which I have reminded you, and in which you are, there should be various ways of arriving at the required result—namely, the providing men adapted to carry out fully the objects of society in all departments. The attainment of the public good in this sense is, I conceive, the practical fulfilment which a nation is required to attempt of the sacred maxim—"to love our neighbours as ourselves." It is acting with a view to benefit mankind at the same time and to the same degree that we are ourselves personally and intellectually benefitted. The establishment of places of education, such as this College, and of this College especially, has resulted from the endeavour to carry out this purpose; and you who are about to profit by the course of instruction here afforded, are bound to recognise with gratitude the opportunity which is thus offered you; and placing yourselves, or being placed, under such obligation, you will be responsible, each to his own conscience, for the result.

The kind of education offered in that department of the College to which you are attached is peculiar, and scarcely resembles any system previously adopted. It has already proved most successful, as an attempt to extend the advantages of college education to many whose special object in after life was likely to be more distinctly *active*, than either contemplative or dependent on the constant and exclusive exercise of the intellectual powers. Some modification seemed needed of the ancient and not unuseful system adopted in our universities of Oxford and Cambridge, for the time required and there employed in the cultivation of language and pure mathematics, had, during the lapse of years, gradually stolen on from the period of boyhood to that of manhood; and for this reason, those whose pursuits would remove them entirely from the further prosecution or application of such subjects, were necessarily deprived of the advantages of college discipline. They were also without the opportunity of acquiring, by any good system, the groundwork and elementary knowledge which should be really useful in their subsequent employments.

The endeavour to determine whether in our own country, as on the continent, it might not be possible to establish a system not less sound and based no less on the peculiar nature and requirements of the human intellect in a certain stage of its development, than that system which has produced so many and such great divines, lawyers, and natural philosophers,—whether, I say, it might not be possible to modify that system, so as to produce men no less useful and no less distinguished in the paths of active and business life—whether we could not by such modification bring forth energies hitherto dormant, and induce a more systematic and philosophic application of thought and intellect to every-day life and ordinary business,—rendering men better able to apply science, because they had been taught to know it properly;—this, I repeat, was the object of the experiment that has been first tried in this place.

It is my intention in this introductory address to explain to you something of the nature of the system we have adopted, and the spirit in which it should on your part be received. You are those on whom we depend for success—we must be supported by your exertions; and we are bound, therefore, to tell you what are our real views and feelings with reference to the working of our plan.

Now, one of the first things that it is necessary to observe may seem, perhaps, somewhat paradoxical: we wish rather to educate than to communicate knowledge. Knowledge in itself is no doubt good; but, in our opinion, education is better, and of far greater importance to you. Our whole system—the College system in the best sense—is a course of training adapting the intellect to acquire knowledge, but only teaching knowledge incidentally. This, it must be understood, is not merely a theory, but a pervading principle. It is not seen in the individual lectures, but it is felt in the general conduct of the whole.

The course of study in the department extends over a period of three years, and in each year the subject of *Mathematics* is expected to occupy a considerable portion of the time and thoughts of the student, the time however diminishing a little as he advances.

The experience of many years and many lives has shown, that for the purposes of mental discipline the peculiar habits of thought and accuracy of expression demanded in the pursuit of mathematical science are in the highest degree valuable. For this reason, as well as because mathematical knowledge is absolutely required in the practical applications of science, you are conducted step by step through that perfect chain of reasoning which has been handed down for more than twenty centuries as the foundation of geometry; you are taught the nature and meaning of that symbolical language, by which, in the hands of a master, the most difficult and obscure problems are ingeniously solved; and you are further made acquainted with the principles as well as the methods according to which this symbolical language of *algebra* may be applied to the determination of problems in geometry, the thinking out of which by continuous argument would be exceedingly difficult, and in some cases perhaps almost impossible.

I allude thus briefly to the fundamental principles of pure mathematics, which form an essential portion of your early studies in this place, in proof of what I have already stated concerning the nature of the education offered. It is based on no hypothetical or speculative novelty, but commences, as all useful education must do, by training carefully the reasoning faculties; and it selects for this training the subject of pure mathematics, as that most likely to be afterwards useful. Be assured that the time and labour bestowed on this part of your studies will never be regretted in after-life, and that whatever your pursuits may be, this mental training will help you to succeed in them.

In thus speaking of the principles of geometry as taught by Euclid, and the nature of algebra as introducing a knowledge of symbols, I have said all that is necessary to illustrate the views adopted in this department of the nature and use of mathematics in education; but I cannot leave the subject without reminding you, that however important it is to understand fully and clearly the bearings of any subject that concerns us deeply, nothing in the whole of education is so important as the having a distinct and clear appreciation of the nature of the argument in every demonstration in geometry, and the meaning of the symbolical expression in every elementary proposition in algebra. Your progress by help of memory is of absolutely no value without this; for nothing is less useful or less important than the mere learning by heart the propositions of Euclid, or performing, without understanding them, the ingenious transformations by which problems are sometimes solved.

While the study of pure mathematics is thus insisted on as the first element in your education—and in this respect the course of instruction is simply a transcript of that which has been found useful at one of our older universities—there is also introduced at the same time another subject, differing much less in reality than in appearance, and of scarcely inferior value as a means of education. I allude to that elementary view of *Chemistry* which is presented in your first year. For if the pursuit of mathematical investigation is valuable in its lasting influence on the conduct of the intellect and the reflective faculties, the elements of chemical philosophy form a subject equally well adapted to improve the faculty of observation and the nature and use of experiment as a means of acquiring knowledge. The one science teaches us to reason upon assumed data; the other to interrogate nature from observed phenomena. The mathematician commences by assuming and defining, the chemist by observing and experimenting: the former is independent of nature and external phenomena, the latter deals only with that which is—with matter in its various forms, and the laws according to which those forms are modified and mutually related.

The introduction of chemistry as a subject of elementary instruction is one of the peculiarities of the course of study here adopted. It is a distinct and marked recognition of the value of experimental science; not merely for its direct result in a certain amount of useful knowledge acquired, but in its effect on mental culture. And in this respect I would have you consider it and avail yourselves of it.

Chemistry is the link by which pure mathematical science is connected with natural history. To understand clearly in what way and to what extent the result of that abstract cultivation of the reflective faculties—requiring theoretical certainty in every proof—differs from the habit of arriving at results by the comparison of various observations and the weighing of probabilities, would involve a disquisition much longer and more metaphysical than I am at present inclined to offer: but I am sure that no one, who is aware of these two very different ways of convincing the human mind, will deny the value or the practical necessity of the latter method in the great majority of cases that present themselves for determination. For this reason it is that the evidence of experimental observation, as taught in the first and simplest operations of chemistry, is of extreme value; and for this reason chiefly—whatever may be your occupation subsequently—you will always feel the benefit of having been taught the principles of chemical science.

And what is perhaps the most beautiful and most interesting point in such education, is that we learn these important habits of mental discipline without effort, and almost without being aware of it. No one whose intellects are fresh and healthy, can enter on the pursuit of natural science, especially in this its most attractive form, without being charmed by the simplicity and beauty of the results obtained by the chemist—exhibited as they are in experiments that command attention by their novelty, no less than by their manifest usefulness. The method of experiment is the first method of nature,—the child and the boy pursue it unthinkingly, and the philosopher differs from them only in arranging and directing his inquiries with reference to some definite and important object. Most of our ideas, if not all of them, are introduced by those inlets to knowledge which we call the senses; and the infant, stretching forth his tiny hands to touch that object which is beyond his reach, and which is only recognised by the eye, is a type, and no unworthy type, of the great master of chemical science, exerting his powerful and well-trained intellect to bring within the range of comparison various results of observations variously made, and to connect phenomena apparently distinct by discovering the nature of their difference and the laws by which they are alike governed.

While the study of mathematics thus tends to cultivate the reasoning powers, and teach the nature of *abstract* truth; and the pursuit of chemistry quickens the observing faculties, and proves the value of *experimental* truth,—there is one department of natural history to which your attention is also required during the first year of your academic studies. It is *Mineralogy*; and by it you will learn something of the methods of recognising important and characteristic peculiarities in which various natural objects differ from or resemble each other. You thus learn to discriminate and to compare; and you learn also why certain characters are more important than others, and how best to seize the true distinctive marks. Nor is this introduction to the classificatory sciences itself unimportant as a mental exercise; but, on the contrary, you will do well to pay careful attention to the reasonings here presented to you, and to the conclusions deduced. As bearing upon chemistry, and teaching the nature and value of the combinations of matter presented in the structure of the earth's crust, mineralogy also presents a large and interesting group of facts, many of which have still to be referred to their legitimate places in science; and many such facts, which at first seem isolated, will be found to have a bearing on questions afterwards presented, concerning the mode in which nature works in her vast subterranean laboratory. Mineralogy is also intimately related to the subject of Geology, to which in the second year of your studies your attention is also directed.

The remaining subjects of study for the first year involve some departments of natural philosophy not requiring mathematical knowledge; some of the elementary practice of surveying; instruction in drawing—useful to all, and absolutely necessary for every practical man; and familiar knowledge of simple machines, and the use of tools in the workshop; since without practical knowledge no one is qualified to superintend the work of others with regard to such subjects.

I can hardly dwell too strongly or allude too often to the practical value of instruction like this. To appreciate the *ideas* of force and motion by reference to actual examples,—to learn the nature and calculate the effect of *laws* of force and motion by the rule and compass,—by the scale and the measure:—to see exemplified to the senses the reality of those effects which by abstract calculation ought to be produced—these are views of natural philosophy which amuse whilst they instruct, and which are easily remembered and constantly put in execution. This system of combining example with precept is well adapted to carry out the objects of the course of education adopted, for it necessarily suggests a ready means of applying experiment to theory; and thus shows at once the value of mathematical calculation, and its most direct and available use.

Nor is it less interesting or less useful to the active spirit of the young student, that he should be shown and hear explained some of those more complicated contrivances which form the boast of our age and have so largely contributed to the greatness of our country. To be able to examine not merely machinery and models, but machines and factories,—to be taught the principles of their construction whilst they are seen in full activity and performing their appointed task,—to watch the results when not the success of a lecture-room experiment, but the fortunes of many and the lives of thousands are dependent—this kind of instruction cannot fail to be as permanently valuable as it is deeply interesting.

But, as I have already reminded you, general instruction in machinery is here accompanied by a special and manual instruction in the workshop. The use of tools, the dexterity required in overcoming mechanical difficulties, and the habit of regarding detail, thus introduced, must be of the greatest value to every man, whatever his position in life may be. And this kind of education, it should be remembered, is not less valuable to the country gentleman, whose object it is to improve his own property or advance the interests of his fellow creatures, than to the engineer, the architect, or the surveyor. The ingenuity which has recently been brought to bear on the manufacture of an astronomical instrument, perhaps the most remarkable that the world has ever seen, is a striking, but by no means a solitary, example of the value of this mechanical knowledge to all. The Marquis of Worcester two centuries ago, and Lord Stanhope in more recent times, are singular instances of men, who, from their position in society, might seem removed from such employment, but whose manual dexterity in the workshop was not less remarkable than the inventive genius they exhibited in machinery. The workshop will not, therefore, be neglected by any one who wishes to occupy a distinguished or even a respectable position in his profession as an engineer or an architect.

It is equally impossible for any one to succeed in such occupations without a familiar knowledge of the principles of geometrical drawing and surveying. Both are required; and both, as they need much practice, must be commenced early and continued steadily. As you advance, and exhibit a taste for one or other particular subject, it may be advisable to turn this instruction in some special direction: but for the first year, the acquiring a useful habit is perhaps of more importance than the extent to which advance is made.

During the second year, the nature of the instruction communicated and the methods adopted do not vary greatly from the scheme I have already explained, the extent of the instruction and the introduction of new and more advanced portions of the various subjects making the chief difference. But there are two points in the education of this year to which I wish to direct your more especial attention. They are the course of lectures on practical chemistry, and that on physical geography and descriptive geology.

The instruction in mathematics, which for the first year was confined to those departments which chiefly involve principles, now includes some of the higher branches, and involves an investigation of the methods according to which pure mathematical science is applied to solve important and complicated physical problems. The instruction in natural philosophy corresponds with and assumes this advance, and involves a consideration of some of those important theories on which depend the working out of practical mechanical problems.

But in chemistry a new view of the subject is taken. From chemical principles you advance to chemical practice, and to the nature of those changes produced in various ways on the raw materials employed in the arts, and dependent on the action of what are called chemical forces either directly or indirectly.

In this way you are introduced to the same kind of information connected with the laboratory and the principles of chemistry, as you have in the lectures on machinery and manufacturing art; which may indeed be considered as the practical and best illustrations of natural philosophy, as the others are of chemistry. When you look around and consider the infinite value of a knowledge of chemical science in the vast multitude of delicate and important operations carried on in our manufactories, you will recognise the value of this part of the course. In all those employments in which *colour* is introduced or required, not only in dyeing but in bleaching, as well as in the arts of tanning and soap making, in the manufacture of salts and acids of various kinds—a knowledge of practical chemistry is the foundation of the whole knowledge needed. In brewing also and distilling—in metallurgy in all its departments, and of late years in many extremely important operations connected with the mixtures and alloys of metals, the same dependence on chemistry obliges every one whose business connects him in any way with them, to study the theory and the practical applications of this science. It is not without reason then that I urge the advantage of this part of your education of the second year. It involves chiefly, as you will perceive, the accumulating a vast number of important facts, and thus to a certain extent differs in character from the education previously afforded.

In the progress with regard to natural philosophy and chemistry will be recognised at once the nature of the education at this part of the course. You will also perceive that the education, although eminently practical, is at the same time founded on principles previously inculcated, and that its result is by no means to form premature engineers or professional men of any kind, but is hitherto confined to creating a class of well-instructed persons, fit for any practical employment whatever.

Together with the applications of chemistry, the subject of geology is now introduced, as a science to which the attention of the students of the second year is especially directed; and as this is the subject on which I shall myself have to address you, I will only at present dwell upon it so far as to give a sufficient idea of its relative importance amongst your studies, and the place which in my opinion it ought to occupy.

The pursuit of geology may be considered to involve three distinct subjects—a mere description of the materials of the earth's crust, and an account of the order of arrangement of the materials regarded simply as matter of fact—a history of the earth as deduced from such observed fact, and applied to account for the appearances—and a statement of the practical results of knowledge of this kind with reference to the practice of engineering and mining, agriculture and architecture. Following in some measure the plan adopted in chemistry, I at first introduce to your notice the principles of geology, and describe the facts observed. I afterwards explain the direct practical applications, and the mode in which these are best made. The former is the subject of a course of lectures given to the students of the second year—the latter is now confined to the third year.

Geology is essentially a science of observation; but as all facts must be grouped and laws obtained from them before they are practically available, a knowledge of the history of the earth, as deduced from the observation of phenomena, is necessary before the facts themselves can be applied. This history I endeavour to give, avoiding as far as possible mere theory, but always having reference to general principles; and, as a department of natural history, possessing all the advantages that belong to the details of that science, and at the same time offering a yet wider and more important field of philosophical speculation, I believe no subject is better adapted for educational purposes, or more likely to enlarge the mind and strengthen the expanding intellect. The vastness of the operations considered; the extreme duration of time involved; the singular variety and the mysterious succession of organic beings; the evidence of the action of chemical forces on a scale so grand that the mind can with difficulty grasp and appreciate it,—all this tends to give to the subject a hold on the imagination; and has in some cases given alarm, and in others extravagant wildness, to the well meaning, but not well informed pursuer. A calm and dispassionate view of the facts, and reasonable deductions from them, forms however, as I have said, a subject not ill adapted to instruct and improve the student, and is absolutely necessary for a fair appreciation and efficient use of the science of geology, as applied to engineering and mining operations.

It is considered important that the student, who has thus carefully acquired during two years habits of thought and observation, who has become acquainted with elementary principles, and is to a certain extent familiar with methods, should terminate his educational course by a third year spent in the acquirement of the higher branches of knowledge, and in the obtaining practical information on various subjects connected with engineering and architecture. The higher mathematics, and more especially the geometry of solids; the principles of mechanism; the modes by which strength of material is tested, and the force of complicated machines estimated; the arts of construction as exemplified in extensive and important public works; the details by which the engineer is enabled to superintend and estimate the cost of such works,—all these enter into the course which is thus provided, and they must necessarily be excluded from the instruction given to the less advanced student. In addition to this, however, the art of chemical manipulation, in which each student is himself engaged in practical analysis and research, and in which he has the advantage of the laboratory and the superintendence, in this case personal and direct, of the professor, cannot fail to be of the greatest value even to those who will hardly again be called upon to investigate personally in this branch of science. With a view to assist in carrying out most fully the high practical character of the education afforded, I have myself undertaken to deliver to these advanced students a special course of lectures on the most important practical applications of geology and mining. We thus hope that at some time the attention of those interested in the progress of education, and who have the ability as well as the inclination to do good, may learn the advantage of inculcating science as a necessary adjunct to practical knowledge; instead of leaving practical men who would willingly receive a sound education, scarcely any means to obtain even technical knowledge, except by incurring great expense and serious loss of time.

In thus speaking of the various branches of instruction afforded to the students of each year, I have not hitherto alluded to that religious instruction which forms a characteristic feature of this as of every other department of our college education. The lectures of the Principal and the Chaplain on some of the more important subjects of divinity, are not only in themselves essential, as keeping up that association of religion which is so valuable, but must also be regarded as a portion of the scheme of education.

The object of all our efforts here is, as I have already reminded you, essentially collegiate: it is to form the christian and the gentleman—the useful member of society as well as the efficient and intelligent engineer and man of business. The discipline of this place and the good feeling for which it has ever been remarkable, is the earliest fruit and most gratifying foretaste of ultimate success. It is a proof of well-regulated intellect as well as good feeling when the natural liveliness and exuberant spirits of youth are confined within decent bounds, and do not feel trammelled by wholesome regulations.

For this reason I regard as an interesting and useful part of our system, and not as a subject superadded and independent of it, this portion of religious instruction. It is not only a part of the college system, but a portion of the special instruction which belongs to the department of the Applied Sciences; and it serves to bind together—founded as it is on the best principles of our nature—many pursuits and interests which might otherwise appear disconnected and incomplete. This portion of instruction is continued throughout the three years of the college course.

Such then is a general sketch of the plan of education which many of you are now commencing, and which others have already partially followed. As a plan, it is sufficiently distinct and comprehensive: it aims at one object which is kept constantly in view; it makes use of simple means which are throughout of the same kind.

Our plan is to prepare men for the ordinary business of life—not so much by forcing knowledge upon them, as by inducing them to acquire it. We believe that the kind of education we offer is not less adapted for the country gentleman than for the engineer and the architect. We think that the banker and the merchant would be the better for having had the training we offer; and we are confident that society would be greatly benefitted if some such plan were adopted in the education of the middle classes generally.

We appeal rather to the common sense than to the intellect, when we ask if such information as that we endeavour to teach is not likely to be useful—if such training is not adapted to practical men?

If this our plan is thus distinct and comprehensive, we may venture also to believe that it is kept constantly in view. We do not mean, indeed, to assert that it is talked about daily in the lecture-room, or that we individually endeavour to refer our instruction to it; but we do say that the system adopted is such as to demand and insure perpetual recurrence to it. Our scheme of lecture-attendance—the examinations held from time to time—the rewards offered in prizes and scholarships, may be mentioned as proofs of this: and we may safely point to the workshop as well as the lecture-room; to the factory inspected, and to the museum visited, as the most certain and convincing testimony to the uniform working of our plan.

The means that we adopt are also very simple. We require regularity of attendance; but we find no difficulty in enforcing order; we encourage the timid; we are anxious to the best of our power to assist those who help themselves.

And the result is seen at present in the satisfactory nature of our annual examinations, and will in time appear in the harvest of useful men who have gone forth from our ranks. Time is necessary to crown us with this reward; but indications are not wanting of our students in this department being likely to attain similar distinctions to those which have already characterised other departments in the College, the period of whose duration has been greater.

In bringing this address to a conclusion, it remains only that I point out once more the essential and peculiar features of the plan we have adopted, and the importance that each one of you should keep in view the unity of this plan while pursuing any subject that may seem to have a more engrossing interest than the rest. We desire to give an education essentially practical—technical, indeed, for some who may require it, but general and untechnical for the greater number. With this object in view, we insist much and pay great and continued attention to those elementary subjects of instruction which chiefly encourage and produce sound mental culture:—the elements of geometry of chemistry and of mechanics serving chiefly for this purpose, and being employed instead of the principles of grammar, elsewhere resorted to, as having more distinct application to the class of facts afterwards engrafted on this stock.

In order fully to benefit by our system however, you will readily perceive the necessity of limiting the pursuit of pure mathematics, which we wish you to employ as a means, not regarding it as an end. Do not therefore permit yourselves to dwell too exclusively on this subject, if you would advance to the ultimate objects we have in view.

The theoretical application of pure mathematics to natural philosophy is another subject to which we invite attention, and require you to obtain some proficiency. But let me warn you, as practical men, against the danger of pursuing in too great detail this portion of mixed mathematics.

It is the especial object of the instruction we give to send men out into the world, not to retain them in the closet. Study all those subjects that come before you minutely if you will, and by all means study them so as to have clear and accurate notions of what you are about; but regard them always in a practical light—refer them constantly to some immediately useful object—think of them as men of business rather than as philosophers.

There is, I believe, no danger of your knowledge in other departments of science becoming too contemplative; unless, indeed, you should be inclined to pursue chemistry, mineralogy, or geology, rather for the amusement they afford than for their distinctly practical results. With regard to my own science, I always have endeavoured, and always shall endeavour, to present it to you in its most practical light; and the pursuits of chemistry and mineralogy are so directly connected with the arts, and with mining and metallurgy, that few of you probably will be tempted to pursue these sciences as objects of exclusive research.

The remaining subjects of instruction are eminently practical, and need no warning of this kind.

Quitting for a moment any reference to the especial nature of the subjects taught, there are two errors diametrically opposed to one another, but towards one or other of which almost every person is occasionally tempted. These are idleness and over-exertion. It would be difficult to determine which of the two has been more fatal to the progress of the student. I need hardly tell you how much danger there is in giving way to the idea that when the immediate task is learned, idleness is permissible. In the schoolboy, indeed, we excuse this, because in most cases the mental effort requires to be succeeded by physical exertion; but for you there can be no such feeling. You must advance steadily, constantly, and incessantly, if you would attain that distinction and success which ought to be the object of your ambition. Relaxation no doubt is necessary, but your relaxation must not be idleness.

On the other hand, you will be tempted in your competition for the honours and prizes offered as the rewards of exertion, to pursue your studies with an unreasonable and excessive ardour, without regard to prudence and health. This is no less an evil than the opposite vice of sloth. You are no more justified in excess of this kind and in the indulgence of mental excitement, than you would be in the unreasonable indulgence of any other passion. Nor can you really benefit by this kind of intemperance. A steady and unwavering progress is most valuable, and most permanently useful; and you had far better fail in obtaining the prize than obtain it at the cost of health.

And now that you have been informed of the nature and extent of the education here afforded—what we offer you, and what we expect from you—my task, that of introducing you to your work, is for the present at an end. I have myself no fear as to the result in your cases individually; and whatever may have been or may be the toil and the anxiety of those who have superintended the growth of this department of the Applied Sciences, of which you are now members,—whatever struggles and difficulties we may have had in carrying out our views, with reference to the subject of general scientific education,—however slowly it may have taken root, and however it may have been checked by the apathy of those whose other occupations were too pressing to allow them to do justice to this,—we are all, I think, satisfied now that as a system it is established; and that we who have laboured earnestly in the cause may fairly expect to see the result in our days—although one of those to whom the system owes much, and who would have rejoiced to see its present success, has unhappily been removed from his sphere of usefulness before success dawned upon us. I cannot forbear here this allusion to our late lamented Professor of Chemistry,* for I feel that without his exertions we should not this day have been able thus to offer congratulation, as well as to express hope; and he would, I repeat, have been amongst those most rejoiced could he have seen his views thus far carried into successful operation.

* Professor Daniell.

REVIEWS.

Mathematical Physics; or the Mathematical Principles of Natural Philosophy: with a development of the causes of Heat, Gaseous Elasticity, Gravitation, and other great phenomena of Nature. By JOHN HERAPATH, Esq. London: Whittaker and Co., 1847. 2 vols. royal octavo.

It is not long since that a Mr. Isaac Frost proclaimed, trumpet-mouthed, a discovery of the most stupendous importance—viz., that the Newtonian Theory was as untrue as it was blasphemous; that the sun was not the centre of our system, but revolved round the earth at the distance of about 20,000 miles; that the moon was a block of ice, distant 6,000 miles; and, "as to *the length of the diameter of the universe*, if any gentleman were to ask me that question," says Mr. Frost, "I should answer—'It is as long as GOD pleases.'"

Mr. Frost's objections to the theory of gravitation were certainly very plausible. "Newton," observes that astute philosopher, "accounted for the force which drives the earth up the ascending node of the ecliptic, but does not account for the force which rolls it down the descending node;" and again, "if the stars are infinitely distant, how is it that their light does not interfere to produce darkness?" This latter objection we consider especially profound,—an opinion which we the more confidently express for two reasons—first, because we entertain it in common with one of the most popular journals of the day; and secondly, because we can't understand it—a sufficient proof with most people of the profundity of an idea.

About the same time that the unscientific public was astonished by the theories of Mr. Isaac Frost—in opposition to Sir Isaac Newton—the scientific public was gratified by the discovery of a new planet, upon which no telescope had yet been turned—on which no eye had ever gazed; which, too remote and obscure to be apprehended by the faculties of sense, was reached by a grasp of intellect not unworthy of him who first interpreted the laws which made necessary the existence of that distant world. How rich must have been the reward of its silent and unobtrusive discoverer! How intense his scorn of the pedants who surrounded him! With what quiet mirth would he turn from their *sesquipedalia verba*, their "*hemihexatetrahedrons*" and jargon, to those cherished results of his toil, the final completion of his Principia! Day, in all her Indian magnificence, had for him less glory than the Night; for Night held the treasure he had staked years of thought to win. Mighty was his ambition—mightier his success.

Somewhere in the wide gap between these two great philosophers we would rank Mr. Herapath,—and in justice to that gentleman, be it observed, nearer to Mr. John Couch Adams than to Mr. Isaac Frost. If our author had succeeded in accomplishing all that the lengthy title-page of his work professes, we should consider him by far the greatest man of his age: profession, however, is not practice, and although we admit that some of the theories he has developed are extremely ingenious and supported by a great deal of beautiful reasoning, yet we confess we are not disposed to accede to the truth of any one of them—simply because they explain only a few, and seem to us quite irreconcilable with the greater number, of the phenomena of nature.

The cause which Mr. Herapath assigns for heat, gravitation, and the other molecular forces of the universe, is a very simple one—the assumed hardness and inertia of the molecules of matter; and the subject of our present review professes to be a general treatise on the action of forces, whether finite or molecular. The first part—on the action and laws of finite forces—is nothing more than a jumbled compilation of certain statical and dynamical propositions. Moreover, although the results of these propositions, which are all old acquaintances (such as to find the centre of gravity, centre of percussion, and the like,) are correct enough, the means by which these results are arrived at are very questionable, and to us in most instances wholly unintelligible. Mr. Herapath has adopted the very common error of assuming the fundamental laws of motion to be axiomatic;—no fact can be axiomatic which the mind can conceive to be otherwise than it is: but it is very easy to conceive the laws of motion to be different from what they really are; therefore the laws of motion are not axiomatic, and consequently depend on experiment and induction. In the theory of collision, Mr. Herapath is at least original:—having previously admitted that a perfectly hard body, such as he defines it, has never been the subject of experience, and moreover that other bodies, usually termed hard, with which we are acquainted, such as iron, granite, &c., are as distinct from perfectly hard bodies as rest is distinct from motion, he proceeds to argue on what would happen supposing two perfectly hard bodies to impinge on each other. He asserts that under such circumstances, the two bodies would each retrace their paths, with velocities equal but contrary to those which they possessed previously to impact. We do not attempt to disprove Mr. Herapath's assertion, but in lawyer style we set up a counter-plea or assertion of our own: we assert that two "perfectly hard" bodies, after impact, would polka together "for an hour by Shrewsbury clock," and then turn green,—and we defy Mr. Herapath to disprove *our* assertion.

To view the subject more seriously, the phenomena which take place during the impact of two ordinary bodies may be well illustrated by the following problem:—Suppose two balls, with masses A and B, to impinge directly on opposite ends of a spiral spring, the mass of the spring being neglected in comparison with either of the masses A or B.

Suppose a were the original length of the spring, z its length at time t from commencement of impact, x the space one end has passed over at time t. Then, since the mass of the spring is indefinitely small, the forces tending to compress it at both ends are equal. Let T be this force at time t;—then we have for the motion of A

$$\frac{d^2x}{dt^2} = \frac{-\mathrm{T}}{\mathrm{A}};$$

for the motion of B

$$\frac{d^2(x+z)}{dt^2} = \frac{\mathrm{T}}{\mathrm{B}},$$

$$\frac{dx}{dt} = c - \int \frac{\mathrm{T}.dt}{\mathrm{A}}.$$

Let u be the velocity A had at first, then $c = u$. $\therefore$ the velocity of A continually decreases, and at time t is diminished by a quantity $= \int \frac{\mathrm{T}dt}{\mathrm{A}}$; and the velocity of B continually diminishes by $\int \frac{\mathrm{T}dt}{\mathrm{B}}$

at time t, the velocities of A and B previously to impact being supposed contrary in direction. Let $x = b$ be the value of x when the spring has reached the limits of its compression; x then is a minimum. $\therefore \frac{dx}{dt} = o$;

$$\therefore \text{ if } z + x = x', \quad \frac{dx'}{dt} = \frac{dz}{dt}.$$

If, now, the spring has no power of recovery—*i. e.* if the force T, ceases, the balls will move on together with equal velocities, $\frac{dz}{dt}$ and $\frac{dx'}{dt}$. Also $\frac{dz}{dt} = u - \int \frac{T}{A} dt$; $\frac{dx'}{dt} = -v + \int \frac{T}{B} dt$;

v being the velocity of B previous to impact.

$\therefore$ eliminating the $\int T\, dt$,

$$(B + A) \cdot \frac{dz}{dt} = Au - Bv.$$

This is the formula for the impact of what are generally termed hard, inelastic bodies—*i. e.* bodies of which the particles have no tendency to restitution after displacement. If, however, after $\frac{dx}{dt} = o$ the spring recoils with perfect elasticity, the integral $\int \frac{T}{A} dt$ during the time that x increases from $x = b$ to $x = a$, will $= \int \frac{T}{A} dt$ taken during the time x decreased from $x = a$ to $x = b$;

$$\text{but} \int \frac{T}{A} dt = u - \frac{dz}{dt} = u - \frac{Au - Bv}{A + B} = \frac{B(u + v)}{A + B};$$

$\therefore$ the final velocity of A will be

$$u - \frac{2(Bu + Bv)}{A + B},$$

which is the formula for the collision of perfectly elastic bodies.

The most important part, however, of the "Mathematical Physics" is that in which the author developes his theory of heat and the molecular constitution of gases; and it is but justice to him to observe that much of the first part of his work is confessedly a juvenile production. Whether his investigation of the motion of a crank, in which he has fallen into the common error of neglecting the mass of the connecting-rod, is to be reckoned among his youthful performances or not we cannot say,—we trust, however, for the author's credit, that it is. We now come to the theory of heat and the constitution of gases:—Newton conjectured that heat might arise from an intestine motion of the particles of matter, and that temperature might vary as the velocity of the particles. Mr. Herapath, on the other hand, supposes the temperature to vary as the momentum of the particles; and combining this theory with his idea of the perfect hardness of the particles—or rather, as we should say, their perfect elasticity—he shows very clearly and beautifully how the pressure of gases varies with their temperature; and how the specific heat of bodies multiplied by their chemical equivalents is constant. There are, however, many phenomena of heat, which appear to us utterly incapable of explanation on Mr. Herapath's theory;—we allude to radiation, conduction, and polarization. How is it that bodies which radiate the best conduct the worse, and *vice versâ?* And how are we to account for the intricate phenomena of polarization? Surely these facts depend on something more than a lawless motion of the particles of matter among themselves. That the particles of matter, or the nuclei of material forces, are continually in motion is highly probable—nay, almost certain; but what that motion is—on which heat, light, and electricity, with all their varied yet definite phenomena, depend—remains yet, we think, to be discovered.

Various theories of the molecular constitution of matter have, indeed, been put forth from time to time,—none, however, that merit much attention, with the exception of the undulatory theory of light; and even in this, the great result arrived at—viz. the form of the wave surface,—although it satisfies most, and has suggested some facts of polarised light, is deduced from considerations dynamically unsound. We may here observe that Fresnel (see "Airy's Tracts," p. 357), in determining theoretically the polarising angle of a reflecting surface, has adopted a hypothesis for the motion of the particles of ether nearly the same as that of Mr. Herapath.

In conclusion, we cordially recommend the work to those of our readers who have sufficient leisure and mathematical knowledge to do justice to the author, though we cannot help expressing a wish that Mr. Herapath had devoted half the time and ability to the mathematics of engineering that he has to the castle-building of hypothetical speculations, and we might then have had the pleasure of reviewing a work of less pretensions but of far more solid usefulness. The most profound mathematicians of the day with whom we have had the honour of conversing on the subject, shrink from the difficulties attending all theories of molecular constitution, and in their wildest dreams we believe have never so much as dared to hope for a solution of even one of those grand mysteries—"Heat, Gaseous Elasticity, Gravitation, and other great Phenomena of Nature."

Railway Locomotion and Steam Navigation: their Principles and Practice. By JOHN CURR, of New South Wales. London: Williams, 1847. 8vo., pp. 181.

"Oh that mine adversary had written a book," cried Job in bitterness of spirit. We, who are not nearly so patient as he, are induced by the perusal of the work before us to exclaim—Oh that mine adversary had to review a book! Mr. Curr has come all the way from New South Wales to have his bark and his bite at modern engineering! A man does not travel 16,000 miles for a trifle; and accordingly Mr. Curr bow-wows pretty loudly.

First, our excellent contemporary, the *Mechanics' Magazine*, comes in for a snarl. From "a careful examination of two volumes and two odd numbers" of that work, our author is satisfied that "the present actual and scientific knowledge of English engineers" is in a most deplorable condition; and so in order to enlighten them he resolved on quitting "a peaceful homestead in the fair clime of Australia," embarked on board the good ship "St. George," for England, arrived safely, and forthwith published the present volume. It is our private conviction that Mr. Curr is the COMING MAN who has been so long and so anxiously expected.

To attempt an intelligible analysis of his doctrines were as vain as to essay a systematic arrangement of the Sibylline leaves, or an interpretation of the oracular teachings of a Pythonissa. Science and satire, analysis and adventure, are so strangely intermingled that dim mortal vision frequently misses the line of demarcation. Mr. Curr sets off with a grave bit of theory about motion of fluids, or a pet doctrine of gravitation, and interrupts himself to tell a personal anecdote. As many "most disastrous chances of moving accidents" have befallen him as Othello, and they are set down in this book, in the very thick of philosophical propositions and algebraical symbols. Our author seems to entertain the idea of combining the truths of science with the "intense interest" of a melodrama. For example, he begins to talk about latent heat, and suddenly stops to tell a startling story of his father being on a certain occasion "reduced to the necessity of concealment in a wood for three days and nights to escape the fury of the populace." In another place, he records a dispute between himself and somebody at Norwich, which somehow or another induced him to go to Margate, where he "issued through the town a printed placard," &c. Further on he tells us that his father was disowned by his grandfather on account of a difference of opinion on engineering subjects, "and the letter to that effect was retained in his family for thirty years or more." Our author is as rich in family anecdotes as in scientific discoveries, and passes from the one to the other with surprising facility. Every reader of Hudibras knows that

"Th' adventure of the bear and fiddle
Is sung, but breaks off in the middle."

But the excursions and imaginative flights of the political satirist, Butler, are nothing to those of the philosophical satirist, Curr.

Poor Doctor Hutton comes in for a more than ordinary share of abuse. Various errors and inconsistencies in his theoretical views are pointed out. Hutton wrote at a time when the principles of mechanics, and especially the practical application of them, were much less understood than at present: and we are quite ready to accord to Mr. Curr the easily-acquired merit of having proved that Hutton is not infallible. He was a much better arithmetician than mathematician, but the time at which he wrote may excuse some of his inaccuracies—and it is but a pious task to avenge his memory by showing that his antagonist commits errors equally grave without the same excuse for them. For instance, Mr. Curr propounds various formulæ for calculating the motion of railway trains, assuming the modulus of friction to be constant; whereas the evidence of uniform experience shows that the resistance to the motion of the wheels on the rails increases very rapidly with increase of velocity. The percussions in passing over the joints of the rails, and the vibrating motion of the rails themselves, render necessary a great expenditure of power. And as these percussions and vibrations, and other irregularities of the motion of trains, are always observed to be much greater at high, than at low, velocities, it is quite clear that till their relation to the velocity be ascertained it is impossible to make the speed of trains a matter of mathematical calculation. The *law* of resistance, or the degree in which the resistance increases with increase of velocity, has not yet been discovered, notwithstanding the efforts of numerous excellent experiments. The self-sufficiency with which Mr. Curr decries the labours of Mr. Scott Russell and others, who are usefully employed in the experimental investigation of the subject, is rivalled only by the ignorance of first principles displayed in the attempt to solve a problem of which the data are not given.

Patience and space would fail us to point out all his other errors—yet one or two instances may be cited. In one place he tells us that the consumption of coke necessary for the conveyance of a given load by a fast train is the same as by a slow one. "If the velocity be doubled," says he, "a given distance is passed over in half the time:" the supply of steam must be doubly fast in the second case, but will be required for half the time. Hence he concludes that in both cases the same quantity of steam (and therefore of coke) will be consumed—totally overlooking the fact that the increased resistance to the train's motion in the second case renders it necessary that the steam should be consumed in the cylinder at a greatly increased pressure. His notion is much the same thing as asserting that the easiest way of travelling fifty miles on horseback is to ride at full gallop.

In another place we are told that "the bite would be lessened on ascending a gradient according to which end of the engine might be moving foremost, as thereby the centre of gravity of the engine would approach or recede from the driving wheels." It were useless to attempt a serious refutation of such nonsense.

> "'Tis a pity when charming women
> Talk of things that they don't understand:"

and similar objects of compassion may be found among the sterner sex.

Here is another specimen of our author's mechanical ideas: "Actual collision of trains moving in opposite directions is a subject scarcely deserving of attention, but as there appears a vulgar notion amongst persons who ought to know better, that if two trains meet, the shock is proportional to their joint velocity, or to twice the velocity of each train; it may be said the shock sustained by each train is proportional to its velocity, and the same is true as respects each person conveyed in it." Does Mr. Curr mean to assert that the shock to each train is quite independent of the velocity of the other train?—that if a man ran against a moving cannon ball the injury sustained by him would merely be proportional to his own velocity, and not depend on that of the ball? If that were true, it is obvious that if he stood quite still he would receive no injury were a whole park of artillery fired at him; and, similarly, that when a train is at rest the passengers need not be at all alarmed at seeing another train drive full tilt against them.

To quit theory, let us take a specimen of Mr. Curr's practical knowledge. The following is a proposition for ascending very steep gradients. "Let the engine be stopped near the foot of such inclined plane—let the driving wheels be removed and a pair substituted being of such diameter as will enable it to ascend." Take off the driving wheels, Mr. Curr? Pooh, pooh, man! what if it were proposed to you to take off your head and substitute that of Newton whenever you came to a stiff bit of mathematics?

Divers other equally rare devices hath Mr. Curr for the improvement of railway locomotion. One especially there is, which is calculated to effect a complete revolution in engineering, but its nature is kept a profound secret. We are tormented with curiosity to find out what it can be, but, No—says Mr. Curr—I have told you a good deal for nothing, beyond the cost of buying and reading my book, but for this master invention I demand a far higher recompense. And then he offers to reveal it confidentially to a committee of the House of Commons—in fact, repeats the Warner story in a new form.

The work concludes with a magnificent peroration, of which the following is a fair specimen:—

"But who proclaims himself my critic—the shadow of a nonentity whose only knowledge of the subject is derived from the book he intends to criticise: no—it will be left to future ages to find the truth .... The principles are ONE—so break one link of the vinculum, and down goes my book to the shades below. The philosopher and the mathematician have been boldly attacked: whether they will continue their prejudices I will not decide: but to convince a man that he has played the fool is not an easy task."

Here, at least, we entirely agree with our author. The "task" *is* difficult—so difficult that we relinquish it in despair.

Sketches, Graphic and Descriptive, &c., for a History of the Decorative Painting applied to English Architecture during the Middle Ages. By G. L. Blackburne, F.S.A., Architect. London: Williams and Co., 1847.

Mr. Blackburne proposes to do for the polychromy of the middle ages, what has been done for that of the Egyptians, Greeks, and Arabs, and to give us a special work of reference for architects and decorators in all that relates to the coloured ornaments suited to works of the mediæval character. This is certainly essential at a time when the taste for such decoration is extending, and when buildings of a high class are in progress. We have had many books on Gothic carving, but few illustrations of painting in that style, and for the reason that until lately the production of illuminated books was very expensive. The new processes for printing in colours come most opportunely in aid of the extended study of the decorative arts. In the works by Mr. Jobbins and Mr. Colling many useful examples have been already given, and no doubt Mr. Blackburne will find many cooperators before he gets to the end of his series.

Mr. Blackburne's text does not seem to us to be of so much value as his plates, although he has undoubtedly taken much pains; but in the attempt to publish a series of examples he will lay the foundation for a history of decoration in this country. He is therefore not to be blamed because he does not shine so much as an historian, as he does as an artist. The state of art among the English before the time of Bede should be examined in comparison with Byzantine monuments, for it cannot be doubted that from Greece and what was then the Byzantine city of Rome these new arts were brought into England, as we have express testimony to that effect.

Mr. Blackburne begins his work, in fact, from the thirteenth century, when the construction of so many larger edifices, now existing, and the practice of painting on walls, as well as on tablets and hangings, gave a more durable character to the labours of the painter and decorator. In the first number we have a choir ceiling from Malvern abbey, with its details; a screen from Aldenham church in Hertfordshire, in the Perpendicular style; a plate of details from the tomb of Lord Bourchier, in Westminster abbey; wall paintings from the chapel of St. Erasmus at Westminster, from Tewkesbury, and from Rochester cathedral; and a lectern stand from Littlebury, Essex. The tiles we think may be dismissed very briefly, for they have already been copiously illustrated in special works.

It is a matter of much congratulation that we shall now possess a body of English works illustrative of mediæval art, and calculated to foster the growing taste for that style. In the works of Carter, Stothard, and Shaw, in those already named, and in works on tombs, furniture, glass painting, fonts, and tiles, the architect, and we may add the artisan, of the present day, finds resources in which his predecessors were wanting.

The Ecclesiastical, Castellated, and Domestic Architecture of England, from the Norman Era to the Sixteenth Century. By James Hadfield, Architect. Vol. I., Part 1. London: Williams & Co., 1847.

Mr. Hadfield has begun an undertaking, the completion of which will require a life of labour, if carried out in the spirit of this specimen. Having chosen the county of Essex as the first, he makes a review of the churches, pointing out all the positions valuable to the architect as examples, and illustrates them by plates full of dimensions and working details, and of a uniform scale. We know of no work, which, with such strictness of plan, has equal practical value.

Four parts are to form the volume devoted to the county of Essex, and these are to contain eighty plates of the churches and mansions and their fittings. We think Mr. Hadfield is undertaking more than is required at his hands in proposing to give plates of stained glass, which forms a special art, and the labour, time, and expense bestowed on which may perhaps deprive the architect of what he will value infinitely more—drawings such as those in the present number.

The text is of a very limited character, simply explaining the architectural features, with little antiquarian detail, the object of the author being to keep up the practical nature of the work, and to throw his strength into the plates. This is a very laudable endeavour, and though the price of the part is large, it is, on account of the number of plates, very cheap. We think, too, that Mr. Hadfield has decided rightly in publishing large parts like the present, rather than splitting them into monthly numbers with two or three plates. There is a certain appearance of completeness about the part even at present which seems to make it of a more practical character.

Mr. Hadfield apportions his labour according to the importance of his work. Some churches are without notice; others, like Danbury, with four or five plates. The author has carefully eschewed perspective views, and there are no elevations of buildings, but a museum, as it were, is formed of details so carried out, that working drawings would be scarcely wanted in copying these examples. The plates, which are filled as much as they can be, are designed simply to help the architect, builder, and workman, and explain themselves so fully that the text is scarcely required. Indeed, the book, on inspection, carries with it its own recommendation, and is likely to meet with such support as to enable the author to proceed with confidence in his praiseworthy undertaking.

A History of the Architecture of the Abbey Church of St. Alban's, with especial Reference to the Norman Structure. By J. C. Buckler and C. A. Buckler. London: Longmans, 1847.

This is a work of such commendable industry, and of so much interest, that we must reserve it for a longer notice in a future number.

HIGH-PRESSURE STEAM.

The greatest object remaining to be accomplished in navigating the ocean by steam, is unquestionably the *saving of fuel*, and this, to any great extent, can only be effected by using high-pressure steam expansively, by which not only *one-half* of the tonnage occupied at least will be liberated, but *one-half* the cost of the fuel will be saved. We need not expatiate upon the immense importance of such a reduction, both to the naval and commercial marine of this country, particularly where distant depôts have to be so frequently replenished, because that can be duly appreciated by every person practically experienced in steam navigation. But no sooner, however, is the proposition mooted, than a fierce fusilade is opened against so dangerous an innovation, which that is presumed to be,—as if any inherent property existed to render high-pressure steam more dangerous or destructive than steam of low-pressure. This, however, results from prejudice rather than from calm and dispassionate reasoning; in the face, too, of daily experience and the successful operation of hundreds of locomotives gliding over our iron roads at something like 60 miles an hour, notwithstanding the very high power employed, which marine purposes do not require,—that it is really gratifying to read your judicious and pertinent remarks in the case of the late explosion of the Cricket steamboat. [see *Journal*, p. 350.]

With properly constructed safety-valves, to limit the pressure with certainty, placed beyond the control of the engineman or driver (which is a matter of equal importance in both systems), high steam will prove as safe, nay safer than low-pressure, if generated in suitable boilers; which, we trust, we shall be able to show. We are not aware if there exists any collected record of the number of explosions which have occurred, distinguishing the class to which each belongs, together with the probable cause and circumstances attending them, beyond the transitory and imperfect accounts given in the news of the day; or we believe it would be found, that not only are the most destructive effects produced, but also that two-thirds, possibly three-fourths, are occasioned by low-pressure steam, or by boilers so denominated (see the frightful account of the explosion in the newspapers of to-day—October the 7th—as detailed before the coroner at Leeds). And what would have been the consequence if many low-pressure marine boilers had been subjected to the fool-hardy and reckless treatment practised on board the "Cricket?" Would they have resisted one-half the time those boilers did?—we presume to think not.

Marine boilers of the usual form of construction and magnitude are the worst to resist pressure; and, therefore, in examining the comparative safety of the two systems, we will assume that the boilers are of the same form—viz. cylindrical (where the tension of the metal is most perfectly applied), and the pressure in one to be four pounds the square inch, and that of the other to be fifty, while the thickness of metal in each shall be in the exact ratio to the strain: thus, multiply the pressure by the radius, and divide the sum by 400 (equal to one-tenth of the strength of the plate for every eighth of its thickness), and the quotient will express the thickness in eighths which the plates of each of the boilers should contain.

Thus, we have two boilers whose power of resistance in relation to their contents are exactly equal; hence, if the fifty pounds steam were to be doubled, the pressure would not be one iota more dangerous than the four pounds steam being increased to eight, and *vice versa*; consequently, in relation to strength, one boiler is as likely to explode as the other: but as neither is likely to take a flight if duly supplied with water, and their safety-valves be in good order, we will proceed to consider the result in case of neglect—first, with regard to a deficiency of water, and next to the valves becoming fixed. With respect to a deficient supply of water, the chance of an explosion would probably be pretty nearly equal, and so would be the force, from the larger volume necessarily pent up in low-pressure boilers; indeed, we are not aware that there is any distinction observed in this particular, but in effect the low steam may be assumed to be more disastrous from its scalding property, as you very properly remark, than high-pressure. In respect to the safety-valves, we have shown that each boiler is capable of resisting the doubling of the working pressure of its contents, or any other extent in the same ratio in an equal degree. Now, it is quite possible for a low-pressure valve to adhere to its seat so firmly as to resist the additional four pounds per inch, and even a much greater increase, ere an explosion ensue; but for a valve of a high-pressure boiler to resist an addition of fifty pounds per inch without being unseated, is scarcely within the bounds of probability. All boilers require careful and efficient superintendence most unquestionably, and casualties from neglect will sometimes occur without doubt; but under an equal degree of supervision and skill in construction, we think we are justified in the conclusion that high-pressure steam in regard to safety has the advantage.

The quantity of fuel saved depends upon the just application of the expansive principle: the usual practice is for the pressure in the boiler to be *constant*, and the amount of expansion varied by expansive gear, according to the exigencies of the service. To prove that this is an error, we have only to imagine a cylinder, say four inches long and one in diameter, with steam of four pounds cut off at one quarter its length and allowed to expand to four times its volume, which will exert a mean force of two pounds and a fraction; this we will assume to be the minimum working power of the engine. Now, if circumstances require the maximum power to be applied of four pounds during the whole stroke, it is manifest that a *four fold* amount of steam will be required, and expansion must be abandoned altogether to effect it when its saving effect is most requisite, as the largest amount of fuel is being consumed. Now, if we reverse these functions, by making the amount of expansion *constant*, and work with a *variable* pressure, it will be found that the steam required will be exactly in the ratio of the work done; thus, if we raise the pressure to *eight pounds*, and cut off the steam as before, we obtain a mean of over four pounds, with just double the quantity of steam, instead of quadruple as above, and of course at one-half the expense of fuel. The pressures here assumed for illustrating the two modes of application are not those, of course, which would be adopted in practice, but the result would be the same in effect if the maximum pressure were sixty-five pounds above vacuum, and the minimum one-half that amount, working with a *constant* expansion of eight or ten times its original volume.

Now that competition is so strong in rates of speed, every degree of pressure is employed and steam generated in all kinds of boilers, suitable or unsuitable; the temptation is so great to run dangerous risks for the sake of victory, that some power of control is become absolutely necessary —a matter, however, of no very difficult accomplishment, though it might be opposed by the proprietors, possibly, as exposing the secret of the doings in the engine-room, with regard to the *real* working pressure; but that is a matter of no weight, nor can it be honestly objected to or denied. We would suggest, then, that a competent person should have the power to inspect *all steamboats* periodically, as to the fitness and condition of the boilers in relation to their working pressure, and to see the following precautionary checks adopted—viz.: One safety-valve, at least, on each boiler, placed beyond the control of the engineer, except as to having the power of lifting it occasionally, to insure its duly operating; or by a slight easement effected at regular intervals by the engine itself, but no power of adding weight. Next, that two graduated gages be fixed in one case above deck; one showing the pressure of steam in the boilers, and the other the level of the water and the excess or deficiency in either case from the fixed working points on the scale. These gages to be open at all times for inspection to every person on board, and minutes made in the log at regular intervals in sea-going steamers, particularly during the night, stating the height of the water and pressure of steam. The sound working condition of these gages to be maintained at all times, and cases of neglect, or tampering with them in any manner, to be visited by a severe fine—perhaps fine and imprisonment, where so many lives are endangered, which would at once put an end to the reckless tampering with the pressure, and insure careful attention to the supply of water, and consequently safety to all on board.

C.

London, October 7, 1847.

FULGURITES AND FULMINARY TUBES.

We have found in a French periodical some remarks on the action of the electric fluid when striking the ground, which do not seem to have attracted much attention here, and which have led us to look into the subject. It is observed that in the beginning of the last century, a hollow tube was discovered, which formed branches, in the sandy plains of Silesia. This tube was placed in a museum under the name of an "arborescent fossil." Somewhat later, similar tubes were found in the neighbourhood of Paderborn, Dresden, and Munster, likewise in Cumberland, in Hungary, on the *dunes* near Bordeaux, and on the plains of Bahia in Brazil. We do not remember any specimens of this kind in the British Museum, although there is an extensive collection of meteoric stones in the mineralogical department. This suggests the propriety of a separate collection, which should include meteorites, fulgurites, minerals and vegetables affected by electric action, volcanic substances, &c. These would extend our knowledge of new branches of science, those of meteorites, geological action, and coralline growth.

All the localities in which fulminary tubes are found, although far apart, have a similarity of character in the soil in which the fulgurites are found, having a fine sand, containing a large proportion of silex. In this sand the tubes are always sunk vertically. Their diameter varies from $\frac{1}{15}$th of an inch to 3½ inches, and the thickness of the coating or wall of the tube from $\frac{1}{16}$th of an inch to 1 inch. The diameter diminishes according to the depth of tube, particularly when the tube ramifies; and these ramifications are sometimes very numerous, giving the fulminary tube all the appearance of the root of a tree.

Some fulgurites have been found six yards long. The external surface of the tubes is composed of grains of sand cemented together; in the inside these grains are melted, vitrified, and mixed with little bubbles, forming a sort of pearl-grey enamel, with which the inner part of the hollow cylinder is lined.

In the Brazils, fulgurites have been found with facettes and completely vitrified, and in Cumberland a vertical fulgurite was found cemented to a porphyritic boulder, at a depth of eight yards. At this point the fulgurite deviated, going off at an angle of 45° and being about $\frac{1}{13}$th of an inch in diameter.

Though several hypotheses as to fulgurites have been formed, that of Dr. Fiedler seems best to meet the case. He has shown that these tubes are caused by the calorific action of lightning, which passing through siliceous sand, melts it in its way. This melted part becomes the inner wall or bore of the tube, and the outer wall is formed by the cementation of grains of quartz imperfectly melted, and joined by water in a state of vapour arising from the great heat developed by the lightning in its passage through the soil. This action of lightning has been determined on several occasions. On the 3rd of September, 1789, lightning struck an oak in the Earl of Aylesford's park, and killed a man who had taken shelter in the tree. On digging up the ground to erect a monument on the spot, a quantity of melted flint was found, and underneath where the poor man's stick had stood a vertical tube of melted sand. Some seamen having noticed lightning fall on the sandy isle of Amrum, off the Danish coast, found, on looking there, a fulminary tube. On the 13th of June, 1841, Dr. Fiedler found a similar tube in a vineyard near Dresden. This tube divided into three branches, and went to a depth of five feet. Artificial fulgurites have been formed by passing the electric fluid through siliceous sand. It may be observed that there are authenticated cases of rocks even being melted by lightning.

DRAINAGE OF LANDS.

Hydraulic engineering connected with the drainage of land becoming daily of such vast importance, induces us to present to our readers the very interesting discussion that took place last month, at a meeting of several highly intelligent and practical farmers and scientific gentlemen collected together at Drayton Manor, at the invitation of Sir Robert Peel. For the report we are indebted to the *Agricultural Gazette*.

Mr. Woodward said that in his opinion thorough drainage was the foundation of all good husbandry, without which manures and skill are thrown away. Some undrained land had come into his occupation, heavy land, which only produced 10½ bushels of wheat per acre; he immediately drained it 3 feet deep, subsoiled it, dressed it with burnt clay, and the first year obtained from it 51 bushels. He regarded the extensive burning of clay land as a most important practice. It rendered the soil so much more friable and convertible, and enabled the farmer to work it with much less horse labour. The effects of burnt clay upon all green crops was wonderful, a most important fact which could not be too strongly impressed upon the mind, as being very essential to the growth of corn, especially when consumed upon the land by sheep, eating at the same time a little oil-cake or refuse corn. He had not, however, found advantage in the use of Italian rye-grass, which he thought undeserving the praise it had received. The treading of sheep was highly advantageous to the wheat crop, provided the land was thoroughly drained and subsoiled. In order to secure the requisite amount of pressure, he had not only employed sheep, but horses, or even men, who he found could tread down land for 1*s*. 6*d*. an acre. He had also found advantage under some circumstances in the use of an instrument which he called a peg roller. This was formed of an elm-wood cylinder, studded with oak pegs about four inches apart; it proved to be a most effectual implement when drawn over the land, imitating as it did the consolidating power exercised by the feet of a flock of sheep. He regarded pressing down the land as opposing an invincible obstacle to the operations of grubs and wireworms. As to dead fallows, he entirely objected to them as wasteful and useless. On his clay land, when in turn for fallow, he planted vetches, and on his gravel, rye, and rye and vetches. For cleaning his stubbles after harvest he employed the implement called a two-edged "skim," which he strongly recommended as a cheap and most valuable modern invention. Mr. Woodward then pointed out what he regarded as the best manner of breaking up inferior pastures and converting them into arable; and concluded a very instructive speech by forcibly pointing out the absolute necessity of sending back to the land whatever is removed by a crop, and by expressing his entire agreement in opinion with Mr. Woolryche Whitmore, Mr. Huxtable, and others, that farming, properly and efficiently carried out, with capital and skill, may be made as profitable an investment as railways or other branches of commerce. Being asked whether he held his land on lease, Mr. Woodward replied that he did. But even if he had not, he, nevertheless, was of opinion that the expenses be incurred in the improvement of his land would have answered his purpose, for his improved wheat crop repaid those expenses immediately. As to leases, he attached little importance to them, provided there existed something like tenant-right, which would by law ensure to the outgoing tenant the whole unexhausted value of the improvements he had made; whether this was to be paid by landlord or incoming tenant was, he thought, of no importance. He trusted that the legislature would see the necessity of passing some enactment that would secure this right; otherwise it was not to be expected that tenants would expend their capital on land. Mr. Woodward having expressed a desire that Mr. Mechi would bring under the notice of the meeting the result of his high farming in Essex,

Mr. Mechi responded to the call. His practice in agriculture coincided so nearly with Mr. Woodward's, that it was only necessary to say that he grew alternately grain and root or leguminous crops, endeavouring as much as possible to grow wheat alternate years. He had originally drained his land 2 feet 8 inches deep, with pipes and stones, at a considerable expense; but since he had had the good fortune to meet with Mr. Parkes he had amended his errors, and was draining more deeply and effectually with pipes alone at one-third the cost. He rented some land adjoining his own; although he held but a seven years' lease, he drained it 5 feet deep with 1 inch pipes, at a cost of from 35*s*. to 50*s*. per acre. ***He could not afford to deprive himself of the benefit of drainage.*** He found it very unprofitable to farm such land undrained. The very first wheat crop remunerated him for the whole cost. The result of his improvements at Tiptree had been to double the produce of his farm and of his labour. A portion of it was formerly a swamp, not producing 5*s*. per acre. He had been entreated this year by a gardener in the neighbourhood to let those 4 acres to him, at an annual rental of 5*l*. per acre. He had removed 3½ miles of unnecessary banks and fences. Taking the arable acreage of the united kingdom, he thought they might safely dispense with 500,000 miles of unnecessary fencing, which, with its timber, displaced much food and labour. He considered the agriculture of this country in a very backward and unsatisfactory state compared with its manufactures. The agricultural mechanical appliances were rude, costly, and unprofitable. The farm buildings generally were bad, and uncentrically placed, causing a national loss of some millions; each ton of produce or manure costing an average carriage of 6d. per mile, renders the position of the buildings an important national consideration. Wagons were a most unphilosophical contrivance. It was quite clear that a long, light, low cart on two wheels, having an area of capacity equal to a wagon, and only costing half as much, was a much more sensible and profitable mode of conveyance. The question was not now an open one, having been thoroughly discussed and decided upon at the London Farmers' Club; therefore, the sooner the wagons were got rid of the better. With regard to the quantity of seed, his experiments (conducted now for three years and publicly recorded) had uniformly been in favour of thin sowing, say from 4 to 5 pecks of wheat, and 6 to 7 pecks of barley and oats. Some of the best farmers in his neighbourhood adopted this system successfully. It was highly important in a national point of view that this question should be settled; for if the quantities he had named were available, adieu at once to the necessity for foreign imports. It appeared to be admitted on all hands, that if a bushel of wheat vegetated, it was an ample seeding; and it was reasonable that it should be so, because if each good kernel produced only one ear, containing 48 kernels (and that was not a large one), there was no allowance for increase by branching or tillering, which we knew would take place to a considerable extent in well farmed land, containing an abundance of organic matter. Thin sowing delayed the ripening three or four days; consolidation by pressure prevented the development and action of wireworm and slug. He had found salt tended to a similar result. He salted all his wheats at the rate of 4 to 8 bushels per acre, and was determined to use much more. He knew a gentleman in Northamptonshire whose wheat crops could scarcely ever be kept from going down, until he used salt, which had effectually kept it standing. He (Mr. M.) salted the manure in his yards. He found that it sweetened them; he supposed it fixed the ammonia. It was a singular fact that whilst salt tended to preserve animal substances, it on the contrary rapidly decomposed vegetable matter. It was a cheap alkali of native production, costing only about 20*s*. to 30*s*. per ton, whilst all other alkalies were nearly eight times as dear. He strongly recommended the abundant use of bones, with and without acid, for root and green crops. It was evident that the bones formed in our growing animals, and in our cows from the produce of the farm, cost us 5d. per pound, or 45*l*. per ton. Now, if we could replace these, as we can do, by bone-dust, at 7*l*. per ton, it was clearly good policy to use them. He considered the waste of the liquid portions of the manure in most farm-yards a great national calamity. It was a great mistake ever to allow water to fall on manure. Water was a very heavy article. A thousand gallons weighed 10,000 lb., and were expensive to cart. He had heard farmers say when rain was falling, that that they should then litter their yards and make manure! Straw and water, in fact. He found in practice that animals did well on their own excrements and straw under cover; that they consolidated the mass until it was four feet thick, when it would cut out like a good dungheap, and be fit to carry on the land. But if rain water were allowed to wash this mass, an injurious effect resulted both to the animal and to the manure. He could not afford to allow his manure to be well washed in the yards by drainage from the buildings, and afterwards to be washed, dried, and mangled by putting it out in heaps and turning over. It was a waste of time and of money. He found that his crops grew better with unwashed manure. A farm-yard should be like a railway terminus—covered in, but amply ventilated. There was comfort and profit in keeping everything dry. It did away with the necessity for water-carts and tanks: the liquid portions of the excrements being just sufficient to moisten the straw and burnt earth, or other absorbent material. He admired and practised, to a certain extent, Mr. Huxtable's system of placing animals on boards. It would answer in a compact farm with good roads, and in cold climates, to feed sheep in the yards on roots. In mild climates, and dry friable soils, it was most advantageous to consume the roots and green crops on the land by folding with sheep. There was no expense of carting off and carting back manure. Farmers had found out that the whole of the excrements were thus applied to the land, whereas in open yards with untroughed buildings, much was washed out and wasted. He hoped to see the time when tenants would consider it to be their interest (as in parts of Scotland) to pay 10s. per acre more rent for properly farmed, permanent, and convenient buildings and drainage, in lieu of the miserable and misplaced dilapidations of the present time. It was, no doubt, partly this difference that caused the Scotch rents to appear higher than our own. He was a decided subsoiler to the depth of at least two feet. It was a cheap and effective way of getting rid of strong rooted weeds, their crowns being generally just below the ordinary depth of ploughing. He did this in dry weather, and with the assistance of a heavy Crosskill roller and scarifier, made his fallows cheaply, quickly, and efficiently. He drilled his wheats at intervals of about 9 inches, so as to hoe them with Garrett's horse-hoe. It cost about 1s. per acre. It was far more expeditious and efficacious than the hand-hoe, and only cost one-fourth the amount. He strongly advocated the abundant use of oil-cake, and also of chalk on heavy clays deficient in calcareous matter. It had been proved that much more produce had resulted from oil-cake folding than where an equivalent amount was expended in corn. Good high farming was by far the most profitable; the starvation principle was a losing game. If we borrowed from the earth we must repay, or we should soon find an empty exchequer.

The Rev. A. Huxtable then rose and spoke to the following effect:—I think this by far the most interesting agricultural meeting that I have ever attended, on account of the variety of important views and practices which have been brought under our notice. For my own part, at so late a period of the day I must content myself with adducing a few facts that have come within my own farming experience, and defending one or two points of my farming practice which have been glanced at by the preceding speakers. As I see so many landed proprietors around me, I must beg permission to impress on them the duty of allowing their tenants to break up, under proper restrictions, the poorer lands now lying in grass. I think that I can show from my own experience that national wealth, the profits of the tenant, and the interests of the labourer, are deeply concerned in converting poor pasture into tillage. Thus, in my own parish, five years ago, there being many labourers out of employ, I obtained the consent of my landlord, Mr. Sturt, to break up the whole of the grass lands of a small dairy farm. It consisted of 95 acres, 10 of which only were then under the plough. When I entered on the occupation the farm supported 14 dairy cows, and grew 48 bushels of wheat and 40 bushels of beans. Now it annually produces 1,600 bushels of wheat, 40 head of cattle, cows, yearlings, and calves; and 100 sheep are fatted, and 80 pigs, and where 3½ labourers were employed, 12 are now sustained all the year round. But the farm, gentlemen, labours under one embarrassment, such a one as I wish you all felt—such an accumulation of manure that, with the fear of laid wheat crops before my eyes, I know not where to place it. Allow me to detail briefly the steps by which this surely happy result has been brought about. I began at the beginning. I first drained the land; but of draining you have heard to-day so much, that I will only say that though it has been most successful, I yet heartily wish that I had earlier known Mr. Parke's deep drainage. My fields would have been far more economically and effectually rid of their bottom water. I tried when this was done to improve the herbage of some of the better pastures, but neither liming, nor sheep-folding, nor guano, enabling me to cut more than 15 cwt. of hay per acre, I pared and burnt it all, and cut down, by my kind landlord's leave, all the hedge-row timber, and grubbed up all save the boundary hedge, and have now a glorious farm. The next object was to provide for the permanent fertility of the soil by keeping a large amount of stock; for I hold that a farm ought to be made self-supporting as far as possible, and the purchase of manures should be regarded as only a temporary expedient—a necessary evil. My first effort to consume the green crops grown on half my farm was very expensive, and therefore unsuccessful; for with regard to the beasts, I was forced to purchase a ruinous amount of straw, and the sheep eating off the Swedes on clay land in winter puddled the fields, and were themselves amidst good food objects most pitiable. But when our principles are good, we must not allow slight difficulties to stop their application. I therefore determined to place my milch and store cattle on boards, as wood is an excellent non-conductor, and after a series of devices I have succeeded in making them tolerably comfortable, so that I am no longer dependent on my straw for the quantity of cattle which I keep. I am only limited in the number of animals which I keep by the amount of green food grown. In like manner, but with a variation of arrangement, the sheep were placed on small boards about 3½ inches wide, with an interval of about ¾ inch between each, to permit the manure to fall freely into properly prepared tanks below. This is by far the most successful provision which I have made. Of 1,000 sheep so placed I have never had one lame. The pigs, in like manner, when fattened, sleep on a boarded stage above their feeding-place, and except in very cold weather, require no straw for litter. Thus I have dispensed with a large expenditure of straw, which my cereals (half the farm) could not sufficiently provide. But I hear some one exclaim, "What do you make of your straw?" First of all, a good deal is still required for bedding the horses, and the young stock which are in loose boxes; and as they never tread the green fields, they require a great quantity of white bedding. Secondly, a great deal is wanted for food, being mixed with the green leaves of the root crop and the mashed turnips. Thirdly, a ton per acre is used in making clover and vetches into imperfectly dried hay, with a due admixture of salt to arrest fermentation. These uses fully take up all the straw which I grow. I think the methods employed in preparing the manure from the "boarded" cattle deserve mention. First the liquid manure flows into large tanks; below them is another, which I call the mixing tank, for in it the manure is diluted with water to any degree which the state of the weather may require, the rule being that, in proportion to the increase of temperature must be the increase of dilution; *i. e.* the hotter the weather, the weaker should be the manure applied. In order to avoid the expensive and often injurious water-cart, I have laid down over the highest part of my farm a main of green elm pipe, of 2 inches diameter, bored in the solid wood; at every 100 yards distance is an upright post, bored in the same manner, with a nozzle. A forcing pump fixed at the mixing tank discharges along these pipes, buried 2 feet in the ground, the fluid with a pressure of 40 feet; of course it rushes up these pierced columns, and will discharge itself with great velocity through the nozzle; to this I attach first of all 40 yards of hose, and therewith water all the grass which it can reach. To the end of this hose another 40 yards of hose is attached, and a still larger portion of the surface is irrigated, and so on for as many 40 yards as are required. When enough has been irrigated at the first upright, the nozzle is plugged, and the fluid is discharged at the next 100 yards distanced column, and so on. For this application of the hose I am entirely indebted to that most able man, Mr. Edwin Chadwick; the green elm pipe is my own contrivance. The cost of the prepared canvas hose, which was obtained from Mr. Holland, of Manchester, was 1s. a yard; the wooden pipes cost me only 1s., and being underground they will be most enduring. By an outlay of 30*l.* I can thus irrigate 40 acres of land; and see how inexpensive, compared with the use of the water-cart and horse, is the application. A lad of 15 works the forcing pump; the attaching the hose and its management require a man and a boy. With these, then, equivalent to two men, I can easily water two acres a day, at the rate of 40 hogsheads per acre of the best manure in the world; I say *best*, because all chemists will assure you that the liquid contains the principal nitrogenous and soluble salts, and therefore is far more valuable than the dung, and it is plain enough to every man, though he be no chemist, that plants can only take up the manure in a liquid form. The principal use which I make of the hose is to water the clover, and, above all, the noble, but this day much-decried, Italian rye-grass. How hard Mr. Woodward was upon its soft sweet herbage! Yet his own excellent principle, that you must carry back to the land an equivalent for what is taken away, may be successfully alleged in defence of this most productive and nutritious of all grasses. It is certainly true that if you cut and carry away Italian rye-grass, and do not also carry back the manure made in eating it, you will not be able to grow wheat after it. But from my own observation I know that if, after each cutting, the hose immediately follows, you may cut it without wrong to the land as often as you like, and an amount of fodder will be obtained which no other plant can approach. It comes the earliest, and it grows the longest of all the grasses; and I feel confident that with such appliances as I have mentioned, you may secure fifty tons per annum of this milk-giving, fat-producing, muscle-making, grass. I refer to Mr. Dickinson, of Curzon-street, as an authority for growing at least this weight of green food, and I believe far more. That you can cut it, by the help of liquid manure, six times a-year, admits of no doubt. With regard to the manure made by sheep, as previously described, you will readily perceive its value if you reflect that when you give a flock in their house twenty tons of Swedes and their tops, you have minus only the increase of their bone and wool made during the three months of their happy confinement, all the inorganic and most of the organic ingredients of the crop being under the boards; in fact you may say that on the boards you have a fatted flock, and below the boards yet twenty tons of Swedes and their tops. I think that a good deal of misapprehension prevails respecting this mode of shed-feeding sheep, for you hear frequent comparison made on the superior system of feeding off crops in the fields. I have no doubt that in the summer months even fatting sheep will "do well" out of doors, and at the same time fertilise and consolidate the land; but I speak of feeding off winter crops by sheep which you wish to fat; and here I cannot think that the two systems admit of comparison, so superior are the results of the house and board system. But the conditions under which an animal is to be reared are quite different from those which you would observe in laying on fat. In the one case exercise is absolutely necessary; in the other case, the quieter and more still the creature is kept the better. Briefly, then, my own practice, which science surely justifies, is this—the greater proportion, about two-thirds, of my best roots are carted to the sheds, and given to the animals preparing for the butcher, whereas the tops and smaller turnips are fed off of by my breeding flock on the land, assisted by oilcake and corn when necessary, and thus the land is rendered firm, and the ewes are kept in healthful exercise. Lastly, I must advert to the treatment of the dung made by the cattle and pigs. That on the boards is hourly swept down, and wheeled away to a long covered shed; contiguous to this is another shed containing a large store of burnt earth and other ashes. The dung is worked up with the ashes, and therewith is mixed the other manures, dissolved bones, soot, powdered chalk, &c. This, about 8 or 10 cart-loads per acre, is carted to the field ready for turnip sowing. The manure is drilled in by one of those that deliver moist manure, and thus eight acres can be got over in a day drilled on the flat. If the field is very poor, the drill goes over four acres in the morning without seed; in the afternoon the same quantity is again deposited in the same ruts, and the seed upon this double discharge. The advantage of this is, that the dung is never exposed to the drying of the sun or air; that the seed being deposited over a moist bed, germinates immediately in the driest season, and cares not for the fly, though for the prevalent grub it is certainly no remedy. The pig manure I consider the best of all; because one-half of the corn I feed them on is in the shape of beans, which contains the best mineral ingredient for growing Swedes, as I have endeavoured to set forth in my "lecture on manures." These, gentlemen, then, are the principal points of the practice which has brought me into that pleasing embarrassment of which I spoke before, and which I wish may befall you all—more manure than you can safely put on your arable land.

THE RECENT EXCAVATIONS AT POMPEII.

NAPLES, Oct. 2.—In the magnificent street leading from the ancient sea-shore, in the neighbourhood of the theatres, to the so-called crossway of the Fortuna, and thence in a direct line to the northern city wall, there has been excavated a house that surpasses in richness and elegance all that has been discovered previously. The space of the court-yard is open, has a mosaic pavement, and on the walls fantastic pictures of the richest and most tasteful style. At the sides of the atrium (court-yard) are small sleeping rooms, with the following wall paintings:—Polypheme, who receives a letter from Galatea by an amorino riding upon a dolphin; Venus occupied with fishing; a Narcissus; a few swimming gods of Love; a Victoria upon a car; and several landscapes. In the background of the atrium opens a tablinum (the reception-hall), with chequered marble pavement. On the walls of this room must have been wood paintings, as the spaces which they once filled are still plainly seen, as also the charcoal remains of those paintings. They were, perhaps, from the hands of those celebrated masters who, according to Pliny, preferred painting upon wood. At the side of the reception-hall is a dining-room, where are seen three large paintings of full-size figures. They represent Hercules with Omphale holding his club, and wrapped in the skin of the Nemæan lion. Next, Bacchus as a boy, and arm-in-arm with Silenus, on a car drawn by two oxen, and followed by Bacchantes. Thirdly, a Bacchanal procession of triumph. Here were also the Triklinian reposing beds, richly adorned with silver.

Behind the reception-hall is the garden, with a fountain at the end, which is adorned with mosaic and a small marble statue of Silenus. In the centre is the water reservoir, adorned with rich marble sculptures. This dwelling joins a second open atrium where the servants lived. Here was found a four-wheeled wagon with iron wheels and much bronze ornament. The kitchen contained many implements of bronze, and the traces of smoke were in many places still visible, after the lapse of eighteen centuries.

The dwelling had—what is very rare—second and third stories, to which led a wide staircase. Upon a small picture close to the staircase lies a letter with the (scarcely legible) name of the owner of the house, in oblique characters, and plainly indicating his rank. It belonged to the Decuria or senators of Pompeii.

The house has therefore been christened, Casa della Sonatrice, or dell' Ercole Ubbriaco. It is the newest excavation of importance

---

NOTES OF THE MONTH.

Royal Institute of British Architects.—The ordinary meetings of this Institute, for the session 1847-48, commence on Monday, the 1st inst., and will be continued as follows:—

1847	November	1	15	29
	December	13	....	
1848	January	10	....	24
	February	7	....	21
	March	6	....	20
	April	3	....	17
	May	1	15	29
	June	12	....	26

Lithography.—Messrs. Hullmandel and Walton have favoured us with some specimens of their new process of "stumping" in lithography, showing its advantages for representing architectural engineering, plans, and mechanical subjects. The tints approach nearer the nature of a wash than ordinary lithography, and the style offers the advantage of forming a complete subject with one printing stone, as from the facility with which effects can be executed for architectural drawings, it supersedes the necessity of a tint stone. The execution of the subjects on stone is, we understand, easy and simple as well as rapid, which we also deem of importance, as there is an economy of time as well as of actual cost.

Royal Artillery.—Some interesting experiments have been carried on during the past month in the practice range of the royal arsenal under the direction of the select committee. It had been suggested by Capt. Chadds, R.N., of the Excellent, naval gunnery ship at Portsmouth, that a great advantage would be gained in naval gunnery by uniting the shot and shell, and firing both at the same time. This suggestion has been tried during the past month, from 32-pounder and 8-inch guns, with remarkable success. The effect produced upon the bulkhead which serves as a target has been surprising, and affords some idea of the havoc that would be committed upon the hull of a ship of war under similar circumstances. The shell, although the lighter body, is said to enter the bulkhead first, and from its inferior specific gravity, strikes above the shot. Another great advantage appears to be the almost momentary bursting of the shell on concussion, the whole of those fired having burst either on striking the bulkhead, or on passing through it. The suggestion, although only intended by way of experiment, promises important results in naval warfare.

Mechanical Equivalent of Heat.—M. Séguin's experiments on the compression and dilation of gases confirm the mechanical equivalent of heat, as obtained by Mr. Joule. M. Seguin, however, reasons thus:—If to these facts be added all those where heat results from motion, such as a blow, compression, friction, change of condition, it will be clear that the two phenomena, identical in themselves, are only the consequences of a general law, which governs the motion of all bodies, and that the phenomena classed under the term caloric, are nothing more than the effects of motion. This principle admitted and properly understood, involves a modification and a vast improvement in the steam-engine. Steam may be said to be used between certain limits of pressure, say equivalent to a fall of temperature of 80°, and on being then condensed or allowed to escape, it is evident that it still contains about 660° of temperature, which is not utilised. By retaining this same steam, and restoring to it at each stroke of the piston the quantity of heat it lost to produce the motion, a complete and immense change in the steam-engine would result.

Metal for Clocks.—M. Laugier communicated to the Academy of Sciences, Paris, the result of a series of experiments with a view to ascertain the proportion of metals to be used in clocks in order to establish a perfect compensation. Hitherto, although very large sums have been expended in experiments for the production of compensation clocks to keep true time, no really satisfactory result has been arrived at. M. Laugier declares that perfect compensation may be gained by employing the following metals, and in the following proportions: iron, 100; copper, 135; zinc, 109; platina, 147.

Atmospheric Rays—Colours of the Horizon.—A paper was likewise received from M. Choron, on the peculiar colours visible on the horizon before the rising and after the setting of the sun. These colours of orange, yellow, red, green, and blue have hitherto been ascribed to atmospheric absorption of certain coloured rays. M. Choron ascribes them to the earth acting as a screen, and shutting out the whole of the white light above the horizon. He gives a series of optical experiments in support of his opinion.

Fortifications of the Southern Coast.—It is reported that, in consequence of a determination of government to put the whole line of the southern coast into a more efficient state of defence, there are to be several powerful batteries erected along that stretch of land commencing at the Castle port at Dartmouth, at the harbour's mouth, to the Start Point; and that the men now on the Coast-guard duty will be regularly trained and augmented in number, so as to constitute a disciplined body for the immediate duty, if required to work the newly-formed batteries.

Value of Land reclaimed from the Sea.—A few days ago were offered for sale, by the Nene Outfall commissioners, at Wisbech, 969 acres of land, in 27 lots, being their portion of between 3,000 and 4,000 acres gained from the sea, by the completion of their great work. The lots varied from 7 acres to 180; and the reserved bid varied from about 45*l.* to 80*l.* per acre; and though none of the lots were actually sold at these prices, above 60*l.* per acre was bid for one lot, containing 103 acres, and for some of the smaller lots higher prices were offered. It is but a few years ago that the whole of this valuable land formed the bed of the Wisbech river, and from the rapid deposits now going on beyond the barrier bank, another portion of from 3,000 to 4,000 acres may be added to *terra firma* in the course of a few years.

The Law of Atmospheric Resistance.—Professor Davies of the Royal Military Academy, has promulgated in the *Mechanics' Magazine*, the following law of atmospheric resistance (the atmosphere being homogeneous within the limits of the problem) to the flight of a projectile:—"If v be the velocity of a shot at any point in its path, and P be a constant depending on the physical condition of the atmosphere; then the resistance of the atmosphere to the progress of the shot will be $P\,(e^{\frac{fx}{}}-1)$: and fx is such a function of x as to vanish with x, and which is under ordinary conditions but slightly different from x itself. In fact, I am led to think that the errors arising from so taking fx are so small as to be less than the probable errors of experiment, as this class of experiments has been hitherto made."

The Eclipse.—The meteorological observations made at the Cambridge observatory during the eclipse on the 9th October have been published, as follows: "The changes in the barometer and hygrometer were very small, but sufficiently considerable to show them to have been in some measure affected by the phenomenon. The observations were taken at intervals of from 10 to 15 minutes. At 6h. 0m. the barometer read 29,933 in., and until the commencement of the eclipse showed an inclination to fall. At the time of the greatest obscuration, it remained stationary, and immediately after it continued to ascend; finally, at 8h. 45m., it read 29,963 in., having thus ascended 0,030 in. in 2h. 45m. With three common thermometers, one with the bulb blackened and exposed to the sun'slight, another with plain bulb in same position, and the third in the shade, the readings were plainly affected, though to a small amount, remaining mostly stationary as the sun became obscured, and varying rapidly as the phenomenon passed off. With hygrometers exposed to the sun's light, and in the shade, the differences were uniform, following the same range as the common thermometers. Owing to the moisture in the atmosphere, the wet and dry bulb readings were nearly the same, the differences being at commencement of eclipse—Wet below dry, 0·5 deg.; at greatest obscuration, 0·4 deg.; and at termination, 1·0 deg."

New Railway Carriage.—Messrs. Adams, of Fairfield Works, Bow, have just constructed some improved carriages for the North Woolwich branch of the East Counties railway. They are 40 feet in length, and 9 feet in width; the extra width being gained by building the carriage frames to the width of the ordinary step-boards. More is thus accomplished on the narrow than has yet been on the broad gauge, where the carriages are only 8 ft. 6 in. in width, by 28 feet in length. The extreme axles are 30 feet apart, and being on eight wheels, these carriages are obviously safer than those on six wheels or on four. Notwithstanding their length, they will pass a curve of 200 feet radius by means of the flexibility and arrangement of the springs, which permit the wheels to traverse laterally. The buffer heads are also made to radiate with the springs or curves, so that they press firmly under all circumstances. The carriages are fitted up in four compartments; one first-class with couches all around, and a table in the centre; the other three second class. They will carry about 100 passengers.

Obituary.—Mr. Cottingham, the architect of several cathedral restorations and other public works, died on the 13th ult., at his residence in the Waterloo-bridge-road.

Death of Vasques.—Senor R. Vasques, member of the order of the Jesuits, and of the Academy of Fine Arts, the most able architect and engineer in the Peninsula, has just died in Spain. He entered the order of St. Ignatius, but continued ardently to pursue his profession, in which he was extremely successful. He was engaged in the immense undertaking of opening a tunnel in the mountains of Guadaran, a much more difficult task than even the most celebrated tunnel of Europe, when he was suddenly attacked by an illness which carried him off.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM SEPTEMBER 24, TO OCTOBER 21, 1847.

Six Months allowed for Enrolment, unless otherwise expressed.

Charles Hancock, of Brompton, Middlesex, gentleman, for "Improvements in the preparation of gutta percha, and in the application thereof, alone, and in combination with other materials, to various manufacturing purposes."—Sealed September 24.

Thomas Moore, of Burnley, Lancaster, for "certain Improvements in looms for weaving."—September 30.

William Edward Newton, of Chancery-lane, Middlesex, for "Improvements in machinery for the manufacture of nets and netting." (A communication.)—Sept. 30.

Richard Johnson, of Manchester, wire manufacturer, for "certain Improvements in the manufacture of wire cloth."—Sept. 30.

Charles de la Salsede, of Paris, gentleman, for "Improvements in the brassing and bronzing the surface of steel, iron, zinc, lead, and tin."—Sept. 30.

Robert Hawkins Nicholls, of Thurlby Grange, Bourne, Lincoln, gentleman, for "Improvements in machinery for distributing corn and other grain on land, and also improvements in giving motion to agricultural and other machinery."—Sept. 30.

Ignacio de Barros, of Lisbon, Portugal, gentleman, for "Improvements in machinery for making lasts for boots and shoes, butts or stocks for fire-arms, and other irregular forms." (A communication.)—Sept. 30.

Charles Jay, of Bathurst-street, Hyde-park Gardens, Middlesex, gentleman, for "certain Improvements in apparatus for evaporating and concentrating saccharine and saline solutions, and which may be also applicable to the evaporation and concentration of vegetable and other extracts."—Sept. 30.

Pierre Auguste Bassaume, of No. 11, Rue du Croissant, in the City of Paris, gentleman, for "a new process for the preparation and engraving of plates, adapted to the printing of cotton stuffs, paper, and other substances."—October 7.

Nathaniel Fortescue Taylor, of Vauxhall Walk, Lambeth, engineer, for "Improvements in machinery for printing and staining paper and other fabrics."—October 7.

Joseph Wye, of Alfred Place, Saint George's, Southwark, engineer, for "Improvements in machinery for driving piles and raising earth and fluids."—October 7.

James Pearson, of Montague Terrace, New Cross, engineer, for "Improvements in locomotive engines and carriages."—October 7.

Alexander Bain, of the Wilderness, Hampton Wick, gentleman, for "Improvements in musical instruments, and in the means of playing on musical instruments."—Oct. 7.

Sir Samuel Brown, knight, of Vanbrugh Lodge, Blackheath, Kent, in Her Majesty's Navy, for "Improvements in propelling and steering vessels, and improvements in the mariner's compass."—October 7.

George H. Dodge, of Attleborough, in the State of Massachusetts, of the United States of America, for "certain new and useful improvements in machinery for spinning and winding yarn."—October 7.

Thomas Hunt Barber, of King-street, Cheapside, gentleman, for "Improvements in machinery for propelling vessels." (A communication.)—October 7.

John Tyrrell, of Great Ormond-street, Queen-square, Middlesex, esq., for "certain Improvements in the manufacture of elastic fabrics from vulcanised indian rubber, gutta-percha, or certain fibrous materials." (A communication.)—October 7.

James Hartley, of Sunderland, glass manufacturer, for "Improvements in the manufacture of glass."—October 7.

Jules Jean Baptiste Martin de Lignac, of Portland-street, in the county of Middlesex, gentleman, for "Improvements in preserving milk."—October 7.

Richard Fell, of Winchester-street, London, engineer, and James Fell, of Ostend, in the kingdom of Belgium, gentleman, for "certain Improvements in obtaining and applying motive power."—October 7.

Charles Frederick Ellerman, of Brompton, in the county of Middlesex, gentleman, for "certain processes or methods of rendering feculent, excremental, and other matters inodorous and disinfecting, and also of retarding the putrefaction of animal and vegetable substances, and certain chemical re-agents employed in the said processes or methods."—October 7.

Matthew Townsend, of the borough of Leicester, framework-knitter, for "Improvements in the manufacture of looped or knitted fabrics."—October 7.

Alfred Vincent Newton, of Chancery-lane, mechanical draughtsman, for "certain Improvements applicable to the construction of floors and other parts of buildings, and also to certain kinds of furniture and fittings for buildings."—October 7.

Pierre Antoine Joseph Dujardin, of Lille, in the kingdom of France, doctor of medicine, for "Improvements in electro-magnetic telegraphic apparatus."—October 7.

Matthew Pierpoint, esq., of Worcester, for "certain Improvements in the distribution of artificial light."—October 7.

Samuel Cunliffe Lister, gentleman, and Isaac Holden, worsted-spinner, both of Bradford, for "Improvements in carding, preparing, and spinning wool and other fibrous substances, and also in making heald and Genappe yards."

Sir John Scott Lillie, of Fulham, in the county of Middlesex, knight, for "Improvements in machinery applicable to tillage, and for agricultural purposes."—October 14.

Thomas Horne, of Birmingham, for "certain Improvements applicable to carriage windows."—October 14.

John Thang Harradine, of Hollywell cum Needingworth, in the county of Huntingdon, farmer, for "an Improved agricultural instrument for preparing land in various ways for agricultural purposes."—October 14.

David Fisher, of Clerkenwell Green, Middlesex, for "certain Improvements in the manufacture of boots and shoes."—October 7.

Francis Lloyd, of Snow Hill, in the county of London, tobacco manufacturer, for "certain Improvements in the preparation and manufacture of tobacco."—October 14.

Matthew Curtis, of Manchester, machinist, for "certain Improvement in machines used for preparing to be spun, and spinning, cotton and other fibrous substances, and for preparing to be woven and weaving substances when spun."—October 14.

Bartholomew Beniowski, of Bow-street, Covent-garden, Middlesex, for "certain Improvements in the apparatus for and process of printing."—October 14.

Joseph Maudslay, of Lambeth, Surrey, for "certain Improvements in the manufacture of candles, parts of which improvements are applicable to the manufacture of other moulded substances."—October 14.

Alfred Vincent Newton, of 66, Chancery-lane, Middlesex, for "an Improved machinery for blooming iron."—October 14.

Arthur Wall, of India-row, East India-road, Middlesex, for "a new or improved apparatus for a method of separating oxides from their compounds and each other."—October 14.

Robert Stirling Newall, of Gateshead, Durham, for "certain Improvements in machinery for grinding grain, paints, and other substances."—October 14.

Patrick Playfair, merchant, and Laurence Hill, jun., civil engineer, for "Improvements in the manufacture of sugar."—October 21.

John Ridgeway, of Caldon-place, Stafford, china manufacturer, for "certain Improvements in the manufacture of paste boxes, and other similar articles, in china and earthenware, or other plastic materials."—October 21.

William Gosswych Gard, of Calstock, Cornwall, engineer, for "certain Improvements in machinery and implements for boring and sinking."—October 21.

Robert Richardson Banks, of Great George-street, Westminster, for "a new method of artificially curing and preserving the berries of coffee by a drying apparatus."—October 21.

Edward Tattersall, of Newmarket, land surveyor, for "Improvements in making communications from one part of a railway train to another."—October 21.

Brooke Smith, of Birmingham, manufacturer, and Richard Ford Burges, of the same place, for "a certain Improvement or certain improvements in apparatus for filtering."—October 21.

James Beville, of Walworth, Surrey, for "certain Improvements in conveying goods and passengers on railroads, parts of such improvements being applicable for working or driving other descriptions of machinery."—October 21.

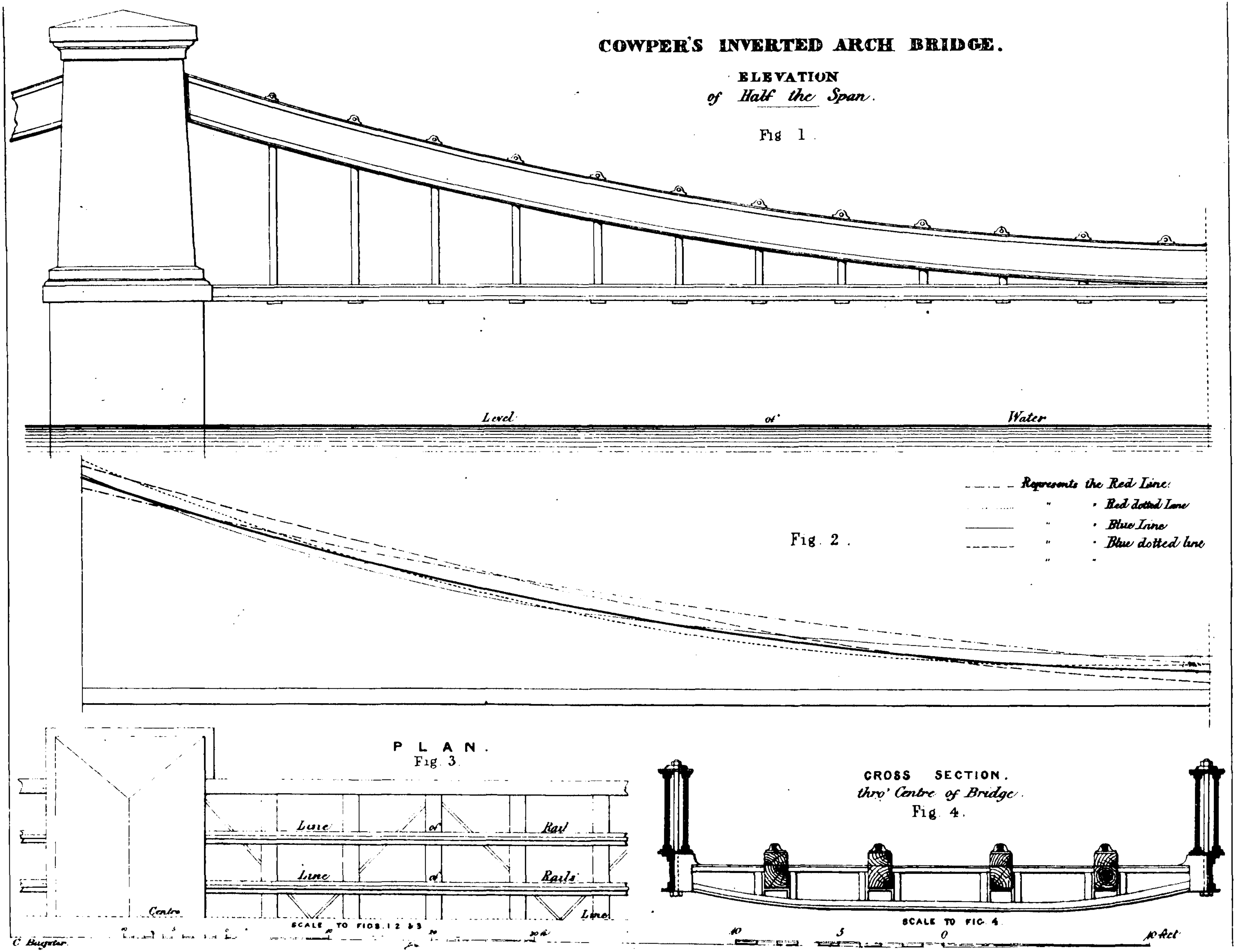
Richard Shaw, of Gold's Green, West Bromwich, Stafford, railway bar finisher, for "Improvements in the manufacture of wrought-iron railway bars and railway chairs."—October 21.

Charlton Henry Sloman, of St. Martin's-lane, Middlesex, for "Improvements in apparatus used for ironing."—October 21.

Thomas Forster, of Streatham, Surrey, manufacturer, for "Improvements in combining gutta percha with certain materials, and in the application thereof to waterproofing fabrics and in moulding various articles therefrom."—October 21.

A QUERY.—Suppose (P) pounds raised one foot high per minute represented the power required to roll a certain cylinder over a certain uniform inflexible road at a given rate. Also suppose (p) pounds raised one foot high per minute represented the power required to crush a certain uniform substance placed equally throughout upon that road. [That is, the power required to crush just so much of that substance in any given time as the cylinder came in contact with during that time].—*Question.* Would (however great the diameter of the said cylinder, and however great its weight) as much power as ($P + p$) pounds raised one foot high per minute be required to move the said cylinder on the said road over the said substance at the given rate, that substance being crushed thereby?

J. W.


COWPER'S INVERTED ARCH BRIDGE.
ELEVATION
of Half the Span.
Fig 1.
Level of Water
Fig. 2.
Represents the Red Line.
" Red dotted Line
" Blue Line
" Blue dotted line
PLAN.
Fig. 3.
Line of Rail
Line of Rails
Centre
Line
SCALE TO FIGS. 1 2 & 3
CROSS SECTION.
thro' Centre of Bridge.
Fig. 4.
SCALE TO FIG. 4.
10
5
0
10 Feet

RAILWAY SUSPENSION BRIDGE.

(With an Engraving, Plate XVIII.)

At the last meeting of the Institution of Mechanical Engineers, held at Birmingham, a paper, by Mr. A. E. Cowper, of the London Works, was read, "*On an Improved Suspension Bridge for carrying a Railway, and for other purposes.*"

In bringing before the Institution of Mechanical Engineers a paper on a peculiar form of bridge, I ought, perhaps, to apologise for introducing matter which may by some of our friends be thought to belong more strictly to our civil brethren; but possibly before the conclusion of the paper, I shall have anticipated any objection which might have been made on that score by showing, in point of fact, that I have only been explaining a piece of boiler-maker's work, and which may certainly be considered to be far enough removed from civil engineering. The object of the present paper is to call the attention of engineers, and railway directors generally, to a mode which I have invented of constructing suspension bridges in such a way that they shall not be thrown out of shape, or in any way distorted, by the weight of a passing load, whether it consists of a railway train or only of the ordinary traffic of a common road. It is well known that suspension bridges are decidedly less costly than any stone bridges, and we may add than most iron bridges, when the span is at all above the length of an ordinary girder; and although many persons have turned their attention to them, particularly with regard to their use on railways, I am not aware that any suspension bridge has ever been made, or proposed, that was at all competent to carry the weight of a railway train in motion, or, in other words, that should be safe as a railway bridge. My attention was particularly called to suspension bridges by the proposal of carrying a railway over the Hungerford-bridge, or over a bridge placed alongside of it; and it appeared to me that the weight of a passing train would so move and distort the chains as to cause the road very soon to get out of order, if not actually to give way; and I then schemed the plan of making a chain of such depth as to include any alteration in the curve of the strain that might take place.

The curve which the chains of an ordinary suspension bridge takes is well known to be a catenary, or rather a curve between a catenary and a parabola; it would be a true parabola if all the weight were in the platform, and a true catenary if all the weight were in the chain. As, however, the difference between the catenary and the parabola is very slight indeed in that portion which would be used for a bridge, we may assume it to be a catenary for all practical purposes. Now, on loading an ordinary suspension bridge with even a small weight, it at once assumes a different curve (unless the weight be equally distributed over the bridge,) and if the weight be large, it will assume a very different curve; so much, indeed, will the form be altered as to injure or strain the material of which the platform or road is composed. Now, it is evident that, if the road has to distribute the weight, it must be a very strong and stiff beam, or, in fact, a girder of the full length of the bridge; and the strength of this girder would very nearly be equal to carrying a quarter of the weight of the load in the centre; it is, therefore, evident that the plan of forming a stiff platform or road for a railway suspension bridge, although by no means impossible, must be at least half abandoning the suspension principle, and be the cause of greater outlay. The plan of keeping the road in shape, by distributing any weight that might come upon it, by means of strong diagonal ties, was the first idea that I had; but it will be found by calculation that these diagonals would have to be very strong, and of considerable height, thereby causing the total depth of the bridge to be much greater. But the plan on which I propose to construct suspension bridges capable of carrying railway trains without being in any way injured thereby, is simply to construct the chain of such depth as to include the curve of strain when the weight is placed on the bridge in the most unfavourable positions. With this object I construct the chains of boiler plate of considerable depth—say three or four feet, or more—and rivet the whole well together without any moveable joints, or separate links, and at the top and bottom edges of the chains (I still call them chains, that I may be clearly understood) I rivet or otherwise attach bars, either flat, half-round, or angle iron, so as to give an accumulation of metal at those parts, and at the same time to render the edges of the chains perfectly secure against any tendency to rip or tear.

In the engraving, fig. 4, it will be observed that there are two chains, each 4 feet deep, which support the ends of cross wrought-iron girders, in the position of sleepers, each chain being composed of four boiler-plates, rivetted together in pairs, each plate being three-eighths thick, and at the top and bottom edges there are securely rivetted strong angle irons. The suspension bars hang between the two pairs of plates forming the chain, and are supported by a small saddle, which bears on the top edges of them. The ends of the cross wrought-iron girders are firmly secured to a light rib of boiler-plate, which runs along each side of the bridge, as shown in the cross section of the bridge; the lower ends of the suspension-bars are secured to the ends of the girders, with means of adjustment, so that the road may be trimmed perfectly level when the bridge is fixed. There are also light diagonal ties introduced, as shown in fig. 3, for more perfectly staying the road to the chains, particularly in case of the breaks being applied whilst the train is passing over the bridge. The rails, either of the ordinary form placed in chairs, or of that form commonly called the bridge-rail, are supported on balks of timber scarphed together, which run longitudinally throughout the bridge, and these are supported by short balks of timber running from girder to girder, immediately under the first. There are a series of diagonal ties placed in the platform, as shown in plan, fig. 3. These act as a means of stiffening the platform, and preventing any vibration or shaking of the parts. There are also diagonal ties or stay-rods, by which the bridge is prevented from moving or swinging sideways. They are attached to the piers, and are very similar to some used by Mr. Brunel, senior, in a bridge at the Isle of Bourbon.

The engraving shows a bridge 200 feet span, having the cross girders eight feet from centre to centre, and the chains four feet deep, which depth has been arrived at by actual experiment; the weight of the road from one line of rails and the train is one ton per foot run, and the weight of a train of locomotives I have assumed at one ton per foot run, and this is allowing some margin for the continued growth of locomotives; and I have taken as a proof load, two tons per foot run; thus the weight of the load, or disturbing cause, will be just double the weight of the bridge. I find the greatest distortion of the curve strain takes place when the bridge is only half loaded—*i. e.*, from one end to the centre; the curve then approaches the bottom of the chain, very nearly in the centre of the loaded half, and approaches the top of the chain in the centre of the unloaded half, whilst at the piers it approaches the top at the loaded end, and the bottom at the unloaded end, as shown by the dotted lines in fig. 2. Again, if the same load be placed in the centre of the bridge (covering one-half of the length), the curve of strain will approach the bottom of the chain in the centre, and will approach the top of the chain at very nearly one-fifth from each pier, whilst at the piers it will be near the centre of the chain, but rather above it. Take one more case, and we shall have disposed of all the heavy disturbing tendencies—viz., that of the ends loaded, and the centre left unloaded; the curve of strain will then approach the top of the chain in the centre, and the bottom of the chain at about one-sixth from each pier, whilst at the piers the strain will be slightly above the centre. I may add that, when the bridge is fully loaded throughout, the curve of strain is in the centre of the chain, throughout its length. I propose to call bridges made on this plan, "Inverted-Arch Bridges."

Photogenic Experiments.—M. Claudet, in a paper lately read at the *Académie des Sciences, Paris*, containing an account of various photogenic experiments, states that the solar spectrum is endowed with three different photogenic actions, which correspond with three groups susceptible of being attributed to the three groups of red, yellow, and blue rays. These three actions have distinct characters; each of the radiations has the effect of fixing the vapours of mercury in Daguerreotype plates, but they are in other respects so different that they cannot mingle or assist each other; on the contrary, they destroy each other. The effect commenced by the blue rays is destroyed by the yellow and red rays, and that which is produced by the red rays is destroyed by the yellow. The effect of the yellow rays is destroyed by the red, and that of the last two is destroyed by the blue rays. These changes appear to indicate that the chemical compound which covers the plate remains always the same under the various influences, and that there is no separation or isolation of the constituent principles. By a proper application of this theory, it will be possible to efface any image upon a plate, and yet leave it in such a state as to receive a new impression.

WORKING STEAM EXPANSIVELY.

When a steam-engine is working at any given speed, the pressure on the crank-pin is equal to the pressure on the piston resolved into the direction of the length of the connecting-rod, minus the force of inertia of the reciprocating parts when their velocity is increasing, or plus the *vis insita* of those parts when their velocity is decreasing:—it is required to ascertain the amount of this $\pm$ pressure.

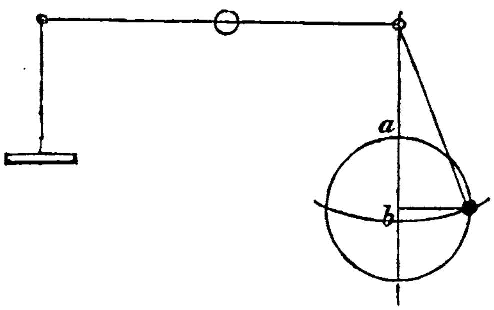
If the square of the velocity of any mass of matter increases in an elementary space n times as much as it would increase by falling through that space,—then the force for that point or elementary space must be n times the force of gravity, or n times the weight of the mass; that is, putting v = the velocity due to falling a given space, and V = the actual velocity,

$$\text{as } d\mathrm{V}^2 : dv^2, \quad \text{or as } \mathrm{V}\,d\mathrm{V} : v\,dv :: n : 1, \quad \text{or } \frac{\mathrm{V}\,d\mathrm{V}}{v\,dv} = n;$$

but $v^2 = 2gs$, and differentiating $v\,dv = g\,ds$,

$$\therefore \frac{\mathrm{V}\,d\mathrm{V}}{g\,ds} = n, \text{ and for the destruction of motion } \frac{-\mathrm{V}\,d\mathrm{V}}{-g\,ds} = n.$$

Let z = the angle passed through by the crank;
r = the length of the crank;
s = the space travelled by the piston;
V = the velocity of the piston $= \frac{ds}{dt}$;
v = the velocity of the crank-pin in the arc $z = \frac{r\,dz}{dt}$;
C = the length of the connecting-rod;
$c = \frac{\mathrm{C}}{r}$, or the value of C in terms of the length of the crank;
n = the force of inertia or insita in terms of the weight;
P = the pressure on the crank-pin caused by the insita or inertia, or the value of n reduced to the mechanical conditions.



The space described by the piston is $= ab$;

$$\therefore s = r\left(\text{ver } z + c - (c^2-\sin^2 z)^{\frac12}\right);$$

$$\text{differentiating } \frac{ds}{dt} = \frac{r\,dz}{dt} \times \left(\sin z + \frac{\sin z \cos z}{(c^2-\sin^2 z)^{\frac12}}\right),$$

$$\text{therefore, } \mathrm{V} = v \sin z + \frac{v \sin z \cos z}{(c^2-\sin^2 z)^{\frac12}}; \text{ and differentiating}$$

$$d\mathrm{V} = v \cos z\,dz + v\left(\frac{\frac14 \sin^2 2z + \cos 2z\,(c^2-\sin^2 z)}{(c^2-\sin^2 z)^{\frac32}}\right)dz.$$

The theorem $\frac{\mathrm{V}\,d\mathrm{V}}{g\,ds} = n$ may be put in a more convenient form, for $\frac{\mathrm{V}}{ds} = dt$, and $\frac{v}{r\,dz} = dt$; therefore, $\frac{\mathrm{V}}{ds} = \frac{v}{r\,dz}$; and, by substituting, we have $\frac{v\,d\mathrm{V}}{g r\,dz} = n$.

The motion of the piston-rod and appendages is vertical; therefore, n must be resolved into the direction of the length of the connecting-rod. By the mechanical theorem sometimes called the triangle of forces, we have

$$\frac{nc}{(c^2-\sin^2 z)^{\frac12}} = \mathrm{P}; \quad \text{or} \quad \frac{c v\,d\mathrm{V}}{(c^2-\sin^2 z)^{\frac12}\,g r\,dz} = \mathrm{P}; \quad \text{consequently,}$$

$$\mathrm{P} = \frac{c v^2 \cos z}{32 r\,(c^2-\sin^2 z)^{\frac12}} + c v^2 \cdot \frac{\frac14 \sin^2 2z + \cos 2z\,(c^2-\sin^2 z)}{32 r\,(c^2-\sin^2 z)^2},$$ the weight being considered unity.

For the beam, let ϱ be a fraction expressing the distance of the centre of gyration from the centre gudgeon when the length of the radius of the beam is 1. Let n' represent the force of inertia of the beam at the point ϱ: then

$$\frac{\varrho v \varrho\,d\mathrm{V}}{g \varrho r\,dz} = \frac{\varrho v\,d\mathrm{V}}{g r\,dz} = n';$$

but of this force, a portion $= (1-\varrho)\,n'$ will be sustained by the centre gudgeon; the remainder, or $\varrho n'$, will be sustained by the top of the connecting-rod, which, multiplied by $\frac{c}{(c^2-\sin^2 z)^{\frac12}}$, gives the pressure on the crank-pin due to the inertia of the beam, which we will call P′; therefore

$$\mathrm{P}' = \frac{\varrho^2 c v\,d\mathrm{V}}{(c^2-\sin^2 z)^{\frac12}\,g r\,dz}, \text{ or } \mathrm{P}' = \varrho^2 \mathrm{P}, \text{ on the supposition that the}$$

end of the beam describes a straight line instead of an arc, which supposition has been made by all writers on the theory of the crank.

The connecting-rod has a compound motion—namely, vertical at the top (neglecting the arc), and circular at the bottom: these two motions may be resolved into vertical and horizontal. The sum of the inertia in the vertical and horizontal directions, resolved in the direction of the length of the rod, will give the value of P″. Let the centre of inertia, in the vertical sense, be supposed to be concentrated in an undetermined point p; this point, when the upper end is moving vertically with greater velocity than the lower end, will be between the top and the centre of gravity; and when the lower end is moving vertically with greater velocity than the upper end, it will be between the bottom and the centre of gravity—practically, it may be considered to be in the centre of gravity.

The upper end will have passed the space s, and the lower end the vertical space r ver z, the point p will have passed a vertical space s', and

$$s' = s - p\,(s - \text{ver } z) = (1-p)\,s + p\,r \text{ ver } z,$$

when p is a fraction expressing the distance of the aforesaid point from the top, the length of the connecting-rod being unity; inserting the value of s, and differentiating

$$ds' = r \sin z\,dz + \frac{(1-p)\sin z \cos z}{(c^2-\sin^2 z)^{\frac12}}\,dz,$$

and the vertical velocity of the point p will be

$$\mathrm{V}' = \frac{ds'}{dt} = \frac{r\,dz}{dt} \times \left(\sin z + \frac{(1-p)\sin z \cos z}{(c^2-\sin^2 z)^{\frac12}}\right).$$

Substituting v for $\frac{r\,dz}{dt}$, differentiating and reducing by the "triangle of forces," we have

$$\mathrm{P}_v = \frac{c v\,d\mathrm{V}'}{(c^2-\sin^2 z)^{\frac12}\,g r\,dz} = \frac{c v^2 \cos z}{32 r\,(c^2-\sin^2 z)^{\frac12}} + c v^2 (1-p) \cdot \frac{\frac14 \sin^2 2z + \cos 2z\,(c^2-\sin^2 z)}{32 r\,(c^2-\sin^2 z)^2},$$

which needs no further reduction, inasmuch as there is no vertical support to the top end of the connecting-rod; consequently, the whole of the inertia or insita concentrated in the point p is sustained by the crank-pin.

For the horizontal motion of the connecting-rod, the inertia is concentrated in the centre of gyration, and the space described horizontally by that point will be $\varrho r \sin z$: differentiating and substituting, we have

$\mathrm{V}'' = \varrho v \cos z$; and ultimately we obtain

$$\frac{v\,d\mathrm{V}''}{g r\,dz} = -\frac{v^2 \varrho \sin z}{32 r} = n'';$$

which will need reducing, because $(1-\varrho)\,n''$ will be supported by the end of the beam laterally; the remainder, $\varrho n''$, reduced into the direction of the length of the connecting-rod, by multiplying by $\frac{\sin z}{c}$ gives

$-\frac{(\varrho v \sin z)^2}{32 r c} = \mathrm{P}_h$; therefore, for the connecting-rod we have $\mathrm{P}_v + \mathrm{P}_h =$

$$\frac{c v^2 \cos z}{32 r\,(c^2-\sin^2 z)^{\frac12}} + c v^2 (1-p) \cdot \frac{\frac14 \sin^2 2z + \cos 2z\,(c^2-\sin^2 z)}{32 r\,(c^2-\sin^2 z)^2} - \frac{(\varrho v \sin z)^2}{32 r c}$$

Let W = the weight of the piston and rod and appendages; W′ that of the beam; and W″ that of the connecting-rod;—then collecting the above results, we have

$$\pm \mathrm{P} = \left(\mathrm{W} + \varrho^2 \mathrm{W}' + \mathrm{W}''\right) \times \frac{c v^2 \cos z}{32 r\,(c^2-\sin^2 z)^{\frac12}} + \left(\mathrm{W} + \varrho^2 \mathrm{W}' + (1-p)\mathrm{W}''\right) \times c v^2\,\frac{\frac14 \sin^2 2z + \cos 2z\,(c^2-\sin^2 z)}{32 r\,(c^2-\sin^2 z)^2} - \frac{\mathrm{W}''(\varrho v \sin z)^2}{32 r c}.$$

In the next month's *Journal*, I intend to give a table of the value of P for different angles of the crank, when W = 1, v = 1, r = 1, and c = 4, which will be about a medium value of c. This will reduce the above to the following form: —

$$P = (W + g^2 W' + W'') \times \frac{T v^2}{r}, \text{ T being the tabular number.}$$

The practical inferences will also be attempted to be shown.

Rochdale, Nov. 15, 1847. M. N.

CANDIDUS'S NOTE-BOOK.
FASCICULUS LXXVI.

"I must have liberty
Withal, as large a charter as the winds,
To blow on whom I please."

I. It is an ill wind indeed that blows nobody good. Penny-a-liners thrive upon accidents, "awful occurrences," and disasters: a famine helps to keep them from starvation, and "a most tragical murder" from cutting their own throats. In like manner, the "Arch and Statue" was a windfall to the critics—especially the small-fry gentry, who having got their cue, roared out as lustily as sucking doves. To that enormity, however, we seem to be now reconciled,—perhaps, by the irresistible argument advanced for suffering the Statue to remain, although the reason assigned was such as to cause some people to quote Johnson, and exclaim—

"From Marlborough's eyes the tears of dotage flow."

It is now the Palace which is the general butt of criticism, or rather is beginning to become so; for although it has been censured severely, censure is not as yet so universally expressed,—many preferring, for reasons tolerably obvious, to be silent, and take no notice of it at all. Their very silence, however, is most significantly condemnatory of the Palace, since they would be fulsomely loud with their praise, were it possible in any way to commend it. Their silence, moreover, betrays what sort of solicitude it is with which they so busily interest themselves, and affect to watch over the interests of Art. Criticism—honest and genuine criticism—is no respecter of persons: it makes no distinction between Prince or Pecksniff; or if it made distinction at all, it would be to animadvert with most severity on bad taste and paltriness of taste in the former, as being decidedly influential for mischief to Art.

II. One presumption strongly in favour of those who betake themselves to the practice of any art to which they were not at first educated in their youth, is that they have been impelled to do so by a natural irresistible impulse towards it and a sincere affection for it. Accordingly, when Mr. Blore abandoned his original profession of engraver for that of architect, there was reasonable ground for supposing he was instigated to do so by the consciousness of possessing not only a preference, but superior talent for the art which he thought proper to make his new calling. It was not, indeed, to be supposed that he would distinguish himself by any particular ability in construction and other mechanical and technical matters, or in what comes under the general term of business, yet it was rather to be expected that he would display some touches at least of genius and imagination—some of those felicitous unborrowed ideas that not all the professional training in the world will enable any one to produce. Nevertheless, it is precisely in the artistic and imaginative that Blore fails, and fails most egregiously; wherefore he may, so far, be said to signalize himself egregiously also. Reversing what the satirist says of Perrault, he has turned from a good draughtsman and engraver, a wretchedly bad architect. Fondness for architecture he may have; although even that may be questioned, since *con amore* feeling never impels him to exhibit at the Royal Academy,—a piece of forbearance in which he emulates another shining glory of the British school of architecture. He will not, it may be presumed, break through his rule of non-exhibiting, even out of compliment to the Palace, and yet he might take the opportunity of showing his "new building" to very great advantage in a drawing, by representing it just as it shows itself through a very dense fog.

III. An article in the *New Monthly*, purporting to be a "Secret History of the Court and Times of George IV.," contains the following interesting contribution to architectural history. "During the time the unhappy man [Cashman, the sailor,] was suffering the sentence of the law, the Prince [Regent] was occupied in the inspection of a surveyor's [!] estimate and plans for the erection of a house for the Duke of Wellington. 'A palace it shall be,' exclaimed his royal highness. Lord Burghursh detailed to the Prince all its *proportions*, it occupying four fronts. The architect of this design is young Cockerell, and his estimate five hundred thousand pounds, every farthing of which, the Prince says, shall be expended upon it. How the money is to be raised is another question." It is still a question perhaps if this same piquant anecdote be little better than one of those random bits of gossip which the concoctors of "secret histories" so greedily swallow and so complacently divulge. At any rate, "young Cockerell" must know something of the matter, yet he seems disposed to keep the secret, notwithstanding that a design which would have required half-a-million to execute must have been something *magnifique*,—the mere fame of which ought to have overwhelmed the author of it with commissions. It did not however, help him to the patronage of George himself, for when Buckingham House was to be metamorphosed into Buckingham Palace, he gave the job to Nash. While as to the Duke, he, perhaps, finding that the intention of building him 'a palace' had clean evaporated, bethought of building for himself a snug little house, for which he employed Ben Wyatt as his Vitruvius, and which, if not an architectural "lion," deserves very well to pass for an architectural sheep.

IV. Another bit is at any rate curious, as showing after what fashion the writer understood what he was speaking of.—"*New Improvements!* Waterloo Place, opposite Carlton House, is beginning to assume something like an uniform feature with (the) façade of Carlton House. The columns are composed of brick supporting a scaffolding pole (!), and the latter supports the entablature (!). Now, when the pole rots, down will come the whole structure. So much for the economy of the architect." And so much, also, for the *sense* of the critic who discerned scaffolding poles supported by the columns, and supporting the entablature.

V. Without corresponding worthiness of design, value and goodness of material only increases dissatisfaction—that is, of the intelligent; for the uneducated in art—and who are so far the vulgar, the uninitiated *profanum vulgus*, let them belong to what class of society they may—have no other standard of excellence than size and cost. Ask such persons their opinion of a building, and they will perhaps tell you it is a very grand one, because it is very large and all of stone, although it may nevertheless be in itself a complete nullity, if considered as a production of architecture, and hardly worth lath and plaster. So far from affording any satisfaction, it is truly mortifying and vexatious to find, as is frequently the case, superior material employed for what is exceedingly poor, if not positively bad in point of design. More than one structure might be mentioned that, owing to the unfortunate durability of its materials, will last to disgrace its author, unless it should have the good luck to be metamorphosed—of which there have lately been one or two instances—into something quite different. Mere market-value is the criterion by which most persons steer their criticism. Tell them that a picture cost a thousand guineas, and—O, the hypocrites!—they will instantly pretend to admire it—to discern a thousand beauties in it, although, in all probability, they had actually turned up their noses at the very same performance had they heard that it cost only two pounds, or that it was painted by some *Mr. Smith*. Almost the very first question or remark of all which people ask concerning what ought to be estimated by its artistic value, relates to cost and price,—which is both exceedingly vulgar, and exceedingly English. It is the ordinary reverence for mere cost and sumptuousness that has obtained so much fame for Versailles, that monument of a taste at once frivolous and prosaic,—poetic only in the wasteful prodigality that stamps it, showing what reckless profusion can do for utter barrenness of imagination, and how exceedingly little the utmost it can accomplish is. All that the most extravagant expenditure of money could effect was there done. Of money-power there was vastly more than enough to have produced the most glorious monument of architecture the world ever beheld, or fancy can conceive, if there be any foundation for the almost fabulous statements that have been put forth relative to its cost, some of which give a total of *Five Hundred*, others of *Twelve Hundred, Millions* of francs! Of art-power, however, there was none; nevertheless great influence for perverting taste throughout all Europe.

VI. Those who are so excessively rigid in their notions as to tolerate no imitative materials for decoration, but would proscribe them altogether as "sham," and of course very paltry also, no matter how artistically they may be employed, and how excellent the effect produced,—such persons, I say, must feel quite scandalised at Sir Walter Scott's taste in carrying "sham" to the *outré* excess which he sometimes did. Verily the great novelist's love of fiction must have been quite overrunning, when he directed Mr. Hay to paint him sham frames to pictures—a species of deception so inartistic—or rather a mere attempt at deception, which instantly betrays itself to the eye, that almost any one would, on seeing it, exclaim with Macbeth: "Unreal mockery, hence!" Lest I myself should be fancied to be here romancing, by imputing the strange freak in question to Sir Walter, I will quote Mr. Hay's own words concerning it. After saying that Scott had directed him where to fix up four pictures,—two *small* ones (one of them a view of Melrose Abbey by moonlight) being to be placed *over* doors,—a most unfit situation for paintings of small dimensions,—he proceeds to state that: "these, after being fixed to the wall by a narrow moulding of oak, were to be surrounded with an imitation of a carved frame of the same material, *painted in light and shade upon the flat plaster.*" Now, however ably executed—with how admirable so ever bravura of relief the appearance of actual carving projecting from the wall might be rendered, the eye could not fail to detect the deception upon almost the very first change of position; and if they happened to be viewed sideways, it would at once be perceived that those frames were only flat painted *borders*, without any projection at all, while the real "narrow moulding of oak" would by its projection on the wall show itself very awkwardly. Such a mixture of the imitative and the real must have been in very bad and puerile taste—both excusable and to be accounted for only as a mere whim on the part of Sir Walter, for the fun of "taking in" his guests after that fashion, making them stare, and enjoying their surprise. Painted frames to detached pictures hung upon a wall are just as preposterous as real picture frames of the usual kind would be for paintings executed upon the walls, instead of either architectural mouldings around them, or else painted borders. Decorative painting should never be permitted to aim at more than mere *pattern* in colours—not at relief or the imitation of actual carving. Painted mouldings or other architectural members—and instances there have been of painted niches and statues—are in vile taste, because the deception so produced can be only momentary, the artifice, if such it can be called, being detected after the first glance, and proclaiming that the decoration so aimed at could not be afforded. With imitative material the case is altogether and widely different: the resemblance may be so perfect that the most experienced eye may not be able to detect it, and provided it shows just the same to the eye, it produces an effect fully equal to what the real material would do. Every one knows, for instance, that gilded ornaments are not of the solid metal, but merely covered with leaf gold of almost incredible thinness—the two hundred and eighty-thousandth of an inch!—what then? the appearance is produced, and it is with appearance, and appearance only, that embellishment has to concern itself. I, for one, am unable to sympathise with those who affect to be shocked at the ingenious imitations and deceptions of art, reprobating them as if they were downright frauds and offences against common honesty. Were any one to sell, or rather attempt to sell, a plaster cast made to imitate marble, for a real piece of sculpture of that material, he would, no doubt, be himself a genuine knave; but there is no moral imposition in placing such casts on the top of bookcases, or in other situations where they may pass for being of marble, which last material would produce only just the same effect.—"What matters it to you or me," I once heard a person say to another, speaking of a lady, "whether she rouges or not. Granting that the bloom of her complexion may be artificial—and you only suspect it,—I take the beauty of it to be just the same as if it was real: a difference of course there is; but that is her affair, therefore a truce with your preaching."—Value of material adds nothing to the merit of design—of the architect's own share in the work, who, if he be an artist, will display talent and produce effect with the homeliest and cheapest materials,—with merely fictitious ones—alias "sham;" while he who is not, will show the very best materials to disadvantage, and render them less valuable than they were before being used, or we may say abused, by being applied to humdrum designs.

VII. Hay has had a hit at Sang's decorations in the Royal Exchange, which he has the delicacy, however, not to mention by name, contenting himself with alluding to it so very pointedly that no one can possibly mistake. "Our general knowledge," he observes, "even of the propriety necessary to be observed in decorations, is so far below the requisite standard that the grossest absurdities are often committed. For instance, we find the most flimsy and fantastical style of ornamental design, borrowed at third or fourth hand from a building devoted to the private luxury of an ancient Roman, adopted as a suitable style for the interior of an arcade remarkable for its plain and substantial massiveness, and devoted to a species of public business of such a grave nature, &c., &c."—"It is scarcely possible," he continues, "to conceive a greater degree of decorative incongruity than this, yet it has been committed in one of our greatest national edifices, amidst all the agitation that exists in regard to national advancement in the art of ornamental design." The censure is perfectly just: the mistake there committed is such an obvious and palpable one, that it is extraordinary it should have been allowed to be perpetrated. Were it possible to entertain so strange a suspicion, we might imagine that this specimen was intended to satisfy the public most effectually one way, namely, by cloying them and sickening them at once, and so preventing all further outcry for similar embellishment in our public buildings.—As to "the agitation that exists in regard to national advancement, &c.," there is a good deal of humbug in it—far more of cant than of sincerity of purpose; or if there be the sincerity, the knowledge which should accompany it is wanting. Lord Morpeth—or if it was not Morpeth, it was Lord Somebody-else—is reported to have said in the House, he thought the public would be satisfied with Buckingham Palace—the unlucky Palace again! but it can't be helped—after Mr. Blore's alterations—his lordship was too conscientious to make use of the word "improvements." But what a mean opinion then must he entertain of the public taste, and how very little regard must he have for its "advancement,"—that is, supposing him not to be himself an utter novice in matters of art, and to have had no suspicion of what a balaam design he was recommending to the "House," *pro bono publico*; a design which now makes the Palace look almost twin-brother to the Barracks just by, in the Birdcage Walk, with which Blore or somebody else must have been so smitten, as to take the leading idea from it.—Verily, it was not without reason that some one lately quoted, or pretended to quote, the following distich:

> "Unhappy Britain! doomed to be disgraced
> By Pecksniff palaces, and Royal taste!"

VIII. Errors of the press are, if generally provoking, sometimes exceedingly diverting, as, for instance, that of a certain "print" which has transformed the "Army and Navy Clubhouse" into that of the "Armoury and Knavery," than which Mrs. Malaprop herself never uttered so amusing a blunder. That there has been any sort of knavery in the matter, we are bound not to suspect; nevertheless, there is much which looks like manœuvering. Most assuredly it looks like any thing but fair play on the part of the Club to enlarge their site after the first competition, without allowing the first competitors—those who had tasked their ingenuity to provide the required accommodation within a space which the Club themselves have since virtually declared to have been insufficient—to take their chance in a second competition. Well, the refusal may have been mercy, although, apparently, it does not say much for the liberality of the "Armoury and Knavery." And what have they got after all by their clever scheming?—why, a piracy from Sansovino for their exterior, and for their interior, a most humdrum, namby-pamby plan, devoid of all invention, contrivance, and study of effect—merits which the "Armoury and Knavery" people have perhaps no conception, much less any appreciation of. For Clubhouses at least, if not for private houses, it might be supposed that something more than mere routine plan would begin to be thought of, for in that direction, if no other, there is room for advance, and great scope for improvement. Admitting that compound forms of rooms are more expensive than the usual four-sided ones, and that they also occasion some loss of space, consequently are out of the question for houses in general where economy as to both cost and space must be chiefly attended to, so far from being an argument against, it is a *raison de plus* for such forms and picturesque effects being purposely introduced in Clubhouses and other houses of a superior grade, instead of four walls with a flat ceiling, and perhaps a cove to it, being, as the *Athenæum* remarks, all the elements out of which their apartments are constituted. Surely, says the writer in that journal, if it be worth while to expend so much as is sometimes done upon superficial and accessory embellishment, it would be equally so to endeavour to secure in the first instance impressive architectural physiognomy, the charm of which is more lasting than the gratification afforded by mere ornamental detail. It is, indeed, greatly to be lamented that neither architects nor their employers perceive—or even if they do perceive, care to turn to account the infinite resources for both design and effect which present themselves as soon as we break away from the wearisome monotony of plan, disposition, and forms in the interiors of houses, which now prevails, to the exclusion of all individual character except that which arises from ornamentation alone.

IX. So very little study is given to matters of plan in rooms, either as regards *ensemble* or individual parts and detail, that the eye is frequently offended by the most unpardonable negligence, and sometimes by the most arrant bungling, in point of design, even in large and expensively fitted-up and furnished apartments, where, just in order to save a little exertion of ingenuity and contrivance, symmetry and balance have been more or less disregarded. Thus that consideration of the subject and actual circumstances, which would almost of necessity prompt fresh ideas expressly adapted to the occasion, is altogether evaded, and the merest ordinary routine is substituted for artistic composition and artistic effect. In fact, the majority of those who call themselves architects, appear to have not so much as any conception of what artistic effect is,—not even so much as to suspect that it can have anything to do with their own art. The truth—and a sad truth it is, architects are not educated artistically: artists they may eventually become, but it must be entirely by the promptings of their own mind, for by others they are not even so much as put into the way of becoming such—which is the utmost that can be done by the very best artistic education. Well, therefore, was it said by one who valued his art, on being asked to take a lad as his articled apprentice: "I can engage to make your son a good practical builder, but as for architect, you might as well ask me to make him an archbishop!"—To dismiss remarks of this kind, I return to what occasioned them, by affirming that effect—genuine artistic effect—is generally the very last thing of all that is thought of in planning interiors. It will, no doubt, be urged very sapiently that effect adds nothing to convenience. Most assuredly not; but so neither does embellishment, which is only for the sake of that species and degree of effect—certainly not the most valuable of all, that is to be so obtained; it being, on the contrary, that which is most easily of all ensured. Consequently, if effect be not worth the study required for producing it, so neither is decoration worth its cost, and the latter may be, by very far, the more costly of the two, because the other may sometimes be produced by the simplest means, without other expenditure than that of artistic skill.

X. The name of Nash, of very questionable fame in John the architect, is now honoured by the talent of Joseph the artist, whose mastery of power in the representation of architectural subjects, more particularly interiors, with all their manifold accessories, surpasses all praise. Those of Windsor Castle by him form a matchless series of architectural pictures, and completely refute the opinion—if such opinion requires other refutation than its own absurdity and evident prejudice—that subjects of the kind, that is, mere rooms and their furniture, cannot be rendered picturesque—at least, not if represented in all their freshness and beauty, and in perfect order, without any of those accidents and disarrangements which are generally considered indispensably essential to the picturesque. Although it may not answer to the usual notion of the picturesque, almost anything may be rendered picturesque, or in other words, highly pictorial in representation, by being treated picturesquely, and in an artist-like manner. Even what is insipid in itself, and viewed with perfect indifference, may be rescued from insipidity, and invested with attractiveness, by the power and skill of the pencil,—as in the case, for instance, with paintings of still-life, which are frequently composed of the most trivial objects—such as would in their reality not be looked at at all. Surely then, what is beautiful, pleasing, and interesting in reality, must, if faithfully pourtrayed, be equally beautiful and pleasing in representation, and possess besides, the additional charm imparted to it by the artist; that is, supposing the latter to have seized upon and brought out all the piquant points and qualities of his subject. Architectural scenes of the kind in question possess this strong recommendation—or what ought to be such—that, besides being works of art themselves, they may be rendered the vehicle for exhibiting other works of art—paintings, sculpture, statues, carvings, mosaics, tapestry, &c., almost any one of which would be an excellent still-life subject. Such scenes are therefore fully worthy of the utmost finish of execution: in them truth of imitation cannot possibly be carried too far, whereas highly elaborate execution seems quite thrown away when bestowed, as it often is, upon the facsimile imitation of what may be seen at any time, and is so trivial that when seen it is not noticed.—Nash's pictures—for they are infinitely more than *drawings*, possess a truthfulness of local colour, perspective, and chiaroscuro, with a captivating effect of general composition, that places them in a very high rank of art—at least would secure for them such rank, were it not for the pedantical and nonsensical etiquette that now regulates precedency in art. Art is not to be measured and valued by the acre. Yet the veriest namby-pamby when magnified to the dimensions of a cartoon passes for "high art." Some very strong instances of the idealess and powerless, marked by outrageously bad drawing, are afforded by the cartoons selected for the recently published "Art-Union," outline prints. If, however, those productions do not tend to enlighten public taste, they serve to illustrate something, since very well might they be called Illustrations of Humbug.

VENICE; AND HER ARTS.

By Frederick Lush.

(*Continued from page 345.*)

Pococke, in his "Description of the East," after giving an account of a magnificent mosque, called Kubbe-el-Azab, or the cupola of the Azabs, in Grand Cairo, states, that there was one particular apartment more sumptuous than the rest, which was built by a grand vizier, who desired the sultan to give him leave to prepare a place fit to offer him a sherbet in, on his return from Mecca. There is every probability that a similar feeling was entertained by the Venetians towards the grandees and merchant-princes of Cairo, Damascus, and other sister cities, between whom a very active commerce and intercourse was carried on;—but whether such a feeling existed or not, it is certain that the same Arabic idea and spirit of building prevailed in Venice, and prompted the early builders; and the palaces, in which the Saracenic predominates, seem to have been cotemporary with, and partly constructed in imitation of, the mosques of the sultans of Cairo. There was not—and there is not at the present day—throughout all Italy a spot more in accordance with the tastes, or better accommodated to the habits, of the orientalist, than the old *Piazza di San Marco*, before it was destroyed by fire, when it bore a close resemblance to the court of a mosque—as shown in the large and curious picture by Gentile Bellini (A.D. 1496), exhibited in the *Accademia*. The inspection of this production—which preserves, as in a rich cabinet, the ornaments, the "barbaric pearl and gold," and costume of the period, and in which is so closely imitated the curiously carved candelabra, crucifixes, and reliques borne by the procession in their celebration of the festival which it represents—enables us to form a pretty correct idea of what must have been its original appearance. Then ambassadors and other personages from foreign countries, sojourning in Venice for the transaction of commercial affairs, or for the mere purpose of witnessing her civic or ecclesiastical ceremonies, must have admitted its splendour, and been gratified with its many gorgeous spectacles. Then it was entirely Saracenic; the collonnades were Arabic, with horse-shoe archivolts; its cornices serrated, the details of the oriental style imitated, and its pavement chequered with bright red and white marble*. The adjoining Piazzetta, in itself, in its features, and in the views it embraced, was, and even now is, equally oriental. Here, the Ducal palace, one of the most beautiful edifices in the world, rears itself,—and there could not, perhaps, be a finer and more appropriate site selected for it. It is set off to the greatest advantage upon its marble terrace or *jettée*, stretching into the lagoon: the picturesque groups of Armenians, Turks, gondoliers, and water-carriers, scattered upon that terrace, and the lagoon variegrated with many a gondola, painted sail, and fruit-laden vessel, being in admirable keeping with its Eastern appearance. "It was constructed by Calendario, in the middle of the 14th century, and seems to have been a contemporary of the mosque of Sultan Hassan in Cairo, just after the two great Kalaons had added so many magnificent edifices to that capital." In its façades, we cannot but admire the principles studied by the architect in the details, which tell with considerable effect in themselves, and at the same time contribute, in a great measure, to the grandeur of the whole; the harmonizing contrast and relief which the curious and elaborate tracery forms to the more simple parts; the opposition of light and shade which are observable throughout; and the difficulty there is, if not the absurdity, of inventing and applying, in the place of these features which now exist, others more appropriate and expressive. It was a common practice among the Arabs, to give also the effect of colour and lightness to buildings which possessed a great measure of solidity, by means of slabs of red and white or green porphyry, and other valuable marbles, arranged in diamond patterns on the external surface of the walls, and sometimes the covering of their domes,—a method of inlaying followed by the Venetians, of which a beautiful example is seen in the broad masses of the Ducal palace, between the windows; an introduction the most happy and the most

* Some of the above remarks are suggested by the reading of an interesting paper in the "Athenæum" of Sept. 25, 1847, called "Arab Gleanings in Venice."

artistic, since it tends to prevent an appearance of heaviness and excess of weight, which might, but for this precaution, result from those masses being above a light corridor and perforated gallery. We see this beautiful feature made as an accessory by Titian to his splendid picture of the "Presentation of the Virgin." And this ancient combination of bright red with polished white marble, seen in almost every mosque of Cairo at the present day, and which so frequently occurs in Venetian pavements, was likewise imitated throughout great portions of Italy, &c., during the middle ages; and inscriptions on the walls, grotesque carvings, heraldic ornaments, and curious devices, having some peculiar reference to the inventor or proprietor, which obtained among the moderns, may be traced back to a very remote period, and were considered an almost indispensable decoration of ancient Arabian, Chinese, Persian, and Hindu architecture. A writer states, that "in the friezes between the floors [of the Square of St. Mark] we see what at first sight appears to be the *Sulus*, or large Arabic 'writing on the wall' of mosques; but as they could not, in a Christian country, write sentences from the Koran, we find, on looking closer, that the characters are figures of white camelopards (giraffes) on a red ground. These carry the mind to the East by more associations than one; for their long legs and tapering necks have quite the air of *Sulus* writing."

"The original Merceria," remarks the same writer,* "with its pendant shutters, narrow crowded thoroughfares, and the wares of brilliant colour in its dark, limpid shades, must have had very much the air of a bazaar—which it has not lost even now. Cantar, rottalo, and other Venetian weights, are still the standards of quantity in the Levant; and in the name of Campo, applied to all the khans of Aleppo, we find a Venetian expression. There were several places in Venice in the form of a khan; one of which—the Campo St. Angelo—is still remaining. The principal one—the Campo dei Mori, or Khan of the Moors, at Madonna del Orto—has been taken down; but I still observed the stone figure of a Bedouin loading a camel, in alto-relievo on the wall next the canal.

"Several remarkable edifices of Saracenic architecture are yet visible on the Grand canal:—one of which is the Fondaco dei Turchi. There is, however, no connexion between its architecture and the subsequent destination which gave it its name. It is supposed to have been built in the 12th or 13th century, when the Saracenic taste was in full prevalence: and extracts from documents which were shown to me by Count Agostino Sagredo, the present accomplished president of the Academy of Fine Arts, show that it was given by the republic to the Duke of Ferrara,—after him passed through several hands to the Pesaro family,—and in 1621 was let by them to the Turks. It is now in course of restoration and repair by the commune. The Palazzo Loredano, a peculiarly light and handsome specimen of Saracenic architecture, built since the invasion of the Italian style—and the celebrated Ca d'Oro, now the property of Taglioni—are both so well known as to require no further consideration.

"No painters caught the oriental costume nearly so well as the Venetians; who, though ambassadors, merchants, and slaves, had frequent opportunities of becoming acquainted with it. The oriental air and manner are better seized in Tintoretto's great picture of 'the Miracle of St. Mark,' or 'a Slave liberated from Bondage,' than in any picture that I have ever seen. The kaoucks were universally worn in the East in Tintoretto's time (and so very nearly in our own age); but, with this exception, the figures might now be alive in Cairo and Damascus, without any one discovering any great peculiarity. Traces of the connexion with the East are constantly appearing in the Venetian pictures. In Giovanni Mansueti's pictures we see *segredies* hung out of the windows; the scarf of Titian's Maddalena is evidently of Tripoli manufacture; and the 'Supper in the House of Levi'—where Paul Veronese is enthroned in all the dazzling splendour and gorgeous magnificence of his genius—has for its principal figure green velvet hose, of a most curious arabesque pattern."

Having pointed out some of the most important relics of Saracenial and Arabic architecture and ornament in Venice, as showing her connexion with the East, we shall now briefly describe its principal characteristics.

The genius of the Arabians and Saracens abounded in liveliness of fancy and in richness of invention, which manifested itself alike in their pursuits and in their poetry,—in their learning and in their arts; in all of which they rendered themselves remarkable. They equally distinguished themselves by their warlike achievements; and the briskness and activity of their temperament (whether the effect of the warmth of their climate, temperance, and constant exercise), joined to their enthusiasm, constantly stimulated them to great exertions and extraordinary actions. Their love of learning and the arts was cultivated throughout the whole of their dominions, and was diffused abroad, being first carried into Africa (where they erected a great many universities), and from thence into Spain and other countries; whilst they conquered Syria, Persia, Egypt, &c., and established themselves upon the ruins of the Grecian empire.* Such a city as Venice, and such a people as the Venetians, was much enriched, therefore, by its intercourse and dealings with the polished Saracens. The style of their architecture is generally regarded as the immediate precursor of the Gothic. To the Gothic (if we may use the term) of some countries it is more closely allied than that of others; and just as the character of the Gothic varied in different localities and countries, according to the Roman and other styles with which it was brought in contact, and with which it was sometimes amalgamated, so we may observe the Saracenic was more or less pure, and underwent different changes as it was translated into different countries. "The Saracens, in their buildings in Egypt, appear to have availed themselves in a small degree only, of the style of the aboriginal inhabitants, and are distinguished by the lofty boldness of their vaultings, the slenderness of columns, the variety of capitals, and the immense profusion of ornaments. The greatest peculiarity, however, lies in the small clustered pillars of pointed arches, formed by the segments of two intersecting circles. The Egyptian Saracenic varies from the Spanish chiefly in the form of the arch, as will be apparent from comparing the gate of Cairo with that of the Alhambra in Grenada, or the great church at Cordova."

As examples of Saracenic decoration in Venice, including among them the Byzantine, we refer more especially to St. Mark's and the adjoining palace; where, notwithstanding the intermixture of these and other styles, we may discern the distinctive features of each:—1st. The blending of the pointed arch, ornate filial, and crocket-work of the Gothic, with the horse-shoe scrolls and richly multiplied geometrical patterns of the Moorish ornaments; forming what the Italians call the Arabo-Tedesco. 2nd. In the façade of St. Mark: the clustering domes and minarets; the tabernacles terminating in pointed pinnacles; and the circular gables, fringed with a most beautiful arabesque foliage. 3rd. The turned wooden grates over the great gates, and the ornamental fans to the windows, of the very patterns used to this day in Cairo—and which, in the 15th century, were all gilt. 4th. In the interior: the twisted columns, of which there are four, two of oriental alabaster—the workmanship imputed to the time of the successors of Constantine; the horse-shoe arches; and the variety of capitals, sculptured with grotesque imagery, where the bell is sometimes covered over with a sort of basket-work of true lovers' knots; and where the scroll, the pineapple, palm-branch, and acanthus-leaf, are placed amongst lions' heads, masks, and half-figures fiddling, &c. Some are beautiful; all are curious; and although the designs might be considered great corruptions and sad departures from the "correct" taste of the Ionic or Corinthian, in the opinion of those who would bring them to the standard of the "five orders,"—yet the invention and originality displayed in some of these capitals must be acknowledged by every unprejudiced observer. In lieu of the volutes in some, pigeons are placed in the angles; in others, rams, with their feet resting on a tier of leaves. The flutes and fillets. twisting round the shafts of the columns in a spiral manner, are frequent in the Venetian palaces. Many other Byzantine, Moorish, and Saracenic features in St. Mark's have already been mentioned. 5th. The portal, called *Porta della Carta*, opening into the Cortile of the Doge's palace, facing the Giant's-stairs, the statues and foliage of which we class under the Saracenic, as partaking much of its character, although said to have been the work of Bartolomeo Buono, of the 15th century. Wood, in his "Letters," says of it:—"The arches here, and indeed in all the parts, are very much broken and confused; the architect appearing to have a great horror of a continued line, whether straight or curved." It is to this latter circumstance, we think, that it owes all its singular beauty. 6th. The Cortile itself; the arcades surrounding which, and the character imparted to it by the two elegantly chased bronze reservoirs in the marble areas, reminding us of those splendid courts erected by the Spanish Moors to their Alcozars and Alhambra. 7th. Nearly all the details of the Ducal palace.—But the peculiarities of the examples above enumerated constantly occur in the early edifices of the Venetians.

We will now turn to a new era that dawned upon Venice, and, with the rise of new thoughts, other styles which were introduced in, and which considerably altered the appearance of, the capital; a change, however, which, on many accounts, increased rather than diminished its charm and celebrity. The edifices of the earlier and of the later epochs (the last we

* "Athenæum," Sept. 25.

* Ockley's "History of the Saracens."

shall now consider)—the former we might term EXOTIC—the latter, as more immediately the growth of Italy, NATIONAL—marked and were identified with the two distinct countries in which they originated. The modifications and improvements of which these were susceptible, and the perfection to which the latter was carried, prevented the city savouring of any degree of monotony; and, indeed, it is in the various phases of style and diversity of character in this city of palaces—favoured as it is in this respect by the views, the most tempting to the painter, which a labyrinth of serpentine streets and canals continually present—which appeal with so much interest to the historian, archæologist, and artist; and constitute the great charms of the pictures of Canaletti.

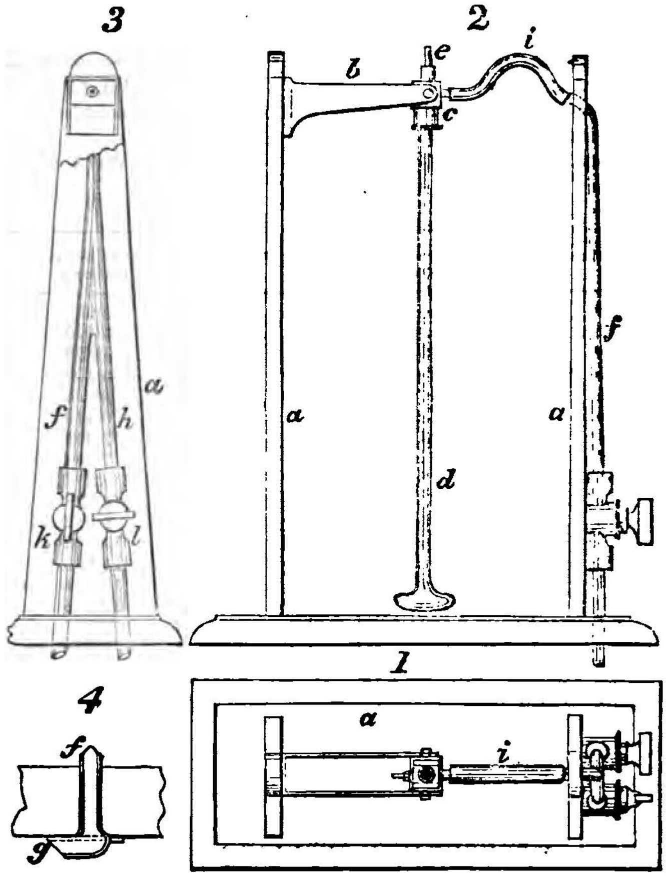
If the Italians exhibited, in their revived architecture, less of the passion for the picturesque than their predecessors, they achieved grander results than had been accomplished by them; if in their works there was less imagination—that is, less of a capricious kind—there was more reason; if less to win upon the feelings of the poet, there was more to satisfy the individual whose views were moulded and shaped by regulation and rule;—but various causes prevent all analogy in the two cases; their beauties and defects are in no way referable to the same standard; and hence it is we entirely demur to that one-sided and partial observation which denies any merit to exist in one style of architecture, because it differs from another: we rather like to enjoy their separate beauties and features; and allow, at least, the existence of fitness, propriety, and every essential of beauty, in all works, however opposite they may be in character, which are in harmony with the tastes and requirements of the nations and times that produced them. But we may remark, in a comparison of the Arabic with the Italian styles, that whereas the former, by the manner of the division and multiplication of the parts, produced a degree of variety that at first seemed almost confusion; in the latter, those parts being less minutely divided, fewer, and larger, simplicity resulted; *before*, it seemed scarcely as if they were under the guidance of any sound canons or fixed principles, where the chief object was to give the freest scope and play to the fancy: but, *now*, the precepts and principles, as derived more immediately from a greater considering intellect and a less indulging imagination, were stern, severe, and settled,—the fancy being reined in—her movements restrained by the cooler dictates of the understanding; yet the influence of a favoured climate shed its elegancy and refinement over the minds of the Italian artists, imbueing them with that poetic feeling which made their works look noble, classic, and stately—and far, very far, from cold or prosaic, though they might not boast of the luxuriant profusion of their predecessors, the Moors and Arabians.

HYDRAULIC LOG.

The common log is a simple apparatus, familiar to all who have been within the view of the encircling horizon; and, were its accuracy equal to its simplicity, it would undoubtedly be a perfect instrument. Such, however, is not the case,—hence various contrivances have been proposed: Massey's patent log, and Cavé's apparatus for indicating the speed of a vessel, are both very ingenious contrivances, but apparently too complicated to answer the purpose intended. The former will answer tolerably well within a limited range of the speed to which the driving-cone is adjusted, but at any considerable variation from that speed its correctness is not to be depended on. Perhaps, it may be said that the common log is sufficient for its purpose, because it has never yet been superseded; true, it has not been superseded, and why?—because nothing has yet been introduced having the two necessary qualities, *simplicity* and *accuracy* combined. I leave the question of the sufficiency of the common log to those who have practical experience on the matter, and who, I am sure, will appreciate an instrument which may at all times be relied upon. And though it matters not much when the errors of the common log can be corrected by observation, yet, when the state of the weather and atmosphere for several days, or weeks, do not admit of observations being taken, it becomes a matter of great importance to know the actual distance the vessel has traversed.

The instrument I propose for this purpose* is free from mechanical complexity, depending for its accuracy entirely upon the natural law and hydrodynamic property of fluids, and having some similarity to a common barometer.

A reference to the annexed diagram will explain the construction of the



instrument. The figures are drawn to a scale of two inches to a foot. Fig. 1, is a plan; fig. 2, is a side elevation; fig. 3, is an end elevation; and fig 4, is a broken section of the pipe *f*, and mouth-piece *g*. *a a*, is a frame or stand; *b*, is a bracket, forming with the piece *c*, a universal joint *d*, is a glass tube having a bulb at its lower end for the purpose of holding mercury and with which it should be rather more than half filled; this tube must be firmly fixed in the piece *c*; *e*, is another glass tube, with a small bore, passing through, and within an eighth of an inch of the bottom of, the former, its upper end being open to the atmosphere, but communication with the latter and the interior of the tube *d*, is prevented by making its passage through the piece *c*, air-tight; *f*, is a pipe, of about half an inch bore, passing through the ship's bottom, as near midships as convenient; *g*, is a mouth piece or cover, having an aperture parallel with the keel; *h*, is another pipe similar to the first, but without the mouth-piece *g*, (or the two pipes may be made in one, like a double barrel gun, in the passage through the ship's bottom); *i*, is an elastic tube of vulcanised india-rubber, completing the connexion of the apparatus.

The instrument being understood, its action will readily be perceived. As the mouth-piece *g*, is turned in a direction with the vessel's motion it is evident that an upward pressure in the tube *f*, will take place in proportion to the velocity of the vessel; and as this upward pressure will be exerted on the top of the mercury, it follows that the latter will rise in the small tube exactly in the same proportion, and will indicate, by means of a gradual scale, the number of miles and any fractional parts thereof into which the scale may be divided. In fixing the apparatus, care must be taken to keep the bulb of the tube *d*, a few inches below the light-draft water-line. Now, when the vessel is deeply immersed, the column of mercury will rise in the small tube to counteract the pressure of the water (about four-fifths of an inch for each foot of immersion), consequently the scale must be made to slide on the tube *d*; the pipe *h*, and cock *l*, are for the purpose of adjusting the scale with the depth of immersion, and is effected thus:—shut the cock *k*, and open the cock *l*, and the mercury will adjust itself to balance the specific gravity of the water above the mercury in the bulb. Set *o*, of the scale to this point, and open the cock *k*, and shut the other, and the instrument is ready to indicate the speed of the vessel.

I subjoin a table founded upon a series of experiments instituted with a view of ascertaining the resistance on a plane in still water at various velocities, the result of which I have given in a pamphlet, entitled, "Practical Observations on the Steam Engine." This scale, however, must be tested by farther experiments to ensure perfect accuracy.

Column 1, represents nautical miles, and column 2 the height of a column of mercury in inches and decimals.

Nautical miles.	Height in inches, and decimals.	Nautical miles.	Height in inches, and decimals.
[illegible]	0·050	9·0	3·968
[illegible]	0·110	9·5	4·420
2·0	0·188	10·0	4·898
2·5	0·306	10·5	5·400
3·0	0·440	11·0	6·056
3·5	0·600	11·5	6·478
4·0	0·784	12·0	7·058
4·5	0·992	12·5	7·654
5·0	1·226	13·0	8·212
5·5	1·484	13·5	8·928
6·0	1·764	14·0	9·612
6·5	2·070	14·5	10·302
7·0	2·400	15·0	11·036
7·5	2·754	15·5	11·774
8·0	3·136	16·0	12·556
8·5	3·538		

November, 1847. G. V. Gustavsson.

WROUGHT-IRON TUBULAR BRIDGES.

In consequence of the experiments made at the suggestion of Mr. Robert Stephenson by Mr. Eaton Hodgkinson and Mr. Fairbairn of Manchester, at Millwall, to ascertain the best form of tubular bridge for carrying the Chester and Holyhead railway across the Menai Staits, Mr. Fairbairn has devoted his particular attention to carrying out Mr. Stephenson's ideas in the construction of wrought-iron tubular girders for railway purposes, and as they are likely to be extensively adopted, we have collected some information as to their cost and weight compared with solid iron girder bridges. It appears that the tubular girder for spans of 60 feet and upwards is in many respects superior to the arch, whether it be of iron, stone, or brick, besides being much cheaper in construction.

The arch, as is well known, is not always admissible where railways have to be carried across public thoroughfares, deep ravines, navigable rivers, and canals. In such situations, the horizontal wrought-iron girder bridge appears to be the only structure which can with safety be applied to such a purpose. Cast-iron girders are applicable for spans not exceeding 40 feet; beyond that point the compound trussed girders have been used, and in every case they are equally if not more expensive and much less secure than those composed of wrought iron, and it is doubtful whether the principle is a sound one. Now, in the wrought-iron girder the weight is less than one-third of the cast-iron, the strength being the same, and as these girders form the parapet of the bridge, they are particularly well adapted for a bridge of considerable span.

In order to show the commercial value of this description of bridge, we give the comparative cost of one of these bridges compared with one of cast-iron, from bridges actually constructed.

Truss Girder Bridge.—The weight and cost of a bridge of 60 feet span having cast-iron trussed girders.

Cast-iron work 76 tons at £12 per ton .	£ 912 0 0
Wrought-iron work as composed of truss-rods, bolts, &c., 14 tons at £37 4s. . . .	520 16 0
Total for the girders, exclusive of cross beams and roadway	£ 1432 16 0

We believe it possible to make a compound girder of the above span entirely of cast-iron riveted in parts, but the increased weight and additional cost would render such a structure inadmissible for such a purpose.

Cost of Stephenson and Fairbairn's wrought-iron bridge.

Three wrought-iron girders, each 66 feet long, riveted complete, weight 30 tons, at 30*l*. per ton, 900*l*., which is the sum required for the girders, exclusive of the cross beams and roadway as before.

The comparative value of the two bridges will therefore be as 9 to 14, irrespective of the superior strength and security of the former to that of cast-iron, in whatever form it may be applied.

The plan has already been adopted by Messrs. Stephenson, Cubitt, Vignoles, Bidder, and others, and Mr. Fairbairn during the earlier stages of the experiments engaged, at the request of Mr. Vignoles, to construct two bridges of this kind—one to be erected over the canal and the other over the turnpike-road on the Blackburn and Bolton railway. These bridges were the first constructed for the support of a railway,* and although they are probably not so well proportioned as others now in progress, they nevertheless exhibit such extraordinary powers of resistance as not only to ensure complete success, but to lead to new and future developments in what may probably be considered a new era in the history of bridges. Viewing the subject generally, we feel assured, from what has already been done conjointly by Mr. Stephenson and Mr. Fairbairn, that the present discovery is only a beginning of an extensive application of this useful art.

Since the completion of the first experiments on sheet-iron tubes, others of a more conclusive character, and upon a much larger scale, have been made. They indicate several new and important facts; and from the greatly increased size of the model tube, with its rectangular cells, greatly superior powers of resistance have been obtained by a considerable increase to the area of the bottom. The ratio of that part to the cellular top, will now stand as 10 : 12, instead of 3 : 5, as formerly indicated in the experiments with the corrugated top.

Through the kindness of the Editor of the *Railway Chronicle*, we have been enabled to give drawings and an account of one of the bridges, that over the canal on the Blackburn and Bolton Railway.

"Fig. 1, represents an elevation of the side girders, each 66 feet long, with a span of 60 feet. Fig. 2, a transverse section of the bridge. Fig. 3. a side view and section of the cross beams; and fig. 4, a section of one of the side girders, including its suspended cross beam and platform.

"The thickness of the plates used in the construction of these girders was half an inch for the sides and top, and ⅝ inch for the bottom; the whole firmly riveted to angle iron, as shown in the sections.

"On referring to the sections it will be observed that the wood cross-beams, D, D, for supporting the roadway and rails, are screwed up to the bottom of the hollow girders by the straps *a a*, and the vertical bolt *b*, which perforates the top cell through the tube *c*, and answers as a stay for connecting the upper and lower sides of the cellular top. Since these bridges were finished, a better and more efficient mode of construction has been adopted, by forming a longitudinal shelf of plate-iron along the bottom of each girder, to receive the cross beams, and also to strengthen the bottom in its resistance to a tensile strain. In this construction it will be observed that the cross beams may be formed of either cast-iron, wrought-iron, or wood, as may be deemed expedient."

This Blackburn and Bolton bridge has already been subjected to severe tests. Before the line was opened to the public, three locomotive engines each of 20 tons, and covering the span of 60 feet, were run together as a train, at rates varying from 5 to 25 miles per hour. The deflection produced by a weight of 60 tons was ·025 of a foot. This seemed to be without any sensible alteration from the difference of velocities. Captain Coddington, the government inspector, and Mr. Flannigan, the engineer, then placed on the rails, in the middle of the bridge, two wedges of the height of one inch, acting as inclined planes. The engines dropping from this height when at a speed of 8 to 10 miles per hour, caused a total deflection of ·035 of a foot. With wedges of an inch and a half thickness, the total deflection became ·045, which is nearly half an inch. Altogether, it has been fully proved that the bridges are strong enough to bear any force to which they may be subjected, whether brought by a dead weight or by impact.

* Simultaneously with these constructions, Mr. Dockray erected, under the direction of Mr. Stephenson, a similar bridge, with a cast-iron top, for carrying the turnpike-road across the London and North-Western Railway at Camden Town.

MR. FAIRBAIRN'S WROUGHT-IRON GIRDER-BRIDGE OVER THE LEEDS AND LIVERPOOL CANAL.

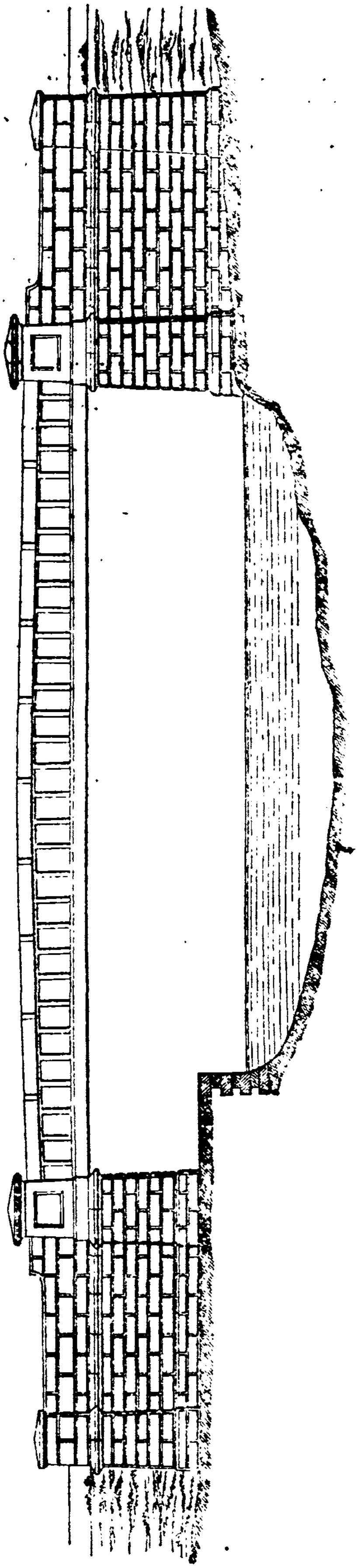


Fig. 1.—Elevation. Span, 60 feet.

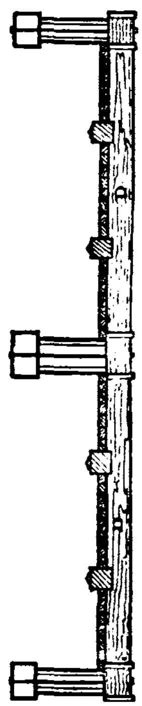


Fig. 2.—Transverse Section of Bridge.

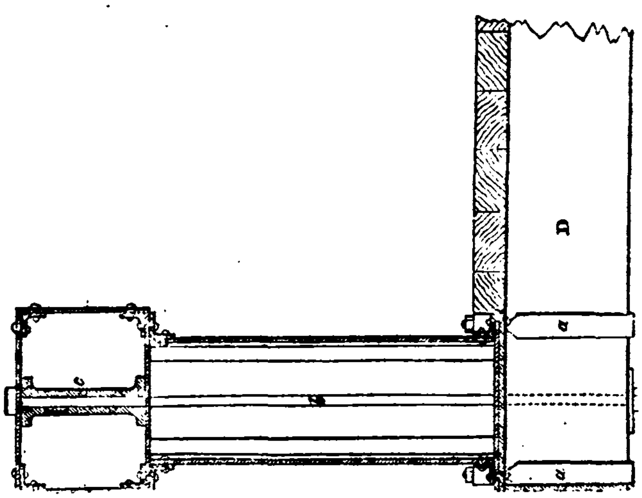


Fig. 3.—Transverse Section of Girder enlarged.

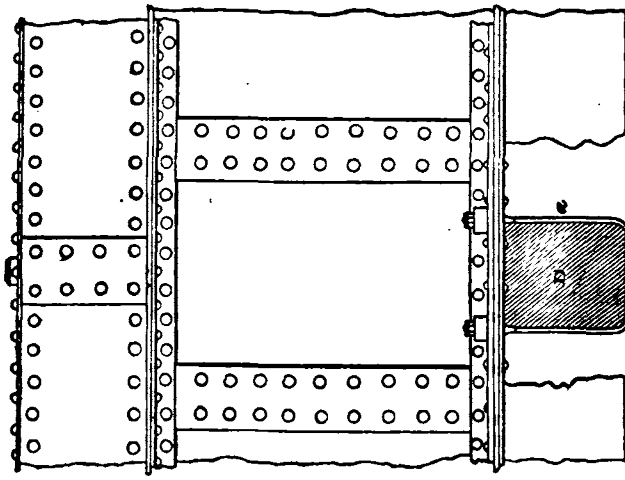


Fig. 4.—Longitudinal Section of Girder enlarged, with Cross-Beam.

HISTORY OF ARCHITECTURE IN GREAT BRITAIN.

A Brief Sketch or Epitome of the Rise and Progress of Architecture in Great Britain. By James Elmes.

"Epitomes are helpful to the memory, and of good private use."
Sir Henry Wotton.

(Concluded from page 341.)

A celebrated politician in the last century acquired the name of Single-speech Hamilton, from the circumstance of having delivered an oration of much promise and great ability, and never again opened his mouth in parliament: so likewise may the architect of one of the most original and tasteful buildings in London be designated by the title of Single-house Wyatt, from his only public work, the Trinity-house, on the north side of old Tower-hill, now called Trinity-square. If John Nash be more polystructural than Samuel Wyatt, the latter may plead that although his progeny be not numerous, his single production is a lion.

This building is a handsome stone and brick edifice, and extends from Cooper's-row on the east to Savage-gardens on the west, with extensive lateral fronts to both of these streets, and consists of a main body and two wings. The principal story is of the Ionic order, raised upon a rusticated ground story. Above the windows are some beautifully sculptured medallion portraits of George III. and his queen, sculptured panels in low relief representing genii with nautical instruments, and four of the principal light-houses on the coast. These sculptures are so beautiful in style and execution, as to deserve being moulded, and casts made from them by the Royal Academy for the use of their students. The style of architecture used in this building is neither so pure as that selected by Stuart for the internal portal of the chapel at Greenwich, so pedantic as that copied by Wilkins in his portico of Downing-college, Cambridge, nor so fanciful as that used by the Adams in the Adelphi; but is a successful adaptation of the Ionic order to proportions of his own, with too much elaboration of foliage in the capitals, trenching on those of the Corinthian. The mechanical execution of every part of this elegant building cannot be too much admired; so beautiful is the masonry and the brickwork of its exterior, that the best workmen both in brick and stone would find models for imitation. The first stone was laid September 12, 1793, by the master, assisted by the deputy-master and elder brethren of the corporation, and the offices opened for business in 1795.

Among the later cotemporaries of Chambers, Wyatt, and Taylor, were—Thomas Leverton, who held an office under the late Mr. Fordyce, in the Crown-lands' Revenue department, and is best known by the extensive and substantial mansion called Wotton-wood-hall, in Hertfordshire, which he designed and built for the late Paul Benfield, Esq., and Grocers'-hall, in the city;—Richard Jupp who held the important office of architect and surveyor of buildings to the East India Company;—and one or two others of lesser eminence. The north front of the East India-house in Leadenhall-street is a pleasing instance of Mr. Jupp's taste and skill in his profession. It is of considerable extent in front, and of greater dimensions in depth; the whole building, or series of buildings, cover a large area of ground facing Lime-street on the east, and Leadenhall-market on the west. The principal front is composed of a six-columned Ionic portico, slightly projecting from two lateral wings. The narrowness of the street in front, and the great value of the ground on which the building is erected, compelled the architect to adopt this flat relief of his principal front; but he has overcome this difficulty with great ability, by constructing a deeply-receding porch or inverse portico behind the columns, which gives a depth of shadow and a bold relief to the design, while it affords a goodly shelter to the directors and other members of the establishment from the easterly and westerly winds whilst waiting for their carriages. The capitals, beautifully carved by an uncle of Sir Richard Westmacott, our eminent English sculptor, are a free and artist-like imitation of the temple of Apollo Didymæus. The triangle of the pediment is filled with sculptures in entire relief by Banks, of which it is not too much to say that they exceed any figures in such a situation that have yet been executed in England. The subject is George III. in Roman imperial armour, protecting the commerce and interests of the company. The king is extending his shield, placed on the right arm, over the principal figure, and resting with his left on a sheathed Roman sword. This circumstance gave rise at the time to an opinion that the artist had worked from an inverted tracing of a design made by an eminent painter, who was well known to have furnished designs for many of the sculptors of his time. The artist, however, defended himself by asserting that the king being represented in protecting the Arts and Peace, the attitude was correct. Cæsar, however, did not enter the senate-house with the cuirass, sandals, sword, and shield of the warrior, but in the peaceful toga and laurel crown, with which it is said he covered his baldness. On the upper acroterium of the pediment is a statue of Britannia, and on the two lower, figures of Europe and Asia.

A very pretty four-columned Doric portico, in a pure Greek style, forms a suitable sub-entrance, through a well proportioned hall, to the minor offices in Lime-street, and shows how quickly this architect imbibed the pure style then recently introduced by Stuart,—for he had been originally educated in a thorough Roman school. Mr. Jupp's portions of this building were began in 1799, and finished about 1805. The elevations of the gigantic warehouses which he erected in many of the eastern parts of the metropolis are very harmonious in their proportions, and exhibit great skill in the use of his very simple materials; gateways, warehouse doors, windows, and piers constructed of simple brick and stone.

The elder Mr. Dance, whose principal works have been before described, left an able successor to his place of architect to the city of London, and to his professional business, in his son, George Dance the younger, who received the honourable addition of R. A. to his name from the Royal Academy of Arts, and was appointed to the chair of Regius Professor of Architecture in that institution; but was too fond of enjoying his *otium cum dignitate*, ever to impart his knowledge to the members and students of the Academy. The family of Dance hold an honourable station in English history; for, in addition to the two architects, one of them was an able comedian in the time of Garrick, particularly celebrated for his personation of Falstaff and other fat heroes of the buskin, to which his corporeity, like that of the celebrated Stephen Kemble, lent an aid that no stuffing could accomplish. Another, Nathaniel, became eminent as a portrait painter, and was, like his younger relative, an R.A. His portraits for identity of resemblance and character of the person represented by his pencil, take a place between those of Reynolds and Romney; less graceful and natural in colouring than the former, he equalled the latter in all the best qualities of a portrait painter. This gentleman resigned his diploma and his palette for a baronetcy, a fortune, and a change of name, as Sir Nathaniel Dance Holland. Another member of this family added a singular triumph to the naval glories of his country, by saving a large and valuable homeward-bound East India fleet, under his command as senior captain, and therefore commodore, of this mercantile squadron. He manœuvred his unweildy and richly-laden ships with such nautical skill and dexterity, when attacked by a superior French fleet of men-of-war and frigates under the command of Admiral Linois, defending himself with such gallantry and well-directed broadsides, though manned by a company of merchant seamen and Lascars, sufficient only to work and not to fight his ships, that the French admiral retired from the contest with serious loss and discomfiture. This gallant action, which stands completely by itself in naval history, procured for its hero the honour of knighthood and personal thanks from his sovereign, a vote of thanks and an honourable reward from the East India Company, and the acclamations of all his admiring countrymen. The English have a propensity to give familiar titles to their favourites, naming one the Hero of Acre, another Nelson of the Nile, the Cock of the Rock to the gallant defender of Gibraltar; so they named Sir Nathaniel Dance the Fighting *Ingy* (India) man.

To return to our subject, the younger Mr. Dance designed, among other buildings of lesser note, two prisons for the corporation of London—Newgate, and Giltspur-street Compter; the former is situated at the corner of Newgate-street and the Old Bailey, and derives its name from the ancient city gate so called, which stood across Newgate-street, between Aldersgate and Ludgate. It was a prison of great antiquity, and as late as 1457, Newgate, and not the Tower, was the prison for the nobility and great officers of state. Being much damaged by the fire of London, it was repaired and beautified by Sir Christopher Wren, in 1672. In one of the niches was a figure, representing Liberty, with the word *Libertas* inscribed upon her cap, and with a cat at her feet, in allusion to the story of Sir Richard Whittington, who bequeathed a sufficient sum to rebuild this gate, which was satisfactorily done by his executors in 1423. This statue, with another of similar rude sculpture, are preserved in two niches in the Old Bailey front of the present building.

On the removal of all the city gates except Temple-bar, the corporation of London resolved on building a new and more capacious prison, in the room of Newgate and Ludgate, the latter of which was appropriated solely for debtors who were citizens of London. The duty devolved upon Mr. Dance, the city surveyor, who accordingly prepared his designs, and the first stone was laid on May 28, 1770, by the lord mayor (Alderman Beckford.) This was the last public act of this eminent and patriotic citizen. The prison was broken into by the rioters in 1780, the prisoners set free, and the interior burned. It was speedily repaired, and after several recent improvements and alterations has become the city and county felons' gaol. On a continuous rusticated ground story are erected a central building and two wings, deeply recessed from each other, and producing thereby an harmonious proportion of light and shade. The governor's house and offices, some of which have been occasionally used for state prisoners under punishment for political offences, occupies the central building, and in the solid wall between it and the wings are constructed doors of solemn and gloomy aspect, leading to the two different departments of the prison. Over these doors are representations in sculpture of fetters, chains, and handcuffs, such as were formerly in use for felons. These, with the entrance-doors and windows to the governor's house, are the only apertures next the street, and, with the coarse chamferred rusticated stones of which the building is composed, and the massive modillion cornice and plain blocking course with which it is surmounted, give an air of sombre melancholy appearance to the building, truly characteristic of the purpose for which it was erected. Indeed, it may be considered as one of the most characteristic designs that ever emanated from an architect's mind. When viewed from the western end, from which the lateral front next Newgate-street being that of the north wing, with its deep recesses terminating with the south wing next the court-yard, which separates it from the sessions-house, the merits of the design are peculiarly striking.

The other prison, that called Giltspur-street Compter, owes its origin to the same cause as the former, and was erected in the stead of two or three smaller, dilapidated, and less commodious houses of detention. It is situated on the eastern side of Giltspur-street, in a line northward of Newgate. The elevation is composed of a centre and two wings projecting from the main body of the building, which is of Portland stone, laid in rusticated courses, and as it is more a house of correction for misdemeanors, and for the detention of untried prisoners till taken before a magistrate, than a penal gaol, it has a series of small semicircular headed windows, and a single central door next the street. For the same reasons, the design is less gloomy, and also less picturesque, than its more solemn neighbour; yet it is an excellent and very appropriate design.

The Lunatic Asylum of St. Luke's, Middlesex, is another work of the same architect, the original building, which was established by voluntary contributions, as an improvement upon the royal hospital of Bethlehem, being taken down to make way for the new square and other buildings on the Finsbury estate of the corporation of London. It stands on the north side of Old-street-road, and is an extensive and lofty building, consisting of a centre and two wings, bearing a just and harmonious proportion to each other, and to the buildings which unite them. They are divided into a series of semicircular recesses and piers. The semicircular part, which is near the ceiling of each story, gives light and air to the cells without exposing the unhappy inmates to the gaze, and often derision, of the multitude, as was the case in the old hospital in Moorfields. Its whole aspect is commanding and highly characteristic of the use to which it is designed, and shows how far genius may use even the plainest materials—this building being, like many of Palladio's, plain brick and a few simple stone dressings; and it is not too much to say that few buildings in our metropolis, or perhaps in Europe, surpass this for unity and appropriateness of style.

The Royal College of Surgeons, on the south side of Lincoln's-inn-fields, is another example of the genius of this tasteful architect. The building is very extensive, occupying a large frontage next Lincoln's-inn-fields, and a great depth to its south front in Portugal-street. The principal front is decorated by a six-columned portico of the Ionic order, tastefully adapted from the Ilissus, with a proper entablature and acroteria. In the frieze is inscribed—"Collegium Regale Chirugorum."

Upon the acroteria above the entablature are a row of antique bronze tripods, attributes of Apollo Medicus, the ancient tutelary god of surgery. Over the centre intercolumniation is a massive shield, on which is sculptured the armorial bearings of the college, supported by two classical figures of Æsculapius, with his club and mystic serpent. In the interior are a spacious and handsome museum, board and council-rooms, libraries, conversation rooms, a handsome hall, and domestic apartments.

The Royal Academy thought so well of the principal front of this building, as to propose it as a fit subject for the competition of its architectural students, who were required to present two drawings, one in outline, figured from actual measurement, and the other shaded and tinted; when their first silver medal was awarded for the best drawings to Mr. George Allen, whose premature death was mentioned in these pages a few months since.

The college have recently made large additions and improvements to this building, by adding two columns to the portico, an additional length on the front, and many alterations in the interior, under the direction of James Barry, Esq., R.A., architect of the new Houses of Parliament.

The gallery of the British Institution, in Pall-Mall, is another instance of this architect's taste and invention. The principal front is amenable to no architectural law; yet it is a beautiful architectural composition. The picture galleries are harmonious in proportion and well lighted. It was originally built for the first Alderman Boydell, for the reception of the pictures that were painted at his expense, for his splendid edition of Shakspeare; and was called, until its present occupancy, "The Shakspeare Gallery." Its use was indicated by one of the most elegant pieces of sculpture ever executed in modern times, representing the apotheosis of Shakspeare, by Banks.

The south front of Guildhall, another work of this architect, has received much censure from not having fallen within the rules of any style of Pointed architecture hitherto executed. That Mr. Dance was not ignorant of the proportions of Gothic architecture, although he might not worship it with all the fervour of the black-letter Dr. Dryasdusts, may be proved by his able restoration of the ancient church of St. Bartholomew the less, before the rebuilding of the interior by Mr. Hardwick. The façade of Guildhall belongs to no style, and is amenable to no laws; but may be considered as a fanciful dream of its inventor, composed of civic ornaments of swords and maces, caps of maintenance, shields, and other civic heraldry, embellished with windows neither Gothic nor Hindûstanee, but a mixture of both, as if some of the pictures of his eastern friends, Hodges and Daniells, with some of Wren's, had been floating before his eyes like dissolving views. The porch is surmounted by a row of queer-looking ornaments, resembling nothing so much as the back flaps of George the Third's life-guards. It is, however, a picturesque and most original composition. Whatever faults may be attributed to Mr. Dance's front to the Guildhall, they are more than compensated for by his well-proportioned, original, and elegant chamber erected for the meetings of the common council of the city of London. The room is of the proportion of two cubes, the centre being given to the body of the court, on the floor of which are ranges of seats for the commoners. The western half-cube is raised above the level of the court, and is appropriated to the chair of the lord mayor, a bench on either side for the aldermen, recorder, and sheriffs, with a seat and table below for the accommodation of the town-clerk, the common crier, and the clerk of the court. The eastern half-cube is separated from the body of the court by a bar, at which counsel, petitioners, and other persons who have to address the court, appear. From the door below the bar is a passage leading to a commodious reporters' box at the further end; and at the eastern end of the chamber is a spacious gallery for persons wishing to hear the debates, which is free to every one so long as there is room. The centre of the court is covered by an elegantly-proportioned spherical cupola, supported on four segmental arches, and lighted from above by a capacious circular lantern. In the spandrels under the cupola were formerly four allegorical figures, painted by Richard Westall, R.A., but being much injured by damp were removed. At the upper end of the chamber over the lord mayor's chair is a fine marble statue of George III., executed by Chantrey, at a cost of upwards of 3,000*l*. Under each pendentive of the cupola is a marble bust on a lofty pedestal of Nelson, Wellington, and Granville Sharpe. The walls are decorated with several fine historical pictures and portraits, many of which were the gift of the first Alderman Boydell.

One more building of this Mr. Dance must be mentioned, for the bold originality with which he violated one of the first principles of his art, and which may be condemned by Palladian pedants, as the Dryasdusts have his Guildhall-Gothic—namely, the little church of St. Alphage, in London-wall. The ancient church on this spot escaping the fire of London, became, about the time the additions to Guildhall were proceeding, so dilapidated, that it was rebuilt from this architect's designs. The singularity above alluded to consists in having elliptical columns, instead of circular, where, being attached to the wall in a very narrow street, great projection could not be obtained; and consequently produce a better effect of light and shade, from the depth of the undercutting, than either pilasters or semicircular columns.

Although Carlton-house, the palace of George IV. when Prince of Wales, has been removed, and the Theatre Royal Drury Lane which preceded the present one has been burnt down, they both possessed architectural qualities too great to suffer the name of their architect, Henry Holland, to pass unnoticed. The former consisted of a centre and two projecting wings; the portico was six-columned, of the Corinthian order, selected from the temple of Jupiter Stator at Rome, the capitals of which are singular for the intertwining of the inner volutes. This portico was presented by George IV., on the taking down of Carlton-house, to the trustees of the National Gallery, and were adapted by Mr. Wilkins, the architect of that edifice, to the central building. Drury Lane Theatre, that was celebrated for the triumphs of Mrs. Siddons, the Kembles, and Sheridan, its talented proprietor, was, in their opinion, and that of all theatrical critics, the very *beau idéal* of a dramatic theatre; nor has its equal been since erected in England. On the summit of this stupendous edifice, the architect had erected a lofty octagon tower, somewhat resembling the Temple of the Winds at Athens, the apex of which he surmounted by a colossal statue of Apollo with his lyre, as the god of music and dramatic poetry. It is singular that, at the awful conflagration which consumed this truly national structure, and caused the House of Commons to adjourn its proceedings in pity to the misfortunes of their brother senator, considering it a general calamity,—the statue of the god, surrounded by flames that reached far above its head, and looking as if in the crater of a volcano, was almost the last object that fell with a death-like crash amidst the fiery mass that was blazing in the pit of this once elegant theatre. This architect also built the first Pavilion at Brighton, for the Prince of Wales. It was a neat, unassuming, sea-side villa, decorated with a few Ionic columns, like those of the Ilissus. This building also met the fate of Carlton-house, and was taken down to make way for the present heterogeneous structure.

One of his buildings, however, did escape destruction—Melbourne-house, Whitehall. It occupies a large space of ground between the Horse Guards and the Treasury, with two fronts—one towards the public street, Whitehall, and the other facing the Mall in St. James's-park. The entrance-front, next Whitehall, is decorated by a four-columned Ionic portico, of the Ilissus order, which, extending to the curb-stone of the footpath, allows carriages to come close to its plinths, and set down visitors under its roof. The footpath is continued under it, which often affords to passengers a friendly shelter from the rain. Right and left of the portico are columns of the same height and proportion, detached from the wall, with projecting entablatures profiled over them, which, with the great projection of the portico, give a play of light and shade too seldom found in the street-fronts of our public buildings. This front has no other aperture but the entrance-door, which opens into a spacious hall, covered by a spherical cupola, which leads to the internal apartments of the mansion. It was built for the late Duke of York, and, from the circumstance of the somewhat overwhelming appearance of its huge cupola, which seems almost to crush the little portico beneath, it gave rise to a ludicrous saying, that Mr. Holland had lodged the Duke of York in the roundhouse, and the Prince of Wales in the pillory. The latter remark alluded to the long Ionic screen that separated the courtyard of Carlton-house from Pall-Mall, through which the portico and the two wings seemed to peep like the head and two hands of a prisoner in that instrument of punishment. On the nothing-to-do appearance of these columns, an Italian architect, the elder Bonomi I believe, inscribed the following epigrammatic question and answer: addressing one of the isolated trunks, he asks—"*Cara colonna che fate qua?*" to which he makes the stone reply—"*Non sapiamo in verita!*" I quote from memory and hearsay, and know not into what *Charivari* of the day to refer for a correct version, if in error. Mr. Holland's other works were on and about the great building speculation of Sloane-street and its neighbourhood, and may be regarded in a similar light, as to architectural character, to those of the Adams in the Adelphi.

As it has been customary to give additions to the names of eminent princes, such as Louis the Great, Charles the Bald, Richard the Lion-hearted, so a cotemporary biographer of the Brunswick family proposes to call the successor of George III. "George the Magnificent." As regent and sovereign of these kingdoms, he exhibited a love for architectular splendour more capricious than tasteful. Gaudiness was more esteemed than elegance, and George the Magnificent delighted more in the costly extravagance of the Dioclesian school, than in the tasteful grandeur of Pericles and Phidias. John Nash was exactly the architect to the regent's mind; and gilded profusion usurped the place and overlaid the purer taste that had been introduced by Chambers, Wyatt, Stuart, Dance, and Holland. Hence, George IV. preferred the gorgeous profusion of the Roman school in its decline, to the sublimer truths of the Athenian in its greatest purity; hence, he preferred the pretty beauties of the Dutch and Flemish masters, to the sober and less apparent magnificence of the Roman school; hence, he preferred cabinets and *bijouterie* to works of sterling merit; hence, he preferred Canova to Phidias; and hence, all the bad taste that emanated from the patronage of George the Fourth. He decorated all the lower apartments of Carlton-house, low in height as well as in situation, with Corinthian columns, redolent with burnished gold from abacus to plinth; so bright, indeed, that their proportions could not be scanned, and their only excellence were their extreme cost. This suite of apartments, which were level with the gardens next St. James's-park, and beneath the splendid suite of state apartments designed by Holland for levees and other regal purposes, were furnished, by the architect, the cabinet maker, the carver and gilder, the upholsterer and carpet maker, with almost Tiberian luxury, for the personal use and comfort of the regent and his favourites, who could make their exits and entrances by the back way in the park, without ever going up to the public and royal part of the regent's palace. This costly and, as Holland left it, tasteful edifice, he swept away, and pulled down Buckingham house, the favourite residence of his father, to make way for the present Buckingham-palace, which all the patchings of Blore have not been able to lick into decent shape: neither has it a tasteful exterior nor a comfortable interior, as the complaints made to Parliament, of the want of domestic accommodation, fully prove. He removed the pretty Pavilion at Brighton for the capricious nondescript which now so expensively occupies its place. Before the removal of Carlton-house, when George IV. entertained the greatest assemblage of princes and warriors that, perhaps, ever met together at the English court, after the great and terrible triumph of Waterloo, the entertainments were both extravagant and childish. A canal, filled with real water and living fish, meandered among the tureens and *plateaux* of the dinner table, till the unfortunate sufferers were killed and nearly cooked by the heat of the soups, the viands, and the *entrées*. There was also erected in the gardens a circular revolving temple or tent, moved by invisible machinery, designed by the chief architect whom the prince deigned to honour, for the admiration of the imperial, royal, and gallant visitors to the regent of England. This building is now applied to a very useful purpose, being the model-room at Woolwich-arsenal. There was also a fragile Chinese bridge thrown over the canal in St. James's-park, which, had it been consumed by the illuminating lamps that showed its barbaric proportions to the gazing multitude, as it was threatened, it would have been spared the disgrace of a sarcasm and an early destruction from premature decay. When Canova, shortly afterwards, visited this country, partly to view our metropolis, and principally to feast his eyes upon the unequalled beauties of the Elgin marbles, he was accompanied in most of his perambulations by an amiable and eminent living architect, whose name I may not mention without permission. He was so delighted with the simplicity and durable construction of Waterloo-bridge, that he demanded of his guide if it were not built at the public expense? He was informed that it was erected by private, untitled individuals; but, if he would accompany him a short distance, he would show him one built by royal command at the public expense, "from the designs and under the superintendence"—to borrow a favourite expression of our craft—of the chief architect to the crown. He took his friend Canova to St. James's-park, he pointed with supreme derision to the pagoda bridge, and exclaimed—"Behold the work!"

Nash must not, however, be judged by these royal puerilities; for no man should be estimated by the worst, but by the best of his works, unless the former so far preponderate as to overwhelm the latter. Regent-street and the Regent's-park will carry the names of George IV. and John Nash, as patron and architect, with considerable applause to a late posterity. The clearing away of the narrow streets, dirty alleys, and filthy courts, without sewers or underground water-courses—a very honeycomb of cesspools, and hive of sordid abominations—that existed between Oxford-street and Pall-Mall, to make way for a broad, handsome, and varied thoroughfare, from the New-road, Marylebone, through the handsome *cul de sac*, Portland-place to St. James's-park, is not only a work of great sanitary welfare to that portion of the metropolis, and has opened a necessary thoroughfare from Westminster to the wealthy district of Marylebone, but is one of the greatest architectural improvements that have taken place in the metropolis between the reigns of Charles II. and George IV. The great sewer alone that extends from Portland-place to Whitehall, and purifies, by its various branches, a portion of the metropolis equal in extent to many a city, would have done honour to the names of Agrippa and Cato the Censor.

The expense of purchasing the ground and property, and interests upon it, was enormous; but the calculations of the architect, and the powerful support he received from his royal patron, enabled him to accomplish, after many and annoying obstructions, this vast undertaking. When the plan for the street and the sewer was completed, the ground was offered to public bodies or individuals, under severe restrictions as to external design and quality of materials, at heavier ground rents than had ever before been paid for houses of retail business. Sites for public and private buildings were taken, as the speculators or builders required; and as fast as portions of the main street were finished, and became connected with lateral streets, they were opened to the public.

Nash did not compel any of the lessees to employ him as their architect, but left every one to make their own choice, reserving to himself and the commissioners for carrying the works into execution a right of rejecting such plans as did not accord with the intended style of the street. From this cause arises the pleasing variety that distinguishes Regent-street from the monotony of many of its more opulent northern neighbours. Instead of single houses, it consists of many fine rows of houses, some of which would not disgrace a palace or royal residence, and might be taken for such did not the subdivisions of the shops or offices show their application. Many of these, as Waterloo-place, the Quadrant that leads from it to Regent-street, the mansion that he built for himself on its eastern side and some of the best connected series of houses, and the two Circusses, that connect the great crossings of Piccadilly and Oxford street by a continuation of the main street to Langham-place, are from the designs of Nash. Some of these, to hasten the completion of the work, he undertook himself as a building speculator, which neither amended his fortune nor increased his comforts; but Nash was a bold, enterprising man, and had a spirit not easily daunted by difficulties. The other architects who principally contributed to this great undertaking were Soane, who will be mentioned hereafter, C. R. Cockerell, the younger Repton, Decimus Burton, the two Smirkes, and the elder Abraham, who being happily in the land of the living, their works do not come into this portion of our history, which will close with the works of our respected predecessors.

Nash's other great work, the Regent's-park, shows the talent of this eminent artist to great advantage. The arrangement of the roads, canal, lake, and plantations, which were all finished and in a growing state before scarcely a house was erected, exhibits the power of Nash's mind in grasping a whole, and his taste as a landscape artist to great advantage. So little did he care about the minor details of his art, that he either knew not or contemned the differences between the schools of Greece and Rome; for once, when engaged in a conference with him, relative to the galleries of the Society of British Artists, which he built from my designs, he inquired why I spoke disparagingly in the "Annals of the Fine Arts," of his architectural taste,—he was asked if he really preferred the mean and meagre capitals that he had employed in the exterior of his own house in Dover-street, and in the porticoes of Waterloo-place, over those of the Ilissus? He replied, that an Ionic was an Ionic, and he did not care which his draughtsmen used. But it is remarkable that he ever after employed the latter, as may be seen in the before-mentioned two Circusses, and some of the more northern buildings of this street.

This beautiful and highly-decorated park bears testimony to the liberality of Nash's great patron, who not only dedicated this portion of the crown lands, previously known as Marylebone-park, to the public, but presented the magnificent royal library of his father to the British Museum, and a splendid collection of casts from some of the finest antique statues in Rome to the Royal Academy, for the use and benefit of the British public. The Regent's-park is bounded on the south by the New-road, from which it has five entrances, two between the east and west sides of Park-square, opposite Park-crescent, Portland-place; one between Ulster-terrace and York terrace; one opposite Marylebone church, called York-gate; and another opposite Baker-street, between Cornwall-terrace and Clarence-terrace;—on the west by a new road leading to Lisson-grove; on the north by Primrose-hill; and on the west by streets reaching to the Hampstead-road. The Regent's-canal encircles nearly the northern half, carried through a beautifully-planted valley. In the centre is a circular road, called the Ring, within which are the beautiful gardens of the London Botanical Society.

The principal terraces and buildings that surround or stand within the park are chiefly from the designs of Nash himself, and two or three by living architects; but the limits of this work do not permit more than a brief mention of some of the best, which are—York-gate and terrace; Sussex and Clarence terraces, named after two of the prince regent's brothers; Cornwall-terrace, named after the second title of the heir-apparent to the British throne; Hanover-terrace, after the reigning family; the menagerie and gardens of the Zoological Society; the royal hospital of St. Katherine, removed from the site now occupied by the St. Katherine's-docks; the Colosseum, a building more resembling the Pantheon of Agrippa than the gigantic structure whose name it assumes; the Diorama, and the villas of the late Marquis of Hertford, Sir Herbert Taylor, Lady Arbuthnot, and that of the late Mr. Burton, called the Holme, beautifully overlooking the spacious lake, and a few others of less distinction. Of Mr. Nash's other works, which are tolerably numerous, the limits fixed to this concise history will not allow me even to name: many of them are some extensive mansions and villas, town-halls, and similar buildings, principally in Kent and Sussex, which are all marked by his peculiar taste, which was neither pure by nature nor refined by study. He was rather a great building projector than a tasteful artist. His taste in landscape gardening, which combines the beauties of Kent and Brown, founded upon the purest English models, was less artificial than those of Le Notre and other masters of the French school, whose formalities are proverbial. Nash lived to a Nestorian age, and, if unlike Wren in anything else, he died, like him, neglected.

A few works of some celebrity must be introduced rather parenthetically, and more briefly than I could have wished. The Auction-mart at the bottom of Bartholomew-lane, opposite the north-east corner of the Bank of England, occupies a situation too public for its slender pretensions to either taste in design or skill in adaptation; the staircase, which leads from the hall to the numerous public auction-rooms in the upper stories, is narrow, steep, and dangerous to a fault—in that portion of a public building which, above all others, ought to be capacious and easy of access. It was erected from the designs of the late Mr. John Walters, who obtained the honour of being selected from a number of his cotemporary architects, as the author of the best design submitted to a committee of auctioneers. This architect also designed Stepney new church, situated at the rear of the London-hospital, Mile-end. It is in the later Pointed style, which appears more congenial to the architect's taste than those of Greece and Rome, for it is altogether better as a work of art than the preceding. It has large transverse windows at each end, and smaller ones of a similar character in the north and south sides. Being finished with octagonal turrets and pinnacles at each end, without either tower or spire, it bears a greater resemblance to a collegiate chapel than to a parish church. The pulpit, galleries, altar-piece, roof, and pewings are of solid oak, carved, moulded, and panelled; resembling in durability of materials the best works of our best church architects. It was erected in 1819, but its amiable architect died young, and much lamented, before its completion.

The offices of the Board of Control, Cannon-row, Westminster, built originally for the Board of Ordnance, by the late William Atkinson, Esq., is an extensive building with two fronts, one facing the river Thames, and the other next the before mentioned street. The Ionic portico of its principal front is one of the best proportioned and most aptly applied in the metropolis. It is four-columned, with a pediment after the best canon of the order—that of the Ilissus. The entablature is continued on each side of the portico, and terminates at the angle of the principal front.

The late King William IV., although never aspiring to the title of a connoisseur in art, yet showed a sound judgment in selecting for his chief architect the late Mr. Jeffrey Wyatt, to enlarge and embellish the ancient royal palace at Windsor, which had been patched by Wren, added to by James Wyatt, and botched by Nash. The additions made by William IV. were extensive, judicious, and in good taste. He expressed his views to his architect, and left him to complete them. He honoured him with knighthood, and, to give him a distinction among the numerous family of his name, he augmented his patronymic to Wyattville; and Sir Jeffrey of that name became distinguished by the favour of his sovereign, and by the taste he exhibited in his additions to Windsor-castle. He completed the noble quadrangle, and perfected the entrance begun by his uncle, James Wyatt, and known as George the Third's staircase; finished some and added others to the noble suite of domestic and state apartments, which are now so generally admired. He rebuilt and added to many of the external towers and other buildings on the principal terrace; and brought the whole exterior into a unity of design, that it never possessed since the days of William of Wykeham, its original architect. He also raised the Keep, or Round-tower, nearly 100 feet above its former altitude; and rendered the whole mass of buildings of which this magnificent royal palace is composed, to a unity of design that its former heterogeneous mixture of styles apparently bade defiance to.

Sir Jeffrey Wyattville began his career as an architect rather late in life, having practised the more profitable business of a builder at the western end of the metropolis. He, however, showed a great love for art from the earliest period of his life, and often exhibited designs, of great taste, in the annual exhibitions of the Royal Academy:—one, a picture in oil of Priam's palace, as described by Homer, showed inventive talent of the highest order. Sir Jeffrey published a beautiful series of his works at Windsor-castle, which ought to be in the hands of every lover of this noble art.

Downing-college, Cambridge, Haileybury-college, Hertford, University-college, London, and the buildings containing the National Gallery and the Royal Academy, on the northern-side of Trafalgar-square, are from the designs of William Wilkins, R.A., formerly Regius Professor of Architecture in the Royal Academy, and author of several works and delineations. These buildings are all of one family, one school, one style—pedantry. Grecian art, instead of giving freedom and beauty of style to the designs of this artist, Minerva seems to have frozen up all his faculties by the terrors of her ægis. So much Greek, so much gold, was a saying of Samuel Johnson; and so much Greek, so much *cold*, was the practise of William Wilkins,—for no liberty would he give or take, no line or member would he use but for which he could not find a precedent in some ancient Greek building—and the older and more formal it was the better. He was a Greek puritan and an archaic methodist. The Corinthian portico of the National Gallery is Holland's, or it would not have been so luxuriant in its foliage. But he has frozen the entablature by his Hellenic coldness. Had he been a sculptor, he would have cut off the Hyacinthian locks of the god of Day; he would have deprived Jupiter of his ambrosial curls, as Delilah did Sampson,—and sent them both into Olympus like a couple of Roundheads. As to the interior of the building, the Royal Academy may well regret the greater dimensions and finer proportions of the large exhibition-room and well-proportioned council-chamber, designed for them by Chambers, and decorated by the pencil of Reynolds. The exhibition-rooms of the National Gallery are unworthy of the name, and some of our auctioneers and picture-dealers have better. As to the portico, it is, from its situation, but of little use; and the Royal Academy are obliged, during their exhibitions, to erect a temporary wooden one beneath and without it, for shelter and shade. At Carlton-house, it was a useful addition to the building: in this place, it is a useless application, stuck up for the admiration of gazing cabmen and hackney-coachmen, whilst loitering upon their stand.

The portico at University-college stands in the same category—useless, and, therefore, an unnecessary appendage to the building. The architect has also mistakenly placed the staircases to the principal story outside of the structure, instead of within its walls, like a Swiss chalet. Should the Emperor of Russia, in imitation of the Empress Catherine, erect another ice palace at Petersburgh, no man could have executed the freezing task so well as the cold and chaste architect of Downing-college.

Yet Mr. Wilkins was a learned man, was a graduate of the University of Cambridge, an accomplished Greek scholar, and, perhaps, the best educated classic that has honoured the profession of architecture since Sir Christopher Wren. Had the talents of Mr. Wilkins been directed solely to literature, Grecian archaiology, the higher branches of mathematics, or to an accurate delineation of those antiquities which he so profoundly admired, he would have obtained a higher standing among the great men of his country, than he does among its architects; lacking, as he does, the architect's greatest qualities—invention, and freedom from pedantry. Had he been sole dictator of art, no style would have passed current in his realm, but the hard, dry, cold Greek of the oldest times, without a shadow of invention to give it vitality. His was the very mummy of the art,—as cold, as lifeless, and as much bound up by the bands of precedent. It is the Greek style of Mr. Wilkins that has wearied so many of its warmest admirers.

The Bank of England, the new Treasury-chambers, before their recent alteration by Mr. Barry, the royal entrance to the old House of Lords, affectedly called by its architect "*La scala reggia*," and some others of his earlier works, show the exuberance of the fancy, while the sound judgment and good taste that acknowledge the rules and precepts of the greatest masters of the art, place Sir John Soane on a level with any English architect since the days of Jones and Wren. Whilst the puerilities and freaks of fancy indulged in in his own house and museum, Lincoln's-inn-fields, the Dulwich-gallery, the new buildings at Chelsea-hospital, and the National-debt-office, in the Old-Jewry, exhibit a wild exuberance of novelty, unchastened by the sober rules of art, it has stamped them with the character of what the Italians would call *Capriccios*, rather than severe compositions. His greatest work, the Bank of England, whether taken as a whole, or considered as a series of detached buildings, erected at several periods, and subsequently brought into a whole by the hand of taste, is a work of singular and sterling merit. The long north front next Lothbury, is simple, grand, and imposing, and is among his earliest and best productions. The west front, next Princes-street, whilst the ugliest of all forms in architecture, an acute angle, which the junction of the two fronts form, is overcome in an original and masterly manner. This is managed by cutting off a considerable portion of the unsightly angle, and converting it into a slight recess; and the two fronts are gracefully connected by a circular portico of columns and pilasters, the entablature of which is surmounted by a beautiful acroterium, over the obtuse angle at the back of the portico, under which is an unoccupied niche, corresponding with those in the Lothbury front. Soane, undoubtedly, had in his mind the semicircular porticoes of the north and south transepts of St. Paul's (of which he has often expressed to me his most ardent admiration), when he placed this segment of the circular temple at Tivoli to conceal this ugly corner. He has, by this means, not only overcome an unforeseen difficulty, but converted what would have been a blemish in common hands into a positive beauty. So original, so happy, and so beautiful, is this gem of our art, that the committee of architectural students of the Royal Academy made it the reverse of their medal, which they struck in honour of their eminent professor, and presented to him before his retirement from public life. It has been proposed, and the thought is a happy one, that a statue of its architect should be placed in this vacant niche, and thus supply all that is wanted—a figure to this unique design. The small quadrangle called the Lothbury-court, is a design of surpassing beauty and elegance. A recessed portico on the right hand, and on the left lead to the bullion-office and other important offices of the Bank; whilst four detached columns of the same order, supporting statues of the four quarters of the globe, conduct, through a semicircular-headed gateway, to the interior apartments of the edifice. That portion of the quadrangle which immediately faces the great entrance gates, possesses a magnitude and beauty sufficient for a triumphal arch. The architect was so justly proud of this design, that he erected a copy of the columnar portion of it, upon a smaller scale, as a decoration to the front of his own villa at Ealing. The ample rotunda, formerly used as a stock-exchange, but now as one of the dividend-paying-offices, is a grand, simple masterpiece of art; as is the large office at the north-west corner of the building, decorated with lofty Ionic columns of beautiful Greek proportions, with a vaulted ceiling. These beautiful and correct works are among Soane's first and best productions. The front next Bartholomew-lane was next in point of time, and shows a greater tendency towards an excess of ornament than the preceding ones. This elevation abutted for some time upon Sir Robert Taylor's Corinthian pavilions, which were afterwards taken down, and the Soaneian style carried on in Threadneedle-street, from both ends, till they joined the centre of the original building, erected by George Sampson, in the reign of William III. This, finally, gave way to the present new centre, which is by no means the happiest of Soane's designs. Thus the Bank became completely isolated, and has but one entrance in each street:—that in Lothbury has been before described; the one in Bartholomew-lane leads to the rotunda and other public offices for the payment of dividends and transfer of stock; the three next Threadneedle-street, which may be considered but as one, lead through a spacious court to the hall, the front and interior of which exhibit a fair specimen of Sampson's style as an architect. The entrance next Princes-street is, I believe, never opened. Thus there are but three entrances to this immense treasure of enormous wealth; nor can a more appropriate building for such a purpose be imagined. The order used is that of the circular temple at Tivoli, known to every connoisseur of picturesque beauty; but which is of such obscure origin, as to be unknown whether it was dedicated to the goddess

Vesta, or to the sibyl so well known in ancient Roman history. Soane was the first architect who ever used this rich and beautiful variation of the Corinthian order since the days of its original inventor.

I am sorry that my proscribed limits have compelled me to treat the works of many of our greatest architects, particularly Wren, Nash, and Soane, with such brevity; but as I, *at present*, propose to enlarge this Memoir, and to illustrate it by engravings of the best works of every period, I respectfully bid farewell to my friendly readers.

James Elmes.

THE BRITISH MUSEUM.

No. V.

The Egyptian remains are particularly interesting, as they show the state of manufacturing art in a country which was the great centre and school of art for many ages. With Egypt the Phœnicians traded, exchanging the productions of that country for those of Greece, the Levant, and the West Mediterranean. The Egyptians were not fond of the sea, and the outward trade was always in the hands of strangers, first Phœnicians, and then Greeks. This was a circumstance which favoured the Phœnicians, for it prevented the rivalry of the most advanced country, at a time when the nations in the Mediterranean were all in a state of barbarism. It is to this trade of the Phœnicians that we, perhaps, owe the specimens of Chinese workmanship which have been found in Egypt, and some of which are now preserved in the British Museum. The trade to the Indies long passed through Egypt, but it is uncertain whether the traffic carried on by the Phœnicians, and Solomon, king of the Jews, from Ezion Geber, on the gulf of Akaba, in the Red Sea, was anterior to that of the Phœnicians or not. From Egypt the useful arts were carried direct to Greece, and in all probability to Etruria and Italy; an enterprise not more difficult than the intercourse between Tyre and Carthage. The traditions of Greece afford many examples of the influence exercised by the polished natives of Egypt; and the latter country was long regarded with reverence as the great seat of learning. The Jews seem to have acknowledged the same superiority in the craftsmen of Egypt.

Egypt had particular advantages in those days as a manufacturing country. It had good supplies of flax, the material of the great woven manufactures; and it had a large working population, supported at a cheap rate. It seems likewise to have been free from home war. Egypt was defended by its deserts, its seas, its swollen river, and its many canals, more than by the courage of its inhabitants, or by the possession of large material resources. It is true, Egypt fell under the rule of the Persians and the Greeks, but these cases of great invasions were different in their effects from that of frequent and harrassing wars, or the petty wars carried on between the towns of Greece. The history of Egypt in this respect is like that of China, which, although it has succumbed to successive Tartar invasions, has enjoyed a settled state at home. The great cities of Memphis and Thebes had greater populations than the most flourishing and powerful Greek states, and accumulated on small spots a large body of artisans, who were favourably placed for carrying out a subdivision of employment. Many manufactures were thus carried to a great pitch, as there is witness enough in the British Museum to prove to us. Indeed, down to the latest period of what may be called "antiquity," Egypt was a great seat of manufactures.

The Egyptian collections have been much improved of late by the addition of proper labels, giving as good an interpretation as possible of the names of the chief personages represented. These collections are the more pleasing, as they contain sufficient to give a very good idea of the public and private life of the Egyptians. The colossal heads of Rameses are fair specimens of their large works; while the common tools, instruments of the toilet, or articles of dress, illustrate their more trifling pursuits. Admirable as is the Greek collection for its works of art, it is wanting in the smaller specimens. The Roman collection is deficient in larger articles. The Etruscan gives us representations instead of the objects themselves.

The Rosetta stone (No. 24) is what first deserves attention, as it may be regarded as the key of the whole system. This monument seems to have been placed in a temple at Rosetta, dedicated by Nechao to Atum. It is of basalt, and contains three inscriptions on the same subject, one in Egyptian hieroglyphics; a second in Egyptian demotic or enchoreal character, a more familiar character or mode of writing; and a third in Greek. The inscriptions are mutilated, and record the services which Ptolemy the Fifth had rendered to his country. They were engraved by order of the high priests, when assembled at Memphis for his installation. The name of Cleopatra likewise occurs. The tablet has lately been put in a frame.

It will be remembered that from this tablet Dr. Young derived his theory of hieroglyphic interpretation, which he tested by its means. As the name of Ptolemy occurs so frequently in the Greek, Dr. Young thought that the corresponding group in the hieroglyphics would be found nearly as often. This proved to be the case, but afforded only one result—the discovery of the name of Ptolemy. The name of Cleopatra likewise was found, and Dr. Young thought it worth while to examine whether the hieroglyphics forming the name corresponded to the letters or syllables of the Greek. If so, the groups answering to Ptolemy and Cleopatra would to some extent correspond, as each contains the P, T, and L. Dr. Young found this to be the case, and thus obtained the elements of an alphabet, which has been extended and applied to such extent, that the dictionary of hieroglyphics now includes many thousand words.

The results of this discovery were not confined to their operation on Egyptian hieroglyphics, but have had an influence on another recondite department of learning—the interpretation of the arrow-headed characters, which, like that of the Egyptian hieroglyphics, so long baffled inquiry. The possession in museums of a few bilingual inscriptions in Arrow-headed and Hieroglyphics was of no avail, so long as both remained undeciphered; but with the unlocking of the secret of hieroglyphics, these inscriptions have acquired great importance. The names of Xerxes, Artaxerxes, and other Persian kings, have been recognised on those monuments, the Egyptian cartouches having been interpreted, and thus give materials for an alphabet of the arrow-headed character, which now engages the attention of many able and persevering students.

The tablet of Abydos (No. 117) is another valuable monument. It was found by Mr. Banks, in a chamber of the temple of Abydos, in 1818, and it was published by M. Cailliaud in 1823, and by Mr. Consul Salt in 1825. It was conveyed to France in 1837, and at the sale of M. Mimaut's collection, it was bought for the British Museum. It represents an offering made by Rameses 2nd or 3rd, of the 18th or 19th dynasty, to his predecessors in the kingdom of Egypt; but it is not yet ascertained whether the list of kings be chronological or genealogical. Originally, it held the names of fifty-two kings, arranged in the two upper lines, or twenty-six in each line. The first twelve names of the first line and the first eight names of the second line, have been destroyed. It still has the names of many kings; and it is probable that the discovery of other monuments will give ample materials for a sound system of Egyptian chronology, a matter of some artistic importance, as it will give us exact ideas of the relative ages of the works which we possess, and will throw very great light on the history of ancient civilisation.

We may observe, by the by, that in the prosecution of hieroglyphic researches, it is very likely that in late monuments and inscriptions, Greek and Latin terms and words will be found inscribed in hieroglyphic characters, for such in other cases is what may be termed a not unusual philological phenomenon.

Two not the least interesting illustrations of Egyptian art are undoubtedly the two colossal heads in the Grand Central Saloon, and in the vestibule of the Egyptian Room. The former is a plaster cast of the face of the northern Colossus at the rock temple of Ipsambul, and represents the king Rameses 2nd. The other is likewise a plaster cast of the same monarch, but the countenance does not seem to be the same. These heads, of colossal proportions, raised so high, and seated as it were on terminals, giving some idea of the trunk, are no less remarkable for their vast size than for the harmony of their expression. To give a full idea of their original grandeur, they should be placed still higher; but as it is, their effect is most imposing, and fully justifies the artistic conceptions of the Egyptians in their colossal works. To the uninstructed multitude, the contemplation of these figures, godlike in form, must have been impressive of awe. They walked, as it were, among the gods upon earth, who were present in all the sublimity of heavenly form, clothed with all the terrors of superstition, and armed with all the weapons of imposture; statues of a hundred feet in height, which might be well supposed to hear their votaries, when, as in the case of the vocal Memnon, they were known to have the power of public speech. Indeed, we can scarcely contemplate unmoved the mighty relics now before us.

The artist will admire that in works so great, breadth and smoothness should be so well preserved, and he will not fail to recognise the hands of great masters. We cannot understand Egyptian art, unless we see it in its bolder works, and then we acknowledge its sublimity. The smaller tablets and statues, the lines of hieroglyphics, and the grim figures, would give us too low a standard of Egyptian skill. In these smaller works they show only their weakness; in the larger works they show their strength; and they have left few rivals. Such a work as the Alexander statue at St. Petersburgh, sinks into insignificance in the presence of the vast outlines of a Rameses, or a Sesostris; and what we now call colossal, measured by the latter standard, becomes unworthy of the name.

The history of some of the monuments in the Museum has often points of interest. Thus, No. 23, the chest of a large sarcophagus of Hapimen, a royal scribe, was brought from Grand Cairo, where it was used by the Turks as a cistern, and named "The Lovers' Fountain." Death had evidently lost its terrors, and in the lapse of ages awe had given way to love. The origin of the modern legend would be curious if it could be traced. The colossal scarabæus (No. 74), removed from Egypt to Constantinople, was brought by Lord Elgin to London. This scarabæus was sacred to the god Tore or Cheper, and was at a later period the emblem of the world. It is a right kingly emblem for the modern Babylon. No. 10, a large chest of the sarcophagus of the king Necht-her-hebi, Her-necht-hebi, or Amyrtæus of the 28th dynasty, was at one time in the mosque of Saint Athanasius, at Alexandria.

Beneath No. 43, is one of the casing stones of the great pyramid at Gizeh, showing the angle of inclination of the sides and the material. It is a calcareous stone. It was brought home by Colonel Howard Vyse in 1838.

What cannot fail to be noticed in many of the larger monuments, is the high polish of the granite, porphyry, or serpentine, which has been well preserved during so many ages. It excites wonder that so much should have been done with the rude means at the command of the Egyptians.

The number of sepulchral monuments belonging to the Egyptians has afforded large supplies for the Museum. These record priests, judges, scribes, and officers of all kinds, and are rather of an inscribed than of an artistical character, though they supply many useful illustrations. A modern cannot but be struck on seeing such proofs of the respect paid by the Egyptians to their dead, of how much behindhand are the English in this respect. Large sums are lavished by us on the idlest and meanest shows; the hire of black carriages with hearthbrushes on their tops, or black horses with long tails, and of blackguards of drunken and dissolute appearance; while the object for whom this unpicturesque and unmeaning procession is got up is consigned to a common grave, and left without the slightest memorial of his existence, or of the regard of his friends. So far is this real disrespect of the dead carried, that the metropolitan cemetery companies have been obliged to put a check on an economy of the rites of sepulchre, which is exercised at their expense and in favour of the undertakers; for it was no uncommon event for a procession of mutes, hearses, carriages, and horses, to consign a bedizened coffin to a common grave.

The money which is spent on funeral show is one of the greatest oppressions of the widow and orphan, who, in compliance with the conventions of society, in order to do as their neighbours do, are forced to spend money on cloaks, feathers, hat-bands, and coffin-trimmings, which they can worst afford in the moment of their severest bereavement. The abolition of this show by those who are above the fear of idle clamour, would render a great service to those classes of the community whose means are limited, while it would allow of the disposal of funds in a manner much more respectful to the deceased, and much more useful to society.

Whoever has observed, has had reason to regret that in later times sepulchral memorials of individuals, even of eminence, are rare in England, and this at a time when there is enough of public and private wealth. Our great show tomb-houses of Westminster and St. Paul's, flatter us that we are not wholly forgetful of duty towards the departed; but we have only to look elsewhere to witness the general disregard of sepulchral monuments: old ones are suffered to fall into decay, and new ones are not raised. The peer, the bishop, or the judge, leaves large wealth behind him, and ungrateful heirs. It is true, public feeling has been better shown towards public men, and officers of the army raise regimental monuments to their deceased brethren; but there is no proper public provision for monumental commemoration, and little private feeling in its favour, although the cemeteries have made some improvement. We want, first of all, a public fund for monuments, and we want next the disbursement by the wealthy classes of some portion of those moneys now wasted upon undertakers. This applied in monuments would give us many valuable works of art, and would be a most laudable exercise of patronage in favour of sculpture, a branch of the arts much and undeservedly neglected in this country, though its cultivation is to be desired. The successful study of sculpture would not only give an impulse to architectural decoration, but it would have its pecuniary bearing on our pottery, our glass manufactures, and on many branches of trade in which the plastic arts exercise an influence.

In the upper Egyptian Room the visitor has his attention drawn to the many articles of glass or glazed ware. As the Etruscans are characterised by their painted vases, so may the Egyptians be by their blue glazed ware. The cases are filled with figures of this material, which are found by thousands in the tombs, being attached to the network or the necklaces of mummies. This alone must have constituted a large branch of manufacture; but the ornaments in the cases in the middle of the room are no less remarkable. Beads and drops, of clear and coloured glass, formed a great part of Egyptian jewellery, and there are many good designs of bead and bugle work, which might be thought to be modern, so neatly are they carried out. Although light blue or bluish green is the favourite colour, yet there are beads of black, white, red, yellow, and scarlet, allowing of great variety in the patterns and designs as worked. The beads and bugles are likewise of many sizes, from the smallest bead now made to a large bugle or eardrop.

The cases in the upper room contain a great variety of objects; they form, indeed, an ethnographic museum of the Egyptians, affording specimens of many domestic objects—indeed, as copious illustrations of Egyptian life as the general student could well desire. The practical man will likewise find particular interest in the tools and materials here collected, and which show the advancement of the Egyptians in many branches of manufacture, not generally supposed to have been then successfully cultivated. In some, the workmen seem not to be surpassed in modern times, and they certainly prosecuted with success most of the useful arts.

The general character of Egyptian workmanship is neatness, and this will be seen in the wove cloths, mats, beadwork, jewellery, cabinet-making, glass-work, and other articles. The Egyptians were very precise in repeating a pattern, so that some complicated designs are carried out with all the accuracy of modern machinery. In this respect the Greeks and Romans were not so proficient; neither are other modern nations so proficient as the English. Even the mat-work is well finished, and the cloth is as well woven as could be desired. Some of the mummy cloth is very good. The inlaying in the chairs and other cabinet work is very fairly done, and the wood work is well finished off in most cases. The metal wares are likewise well wrought, and the bronze kettles are as finely turned as could be desired by the most fastidious. Alabaster vases formed a very successful branch of Egyptian manufacture, and the many which are to be seen in the Museum are cleanly finished inside and out, seemingly by the lathe. The Egyptians supplied plain and coloured glass to the Greeks and Romans, and there are some bottles in the Museum, with broad bottoms, which are of very fair size. The glass articles are, however, generally small, being phials, beads, and articles of ornament. The specimens of Egyptian crystal in the Museum are not so good as those in the Roman collection, but which it may be presumed are likewise of Egyptian workmanship.

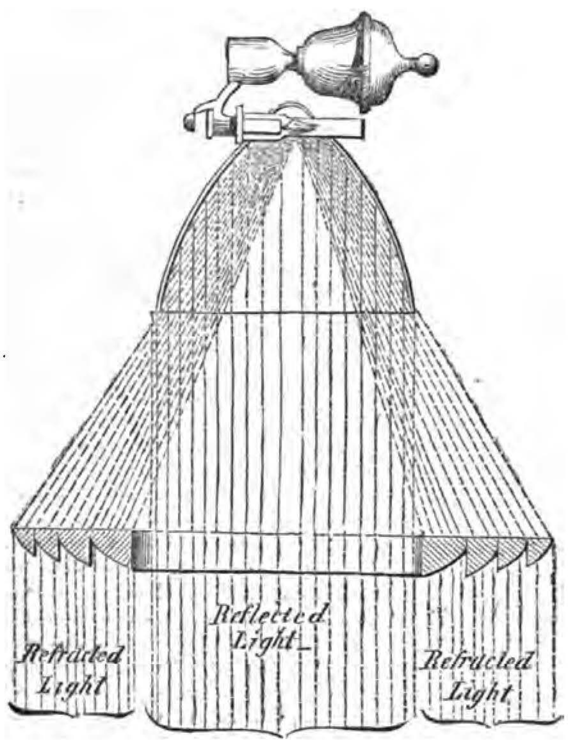
Some of the specimens of enamelled portraits are among the most interesting relics of Egyptian art, and it is to be regretted that we have not more of these relics, which are of a durable character. One figure, in low relief, in which the colours of the head dress are well burnt in and enamelled, is particularly to be admired.

The glazed earthenware figures are generally covered with hieroglyphics in black, and glazed with blue. The Egyptians had the means of beginning the porcelain manufacture in Europe, but though there are specimens of plates with designs, the Egyptians did not prosecute this manufacture to any extent, or the demand for decorated pottery would have been large among the Romans. It was left for modern times, after the introduction of Chinese porcelain into Europe, to carry out the porcelain manufacture. As the Egyptian decoration was chiefly confined to hieroglyphics, there seems to have been no demand for their glazed figures among other nations.

NEW LIGHTHOUSE APPARATUS.

Mr. Alexander Gordon has for many years directed his talents and attention to lighthouses, and, after extensive experience in fitting and improving the lights, has at length produced, under the highest auspices, a system of lights so powerfully concentrated as to promise in their adoption a very great advantage to ocean and river navigation. One of these lights was exhibited lately at Messrs. De Ville and Co.'s manufactory, 307, Strand.

Fig. 1.



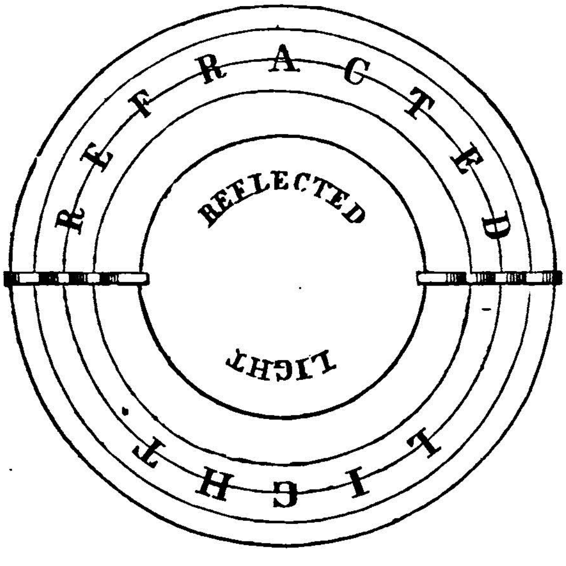


Fig. 2.

Previously to describing the new light, we will give a short historical account of lighthouse lights. About the year 1792, glass refractors, five inches thick and twenty inches diameter, were substituted for reflectors, the focal point being nineteen inches distant; and they were to be seen in use in an English lighthouse as late as the year 1832. Buffon had proposed to reduce such a refractor in thickness, by cutting the lens into steps, so as to absorb less light. In 1811, it occurred to Sir David Brewster that a lens, or set of lenses, might be built of separate pieces of glass. In 1819, the late M. Fresnel proposed that the generating sections of the rings not only ought not to have the same centre, but even that the different centres should not be situated on the same axis of the lens. A few years afterwards, M. Fresnel engaged M. Soleil to construct eight such lenses for the lighthouse of Corduan. In 1827, the Trinity Board witnessed some experiments with a lens of the kind, which had been made by Mr. Gilbert, under the direction of Sir David Brewster. In 1828, that board imported a lens from France. In 1838, Mr. Gordon introduced a polyzonal arrangement (both dioptric and catoptric), constructed by M. Maritz, of the Hague. And, subsequently, the Trinity Board, and particularly the Commissioners of Northern Lights, at the instance of Mr. Alan Stevenson, introduced the French system extensively in England and Scotland. In 1840, Mr. Gordon constructed a revolving light for Jamaica, with Huddart's reflectors, and without refractors. In 1843, the Bermuda lighthouse tower, constructed by Mr. Gordon, was lighted by Fresnel's system, contrary to Mr. Gordon's desire, who recommended very large prolate reflectors. In 1846, he introduced a fixed light for the Point de Galle lighthouse.

The new system of lights exhibited by Mr. Gordon is a following out of his prolate reflectors, as applied to the Ceylon lighthouse, by saving the radiated light which formerly escaped past the lips of the reflector. This latter portion of the light, which was formerly lost, is now bent down and thrown into the beam, as shown in the annexed engraving.

The specimen light exhibited was a single one, of great concentrated power; and although the light was only about an inch in diameter, from a common Argand lamp, its dazzling brilliancy was scarcely subdued at a distance of 50 yards. In this light, Mr. Gordon has combined a very prolate reflector and the refractor of Sir David Brewster deprived of its central portion; and by this system he is enabled to throw into a beam nearly [illegible]ths of the whole light generated by an Argand lamp. The parabolic or conic reflector is fixed horizontally, and opens at 13½ inches from the light; at a diameter of 15½ inches, and at 14 inches from the mouth of the reflector, are fixed glass zones used as the refractors, being composed of four circles (each in three pieces), varying in size and thickness,—the inside face being even, and the outside of the glass cut away into curved steps, to prevent useless portions from absorbing any of the light, as shown in the engraving, fig. 1.

Mr. Gordon proposes to use these new "systems" in some lighthouses immediately.—For Revolving Lights: To use one or more of these systems, each furnished with an Argand burner, on one or more revolving faces, according to the size of the required beam.—For Fixed Lights: To use such a number of these systems as will light the circle (of 360°), or any required portions of the circle; twenty-four systems, each with its own lamp, for the whole circle, and twelve systems for the half circle, and so on: one system to 15°.—For Flashing or Intermitting Lights: Such combination of these systems as the situation may require.—For Steam-ship Lights, or Railway Lights: A similar but smaller system; the source of light being any that is known and convenient for the required purpose.

RAILWAY EXTENSION FOR SPEEDY TRAVELLING.

If there be one thing that has more than another served the purpose of retarding railway progress, it is to be found in the dogma so studiously put forward on all occasions by "authorities"—meaning thereby railway makers—that "Speed is Weight," even though weight be not always speed. Whether on the broad gauge or on the narrow, weight has been constantly increasing in the process of competition; though it was evident to all who took the trouble to examine, that speed was not increasing in proportion to weight. Let any one examine or watch the rails on any railway while an engine, with from six to nine tons on each driving-wheel, is passing over them,—let any one watch the deflection of the rail, whether on the continuous bearing of the broad gauge or the bridge rail of the narrow,—and he will be satisfied that the process, even on the nominally level line, is really that of ascending a constant gradient, varying from 1 in 30 to 1 in 70. The process is that of driving a wave of rail before the driving-wheels of the engine, just as the bows of a steam-vessel drive a wave of water before them. We believe, in short, that the process of propulsion on railways is analogous to skating—that the adhesive impulses are given at intervals on hard points, such as well-packed sleepers; and it is on this principle only that the constant, irregular action of the draw-springs can be accounted for. As regards durability, there can be no question that the continuous bearer of the broad gauge is far superior to the bridge rail of the narrow,—and probably that may account for much of the alleged advantage in working expenses. The want of continuous bearing in the mode of laying rails in chairs on cross-sleepers is a serious evil. At the joint chairs the strength of resistance is not one-third that of the intermediate chairs, and therefore it is that the passenger counts every joint as he passes over them. The cross sleepers at the joints are beaten down, and the ground is hollow beneath them. Water gets in, and "maintenance of way" increases in amount. The rails hammer in the chairs, the keys get loose, and danger becomes imminent. If there be one rule more important than another in "maintenance of way," it is that of making the whole road, both rails and substructure, of equable resisting power throughout. It were better and safer to have a flexible rail throughout, than one alternately hard and flexible; and therein is the prominent advantage which the structure of the broad gauge has over the narrow,—though probably, taking the weight of the engines into comparative account, the rails of the narrow gauge are better proportioned as to size than those of the broad. The importance of this question will be obvious to every mechanical mind. Equal movement in all moving machinery is the thing aimed at in every case where durability is desired. Why else are fly-wheels—and why are blocks of iron placed on engine wheels to balance them? Why is it sought to keep locomotive cylinders as close as possible to the central line of the train? What but for equal movement? And yet the rail is so contrived as to produce continually-recurring blows at every joint. This must be amended before economy can be obtained.

That the railway dogma, "Weight is Speed," is a fallacy, may be gathered from the whole animal creation. The swift eagle, when divested of his wings and feathers, is reducible to a very small bulk of body. The slow goose or duck is chiefly body, with but small wings. The swift Arab horse is light, but muscular, like a double-cylinder engine, working by pure elasticity. The slow Flanders horse is like an atmospheric engine of the olden time, the muscles only serving to put the gravity in action. Who ever dreamed of applying a Flanders horse to a fast coach? Who ever dreamed of applying an Arab steed to draw a coal-wagon? Yet this is what railway competitors have been doing up to the present time. Elephants, leviathans, were a fitter term than horses. We have heard that there are existing engines weighing 35 tons, and that engines yet in embryo will, when they achieve their monstrous birth, weigh 40 tons. It is some years since a strange nondescript, called Harrison's Patent, was produced on the broad gauge. It made a trial—but all its try ended in standing still. We asked a "rude unlettered driver of the rail" why it did not answer. The answer was concise,—"It weighs forty tons." That reason is fast getting to be obsolete. If the proportion of engine weight to train weight continues to increase as it has done for some time past, the horse will soon cut up the carriage. As a rough and ready acquaintance remarked,—"The train is nothing; anything can draw these carriages, so long as the engines can draw themselves."

Many men have had their doubts of the truth of the railway dogma, "Weight is Speed." One man—a railway officer—was found bold enough, after some preliminary thinking, to put the dogma to the test of experiment. Having had constructed for him a manumotive carriage, he found that considerable speed could be attained with a light vehicle, but the speed was limited by the limited strength of man. To get a steam locomotive constructed for a speed of twenty miles per hour, and weighing only 5 cwt., was his next problem,—the object being to lift it off the rails to get out of the way of fast trains. Builders were found to undertake this: the axles were made as light as those of a pony gig, the wheels of wood, and all parts reduced to the minimum. It worked, and would ascend an incline of 1 in 19; but the boiler was not well arranged, and the axles were too close together for steadiness. It was taken in again, the axles set ten feet apart, and a new boiler applied. But there were two serious defects: the axles were too light for the increased weight, and the wheel tyres were too narrow for the "points." It was evident that, as in most cases of alteration, the parts were not fitted to each other. The second trial was made, and it soon became evident that the engine would go, but not for any length of time. As predicted, the engine went off the rails at the points, strained the axles, and again came into dock. New wheels, of iron, were applied, and stronger axles; and those who predicted, first, that the engine would not go, and, secondly, that it would fly off the rails by reason of its lightness, were out in their calculations in both cases. The maximum speed attained was 47 miles per hour—40 miles the average of 56 miles from London to Cambridge. The total weight, with fuel and water, was 22 cwt., and the number of passengers were eight, including the driver. On that memorable day the dogma, "Weight is Speed," was extinguished for ever. One hundred-weight was ou nd equivalent to thirty hundred-weight, and the vehicle was steadier at maximum speed than a first-class carriage.

The railway officer who established this fact, of measureless importance to all future railway progress, is Mr. Samuel, the resident engineer of the Eastern Counties railway. The builders of the engine are Messrs. Adams, of Fairfield Works. The draughtsman of it in its original tiny form is Mr. Reynolds, of the Eastern Counties, and formerly a pupil of the Fairfield Works.

We have not given the working drawings of this remarkable production of foresight and perseverance, as the engine, though a practically useful machine, and money-saving to the Company, will not be a pattern, but will be far eclipsed by its successor. We give the general form and dimensions, as being all that the intelligent mechanic would really desire to know.

An oblong box, the frame being of angle-iron, measuring 14 ft. in length, by 4 ft. 4 in. in width, is suspended by axle girders in spiral springs, beneath the axles of and within side four wheels, each 3 ft. 10 in. in diameter, the axles being 10 ft. apart. The axles are three inches in diameter. One of the axles is double-cranked at right angles, in the usual mode, and to this the connecting rods of a pair of steam cylinders are applied to produce motion, also in the usual manner. The oblong box is divided about midway by a partition. At the front end of the box thus divided, is placed a vertical boiler and the machinery, with the driver, the whole being contained within the base of the four wheels, and supported below the level of the axles. In the hinder part of the box are placed seats for seven passengers, some along the sides and some above the axle, which passes through the box, the entrance being behind. The cross-seat for the driver has the water-tank within it. The cylinders are 3½ inches diameter, with a 6-inch stroke. The reversing gear and link motion are as usual. The diameter of the boiler is 1 ft. 9 in.; the tubes are in number. It has been proved by cold-water pressure to 200 lb. on the inch. The consumption of coke is 2 lb. per mile, and the total expense for driver, coke, and oil is under one penny per mile. It will be obvious to every one that, with a pressure of only six to seven hundred weight on each driving-wheel, "maintenance of way" need not be taken into the account, as where six to nine tons are placed on each driving-wheel; and, also, that as no deflection of the rail takes place, there will be no slipping.

Changes, however, cannot take place rapidly, and, as a matter of course, those who propounded the dogma that "Weight is Speed," are not likely to acknowledge their error off-hand.

But our business is with the question, commercially and mechanically. The press teems with complaints of the absorption of money by the extension of railways; and either railways must stop progress, or they must be produced at a far cheaper outlay than hitherto.

As regards passengers, speed is the object: as regards goods, weight is the object more than speed; but when goods are borne on the same rails as passengers, they must, for the most part, travel at the same rate of speed. Differing speeds on the same line of rails, unless with long intervals, are a fruitful source of collision.

On the main lines of rail the traffic is stated to be so enormous, that goods wagons are constantly in arrear.

If, therefore, the passenger traffic could be transferred to other lines, exclusively devoted to passenger traffic at great speeds, it would be a very considerable advantage to the public, both in point of safety and rapidity, and also in the forwarding of goods.

At such a proposition the short-sighted amongst existing railway owners will take the alarm, for fear of the depreciation of their property. However, we do not see how their alarm could benefit them. The best way is to look all danger steadily in the face, when, where, and how it may occur. But, fortunately for them, the danger in the present case is purely imaginary.

It will, we believe, be a conceded point, that the public would prefer frequent trains carrying small numbers of persons, to unfrequent trains carrying larger numbers, and would also prefer increased speeds. And, provided it can be made apparent that they can thus be carried also more cheaply, we presume that both directors and shareholders would agree as to its desirability.

Now, in the first place, a large train involves the use of a heavy engine, as at present managed. It also involves an amount of station-room and servants, both at the termini and intermediate stations, proportioned to the numbers of the passengers. This large amount of property and persons are employed all at once, but with long intervals.

In the second place, the large train involves great momentum and greatly-increased dead weight to support shocks. It also involves the use of much heavier rails and roadway, bridges, embankments, viaducts, &c. It also involves much greater risk to passengers, by the great space taken to check the momentum and bring the train under the control of the breaks in case of sudden stoppage. And the slower the movement the larger must be the amount of stock.

With light trains all these conditions are reversed. A small station and a small number of servants, constantly occupied, will do the whole of the work; and thus a comparatively small outlay of capital is required, and a smaller amount of wages has to be struck off the general receipts.

With light trains the momentum is lessened, and less power is required both to stop and start. In case of impending collision, the risk in case of shock is lessened, and the space required to bring up in is comparatively small—50 to 60 yards would probably be enough. The small engine we have been describing will bring up from speed in about 50 yards.

Rails and roadway of far lighter structure will suffice for light trains—so much lighter as to seem almost an imputation on our "heavy-coach" railway makers. Yet, after all, the error they have committed has been in making their rails too light for their loads, and thus wasting engine power. And the greater the speed the smaller the amount of stock.

All this is to be accomplished, not by running trains on railways, or steam-carriages on highways, but by running *steam-carriages on railways;* in other words, by putting the load on the engine, instead of drawing it behind or propelling it before; thus increasing the adhesion of the driving-wheels in proportion to the increase of the load—getting rid of a large amount of dead weight on the wheels and carriages usually driven behind. And such light engines may have their adhesive power still further increased by a single carriage propelled before or driven behind, making such carriages rest a portion of their weight on the engine frame.

If we be told that such steam carriages do not yet exist, we can but refer to the practical demonstration of the engine already built, and state that we have now before us a practical tender, from persons fully competent to carry the plan into action, to furnish steam-carriages, rails, and timber-work ready for use, provided the land be delivered levelled and ballasted, ready for the permanent way, at the price of Two thousand pounds per mile of single way, the carriage to travel 50 miles per hour, and carry 1,000 persons per day of twelve hours, over a line of twenty miles in length, with greater safety than by the present system. The railway may be laid in ballast, or carried on piles.

On reverting to our description of the present engine, it will be seen that the gravity is chiefly below the axles and within the base of the wheels. Only those who are familiar with engines and wheel-carriages can fully estimate the importance of the principle here involved. With a pendulum-balance the weight is always seeking to be vertical. With a prop-balance the weight is always seeking to deviate from the vertical line. With a carriage moved by external power the adhesion of the wheels is lessened and increased from one to another by oscillation, and this while increasing the risk and light draught. With an internally-moved carriage, adhesion is required for the purpose of propulsion, and the pendulum action is the best adapted for it, as well as for safety. In short, the same qualities are required in a locomotive engine as in a ship, to ensure steadiness and swiftness,—"a low and a long hull."

The engine about to be constructed will have its frame not more than nine inches from the rails, all four wheels drivers, and will carry twenty or thirty passengers, as may be preferred.

The railways we have been describing may be laid either on piles, over fields, or on river banks, or on the surface of existing highways, inasmuch as the steam-carriages will ascend inclines of one in fifty, or pass round curves of two hundred feet radius with great facility. The weight of the engine will be about $2\frac{1}{2}$ tons, that of the passengers about the same, making up altogether 5 tons, or $1\frac{1}{4}$ tons per wheel. Supposing it desirable to convert such engines to goods traffic, a wagon of five tons might be applied before and behind, pressing on the engine to increase the adhesion with a reduced speed. By this system, the old highways might be brought back to their former state of prosperity, and property along their borders actually increased in value.

Do railway owners see in this any deterioration of their property? We do not. If it be so, do they think they can keep it back when once shown to be a public advantage? Do they think the landholders, who were strong enough to dictate terms to railway makers for their own benefit, and drive them away from the vicinity of the old highways—do they think they will be less powerful to intermarry their highways with railways—to make railways over their land, when they are brought within the compass of their own means? We do not.

But railway men need not fear the result. The railways will ever have the same advantage over the highways that they ever have had, in better gradients and straighter lines; and they have, moreover, a source of profit that they have never yet looked to—the capability of making four lines of rail complete, with the exception of tunnels, road bridges, and stations. For the light engines and mode of transit we have been describing, the slopes and embankments are perfectly eligible. For example, in the outer fence of the railway, which is to be made sufficiently strong for the purpose, an edge timber is to be laid, and on that a light rail. A similar rail is to be laid on the embankment, and the two connected by the rails. The level of the rails is about a foot below the main rails. In cuttings, the reverse mode must be adopted, with the rails about a foot above the main rails. To wide bridges, a light wooden frame may be used. At tunnels, in vertical chalk or rock cuttings, at stations, and at level road bridges, points must be made for the main line. With light engines, capable of sixty miles speed, this would be no serious objection. With the main lines thus relieved of the fast-train passenger traffic, a much larger amount of goods and slow passengers might be carried. It is not on the Eastern Counties line, from which railway improvements have of late so largely emanated that these considerations will be lost sight of, and the Directors have done well and wisely to foster the mechanical aptitude amongst their officers for the production of railway improvements, that must tell most beneficially on their shareholders' pockets.

The amount of good that must result from this new system of railway transit, wherein the proportion of dead weight per passenger, at increased speed, is reduced from about 9 cwt. to $1\frac{1}{4}$, must be enormous. And to be achieved at the rate of £2,000 per mile, minus land and levelling! We have only regarded the question in the aspect of rapid passenger transit, but if the speed be reduced, the power becomes available for larger loads. We see in this system a means of effecting transit even in the wildest countries—a means of crossing the Isthmuses of Suez and Darien, even by individual capitalists—a means of penetrating to the southern point of Italy, and shortening sea transit without coming to England for capital—a means of regenerating Spain and making it a nation, instead of a bundle of quarrelling provinces—a means of instructing all the innumerable branches of the main lines of railway already constructed throughout Europe—a means whereby almost any individual landholder may make his own railways through his estates, and thus achieve a system of agriculture of threefold produce—a means whereby Ireland may easily be intersected and civilised, and the reproach taken away from us, that a wild people, knowing no law but the "wild justice of revenge," still dwells within the borders of our island domain.

The principle herein enunciated is that of inducing adhesion and propulsion by the agency of the load on a self-moving machine, in opposition to that of making an enormous machine to produce its own adhesion, independently of the load, and therefore requiring a machine always of the maximum weight, even with a minimum load.

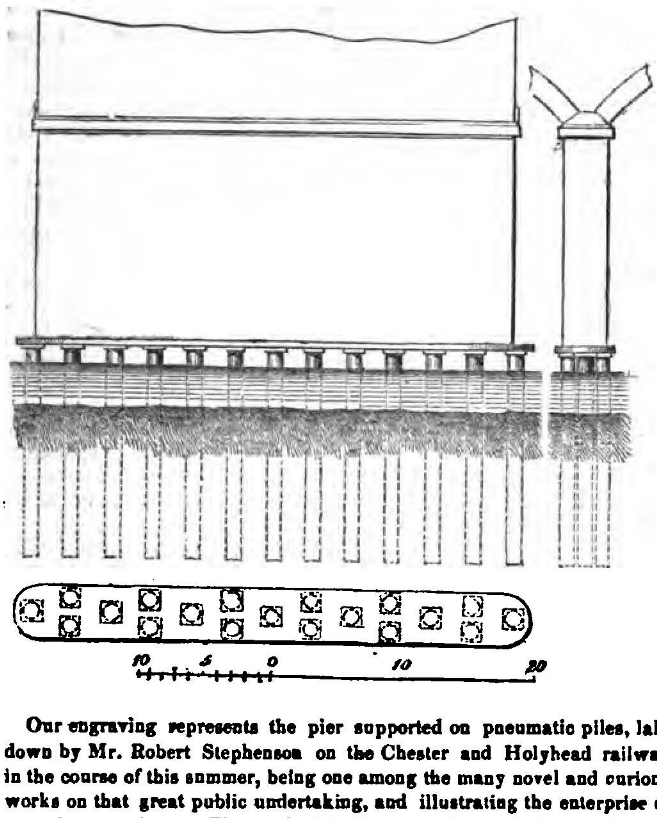
We invite our readers, who may be interested in this branch of science to investigate the data as patiently as we have done. The proposition to carry a first-class load of passengers on a self-contained machine, weighing only half the weight of an ordinary first-class carriage, and at a greatly increased speed, is a matter deeply touching the welfare of all who are connected with railways. We shall return to this important question at a future opportunity.

Photography.—M. Niepce de St. Victor, in making some experiments in photography, finds that if a sheet of paper on which there be writing or printed characters or a drawing be exposed for a few minutes to the vapour of iodine, and there be applied immediately afterwards a coating of starch moistened by slightly acidulated water, a faithful tracing of the writing, printing, or drawing will be obtained. M. Niepce has also discovered that a great number of substances, such as nitric acid, phosphoric acid, chlorurets of lime and mercury, &c., act in a similar manner, and that various vapours, particularly those of ammonia, have the effect of vivifying the images that are obtained by photography.

PNEUMATIC PILE-DRIVING.

Pile-driving is a process of great importance to the hydraulic engineer, and the means of facilitating it have engaged the attention of many. To drive by the common monkey is a clumsy operation, because the power is brought to bear on the substance of the pile rather than on the soil in which it is to be driven, and because the depth to which a pile can be driven is limited by the length of timber of which piles can be made. The effective power brought to bear has been increased by the American and other steam pile-driving machines, but without materially reducing their cost. Within the last two years a new process, called Dr. Potts's, has been introduced, which has been already applied by Mr. Robert Stephenson and other eminent engineers.

Although Dr. Potts's process is very simple, it is so different in its effects from what is imagined, that it is necessary to speak of it rather fully, in order to give a precise idea to those who, by forming quick preconceptions, may miss the principle. We have already intimated that in the common solid timber pile, power is applied to the head of the pile, and not directly to its base, or the soil into which it is to be driven, whereas Dr. Potts's pile is hollow, and the power is brought to bear immediately on the soil in which the pile is to be fixed. This is done by making the pile hollow, by exhausting the air from it, and so drawing up the soil from below the pile, whereby it is made to sink. The pile is not driven down, as most would think, by the sole pressure of the atmosphere on the top of the pile, but the shingle, gravel, or sand being removed into the pile as the air is exhausted, the soil is constantly excavated beneath the bottom of the pile, and driving and excavating proceed at the same time. This we look upon as the real distinction between the old and new process, and the point in favour of the latter, while the power is further economised by being applied direct to the true scene of action.



Our engraving represents the pier supported on pneumatic piles, laid down by Mr. Robert Stephenson on the Chester and Holyhead railway in the course of this summer, being one among the many novel and curious works on that great public undertaking, and illustrating the enterprise of its eminent engineer. The viaduct is skew, and is carried over a branch of the sea, in the island of Anglesey, and consists of two land piers built in the usual way, and of this centre pier, laid on a sand bank. It is 36 feet long and 8 feet wide, and is built on 19 cast-iron tubes, each 16 feet long and 1 foot diameter. The tubes were sunk by means of a small double air-pump, with cylinders 4½ inches diameter, and 16 inches length of stroke, worked by four men; the pumps were placed on the land pier, and a half-inch lead pipe was carried from the pumps on to the water at the place of driving.

Each tube was placed perpendicular over the spot on which it was to be sunk, and then a square iron cap placed on the top, with the half-inch leaden tube just described passing through it; at every stroke of the pump the air was exhausted from withinside of the tube, and as the exhausting process proceeded, the pile or tube made its way downwards, and the soil displaced at the bottom passed into the lower part of the tube,—and thus the operation was continued until the pile was sunk to the required depth When the whole of the nineteen piles were sunk to one level, as shown in the annexed engraving, a cast-iron plate, weighing 9 tons, was placed over them, just on a level above the surface of the water, and formed the foundation upon which the superstructure was built.

The pumps were brought down by coach, put together, worked, unshipped, and sent back again, all within a few days, so that nothing cumbrous in the way of apparatus is involved in the application—and, indeed, the air-pump can be carried where the pile-driving machine cannot. The piles were driven at the rate of half-a-minute per foot for the first six feet, and at about three minutes to the foot for the remainder.

The arches are 20 feet wide on the square, and 26 feet on the skew; and the piers 3 feet wide on the square, and 3 ft. 10 in. on the skew.

In July 1845, a pile of cast-iron, of 2 ft. 6 in. diameter, was driven into the Goodwin Sands by the engineers of the Trinity House. The rise of the tide and the state of the weather prevented the uninterrupted progress of the work, and it was unavoidably divided into three separate periods, which gave the following results:—

July 19	in 3 hours,	driven 22 ft.	0 in.
„ 21	1 „	„ 10	0
„ 26	1½ „	„ 1	7

The total depth driven below the surface of the sand was therefore 33 ft. 7 in. This is only one of many experiments performed by the Trinity Board, who have a license for the application of the patent, and have used it in many of their smaller works.

In the autumn of this year, the Trinity Board erected a beacon, by the pneumatic process, on the South Calliper of the Goodwin Sands—a very dangerous spot. The centre column is a tube of cast-iron, 2 ft. 6 in. diameter, put together in 10 and 20 feet lengths, and inserted 32 feet deep in the sand. Around it are four other cast-iron tubes, each of 15 inches diameter, the whole braced together, and supporting a cage on the top, which is 56 feet above the sand level. In the great storm in October, this work was broken; but this failure had nothing to do with the pile-driving process, which was efficiently carried out, the piles being driven 32 feet,—whereas, in Admiral Beaufort's experiments on the Goodwin, he could only drive a steel bar 8 feet with a sledge hammer; and Captain Bullock, R.N., found that a pointed iron rod of 3 inches diameter, when driven 18 feet in the same sands, took 46 blows of a monkey weighing 1 cwt., and with a 10-feet fall, to drive it one inch. It should be observed, the beacon on the Goodwin was of cast-iron only.

Dr. Potts's plan allows the application of cast-iron tubes of any diameter and any length, whereas wood pile-driving is limited by the scantling of the timber, and timber piles of a large scanting are very expensive. Two feet six inches, used on the Goodwin, is an unexampled diameter for a pile, but there are no such narrow limits to the new process. Metal or wood may be used for the tubes, and they may be made of staves hooped. The patentee offers to put down small fishing and bathing-houses and stations in the sands, at very moderate rates, and the plan is likely to be applied for columns for carrying electric telegraphs over rivers, and for piers or towers of suspension bridges.

It should be noticed that a cylindrical tube, placed vertically on a body, of sand and water, cannot be made to descend without great pressure, and then only a few inches; but by exhausting the air from the tube and drawing up the soil from the bottom it sinks most rapidly.

It is found in practice that not merely will sand, shingle, mud, bog, and clay be carried up the pile, but even large stones are carried in suspension, so that every kind of soil can be mastered except rock—and there it is not wanted, because there is a solid foundation.

The hydraulic engineer will at once appreciate the utility of this invention for river and sea-walls, piers, and breakwaters; but its applications are very numerous, and, as it can be most economically used, it will lead to many new classes of works, for it extends the range of engineering. Mr. Alexander Gordon, in laying down one of his new colonial lighthouses, proposes the application of this plan, of the practicability of which be speaks from experience, and in a paper published by him on the subject, he writes warmly in favour of trying it in other situations. Mr. Robert Stephenson has, however, been the first to apply the plan on any considerable scale, though what has been done hitherto by all parties is far from enough to make it generally known among the profession. Those of our

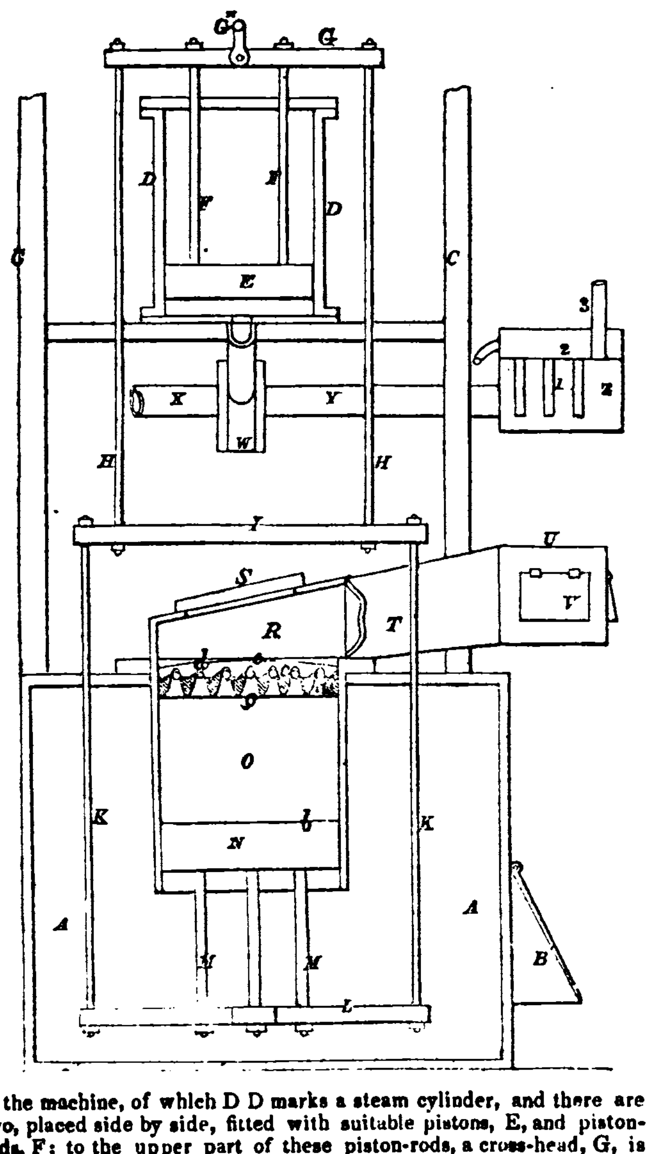
readers who feel an interest in seeing the plan in working, should visit what may be called the museum of the patentee, at No. 9, Buckingham-street, Strand, where a great many models have been exhibited and experiments made, and which are really deserving of inspection by professional men, especially those practically engaged, as so many are, in hydraulic engineering.

REGISTER OF NEW PATENTS.

HYDRAULIC AND PNEUMATIC MACHINERY.

John Walker, of Crooked-lane, London, for "*Improvements in certain hydraulic and pneumatic machinery, and in the application of steam or other powers thereto.*"—Granted April 20; Enrolled October 20, 1847. [Reported in the *Mining Journal.*]

This invention, which is comprised under two heads, consists of the following arrangements and combinations of parts—the first is as follows:—In the accompanying drawing, A A, marks a metal tank, having three sluice-doors B, covering openings therein, either of which may be covered or uncovered at pleasure. Such tank is supported by a strong framing of wood, and upon the top of this tank are strong metal framings, C, which support and carry the several working parts



of the machine, of which D D marks a steam cylinder, and there are two, placed side by side, fitted with suitable pistons, E, and piston-rods, F; to the upper part of these piston-rods, a cross-head, G, is attached, from each end of which there depend two rods, H H—the lower ends whereof are attached to a cross-head, I, from which there depends, in a similar manner to the cross-head, G, two rods, K; the lower ends of the last-mentioned rods are securely fixed to a cruciform-shaped piece, L, to which piece there are fixed four rods, M with their upper extremities attached to a valve-piston, N, of peculiar construction, hereafter mentioned and exhibited in transverse and vertical section. O, marks a water cylinder; there being two of them placed side by side, and fixed to the framing, P, as is the case with the steam cylinders, D D. The water cylinders, O O, are furnished at their upper ends with valves, Q, similar in construction to those in the pistons, N; and such valves are arranged and combined as follows:—*a* marks a grating, upon the outer edge of which there is shrunk a wrought-ring, *b*; and the lower edges of the bars, *c*, which form this grating, are made wider than the upper part, or seat, for the valves, *d*, to allow the water to pass freely—such valves being composed of metal tubes, plugged with wood; and they have free liberty of vertical movement, and are guided in their proper course by cross pieces *e*, which embrace their ends; and immediately above the valves, Q, which are fixed at the tops of the cylinders, O, there is a box, R, furnished with a cover, S, over each valve; and to this box is attached a pipe, T, which terminates in a box, U, having three clacks, or sluice-doors, V, which can be opened or closed at pleasure. W marks a slide for regulating the admission of steam through the pipe, X, to the two cylinders, D D, alternately. Y, the eduction pipe, to which is attached a rectangular-shaped box, Z, arranged in the following manner:—1 1 mark a series of pipes, which extend to within a short distance of the bottom of the box, Z—the upper ends of such pipes being fixed in a partition-plate, 2, as also is the eduction pipe, 3. The operations of this machine are as follows:—Steam, of the pressure of about 25 lb. to the square inch, being admitted to the under side of one or other of the pistons, E, will cause it to ascend, and thereby impart motion to a crank-shaft, through the medium of a connecting-rod, G, and the upward movement of one piston will cause the downward movement of the other—the cranks upon the shaft being suitably placed to effect the same—and the heated air will pass alternately from one cylinder to the other by a valve, which connects the two cylinders together; and such movement of the pistons will impart motion to the valve-pistons, N, in the water cylinders, O' through the agency of the rods and cross-heads before mentioned; and, assuming the tank, A, to be charged with water, and one of the valve-pistons, N, to be at the top of the water cylinder, the descent of such piston will cause the valves, or tubes, *d*, to be raised, and the water below them will pass until the piston has completed its downward stroke. The quantity of water which passes will depend upon the velocity of the piston, which, for raising water, the inventor states, he has found 70 revolutions per minute of the crank shaft to answer.

The piston is now ready to perform the upward stroke, by which movement the tubular valves, *d*, will be closed, and the body of water above them will be thereby raised, and forced through the opening in the valve, Q, the downward stroke of the piston causing the tubular valves in the valve-seats, Q, to be closed; and this will continue so long as the water in the tank is not lower than the bottom of the water cylinders. The water thus raised may be passed off through one or other of the sluice-doors in the box, according as the machinery is required to be used either for draining, irrigating, or raising water. The waste steam from the cylinder passes into the box, Z, and the water from the cold-water pump passes through the pipe, 4, into the said box. The cold water, as it passes down the pipes, 11, becomes heated to the boiling point, or nearly so, in which state it is forced into the boiler by the hot-water pump, which receives motion from the crank-shaft. The inventor states that, in adapting this machine for pneumatic purposes, the cistern and box may be dispensed with; and the position of the piston and valve must be reversed, and the velocity of the crank-shaft should not be less than 120 revolutions per minute.

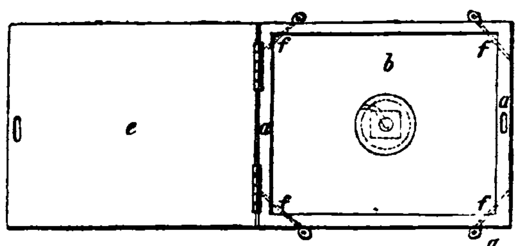
The second part of this invention consists in the application of vanes, mounted upon a spindle in sets, each set being placed in an opposite direction to the other. The inventor states that, although he has used flat vanes, he does not confine himself to them, as, in some instances, he prefers using vanes forming the segment of a screw, similar to those used for propelling boats. These vanes are mounted upon each end of a spindle, the periphery of which fits into a short cylinder, the ends whereof being open; and such cylinder is fixed within a box or cistern, at one side whereof is a suction-pipe; and, at the top of the open cylinder, there is attached a pipe, which is the exit-pipe for the passage of water, or air. The said spindle may receive motion from manual or steam power; and the motion of the vanes in one direction will cause the water to be raised up one pipe, and a reverse movement of the vanes will raise it up the other pipe—the water, in the first instance, passing the openings between the vanes, through the open ends of the short cylinder, and, in the latter case, passing out at the ends of the cylinder, and down the suction-pipe. The velocity of this machine, when employed for raising water, should not be less than 150 revolutions per minute; and, when employed for pneumatic purposes, about 1400 revolutions per minute. The inventor claims the combination and arrangement set forth as constituting improvements in certain hydraulic and pneumatic machines; and secondly, the combinations and arrangement of a high-pressure engine for such purposes.

COPYING PRESSES.

William Henry Kempton, of South-street, Pentonville, gentleman, for "*Improvements in copying presses.*"—Granted March 23; Enrolled Sept. 23, 1847.

This invention consists of a copying press so arranged that the act of shutting a lid or cover acting on a bed or surface is, by the resistance of a spring or springs, caused to produce the requisite pressure for copying letters or other documents, as shown in the annexed engraving. Fig. 1 is a plan of the copying press open, and fig. 2 a sec-

Fig. 1.



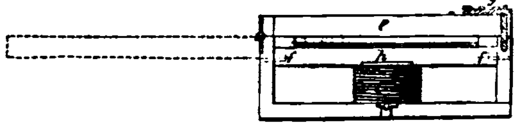


Fig. 2.

tion thereof, the lid or cover being closed. *a*, the frame; *b*, the bed, constantly pushed upwards by a spring or springs, *c*, for giving the requisite elasticity between the bed *b*, and the lid or cover *e*. *f*, stops to prevent the bed or surface, *b*, rising too high. The letter or other document with damped paper and other materials, as in other flat copying presses, are to be placed on the surface of the bed *b*, and then the act of closing the lid *e*, will cause the bed *b*, to be pressed downwards, and the lid is to be retained shut by a bolt *g*, for a short time, when the desired copyright will be obtained.

OIL-CAKE PRESSER.

James Robson, of Dover, Kent, engineer, for "*a new and improved instrument to be used in expressing oil from vegetable and other substances, and in making oil-cake, &c.*"—Granted April 15; Enrolled Oct. 15, 1847.

When manufacturing oil-cake, it is usual to employ instruments made of horse-hair, called "hairs," for enclosing the flannel bags containing the substance to be pressed; but, in consequence of the horse-hair fabric soon becoming clogged, the patentee substitutes an instrument constructed of metal, as shown in the annexed engravings.

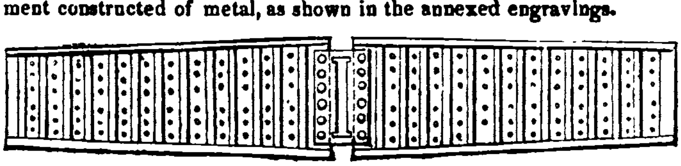


Fig. 1.

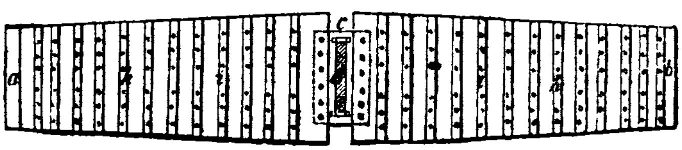


Fig. 2.

Fig. 1 is the interior view, and fig. 2 the exterior of the instrument, in an open or extended state; fig. 3 a longitudinal section, and fig. 4

Fig. 3.

Fig. 4.

a transverse section, of the instrument. *a*, *b*, are two metal plates or flaps, corresponding to those hitherto made of horse-hair cloth; but the shape may be varied. *c*, is a leather hinge, connecting the two plates; and *d*, a handle. Along the sides of the plates, and at the end of the plate *b* a rim is formed, to prevent the material from being pressed beyond the edges of the plates. Across the inner side of each plate, a series of ridges and depressions are made, in such a manner that when the instrument is closed, the ridges on the plate *a*, will come opposite the depressions in the plate *b*; and through the sunken portions of each plate a series of holes *h*, are formed, opening into grooves *i*, across the back of the plates: these holes may be one-sixteenth of an inch in diameter, and half an inch apart; but the patentee does not confine himself to these dimensions. The linseed or other matter to be pressed is prepared and placed between the plates, and pressed in the same way as when using a like instrument made of hair.

RAILWAY CHAIRS AND FASTENINGS.

Charles May, of Ipswich, Suffolk, civil engineer, for "*Improvements in railway chairs, the fastenings to be used therewith, and in trenails.*"—Granted March 27; Enrolled September 27, 1847.

The first part of this invention consists of improvements in manufacturing railway chairs. In performing this part of the invention the mould is formed in a similar manner to that described in Ransome and May's patent of Feb. 1841, in which side plates of metal are used to form part of the mould and for guiding the core. This part of the invention consists of forming the core for the interior of the jaw of a chair, with sand upon a metal interior, or core-bar, combined with the using of metal side-plates or surfaces as part of a mould, and as supports to the core. This part of the invention also consists of having a cross-bar attached to the flask, into which the tail-end of the core projects. And further, it consists of using metal cores for casting the holes for the trenails or fastenings.

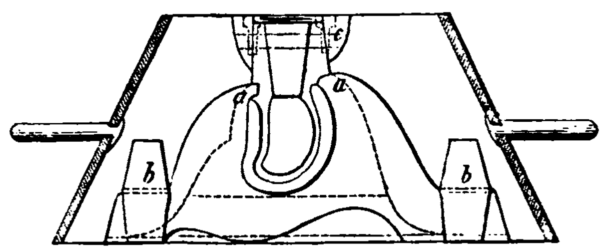


Fig. 1.

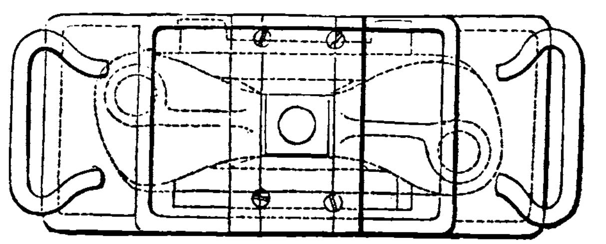


Fig. 2.

Fig. 1, shows a longitudinal section; fig. 2, a plan of a flask, with a sand-mould representing a chair cast on to a core, the top side of the mould being removed. To produce a clean or chill surface in certain parts of the chair, the iron part of the core is left to come in contact with the melted metal, as is shown at *a*, fig. 1; the extent and portion of this clean or chill surface may be varied. To produce clean or chill holes for the trenails, the metal cores at *b*, *b*, are used; *c*, is a cross-bar fixed across the flask, so as to receive the tail-end of the core in such manner as to ensure its correct placing and holding when in the sand-mould, which cross-bar will be found advantageous (when casting railway chairs) for holding the core used, whether employed separately or in conjunction with the side-plates shown.

The second part of the invention consists in so arranging apparatus that a rammer, or rammers, worked by mechanical power, may be employed in ramming the sand into a core-box, so as to make suitable cores for casting railway chairs.

The third improvement relates to combining a process for preserving the wood used for fastenings of railway chairs and trenails with the process of compression, that for preserving the wood being first performed, and then the compression:—Take the heavy oil of coal-tar, called creosote, and pass through it, in a close vessel, a stream of steam from a boiler capable of sustaining from 80 to 100 lb. pressure; the pieces of wood prepared for the trenails or wedges are placed in a vessel also of great strength, and the combined vapour of water and creosote allowed to act upon them for some time (half an hour to an hour); this combined vapour penetrates the wood effectually, and when it is desirable to combine more of the creosote with the wood, it is subjected to the vapour of creosote only, without the vapour of water. The patentee states that such modes of impregnating wood with preservative matter is not claimed by him, the same being old and well known. The process of compression is to be performed (when the wood is dry) as described in the said former specification.

The fourth improvement relates to the manufacture of wood fastenings used with railway chairs, and of wood trenails. In practice, such fastenings as are described under the said former patent are liable to exposure to moisture before inserting them, or applying them to the purpose for which they are intended, and they thus frequently become swelled. And it has been found desirable to retard this swelling process, which the patentee accomplishes by covering with any repellant of water, as varnish or grease; but it is not intended that this shall permanently repel moisture, as they are required to swell after driving. It has been found that a thin solution of common resin in oil of turpentine answers very well, which is used as a coating to such fastenings as soon as they are made.

LUBRICATOR FOR MACHINERY.

James Carter, of Oldham, Lancaster, painter, for "*an Improved lubricator.*"—Granted Dec. 14, 1846; Enrolled June 14, 1847. [Reported in *Newton's London Journal.*]

This improved lubricator is for lubricating shafts, bearings, axles, and working surfaces of machinery generally, and is intended to furnish a certain quantity of oil or other lubricating matter to the surfaces at determinable intervals, which may be varied and regulated at pleasure.

The annexed engravings show a lubricator as applied to a bearing, and are calculated to furnish the oil or lubricating matter once in every 5,200 revolutions of the shaft. Fig. 1 is a side elevation of the ap-

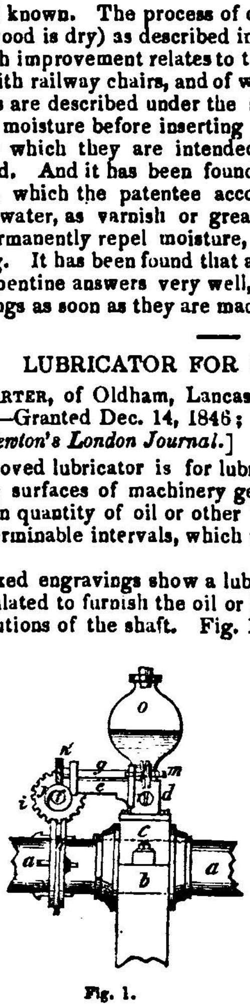


Fig. 1.

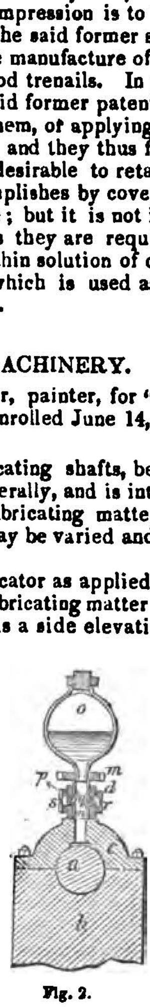


Fig. 2.

paratus; and fig. 2 a transverse section. *a*, is the shaft to be lubricated; *b*, the journal carrying the same; and *c*, the cap or top-plate of the bearing. To the top of the cap *c*, a box *d*, is attached; to which is fixed a bracket *e*, for carrying the shafts *f*, and *g*. Upon the shaft *a*, is keyed a worm *h*, which is cast in two pieces (for the convenience of fixing on the shaft), and fastened together with small screws. This worm actuates a worm-wheel *i*, of twenty teeth, keyed to one end of the shaft *f*, which, at its other end, carries a worm *j*, in gear with a worm-wheel *k*, also of twenty teeth, keyed to the shaft *g*, which also carries a worm *l*, for driving a worm-wheel *m*, having twenty-seven teeth. This wheel *m*, is fixed at the upper end of a hollow plug *n*, which is ground true, and revolves in the box *d*. To the top of this hollow plug *n*, is fixed the cup or vessel *o*, which contains the lubricating matter. The plug *n*, is open at top and bottom, and has two openings, *p* and *q*, one at each side; it is also provided with a midfeather, extending above the opening *p*, and below the opening *q*. As the plug *n*, revolves, the opening *q*, coming opposite to the screw *r*, allows the oil to fill the space between the plug and the end of the screw *r*. The revolution of the plug then brings the opening *p*, opposite the screw *r*, and allows the oil left in the space between the screw and plug to pass through the lower part of the plug *n*, on to the shaft *a*; at the same time the opening *q*, comes opposite to the screw *s*, and fills the space between the end of the same and the plug *n*. Thus it will be seen, that the quantity of oil left in the spaces at the ends of the screws *r* and *s*, is furnished to the shaft *a*, twice in each revolution of the plug *n*; and as the wheel *m* has twenty-seven teeth, and the wheels *i* and *k* have each twenty teeth, then $20 \times 20 \times 27 = 10400$; therefore, the oil is furnished twice in 10,400 revolutions of the shaft *a*, or, as above stated, once in 5,200 revolutions. It will of course be evident that the quantity of oil may be regulated by means of the screws *r* and *s*; and the intervals between each supply may also be regulated by altering the relative proportions of the gearing. It will also be evident, that the same arrangements of mechanism may be applied, with a slight variation, to lubricating flat surfaces, such as substituting a ratchet-wheel and click, or other suitable contrivance, for the worm *h*.

The patentee claims the construction and arrangement of mechanism consisting of the box *d*, and plug *n*, as shown in the drawing, and above described, when applied to the purpose of lubricating; without confining himself to the particular mode of actuating the same, or to the exact proportions or dimensions of different parts of the same.

REVIEWS.

A Catechism of the Steam-Engine, illustrative of the scientific principles upon which its operation depends, and the practical details of its structure, in its applications to mines, mills, steam navigation, and railways, with various suggestions of improvement. By John Bourne, C.E. London: Williams, 1847. 12mo. pp. 276.

Mr. Bourne is already known as the editor of a quarto treatise on the steam-engine, published in parts, and bearing the name of the "Artizan Club." The present work has much the same merits and defects as its predecessor—it displays, on the one hand, the same diligence and care in collecting important facts and original experimental information; on the other, it displays the same want of care and diligence in arranging these valuable materials. This "catechism" is not, as far as we have been able to discern, arranged on any definite plan, and the order of the various topics has apparently been left to chance. This, however, is not a *very* great disadvantage in a work dealing principally with facts, and not professing the character of a systematic exposition of the general theory of the steam-engine. The scientific principles are, for the most part, tolerably accurate, but they are scattered up and down the book—not connected by a logical chain of reasoning, of which every single link is necessary for the continuity of the whole. It may even be doubted whether the construction of such a chain be yet possible—whether we yet possess body of facts respecting the operation of the steam-engine sufficiently copious and precise to permit their reduction to one general code of laws. Mr. Bourne has not attempted here this perilous enterprise, but has accomplished a task less ambitious, but far more useful—that of collecting in a compendious form a great number of experimental observations, practical details, and dimensions and minutiæ of the construction and management of engines of various kinds. This practical information will render his book one of real and direct utility to a large class of our readers.

Some, however, of the doctrines laid down by our author require elucidation; the following is one of them:—

"*Q.*—By what considerations is the momentum proper for the fly-wheel of an engine determined?

"*A.*—By a reference to the power produced every half stroke of the engine, joined to the consideration of what relation the energy of the fly-wheel rim must have thereto, to keep the irregularities of motion within the limits which are admissible. It is found in practice, that when the power resident in the fly-wheel rim, when the engine moves at its average speed, is from two-and-a-half to four times greater than the power generated by the engine in one half-stroke—the variation depending on the momentum inherent in the machinery the engine has to drive and the equability of motion required—the engine will work with sufficient regularity for all ordinary purposes."

The last paragraph is rendered ambiguous by the vague use of the word "power." The "power resident in the fly-wheel," we presume to mean its *vis viva*, or mass multiplied by the square of its velocity—in fact, there can be no other measure of the *power* of a fly-wheel. The "power generated by the engine in one half-stroke," probably signifies "work done," or the pressure on the piston multiplied by the distance through which it acts. This "work done" is always equivalent to a determinate amount of *vis viva*; that is, if it acted on a body or bodies subject to no prejudicial resistances, would produce a certain calculable velocity, such that the *vis viva* would be the same, whether the mass acted on were small or great. Consequently, Mr. Bourne's rule may be stated thus:—when the engine is in its normal state of working, the *vis viva* of the fly-wheel must be two-and-a-half to four times greater than the *vis viva* which the engine would produce during a half-stroke. For example, if the mass of the fly-wheel (supposed to be collected at its rim) were M, and V the linear velocity with which it generally moved, $M V^2$ would be its actual *vis viva*. Suppose that if the engine could act on the fly-wheel *exclusively* for a half-stroke, the velocity generated would be v; the corresponding hypothetical *vis visa* would be $M v^2$; and adopting the highest of Mr. Bourne's ratios, we should have

$$4 M V^2 = M v^2, \text{ or } 2 V = v,$$

which would reduce the rule to a simpler form, as follows:—the mass of the fly-wheel must be so chosen, that the velocity which the engine *would* produce in it by acting on it exclusively for half a stroke may be half its actual velocity when the engine is in its ordinary state of working.

We have endeavoured to develope the rule in the above manner, not from its intrinsic value, but merely to illustrate the extreme importance of adhering, in all mechanical disquisitions, to measures of force about which there cannot be any possible ambiguity. The use of vague phrases to indicate the various effect of forces is the true cause of the difficulty of the subject. If a precise, systematic nomenclature were universally understood and adopted, there would be far fewer of the idle discussions of principles with which we and our contemporaries are bored, and far less money would be spent in securing by patent the exclusive right of effecting impossibilities.

With respect, however, to the intrinsic value of the above rule respecting the fly-wheel, it is to be observed that it can only apply to engines performing a particular class of duties. The duties may task the engine in such an equable and uniform manner, that no fly-wheel need be required. Or, again, the resistances may be capable of such great fluctuations, that a fly-wheel of enormous dimensions may be required. The *variation of resistances* is not taken into account in Mr. Bourne's rule. A fly-wheel is a kind of bank in which force is treasured up in times of abundance, to be redistributed in times of scarcity. The greater the superabundance at one period, and deficiency at another, the greater must be the capacity of the bank.

Another doctrine adopted in this treatise, and which seems liable to lead to erroneous conclusions, is the following:—

"Setting aside loss from friction, and supposing the vacuum to be a perfect one, there would be no benefit arising from the use of steam of a high pressure in condensing engines, for the same weight of steam used without expansion, or with the same measure of expansion, would produce at every pressure the same amount of mechanical power. A piston, with a square foot of area, and a stroke of three feet with a pressure of one atmosphere, would obviously lift the same weight through the same distance, as a cylinder with half a square foot of area, a stroke of three feet, and a pressure of two atmospheres. In the one case, we have three cubic feet of steam of the pressure of one atmosphere, and in the other case 1½ cubic feet of the pressure of two atmospheres. But there is the same weight of steam, or the same quantity of heat and water in it, in both cases, so that it appears a given weight of steam would, under such circumstances, produce a definite amount of power, without reference to the pressure."

This reasoning seems to overlook the gain of mechanical effect resulting from the employment of very high-pressure steam used with a great degree of expansion. Theoretically, the higher the steam-pressure, the greater will (by working expansively) be the power obtained from a given quantity of fuel. It may be assumed that a pound of coke or coal will evaporate the same quantity of water at any pressure. The steam produced, therefore, will, while acting at full pressure, or unexpansively, effect the same amount of work in both cases. But when the steam is cut off and expanded, more work will be *got out* of the high-pressure steam than the low-pressure; for the former may be expanded to a greater degree than the latter, before it become so weakened as to be incapable of further useful effect. The use of high-pressure steam is not so indifferent a matter as the above quotation seems to suggest. Setting aside the question of safety, the higher the pressure of the steam the greater will be the economy of fuel, supposing the expansion always carried to that point where the steam ceases to act beneficially. A mistake on this point seems to have led Mr. Bourne to say further on, that "the superior economy of the Cornish boiler is not derived from any peculiarity of form and arrangement, but from the immense extension of heating surface."

In treating of the resistance to the motion of railway trains, Mr. Bourne falls into the common error of assuming that the rapid increase of resistance resulting from the increase of velocity is due to the action of the air. This resistance is only one item in the calculation, and is often (we are inclined to think) a very small one. The deflection and vibration of the rails, concussions at their joints, strains from the wheels or axles being slightly twisted, and the thousand-and-one jolts, jars, rattlings, and vibrations inseparable from rapid motion absorb the greater part of the power required at high velocities.

In alluding to one or two deficiencies in the present treatise, we would by no means have it inferred that they are samples of the whole book. On the contrary, the information conveyed seems generally very trustworthy, and it has the advantage of being communicated in an intelligent manner. Had we space to dilate on the chief merits of this work, we might have chosen numerous texts for the purpose—among others, the excellent account of the present state of knowledge respecting the performance of marine screw-propellers, and the clear descriptions given of various details of the mechanism of locomotive engines.

A History of the Architecture of the Abbey Church of St. Alban, with especial Reference to the Norman Structure. By J. C. Buckler and C. A. Buckler. London: Longmans, 1847.

We had hoped to have had more space for our notice of the valuable work of Messrs. Buckler, but we find that with the close of our volume, we have too many subjects claiming our attention, and yet we do not like to delay what is an act of justice towards the authors. We cannot but feel that the design of the work, that of giving a complete account of the Norman architecture of the Abbey at St. Alban's, is highly praiseworthy, and is carried out in a conscientious spirit of labour. The history of Matthew Paris has been particularly valuable to the authors, and they have made very good use of it, the old monkish annalist having shown an earnest desire to commemorate everything of interest in connexion with the building and its abbots. He lived, too, at a time when the most important works were carried on for its adornment, and we can hardly help wishing he had given us still more information as to details, though really we owe him, as it is, a large debt for what he has so copiously recorded.

By a careful collation of such records with the present building, Messrs. Buckler have been able to reproduce the old Norman structure, and to give us a lively picture of such a building in its pristine and palmy state. This makes the work, what naturalists would call a monograph—a well described account of a fine specimen, and is therefore very useful to practical men, who have occasion to study or apply the Norman style.

The Norman abbey church is one of the first class as to size, for its length from east to west was 440 feet, forming a long Latin cross, and having a transept of 176 feet in length, and a lofty lantern tower in the choir. The long nave of thirteen bays may be considered one of the grandest parts of the structure, though perhaps the breadth was too small for the vast length. The authors remark that particular regard seems to have been paid to laying out the plan of the church, and fixing the positions of the piers. Measurement has proved the extreme accuracy of this part of the work. There is not, however, such conformity in the superficies of the walls and pilasters, and their retreating members, though the appearance of the building generally is correct. When we consider the imperfect organization of labour and machinery in those days, the merit is very great.

The materials employed being chiefly from the remains of the Roman city of Verulamium, give a peculiar character to the building, and the more particularly as the want of stone in the neighbourhood led to the use of cement as a covering in some places. Where this has been stripped off, the appearance of the building is much injured; but it has enabled Messrs. Buckler to give many interesting drawings illustrative of the details of construction.

It is noticed that the upright line of the walls is preserved throughout their height, which measures 68 feet 3 inches from the original pavement in the nave. There is, however, a deviation in the exterior of the lantern tower, which has pyramidal sides up to the belfry stage, above which they are perpendicular, while the contignation is arraigned as being abrupt, and not altogether pleasing.

One peculiarity pointed out is that the remaining abutment piers on the exterior of the upper wall of the south aisle take their places beyond the lines of those below, and are based on the brick vaulting with perfect security. The reason of this is not explained, nor is it obvious.

Messrs. Buckler have observed that many of the smaller arches in the building are irregularly curved, and indeed distorted. This is not uncommon in Norman buildings of elaborate design and costly material, and is supposed to arise in some cases from the arches being turned over the openings without the help of wooden centrings, or with rough frames.

In this church the system is fully seen which was adopted by the Norman architects of building walls across all the openings, so as to tie the whole of the work together for greater security. The extent of this underground work as discovered by Messrs. Buckler within the eastern aisle is said to be truly astonishing. The system was sometimes imitated by the architects who made additions to the building.

Of the columns of the nave it is remarked that there is far less bulk and appearance of casing than in those of Winchester cathedral, as greater dependence could be placed upon the strength of the brick-work core, than upon that of rubble-work.

The west front was 155 feet in its extreme breadth, being flanked by two lofty towers, measuring 40 feet in the square on the outside, and being planted on massive stone and brick foundations.

With an opinion of the authors, in reference to another subject, we cannot but concur. They observe that in Herefordshire, the greater number of church towers are characterised by slender spires, constructed of timber and covered with lead. They regret that these should ever be removed, as they so often are for the value of the lead. Though the spires may be less ancient than the towers, their age is still great, and their destruction cannot but be considered an act of barbarism.

In conclusion, we cordially recommend this work to the libraries of our readers, to whom its moderate size and price offer an additional inducement.

An Easy Introduction to Railway Mensuration. By E. V. Gardner, C.E. London: Weale, 1847.

The idea of this book is a good one, and, once conceived, it was easy for Mr. Gardner to carry it out; while as a special work, it is likely to pay well. It consists chiefly of working plans and forms from the Brighton Railway, the South Western, the Farnham and Alton, Syston and Peterborough, and Salisbury Branch Extension Railways. The book is therefore practical enough, and, by having a number of ruled pages, can be studied and worked up at the same time.

Among the illustrations are a specification, small barrel culverts, large culverts with wing walls, open culverts, bridge, occupation road, occupation bridge, skew bridge, viaduct, timber viaduct, another with iron tension-rods, &c. There are likewise plans and sections with curves set out, off-sets for unsoiling, outside fencing, and ditches, &c. Mr. Gardner says enough about tunnelling to enable the student to understand the mode of mensuration, and how to set off the ranging line from above to below. Full directions are given as to the measurement of cuttings and embankments.

Mr. Gardner recommends that the number of parts measured should always be placed first, to prevent error of quantity, such as occurred a few years since in the erection of a new church a few miles from London, where the gallery was measured and not twiced, thus leaving one gallery wholly out of the quantities, which could hardly have happeded had the No. 2 been placed first. In all cases, even in cubing the dimensions given for practice, Mr. Gardner urges that every dimension should be checked, to prevent error; and before beginning to measure, to well study and understand the plan.

We think the work will be found useful by the parties for whom it is designed.

Plane and Spherical Trigonometry. Part I. containing rules, examples, and problems. Part II. containing the principal formulæ, with exercises and examples; the proofs of the rules in logarithms and trigonometry, and the construction of logarithmic tables. By H. W. Jeans, F.R.A.S., Royal Naval College. London: Longmans, 1847. 2 vols. pp. 124 each. 12mo.

The first of these little volumes contains a collection of rules for applying logarithms to geometry, navigation, &c. The second volume gives *separately* the demonstrations of the rules. This separation may be useful to those who are required to deal rather with results than principles—whose occupations render it necessary for them to obtain arithmetical results, by processes of which they are unwilling or unable to comprehend the logical accuracy. We do not much admire the learning-made-easy system; it misses all the advantages of mental discipline, and fosters mere superficial attainments. The knowledge-doctors are the professed apologists and coadjutors of shallow-headed students;—their very trade is to coat ignorance with a varnish. However, there are certain cases in which it is absolutely necessary to set people in the way of working problems without understanding the principles of them; for instance, it would appear, from the work before us, that this necessity exists at the Royal Naval College.

The rules are concisely and clearly expressed, and are accompanied by numerous examples fully worked out.

Elements of Geometry. By J. D. London: Longmans, 1847.

What the object of this pamphlet may be we cannot make out. The author introduces new and complex processes, without any preface; and he gives new definitions, which are no more definite than the old ones, and much less philosophical.

GEOLOGICAL LECTURES,

By Professor Ansted. Delivered at King's College, London—Session, 1847.

Geological Considerations affecting Agriculture.

After some prefatory observations, Professor Ansted proceeded to explain the points in which the practice of agriculture was affected by geological considerations and knowledge. They were two in number—first, that which related to *materials*, taking one of the divisions of the subject mentioned in the preceding lectures: under this head they would have to consider the nature, use, and way of modifying those materials. Secondly, considering the earth as the basis of operations, they would have to observe how agriculture was affected by the arrangement of materials; and how, by certain laws, affecting the structure of the earth, the soil might be rendered more fertile, by supplying water where needed, or by removing it by drainage when the land was flooded. Certain mineral substances were necessary for the growth of plants; and hence, if they took any of the vegetable substances in common use by man, and exposed them to a high degree of heat—thus getting rid of the carbon, oxygen, nitrogen, hydrogen, and some other elements of the plant—there always remained a residuum of ashes, which contained the mineral substances necessary in the growth of the plant consumed. If, for instance, they took any of the cereals, such as wheat, and burnt its straw, ear, and corn, they would find in the ashes which were left a considerable portion of silica; and in other plants there would be certain quantities of potash, soda, lime, and magnesia, not unfrequently a little iron, and sometimes, but not often, phosphorus. All these, then, were materials necessary for the growth of plants, and it was useful to know whether any particular spot where these plants were intended to grow, possessed the materials necessary for their health and sustenance. A knowledge of the "chemical composition" of soils was, therefore, highly important, as some of the above substances, occurring in certain proportions of the soil, might be noxious, and even poisonous, to some plants; while to others they might be indispensable. There was, in fact, no universal poison. It was also necessary to know something of the "condition" in which these constituents were present in the soil. Supposing, for instance, there were potash, soda, and phosphorus, it was well to know whether these materials possessed a greater affinity for the substances with which they were already combined than the plant was able to overcome, as, in that case, they would not benefit it; or, if those materials or constituents were free, whether they were so much separated as to render them not only useless, but noxious and mischievous. It was also exceedingly useful to know the "mechanical condition" of the soil. Plants throw out roots and rootlets, not only to imbibe nourishment from the soil, but to form a wide-spread basis to support the upward growth of the stems, and to enable them to expose themselves to the weather, or to connect themselves with other plants, according to their peculiar habits. In all cases, it would be useful to know whether the surface of the soil was likely to afford this mechanical support.

In considering the nature of the soil, with reference to plants, it was necessary to do so partly in respect to its composition, and partly as to its derivation. They had nothing to do, as geologists, with the organic substance contained in the soil, which consisted chiefly of carbon in the state called humus—that belonged to the agricultural chemist, rather than to the geologist; but it was necessary that the latter should know what were the mineral ingredients of which the soil was made up, and how far they were capable of adapting themselves to its organic portions. They had nothing to do with the organic portion of the soil itself, but they had a great deal to do with its relations to the inorganic, or earthy, constituents. The three principal ingredients of all soils were silica, alumina, and lime, which mostly existed in the three conditions of sands, clays, and limestones. There were also very important mixtures, known as loams and marls—the former being admixtures of clay and sand; and the latter of clay and limestone. With regard to the next point, all soils were derived from the subsoil, and the mode of derivation was a matter to which he drew particular attention. They were derived by the chemical decomposition and mechanical disintegration of rocks; for the soil was connected with and derived from the rock always, either directly or indirectly. [The lecturer here referred to several diagrams, on which were depicted the soils, as they appeared in the course of derivation from the fundamental rock.] In these cases the derivation was direct; but, in others, when the material was brought from a great distance, it was indirect. It was not, for instance, difficult to divine the way in which the weather acted on the surface, or to understand how fragments of rock might be removed great distances, and deposited many miles from their original beds. Every year vast quantities of material were deposited in the Atlantic, brought by icebergs from the Polar regions, and the materials for future soils were thus obtained *indirectly*; what they had most to do with was, however, obtained *directly*, as almost all soils in England, except gravel, were obtained directly. Soils varied in thickness, from a few inches to 100 feet or 200 feet; but, ordinarily, were from a few inches to 3, 4, or 5 feet in depth. The subsoil also varied a good deal in depth, which depended very much upon local circumstances. The lecturer then referred to the diagram of a road section near Penrhyn. The foundation was slate-rock, and over that was a kind of rubble, into which the rock was decomposed. Rubble was a general term used to describe any rough disintegrated mixture of rock, or broken fragments, with sand; and from the rubble was derived the subsoil, and from that the soil on the surface. In another section, of which a diagram was exhibited, the slate at its usual depth lay in the ordinary direction; but, near the surface, it was "bent over." On this the lecturer remarked, that it was impossible ever to determine the true dip of beds close to the surface, as it was a common thing to find it altered at the surface—broken, in fact, as if by some mechanical force, and often inclined at a considerable angle to the underlying bed. This often helped in the formation of soils; for the broken portions became mixed with sand and silt, and formed rubble, from whence the soil was directly derived. In the diagram alluded to, the next bed to the rubble was a loamy clay, which contained about 50 per cent. of sand. This, however, was not silica, and though it put on the shape of clay, neither was it pure alumina; but a silicate of alumina, mixed with sand. Clay generally contained a good quantity of free sand, and when mixed with about 50 per cent. of that substance, became loamy clay. In that state it was better fitted for agricultural purposes, though it still required more carbonised matter to make it into soil. In the diagram, there was about 2 feet of this loamy clay, which was called the subsoil, and above that the true soil, which, in this case, was of a loamy nature, and contained a rather large quantity of sand. Here, then, was the soil and subsoil directly derived from the rock. The lecturer also further illustrated this point by other diagrams, in which granite was the base from which the rubble was formed.

Soils varied much in value according to their different depths, and the textures of their materials. When the depth was small they were liable to be carried away, or to be soon exhausted by the growth of vegetables on it; and then those particular ingredients, on which the vegetables subsisted, were required to be replaced, or a further decomposition of soil, at a more rapid rate than ordinary, became necessary. The application of other substances from a distance was thus sometimes necessary; but, for this, some chemical, as well as geological, knowledge was indispensable, or more harm than good might be done. The texture of soils differed very much. Some were exceedingly dense and heavy, and would not be easily washed away or displaced; but, though permanent, they were often very difficult to be managed, particularly when they were so dense as scarcely to allow the roots of plants to penetrate. Others, again, were so imperfectly made up, and so large and coarse, as almost to preclude the use of the ordinary instruments of tillage. Some soils contained a great deal of clay, and were so tenacious, as scarcely to allow the plough, or even the spade, to act upon them. These were exceedingly unmanageable, for though it might be thought that a large admixture of sand would lessen this adhesiveness, it was generally found that the sand, after a time, formed hard masses, and was apt to collect the clay into lumps, instead of making it more loose. Some soils possessed a large absorbent power; while others would allow water to pass through them very readily. In soils of the latter kind valuable manures were soon washed through them, without producing much effect. In these cases, a remedy might be found in the practical application of geological knowledge, as, for instance, liming the land, by putting on unburnt limestone in small lumps, instead of slacked lime, and trusting to the slow decomposition of the limestone by exposure to the weather. There were many other circumstances of a similar nature, such as the capillary powers of the soil, or its aptitude to crack and form great yawning chasms in times of drought; the relations of the soil with regard to heat, as its soon becoming hot like sand, or remaining cool, or transmitting heat slowly, like clay. These points depended almost as much on the substance that was below it, as on the texture of the soil itself.

The lecturer then proceeded to describe the soils derived from the various geological formations in different parts of England. The districts, which exhibited chiefly the igneous rocks, were the western parts of Cornwall, some portions of Wales, and the greater part of Scotland, in all of which existed some geological conditions, to be considered in reference to agriculture. In composition these rocks were chiefly granitic, or, as it was called, porphyritic; and they were made up of the crystal imbedded in a kind of paste; and generally of crystals of felspar and mica, in a base of quartz. These rocks existed in very different conditions, dependant principally upon the prevalence of the different ingredients, and their different decomposability. First, they had the quartz, often in compact masses, and so hard, that it was exceedingly difficult to break. Where this mineral was in large masses, and not much modified, it presented a most unfavourable condition for agriculture, and indeed was almost hopeless, as it was next to impossible to get it disintegrated by any natural exposure. When mixed with felspar, however, the case was different, for that mineral contained substances of the greatest importance in the composition of plants. When the felspar in granite decomposed readily on exposure, it often formed a very valuable soil. Much of the best soil in Cornwall was in this condition, particularly that on the lower hills, which, being most exposed to the operation of the weather, contained the greatest quantity of granite in a decomposed state. They would always find that the most fertile granite contained a good deal of decomposing felspar. On the condition of the mica also might depend much of the disintegrability of the granite.

The next rock, he would consider, was gneiss, which contained the materials of granite in a mechanical condition. These would also form a fertile soil; but they might safely conclude, if it were hard and compact, that a good soil would not be likely to be formed. In the Highlands of Scotland there was a vast quantity of gneiss and mica slate, and there the country was uniformly barren on the hills, though there were spots which had been made productive. The whole district, however, might be described as barren, affording support to little vegetable produce besides heather.

Another class of igneous rocks were those which were forced up from beneath others, and were called intrusive rocks. Of this kind were the basalts in Ireland; and the enormous masses of India, where there were 200,000 square miles covered with scarcely anything else. These rocks were nothing more than lava, or melted rock, poured out upon the surface; they were readily decomposable, and among the most useful and important ingredients of soil they were not the least valuable. From these rocks were obtained rich and fertile soils, as was exemplified by the districts in which Indian cotton was grown. These rocks, which in England were often called trappean, and which were probably poured out millions of years ago, were capable of being mixed with the soil in their neighbourhood. They contained many of the materials most required by vegetables. Clay-slate was what was called a metamorphic rock, and was, when in its simple and most characteristic form, too little mixed with sand, and contained too few of the materials required by plants to be a valuable substance for soils. It contained, however, a little iron, and sometimes a little soda, and other like ingredients, but not in such a state as would readily mix with carbon, and the gaseous products necessary for plants.

Besides these, there were the oldest rocks, or Silurian rocks, which were formed in Wales, twisted and contorted in every possible way. The lower portions of these rocks were eminently siliceous, with a very small quantity of alumine, carbon, and limestone, and a little potash and soda. Other parts of the Silurian rocks had a great admixture of shales, with nodules of limestone and large lenticular masses, distinctly traceable to local causes. These rocks could be made fertile by careful admixtures.

The Silurian rocks were succeeded by two other formations. The first of these was the old red sandstone, which was found in Scotland, and in corresponding beds in Herefordshire. This, when unmixed, was a very barren rock, and oftentimes formed hills perfectly naked. Assisted, however, with the calcareous lumps called corn stones, it formed sometimes a rich corn land. It was also well adapted for the growth of fruit trees; and produced the apples and pears from which the famous cider and perry of Herefordshire was made. Devonshire, which was also noted for cider, possessed the same kind of soil, though of a different geological period.

The Devonian rocks, containing a large quantity of silicious matter and schists, which prevailed in Cornwall and the north-eastern parts of Devonshire, were also capable of being mixed with other substances, and rendered fertile. These corresponded in age with the old red sandstone, but differed in mechanical condition.

Next to these succeeded the carboniferous rocks, of which there were three distinct divisions. First, the carboniferous limestone, generally compact in form, very hard, very little weather-worn, not easily disintegrated, and not easily decomposed if not disintegrated, covered mostly with a very thin soil, and well adapted for the purpose of sheep, and other animals, which preferred a close fine grass. Rich soils were seldom obtained by admixture with rocks of this kind. Next, there was the millstone grit, not so coarse a conglomerate as the old red sandstone, and commonly better adapted by mechanical condition for agricultural purposes; but not often forming a rich soil, though covering a wide extent of country. And, lastly, there were the coal measures, of which the vegetable produce beneath the surface was of far greater importance than the agricultural excellence of the soil. The third class of carboniferous rocks were met with in the northern and cent[illegible] counties, and in South Wales.

The next in succession were the permian rocks, consisting of the m[illegible] sian limestone, which generally coasted the coal measures. This su[illegible] could never be safely used as a lime manure—caustic magnesia being [illegible] mischievous. The soil derived from these rocks was not remarka[illegible] richness.

Then came the new red sandstone, which was necessarily a p[illegible] sisting of unmixed loose sand, but which was often associ[illegible] siderable quantity of red marl, containing a large proportion of calcareous and argillaceous matter, and this, when brought to the surface, made a most excellent soil. The rich grazing lands of Devonshire and Cheshire, and other parts of England, were constituted of this kind of soil. It was also manageable from its ready drainage, and valuable from the salt obtained from it.

The next substance was lias, and then the whole series of oolites. Lias consisted of thick beds of argillaceous matter, which was more extensively seen in plains and valleys. It formed a very valuable soil, and might be traced throughout England. Lias contained a good deal of calcareous matter, and was not far removed from the new red sandstone on the one side, and the lower sands of the oolites on the other. The oolites were a large mass, which supplied in their lower portions a great quantity of building stone, quarried in the neighbourhood of Bath, near Oxford, at Ketton, in Northamptonshire, and elsewhere. These rocks were often overlaid by beds of clay of considerable thickness, as in the fens of Lincolnshire and Cambridgeshire; and in their upper portion the oolites again contained a quantity of hard and valuable building stones, as in Portland Island.

Lastly, there were the cretaceous rocks, which included the dark red sands of Bedfordshire, and the broad and extensive downs of Sussex and Wiltshire, and extended through England to Yorkshire.

Geological Science applied to the Mixture of Soils, and to Draining for Agricultural Purposes.

Professor ANSTED prefaced his remarks, upon the above-mentioned highly interesting topics, by some observations upon the formation of soils from certain rocks, which, in his previous lecture, he had but just glanced at; and, first, as to the cretaceous, or chalk formation, which extended from the western coast of England, commencing near Portland Island, in Dorsetshire, and running in a north-east direction, through Buckinghamshire and Bedfordshire, to the east and south-eastern shores. The chalk formation was divided into two kinds; the most important of which, in some respects, was that known as the lower green sand series. This sand, in Bedfordshire, and some other places, was of a very dark red colour, which, by itself, was liable to be very barren; but, when mixed with clay, it made a very rich soil, particularly if the clay contained a proportion of limestone. The lower green sand was generally underlaid by the Kimmeridge clay, covered up with the gault, which, in Cambridgeshire and elsewhere, formed a stiff clay. In either case, the materials would bear mixing with the green sand, and generally produced rich and productive soils—this formation was, therefore valuable. The upper cretaceous beds contained carbonate of lime in too pure a state to furnish of itself a good agricultural soil. In this way, the chalk could not be considered as affording of itself a rich soil; but rather one which was capable of being made so. It was, however, valuable as a grazing soil for sheep, producing a short fine grass; but the quantity of surface required for the support of a small number of animals diminished its value in this respect very considerably.

He next referred to the tertiary beds, which, in England, embraced only a comparatively small series. The London clay formed the great mass of the tertiary deposits: it was found principally in the neighbourhood of the Thames, and in Hampshire. The London clay was generally underlaid by a more plastic clay, and covered with sand. This was particularly the case at Bagshot Heath, in a large tract of country near Woking, traversed by the South Eastern Railway; and those who had travelled upon that line would have remarked that it passed for the most part through a poor and somewhat sterile country; though, where the clay was mixed with pebbles and sand, it was capable of becoming looser in its texture, and of being made a more available soil, and, indeed, a valuable one, by means of a great deal of manure. The tertiary beds, however, could not be considered naturally valuable for agriculture, although they were often made so from local circumstances. The tertiary deposits of Suffolk and Essex were called crag, and consisted either of a shelly or marly sand, but generally shelly. This was particularly capable of being made a good soil, when mixed with the clays near it.

There were other beds, which, as geologists, they were bound to consider—namely, those which were known by the general name of gravel, which was a mixture of pebbles and sand, and, being liable to accumulate in every favourable locality, was met with everywhere; it was, in fact, the most abundant of the earth's superficial coatings. The circumstances which induced it were exceedingly various, though mostly connected with the changes effected by running water. Where it had accumulated suddenly, the finest sand would be found mixed with the coarsest pebbles; in other cases, it might contain a great deal of clay; and in others, silt. These formed masses, which required always to be considered in regard to their local relations. Gravel constituted not a bad soil for agriculture, as it was readily drained; but it depended on what was near it, or with it, whether it could be made a good one.

All the circumstances connected with the formation and nature of soils geologically must be taken into account when the agriculturalist studied that most important subject, the improvement of the soil by admixtures of other soils. This was a question which required the most careful handling, as it was a dangerous thing to play with soils, and equally hazardous to make speculative changes without a good chemical knowledge. To mix soils with advantage, it was indispensable to have a certain amount of that knowledge, and also an intimate acquaintance with many facts which were purely geological.

In the first place, it was important, if the soil at the surface was not good, and it was sought to be improved by a mixture, to consider its geological relations, the circumstances under which it was presented, and the way in which it was associated with the surrounding material. The appearance of the surface, the structure of the country, the way the beds succeeded each other, and their inclination, ought to be familiar to the geological agriculturalist; and, when it was not so, that knowledge ought to be gained, in the first instance, by sections and models. This knowledge was indispensable; for, without it, they would neither know where to find the material required, nor, when found, be able to get it. Then, again, it was very important to know under what circumstances certain rocks, known to be valuable, might be expected to occur in nature. For instance, there were certain igneous rocks, of volcanic origin, which were very valuable bases for soils, and equally valuable for mixing with others. These had, probably, been produced during a volcanic disturbance, by which they had been forced up in a melted state to the surface, and had, perhaps, not only filled up a crevice, but had also run over in a sheet like lava. Now, it was quite clear that a person ignorant of its geological relations, wishing to obtain this material, would be puzzled by its departure from the ordinary phenomena of strata, and he might waste both time and money, without succeeding at last in reaching the valuable rock. Volcanic rocks of this kind might thus lie either vertically or horizontally; but it must be obvious, that very different operations would be required in each case to obtain them. A difficulty in obtaining them, arising from geological ignorance, was the frequent cause of many valuable veins of igneous rock being neglected, or unknown. The mixture of these volcanic rocks, with others that were stratified, almost always improved the soil; but not invariably, as there were some exceptions to the almost universal rule, of their being easily decomposable by exposure at the surface.

There was one important process in agriculture, often made use of, though not always with similar results—viz.: deep ploughing. By this process, the soil at the surface was mixed with that beneath it, and a large proportion of the subsoil brought to the surface. This was sometimes beneficial, and at others mischievous. Unless the origin of the subsoil was known, it was impossible to determine beforehand whether it would be useful, or otherwise. Generally speaking, it was useful; because the soil was ordinarily derived from the subsoil; and if the soil were good, then the subsoil would be good, and it might be mixed with advantage. This, however, was not always the case; and by deep ploughing, a very different and inferior material might sometimes be turned up. How useful, then, must be that knowledge, by which the certain result of such a treatment of the soil might be previously determined. [The learned professor illustrated this point by a reference to several diagrams, in which the subsoil was represented as derived from various materials.]

The next part of the subject was the soil as connected with water; and there were two cases, in which agriculturally some geological knowledge on this point was important—the one was, when too much water was present in the soil, and it was necessary to get rid of it; and the other was in the way of irrigation, where soils received too little water, or did not retain a sufficiency for the purposes of vegetation. Plants differed enormously as to the quantity of water they required. Soils, which, in this respect, were admirably adapted for one kind, were utterly unfit for another species—some plants grew well on soils where others would not grow at all. In these questions, then, a consideration of the nature of the crop desired, and the climate in which it had to be grown, was indispensable. Draining, also, was connected with geology—both surface drainage and deep drainage; and the methods of obtaining a supply of water, being dependent on the nature of the earth's crust, were equally connected with that science. Drainage involved one or two other points. When it related to the drainage of large districts, it was a subject of the deepest importance, and then it naturally came more under the head of engineering than agriculture. Both draining on a large scale, and the obtaining of water on a large scale, for the supply of our towns and cities, were subjects of the greatest engineering importance; but he intended now rather to consider the general subject with reference to agriculture. In the first place, then, he would touch upon the use of water to plants, which was very simple and easily understood. Plants could not live without it, and they derived it partly from the air and partly from the earth. They also obtained with the water other substances, which were important. None of the plants, which were of value to the agriculturalist, would bear a continual exposure to the presence of water. A great deal of mischief resulted from too much water, although injury was also the result of a want of it. This element came exclusively from the clouds in the shape of rain, or snow. The melting of the snow on the mountains, and tributary rills produced by natural drainage, formed brooks and streams, and ultimately rivers. Springs came out upon the surface, without being apparently connected with the fall of rain, but they were derived from it. The rain was absorbed by certain beds, and often emerged at a great distance, in obedience to certain mechanical laws. [The formation of springs was then illustrated by reference to a number of diagrams; and, by the same means, Professor Ansted showed in what manner irregularities of surface (the permeable beds lying in a favourable direction) produced natural drainage.]

Where there was no natural drainage, the artificial operation connected itself inevitably with the circumstances under which the superfluity of water occurred. One of two things ordinarily would have to be done; they would either have to get rid of the superficial surface-water, and that which might arise from springs, or they would have to get rid of floods produced by the overflowing of rivers. In either case, the superfluity should be got rid of in a natural way; and, looking at the general character of a district, this would be easy or difficult, according to circumstances. But, whatever the nature of the effect to be produced, a knowledge of the peculiar structure of the district was indispensable; and a practical application of geological knowledge would often help to produce a perfect drainage, by taking advantage of the formation of the earth's crust. Where beds of clay, or other impermeable soils at the surface, rested on beds of sand, the upper beds might be drained by means of perforations, unless it happened that the sand, or gravel below, contained an excess of water, in which case the attempted draining would increase, rather than lessen, the water surface. This condition of the lower beds would, however, be detected by the geologist by a reference to the natural outlet. Another simple and efficacious mode of draining a district, laid under water by springs, was that of cutting a trench along the strata from which the springs arose on their natural outcrop, and thus conveying the water away. The drainage of the surface, however, and cutting off springs, were very different things, and belonged to entirely different conditions of structure.

The subject of drainage on a large scale was one of great importance; and though the drainage of the fen lands was a work generally intrusted to the engineer, rather than to the geologist, yet a knowledge of the principles of drainage was necessary to the agriculturalist, if he wished to take a full advantage of the work of the engineer. The principal works of this kind were in England and Holland. In Lincolnshire and Cambridgeshire, there was a vast tract of land nearly level, composed of a tough clay, quite impermeable to water. It was partially drained by a number of streams which ran across it; but which also drained the higher lands and hills, by which the flat country was hemmed in on the land side. These streams brought down a large body of muddy water, and their tendency was to spread the mud over the low country. When there was a broad expanse of flat land, and a quantity of water thus running over it, the fall being slight, a little thing served to check the passage of the draining streams. In the present instance, the Ouze, the Nene, the Glen, and the Welland, and their tributaries, all ran along the surface of the clay; and if any accumulation of silt were allowed to remain at their mouths, and they could not with facility empty their waters into the ocean, the movement of the stream would be checked. If any foreign body should accidentally fall into the stream, a portion of the bank on the other side of the obstacle would be carried away; and thus, supposing the water ran in a straight line at first, it would, in a short time, deviate from that straightness, and those meanderings which were so admired in other rivers, but which were so fatal in these, would be caused. The more tortuous the course of the stream became, the slower would be its pace, and the less effective its power as a draining agent. At the same time, the gradually increasing accumulation of silt at the mouth would stop the ocean out, and the flush of water from the river would be thrown back upon the land, and thus the low lands would eventually become a swamp. All this, however, might be easily counteracted by keeping clear the streams, and removing the obstructions at their mouths; but, supposing that the natural drains, the rivers, were not sufficient to carry off the whole surplus water, some further operations were necessary, such as artificial cuttings. One of the results of draining being to make the land lower, embankments to keep out the sea were required, and steam-engines, to pump the water from the drains over the embankments into the ocean. The selection of the line of these drains, and the carrying into effect the plans suggested by the circumstances, were operations which had to be performed by the engineers.

Of the fen districts of England, a great deal had already been done towards their drainage—badly at the commencement of the undertaking, but still a great deal also had been well done, and whole districts were now in the course of being drained satisfactorily. The fen district was divided into several sections, known by the names of the streams which intersected them. The principal of these were the Ouze, the Nene, the Glen, and the Welland. The lower part, called the Great Bedford Level, in which the operations had been conducted in the most perfect manner, and at a very enormous expense; the drainage was partly effected by two great cuttings, parallel to each other, from St. Ives to Downham, not far from the place where the Ouze ran into the sea. The tract between the cuttings, which comprised 5,000 acres, was used for the purpose of holding the surplus water, and so preventing it from running over the drained land without the embankments of the two cuttings. In making canals of this kind, the first and principal thing to be done was to construct safely the embankments on either side, the water being lifted over from the ordinary drains by means of steam power. But the case was different when the sea had a tendency to inundate a whole country, and required to be kept out by embankments along a line of coast. This was the case of Holland, of the delta of the Rhine, and of river deltas generally. Deltas consisted of the land formed by deposits of mud at the mouths of rivers. There was often a considerable quantity of organic matter in this mud, secreted by animalculæ, which were killed by the action of the salt water upon them. The difference between the condition of Holland and the fen lands of England was this—in Holland, the soil was being daily added to by deposits of river mud just at or below the level of the sea; while, in England, it was land already formed, and just above the level of low water—so that all they had to do was to keep it so. To maintain their position in Holland, draining operations, of the most gigantic extent, had constantly to be kept going on, at a corresponding magnitude of cost.

The geological conditions necessary to produce fen land were these:—A river coming through a flat country tended to form a delta, which, as it increased in size, became dry, or might be made so by draining. This was one method; but sometimes it happened that a stream ran through flat clay lands near the sea level, when it naturally had no inducement to move otherwise than sluggishly; while, on the least opposition, its banks became washed away, and its waters spread over the adjacent lowlands. It was not, in this case, difficult, by direct cuttings and embankments, and a few steam-engines, to drain the country, and, by certain operations, to clear the mouths of the rivers. On flat coasts a good deal might be, and actually was, reclaimed from the sea by such means. It was proposed at the present time to take in most of the enormous tract of land, now forming the great bay called The Wash, simply by embankments, and, taking advantage of natural advantages, narrowing the outlet of the rivers—enabling the sea to form its own embankment by silt—and pumping out the superfluous water. In Holland, they had to pump out the water from lands below the level of the sea: in this case, the embankment to keep out the sea would alone be necessary, and there would be no great danger from the sea, except at extraordinarily high tides. With regard to books on this subject, there were many Dutch, and some English ones. The last part of the *Agricultural Journal*, vol. viii., containing an account of the present state of the English fens; M. De Beaumont's *Leçons de Geology Pratique*, giving a long account of the deltas of most of the European and other rivers; *Johnstone's Lectures on Agricultural Chemistry and Geology*, and some other works on general drainage, were laid on the table at the close of the lecture by Professor Ansted.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

DECORATIVE ART SOCIETY.

Mr. Dwyer read a paper on the 13th October, before the Society, on the following questions:—What is high art? historical art? fine art? &c. Under what conditions do these become identical? and what is the relative value of each for the purposes of decorative art?

Mr. Dwyer complained of the mysticism and want of definition in all writers treating of what they call high art. For the most part, however, we should find that the study of nature is held to be the starting-point from which we are to be led away into a complexity of technicalities and metaphysical reasonings. As in writings, so it would be found in works. The architect, sculptor, painter, and poet, each attempts a mysterious grappling of mind with matter of fact, occasionally developing a high degree of intellectuality with much that is either unmeaning or not easily understood. Then there is the continually varying misapplication of technical terms in art, arising from an absence of principle in giving fixed names to definite things, which renders it a matter of difficulty to understand the proper limits and distinctions which exist between even such terms as high art, historical art, fine art, &c. He had sought for precise definitions from living artists of good repute and long standing, but obtained none; he had heard much of reasoning, in small circles as it were, which convinced him that a more general and comprehensive knowledge of art in its various phases would be useful, indeed, among its professors. The ordinary criticisms of the day upon art were to him vague and meaningless, and would generally, if divested of doubtful technicalities and expressed in plain English words, expose their flimsy construction. In tracing the progress of art, Mr. Dwyer felt that it had been strangely handled, not alone from the restless ambition of some of its votaries and professors, but still more so by the wanderings of others after the indefinite. Princes and popes have at certain periods patronised its works, but he considered that the attention at present directed towards art, throughout Europe, would probably promote an unprecedented Progress. Nevertheless, he held art in itself to be capable only of slow progress, simply because that must arise solely from a succession of improvements in imitative skill. A parallel to the present demand for variety of style and character had not, he said, existed in any previous period. In painting, sculpture, and architecture, we may learn to discover distinctive features marking a period, and most clearly showing the development of progression. Mr. Dwyer contended that the sameness of treatment in the works of most artists testifies to the tenacity with which copying or imitation clings to all, and that therefore it is essential to reflect and know, how far the different schools of art have relation to each other in respect of imitation,—how much an artist has been indebted to previous examples,—before we can adjudge to him a qualitative rank. Mr. Dwyer then enumerated celebrated works by Greeks, Romans, Italians, Venetians, French, Flemish, and Dutch, which were, he maintained, in harmony with the tastes and moral dispositions of the respective nations at the time they were produced, and also that art is in a great measure localised—dependent on certain rules, as developed by existing specimens, and by the position these held in the public estimation,—that it is essentially a thing of time, place, and circumstance. By judging of works of art upon a particular consideration of beauty, and by admitting one *class* of production as superior in rank to another, without reference to a comprehensive view of art generally, a great injustice has been engrafted on our received opinions upon art. Distinctive ranks in the departments of art, Mr. Dwyer contended, were a great evil, and to equalise them would be a great good achieved. Until the difficulties attendant upon the operations of art are understood, and unjust prejudices removed—until painters in oil, water, encaustic, and fresco, cease to disparage each other's work, and to exaggerate the importance of their own, until all aristocracy in practice of art shall be dissipated, and art, in humble garb of plaster and clay, be looked upon as kindly as if in marble, until some new energy shall have swept away these prejudices, as unreasonable as unjust, and a combination of artists in one emulative course of comprehensive inquiry and dispassionate reasoning, shall contribute to that one great purpose called art—we must not, it was contended, look for a positive and marked progressive feature to be developed in our times. It was then explained, that art being essentially based upon ideality, with an accurate presentment of effects in form and colour, after nature, is constituted and regulated by certain principles in harmony with the prevailing taste, education, or fashion, so as to excite pleasing emotions; and that it is therefore necessary to specially advance education and train the mind, before the really beautiful in art can be properly appreciated, or the genius evinced receive a just and fair criticism. Several instances were referred to, showing the power of art in expressing clearly and intelligibly to all whatever sentiment it is intended to impart,—as the "Laughing Faun" and the "Dying Gladiator," in sculpture; or the "Creation of Adam," by Michael Angelo; the "Transfiguration," by Raffaelle; and the "Last Supper," by Leonardo da Vinci, in pictures. These examples, it was said, testify to a mental or reasoning ideality, combined with a skill in depicting the essence of things material, and should therefore rank far above imitative skill in the abstract. Ideality is yet more severely tasked in connecting the several ideal embodiments into a grand whole, or complete picture, as in the "Last Judgment," by Michael Angelo. Art such as this, he said, might be called *high art;* but the qualification ought not to be attached to the works of an ordinary artist, whose vanity leads him to lay a surreptitious claim to take rank under such a banner.

The characteristics of Greek art, it was stated, are quite distinct from the examples last mentioned, although both have received great and well deserved admiration. The Greeks, however, approached only to a perfect embodiment of physical beauty, without evolving the attributes of the higher powers of mental reasoning: this would arise simply from their progressive refinements being based chiefly on skilful imitation. Art had undoubtedly been extensively encouraged by the Greeks, from the great number of their works; and if, instead of pursuing the *heroic vein*, they had sought to impart a *moral purpose* (expressions to be taken in their broadest sense), then, indeed, would their productions have attained to a truly glorious eminence. It was Mr. Dwyer's opinion that their wonderful skill, when receiving additional purpose and meaning, would have created much nobler works through their embodiment of mental attributes. The frieze of the Parthenon, he contended, while he had the fullest appreciation of its beauties, ought not to be viewed in any other light than as a production in *imitative art*. Nature, he said, had been so faithfully studied and delineated, that very few inaccuracies could be discovered; but he deduced from this and the pervading similarity of features and vacant expression, not only that the *models* must have been of a superior class, but also that the Greek artists had relied upon their powers of imitating objects as they were seen by them.

The second part of this paper was read by Mr. Dwyer on October 27. His plan of treatment sought rather to embody generally, than to judge of art in its details. Simplicity with purpose constitutes perfection in art; and although these are the most rarely developed, they are most readily recognised by the public. What constitutes historical art? Is it represented by battle scenes, massacres, processions, or reviews? He thought we ought to find a combination of characteristics in persons, time, and place, harmonising with the event represented, and with mental attributes commanding reverential attention, and exciting a feeling of emulation in the spectator. In painting, the accredited substitutes are too commonly portraits and gatherings from old prints. The recent exhibition at Westminster Hall, professedly of historical art, was in point. The painting of "Alfred the Great inciting the Saxons to prevent the Landing of the Danes," displayed a high purpose,—an attempt to show in a simple fact what our navy once was, and lead us to respect him who by his genius improved the bulwarks of our country, and laid the foundation of our present mercantile greatness. On the other hand, "The Battle of Meeanee" could only excite a feeling of horror, and was better fitted for the Horse Guards than for a decoration in the new palace at Westminster. A moral lesson might be discovered in "Richard Cœur de Lion forgiving Bertrand de Gourdon,"—an embodiment of a noble principle in Christianity. On the other hand, "Edward's *generosity* to the People of Calais during the Siege of 1346," is too problematical. He called attention to a scriptural picture, by Mr. Riviere, relating to the "Seven Acts of Mercy," in which the conditions of sickness, hunger, and the houseless, were expressed through the means of English associations—appealing in English garb to English understandings, and thus rendering art more sympathetic.

The decorations for the new palace at Westminster, according to the comprehensive system laid down by the Commissioners of Fine Arts, afford an unexampled opportunity to artists to gratify the desires of all who venerate painting only in its noblest workings. He hoped the term "decorations" would not continue as hitherto to be misunderstood and restricted in its meaning, by artists generally, and that the time had returned when all branches of the arts would be considered honoured in their application as decorations. What has lately been the general estimation of a painting on a wall? why, mere ornamentation, whereas, if removed from such a position and framed as a picture, it is recognised as of fine art, or high art. He further remarked that artistic works in metal, such as jewellery, &c., would, if in marble, take rank as fine art. These false distinctions, he contended, had led to an overflow of followers into certain divisions of art called professional, while in others, deemed industrial, a scarcity equally evident prevails. A skilful designer for manufacturers is as much an artist as the painter of landscapes or portraits, and the designer requires for his purpose abilities both mentally and manipulatively superior to the other. He pointed out Holbein, who, as a portrait painter, imitated admirably, but as a designer, he invented nobly. He also named Quentin Matsys. Successful works in art emanate only from a congenial source, and the taste of a nation must always influence their production. Whatever is truly great or practically useful is always based upon simplicity. The simple outlines of Greek and Etruscan vases, have caused, perhaps, more abstruse geometrical investigations into conic sections than even the planetary systems; yet, he thought, geometry had not been brought to assist art in their formation.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

Nov. 1.—Samuel Angell, Esq., V.P., in the Chair.

The Chairman addressed the meeting on the occasion of the opening of the new Session, and alluded to the generally improved character and style of many new buildings in progress, and to the sanitary measures that now so properly engage much of the public attention. He adverted to the loss the Institute had sustained by the death of Mr. George Allen, Fellow, and likewise to the recent death of Mr. L. N. Cottingham, an architect whose talents had justly brought him into considerable notice.

A paper was read by Matthew Digby Wyatt, Esq., on "*Mosaics as applied to Architectural Decoration*," which he illustrated by a large collection of prints, and his original drawings and sketches of mosaics in various Italian churches, some rare Roman and Florentine mosaics, and a variety of specimens of those of modern manufacture by Messrs. Minton and Co., Mr. Alfred Singer, and Mr. Jeakes.

Nov. 15.—Charles Fowler, Esq., Vice-President, in the Chair.

Mons. Firmin Epellet, and Major-General Howard Vyse, M.P., were elected honorary and corresponding members. Mons. Epellet is the architect of the department of the Pas de Calais, and he has recently completed the town-hall of St. Omer.

Mr. T. L. Donaldson remarked on Mr. Knowles's plan of the Parthenon, which was among the drawings exhibited, that it showed a joint in the pavement under the centre of each column of the *naos*, which is quite contrary to modern practice. Mr. Donaldson always considered that there must have been some communication between the *naos* and the *opisthodomos*, for the latter was used as the treasury, and it was necessary that the priests should have access without having to go round to the outside and other end of the building.

Mr. Penrose did not think that this hypothesis could be established, for there were no signs of such a doorway in the remains of the Parthenon.

Mr. C. H. Smith gave an account of a kind of trap or porphyritic building stone used in Devonshire, where Crediton church was built of it. He presented specimens to the Institute. It belongs, he said, to the igneous formations, and is formed chiefly of melted felspar, but having many bubbles, afterwards filled up with carbonate of lime. Its colour and durability vary very much. That of a light grey colour is least to be depended upon. The line of bed could not, he observed, be detected, so as to afford any inference as to its indication of the durability of the stone. He took the opportunity of remarking that with respect to limestones, such as Bath stone, the oolites, Caen stone, &c., setting them in the line of their beds made no difference; it was only in the case of sandstones that any benefit was gained. It is quite impossible for any person to say from an inspection of a block of Caen stone, what is the way of its bed. The best looking stone is the least durable, and the darker the most durable; and generally speaking, the finer grained oolites are the least durable, and the coarser grained the most durable.

Mr. George Godwin called the attention of the meeting to some experiments on Caen stone at Mr. Cubitt's. Without reference to the action of the weather, a piece of Caen stone of the size of a brick, laid with the bed parallel to the pressing surfaces, required a crushing force of 50 tons; another piece laid with the bed perpendicular to the pressing surfaces was crushed by a force of 30 tons only.

Mr. Ambrose Poynter thought it well worthy of notice that the mullions in the windows of Henry the Seventh's Chapel stood, throughout, contrary to the way of the bed, and yet they are in the best state of preservation.

The Vice-President thought this statement of Mr. Poynter's might be reconciled with the experiments detailed by Mr. Godwin, for the mullions had little or no weight to carry, and consequently no crushing force, while they were best preserved from absorbing wet, by having the bed-line of the stone placed vertically instead of horizontally.

In the course of the discussion it was remarked that Caen stone was very variable, containing hidden veins and faults, and nodules of clay, which were liable to be affected by frost.

Mr. Donaldson laid before the Institute an account of the church of Santa Maria del Fiore, at Florence, and of the design for completing the façade, sent to the Institute by Cavaliere Niccolo Matas. The dome is one of the earliest modern domes, and second in size only to St. Peter's, at Rome, but older.

Some discussion took place on the propriety of the meeting coming to an off-hand vote, approving of the design of Cavaliere Matas, and at length a committee was appointed to examine and report.

ON MODEL EXPERIMENTS.

(Continued from page 368.)

In the last number of the *Journal* we obtained formulæ for the comparison of the weights capable of being sustained by similar girders; we now proceed to apply our formulæ to the experiments so ably conducted by Mr. Hodgkinson, with reference to the proposed bridge over the Menai Straits. A report of these experiments will be found in the May number of the *Journal* for 1846, from which we extract the following table and explanation:—

"To obtain the strength of tubes, precisely similar to other tubes fixed on,—but proportionately less than the former in all their dimensions, as length, breadth, depth, and thickness,—in order to enable us to reason as to strength from one size to another, with more certainty than hitherto, as mentioned before. Another object, not far pursued, was to seek for the proper proportion of metal in the top and bottom of the tube. Much more is required in this direction.

In the three series of experiments made, the tubes were *rectangular*, and the dimensions and other values are given below.

Length.				Distance between supports		Weight.		Thickness of Plates.	Last observed Deflection.	Corresponding Weight.	Breaking Weight.	Value of f, for crushing Strain.
ft.	in.	In.	In.	ft.	in.	cwt.	qr.	Inch.	Inch.	Tons.	Tons.	Tons.
31	6	24	16	30	0	44	3	·525	3·03	56·8	57·5	19·17
31	6	24	16	30	0	24	1	·272	1·33	29·8	22·76	14·47
31	6	24	16	30	0	10	1	·124	1·29	5·04	5·53	7·74
						lb.	oz.			lb.	lb.	
8	2	6	4	7	6	78	13	·182	·66	9,416	9,976	29·17
8	2	6	4	7	6	38	11	·065	·32	2,696	3,156	15·81
8	2	6	4	7	6	..		..	..	..	..	..
4	1½	3	2	3	9	10	12	·061	·436	2,094	2,464	24·66
4	0½	3	2	3	9	4	15	·03	·18	560	672	18·42

The tube placed first in each series, is intended to be proportional in every leading dimension, as distance between supports, breadth, depth, and thickness of metal, and any variations are allowed for in the computation. Thus the three first tubes of each series are intended to be similar; and in the same manner of the other tubes, &c."

Here it will be observed that in the first set the dimensions are four times the dimensions in the second set nearly, and the dimensions in the second set are very nearly twice those in the first. Comparing the first of the second and third sets, we find in the first of the second set the weight of the tube 78 lb. 13 oz., and the breaking weight 9,976 lb.; and in the first of the third set, the weight of the tube 10 lb. 12 oz., and the breaking weight 2,464 lb. Now, by the formula deduced in our last paper, if w be the imposed breaking weight, w' the weight of a girder in scale 1, the breaking weight of a similar girder in scale u will be $\left(\frac{2w-(u-1)w'}{2}\right)u^2$.

Here $(u-1)=1$; $w'=10$ lb. 12 oz.; $u=2$ lb.; $w=2{,}464$ lb.;

$$2w-(u-1)w' = 4918 \text{ lb. nearly } \therefore \frac{2w-(u-1)w'}{2} \times u^2 = 9836.$$

This, as will be seen, is only 140 lb. less than the breaking weight as found by experiment. It will be observed, moreover, that the tube in the second set is rather more than twice as thick as that in the first, which sufficiently accounts for the slight discrepancy. Comparing now the first experiment of the first and second sets, we shall find the value of the breaking weight in the first, deduced by the formula from the second—too great:

putting $u=4$ lb., $w'=78$ lb. 13 oz., $w=9{,}976$ lb.,

the breaking weight were = 70 tons,—an excess over experiment of nearly 13 tons. The reason of this difference is obvious: our formula supposes that the breaking tension per square inch, in all the models compared by it, is constant. This, no doubt, would have been the case in the model tubes of Mr. Hodgkinson, had they been constructed of one uniform plate of metal, and not rivetted. The necessity of rivetting is one great cause of the mishaps which are constantly occurring in iron bridges,—as we endeavoured to show a few numbers back, in a paper on the cause of the breakage of the Dee Bridge [see *Journal*, p. 294]: the longer the bridge, the wider and more numerous must be the joints, and the greater the chance of irregular strains. The effect of rivetting, we observe, has been to reduce the breaking tension per square inch one-fifth, in the first of the first set of experiments as compared with the first of the last set;—how much that effect would be increased in a tube 460 feet long, or fifteen times the dimensions of the longest experimented on by Mr. Hodgkinson—we leave our readers to judge.

We trust, in the meanwhile, that Mr. Hodgkinson will continue his labours on tubes of still greater length, by which means only can we hope for anything like an approximation to a law for the mean effect of a number of rivetted joints. However, as we have often observed, the mischief most to be apprehended is not of a statical but dynamical character,—the constant recurrence of vibrations, tending to loosen the joints, perhaps to impair the nature of the iron, and ultimately so to weaken the structure, that a slight jar or strain may be sufficient to produce sudden disrupture of the whole.

CITY OF LONDON UNION WORKHOUSE COMPETITION.

A controversy is going on as to the competition for this building, which is likely to draw the general attention of the profession. The facts, we are informed, are these.

The surveyor who measured the ground for the guardians is named as the favoured candidate, and by a majority of two obtains the award of the first premium. He has resorted to the extraordinary measure of sending round to the guardians a plan and particulars of his own design, and so has brought himself before the tribunal of the public. On this plan he is charged with having taken 17 feet more ground in width than is allowed to the other competitors, the presence or absence of which would make a great difference in the accommodation, as the space of ground is uncommonly narrow.

Had the matter rested merely with the board of guardians, we could not have interfered until a decision had been given; but as the surveyor has pleaded to the jurisdiction of the public, we feel that we have a full right to institute such a comparison between his and the second plan, as will show that there are no sufficient reasons for the selection; and under the peculiar relation of the surveyor and the board of guardians, we cannot but look with suspicion on the present state of the case.

The comparison, unfortunately, is of the defects of the surveyor's plan, from which the other is free. Only eight day rooms are provided for 1,000 inmates,—but then the surveyor says that two "work rooms" are day rooms, and two "dietary rooms" in the *basement* are day rooms, having, consequently, two sunk areas as airing yards. No separation is made of aged women, mothers with children, and prostitutes, who are to be placed in one day room. The rooms for aged couples are made to look out on a dead wall close by, and having privies and urinals beneath. The infirmary does not contain sufficient accommodation. The Poor-Law Commissioners have wisely protested against dormitories on the ground-floor, but the surveyor has provided them. The passages are circuitous, and many of them will require gas in the daytime.

As the strip of ground is long and narrow, the surveyor has made his buildings to stretch across it, so that they can be built against at a future time, and light and air excluded.

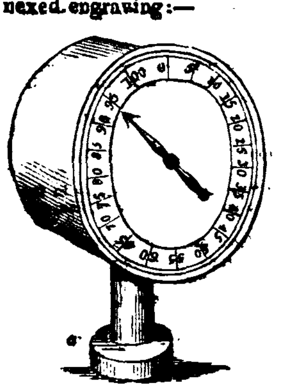
As to the design of the chapel which he has sent round, we cannot but think it too ornate and preposterous as applied in such a building.

The other plan runs in one compact block along the ground in its greatest length, having wide spaces on each side for courts and yards, which can never be interfered with by any buildings on either side. One corridor is carried through the building from end to end, proper access is provided, fourteen day rooms are laid down, no communication can take place between the sexes, and even the male and female infirmaries are separated.

A body of masters of unions have pronounced in favour of the second plan and against that of the surveyor, and it is certain that the latter will be rejected by the Poor-Law Commissioners. Whether the board of guardians, who are friends to the surveyor, will dare to pass his plan after the discussion which has taken place, remains to be seen; but if they do, we shall certainly not fail in our endeavours to do justice to the architectural profession.

SYDNEY SMITH'S PATENT STEAM INDICATOR.

At the third quarterly meeting of the Institution of Mechanical Engineers, held at Birmingham on October 29th., a new steam indicator, patented by Mr. Sydney Smith, was explained to the meeting; it consists of a dial six inches in diameter, and the body four inches deep, and in all, about ten inches high, as shown in the annexed engraving:—



The details of the invention were not given, but from what could be gathered there appears to be a tube of cold water communicating at one end with a steam syphon, attached in the usual manner to the boiler, and the other end of the tube is attached by a flange to the flange *a* of the indicator; at this point there is an elastic web of india rubber, which cuts off the communication of the cold water in the tube; on the top of this elastic web there is a vertical rod, which, as it rises or falls, acts on a weighted pendulum fastened on to the axis of a pinion, gearing into other wheels that communicate with the hands of the indicator. It will thus be seen that as the steam in the boiler increases in pressure, it presses upon the surface of the cold water in the syphon, and consequently the pressure is transferred through the tube of water to the elastic web, and raises the vertical rod, which actuates the gearing of the dial. The only use of the cold water is to keep the india rubber web cool. It does not matter what length the tube may be,—if the indicator be screwed on to one of the legs of the syphon, 18 inches to 2 feet long, it will be sufficient.

The apparatus is out of the reach of the engineer, and the value of the invention is enhanced by the accuracy of the indications not being affected by the distance at which the dial plate may be from the boiler. For example, in marine boilers the indicator may be alongside the compass, and be as faultless a guide of the pressure of the steam, as that instrument is of the course of the vessel.

Mr. George Stephenson considered it a most valuable invention, and stated that he had had one put up at his collieries at Tapton:—"It is placed some distance from the boiler, and in another house, and works most beautifully, showing the rise and fall of the steam in the most delicate manner. The indicator is like the face of a clock, with a pointer, making one revolution in measuring from 1 lb. to 100 lb. upon the square-inch of the pressure of steam; it is quite from under the control of the engineer, or any other person, so that its indications may be relied upon, and the construction is so simple that it is scarcely possible for it to get out of order."

"The Indicator" is adapted alike to high or low-pressure engines. The high-pressure is figured from 1 lb. to 100 lb., and the low-pressure from 1 lb. to 50 lb. upon the square inch.

One of these indicators has been fixed to a boiler at Messrs. Miller and Ravenhill's manufactory, Glass-house-fields, Ratcliff; another in the *Ant* steamer; and one at the Polytechnic Institution.

LIGHT FROM ELECTRICITY.

Mr. Staite delivered a lecture at Newcastle-on-Tyne, on his "*New Mode of Lighting by Electricity.*"

Mr. Staite having first described his galvanic battery and other apparatus, which are on an entirely new principle of his own maturing, and which cannot be well described without diagrams, observed, that the production of light from electricity was not a new thing *per se*. The experiment of the charcoal points, and the phenomena of the voltaic arc, with powerful batteries, were well known. The difficulties hitherto experienced had been—1. The economical production and application of the electric currents.—2. The discovery of a suitable material for the development of the light.—3. The rendering of the light permanent (the greatest difficulty of all). By what means, and to what extent, he had overcome these difficulties, Mr. Staite informed his audience. He produced, under a glass receiver, a brilliant light, before which the gas jets of the lecture-room turned, not pale, but yellow. "The peculiar characteristics of the electric light (said Mr. Staite) were its purity and volume. The most delicate shades of colour might be detected, while the eye was not distressed by its effects. The same quantity of light, developed by gas, or any other known means, would be absolutely unendurable. That the light was not the result of combustion, strictly speaking, was evident. There could be no combustion without the presence of oxygen; and, as the light was developed to the best advantage under a closed glass, from which supplies of atmospheric air were excluded, it was quite certain that combustion had nothing to do with the matter." The light, in fact, the lecturer remarked, could be produced as readily in water as out of it. He showed its peculiar applicability to coal mining, for it could not explode the foulest atmosphere. He then came to the comparative cost of the electric and other lights. With a battery consisting of four small cells, a light was developed equal to 380 mould candles (sixes), or 300 wax candles, or 64 cubic feet of the best gas, burnt in the standard burner. This was effected by a consumption of zinc equal to 0·77, or 77-100ths of a pound, being little more than ¾ lb. of zinc per hour. When the light, however, was brought to its maximum, by increasing the distance of the electroids to their limit, the light was increased nearly threefold, whilst the current itself was reduced to about three-fifths in quantity. "This curious fact (continued Mr. Staite) I have frequently observed before. So that the light, when developed under the best circumstances consistent with its permanence, was produced by a consumption of a seventh part only of a pound of zinc per hour—and that light equal to 380 tallow candles. Assuming that the zinc so consumed was worth one halfpenny, and that the cost of the working solution, deducting the value of the products (sulphate of zinc, &c.), was as much more, we have the following comparative result:—Electric light, 1d. per hour; gas light, equal thereto, 6d. to 8d.; tallow candles, 7s. 6d.; wax, 12s. 6d." [But, in addition to the zinc and solution, an allowance must be made for apparatus, skill, labour, &c., as in the manufacture of other lights—gas, wax, tallow, &c.] In conclusion, Mr. S. observed, "By a careful comparison of all modes of effecting artificial illumination, I think I am justified in saying that there is no light so cheap as that evolved by voltaic currents of electricity; and there is certainly none which exhibits such pure and brilliant results. The absence of all smoke and flame, and noxious gases—the non-consumption of oxygen—the impossibility of its igniting surrounding substances—and the simplicity of the apparatus—are powerful recommendations for the adoption of the light in all places where purity, and brilliance, and safety, and economy, are sought for."

In the course of his address, Mr. Staite truly observed, in reference to the alleged jealousy of coal-owners, gas-makers, &c., that it was idle to throw obstacles in his way; if his electric light had superior merit on its side, it would come into use in spite of any local opposition; if, on the contrary, in practical value it was inferior to others, it would fall into oblivion.

NOTES OF THE MONTH.

The Building Act.—A committee, nominated by Lord Morpeth, consisting of Mr. Hosking, Mr. Poynter, and Mr. Shaw, the official referees; Mr. Pownall and Mr. Aitcison, district surveyors; and Mr. Biers and Mr. Piper, builders, has been appointed, for the purpose of considering the objectionable parts of the present act, with a view for amendment in the present session of Parliament.

Tidal Harbour Board.—Capt. Betham, R.N., Capt. Washington, R.N., and Capt. Vetch, R.E., have been appointed to form a "Tidal Harbour and Conservancy Board," under the jurisdiction of the Admiralty, each to receive a salary of £800 per annum.—How is it there is not a C.E. in the appointment?

The Nelson Column, Trafalgar Square.—Mr. Carew, the sculptor, has just completed the model of the principal bas-relief, for the compartment of the base facing Whitehall. The group is taken from Southey's "History of the Battle of Trafalgar," were it is stated that Nelson, observing "they had done for him at last," ordered new tiller ropes to be rove as the others were destroyed. There are, in all, fifteen figures, above seven feet high, the centre group taking Lord Nelson to the cockpit.

The School of Design at Somerset House has been re-modelled. The general direction, hitherto vested in the Board of Trade, has been confined to three persons in that office—Mr. Lefevre, Mr. Porter, and Mr. Northcote. The council of all classes of persons has been supplanted by a council of three, consisting of Mr. Richmond, the painter; Sir R. Westmacott, the sculptor; and Mr. Ambrose Poynter, the architect. Mr. Wilson, the late director, has had assigned to him the superintendence of the provincial schools; and two of the late masters, Messrs. Townshend and Horsley, have been appointed professors in the school. There is to be a third professor, but the appointment has not yet been filled up.

Cape Town Gas-Works.—In consequence of an article which appeared in our *Journal* some time since, stating that the apparatus for lighting up Cape Town with gas was then being obtained in England, a correspondent writes us word from the Cape—"It may be gratifying to some of your readers to know that the works have since been erected and in operation now twelvemonths, to the surprise as well as gratification and enlightenment of the inhabitants here, who have most liberally encouraged the undertaking, the works having now nearly 600 lights to supply, with a steady, increasing demand, and which success must be mainly attributed to the ability and persevering energy of the engineer, Mr. Alexander Wilson, formerly of the London Imperial Gas-Works, and to whom the greatest credit is due for the manner in which the works have been carried out and conducted,—but it must not be omitted to mention the able managing director it has lost in the late lamented F. S. Watermeyer, Esq., through whose instrumentality the company was first formed."

College of Surgeons.—The College have bought Alderman Copeland's house in Lincoln's-inn-fields, for £16,000, so as to enable them to enlarge the library and Hunterian museum. This is likely to make more work for Mr. Barry.

Royal Academy.—Mr. Sydney Smirke and Mr. F. R. Pickersgill have been elected Associates.

Highton's Electric Telegraph.—The electric telegraph on the Baden Railway, opened on the 15th of October last, is worked by Highton's Patent Gold Leaf Telegraph, the practical working of which gives the highest satisfaction. Professor Eisenlohr, of Carlsruhe, appointed by the government to superintend it, states that, *with one wire only*, information is being transmitted at the rate of 30 letters a minute; whilst the most complicated apparatus, and one that costs ten times as much, and requires a much more powerful current of electricity, gives not more than 60 or 70 letters per minute, and is not so certain in its action.

China Grass Rope.—A rope has been lately manufactured from a new material, called "China Grass," at Manchester, by Mr. Thomas Briggs, of Salford, expressly for the iron-works of the Earl of Fitzwilliam, at Elsegar; it is 600 yards long, and weighs 14 cwt. 3 qrs. and 14 lb. Ropes made from China grass are stated to be much stronger and more durable than those composed of hemp, but are more expensive. Before manufacturing ropes of a large size from this material, Mr. Briggs had some small ones made, which he tested by working in blocks on his own concerns; he found them to work well, also to be very strong, and of great durability. In coal-pits and mines, where ropes of great strength are required, those made from China grass are much sought.

Turkish Honours.—Tribute to British Science from the Sultan Mahmoud.—Mr. Fairbairn, of Manchester, has been presented with a decoration of one of the Turkish orders, in consideration of the valuable services performed by him in his capacity as engineer to several extensive works, undertaken at the desire of the Sultan.

Professor Willis has undertaken the editorship of Mr. Parker's new edition of the "Glossary of Terms in Gothic Architecture." This engagement will ensure the work being brought out with success.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM OCTOBER 22, TO NOVEMBER 25, 1847.

Six Months allowed for Enrolment, unless otherwise expressed.

William Kirrage, of Warner-place, Hackney-road, Middlesex, for "an Improved combination of material for building purposes, and a new application of certain materials for building purposes."—Sealed October 22. Two months.

Edward Barker, of Budleigh Salterton, Devon, gentleman, for "certain Improvements in the preparation of manure."—October 26.

William Thomas, of Cheapside, merchant, for "certain Improvements in the construction of stays, and in machinery for manufacturing stays; parts of which machinery are applicable to other species of weaving."—October 26.

George Petrie, of 14, Mountford-street, Whitechapel, Middlesex, for "certain Improvements in electric telegraphic apparatus."—October 26.

Charles Carey, of Churchyard-row, Newington Butts, Surrey, gentleman, for "Improvements in obtaining infusions or extracts from coffee and other matters."—October 26.

Meyer Meyer, of Artillery-place, Finsbury, Middlesex, for "certain Improvements in the manufacture of umbrellas and parasols."—November 2.

James Walker, of Glasgow, gentleman, for "Improvements in weaving."—Nov. 2.

Thomas Dunn, of the Windsor-bridge Iron Works, Manchester, for "Improvements in the manufacture of railway-wheels and axles, and in machinery and apparatus for placing carriages on to a line of rails, for removing them from one line of rails to another, and for turning them."—Nov. 2.

William Boulnois, of Baker-street, Portman-square, Middlesex, gentleman, for "Improvements in draught harness."—Nov. 2.

Jean Charles Victor Coullon, of Auxerre, France, for "Improvements in propelling vessels."—Nov. 2.

Bernard Von Rathen, of Putney, Surrey, civil engineer, for "Improvements in obtaining and applying motive power."—Nov. 2.

William Longmaid, of London, gentleman, for "Improvements in the manufacture of alkali and chlorine."—Nov. 2.

Thomas Langton, of Bullwell, near Nottingham, for "Improvements in the manufacture of knitted fabrics."—Nov. 2.

James Murdock, of Staple Inn, Middlesex, for "an Improved capsule or small case for protecting matters enclosed therein from the action of the air, and an improved material to be used in the manufacture of the said capsules."—Nov. 2.

Thomas Hancock, of Stoke Newington, Middlesex, for "Improvements in fabrics elasticated by gutta percha or any of the varieties of caoutchouc."—Nov. 2.

Richard Laming, of Clichy la Garenne, France, for "certain Improvements in manufacturing and purifying coal gas, and in treating a residual product of such manufacture, also improvements in preparing materials to be used in the purification of coal gas."—Nov. 4.

Charles Low, of Roseberry-place, Dalston, Middlesex, gentleman, for "Improvements in the manufacture of zinc, copper, tin, and other metals."—Nov. 4.

Cyprien Marie Jessie Du Molay, of Paris, gentleman, for "Improvements in inlaying and coating metals with various substances."—Nov. 4.

John Lawson, of Paisley, North Britain, for "Improvements in machinery for separating burs, seeds, and other matters, from wool, cotton, and other fibrous substances."—Nov. 4.

George Wells, of 7, Penton-place, Walworth, for "a machine for the purpose of causing communication between the guards and engine-drivers of railway carriages, whilst travelling on railways, and also for communication between vessels at sea and the shore, and for other similar purposes; and which invention it is intended to call an atmospheric signal by land or water."—Nov. 4.

Jean Marie Durafour, of Lyons, France, for "a new fastening or improved system of lacing without eyelet holes."—Nov. 4.

Joshua Procter Westhead, of Manchester, for "Improvements in the manufacture or treating of india-rubber."—Nov. 4.

James Pedder, of New Union Street, Middlesex, for "certain Improvements in steam-engines, and in propelling."—Nov. 6.

Robert Davison, of Broad-street, City, and William Symington, of the same place, for "certain Improvements in the application of heat to the preparation, desiccation, and preservation of bread-stuffs, confectionary, pulse, meats, vegetables, and other edible substances."—Nov. 6.

George Henry Bursill, of Hornsey-road, Middlesex, and Joseph Radford, of Maida Hill, gentleman, for "Improvements in envelopes, wrappers, and covers, and in machinery and apparatus for the manufacture thereof."—Nov. 6.

John Robertson, of Tweed-mouth, Berwick, gentleman, for "Improvements in architecture; the elementary method of formation employed in the same; also further applicable for harmonizing formation, as of urns or vases."—Nov. 9.

Henry Fielder, of Carlton-villas, Maida Vale, Middlesex, for "Improvements in the construction of iron beams or girders."—Nov. 9.

Reuben Dyer, of Boston, Lincoln, brewer, for "Improvements applicable to two and four wheel carriages."—Nov. 9.

Edward Waud, of Bradford, Yorkshire, spinner, for "certain Improvements in the construction of machinery for preparing and spinning alpaca, mohair, wool, flax, and other fibrous materials."—Nov. 9.

George Heaton, of Birmingham, for "Improvements in locomotive engines."—Nov. 9.

Henry Krebs Claypole, of Liverpool, gentleman, for "certain Improvements in the process, apparatus, and machinery for making sugar." (A communication.)—Nov. 9.

Joseph Jean Baranowski, of 3, Rue Neuve Clichy, Paris, gentleman, for a ready-reckoning machine."—Nov. 11.

Israel Kinsman, of Ludgate-hill, in the City of London, merchant, for "Improvements in the construction of rotary engines to be worked by steam, air, or other elastic fluids." (A communication.)—Nov. 11.

Frederick Collier Bakewell, of Hampstead, Middlesex, gentleman, for "certain Improvements in machinery or apparatus for making or manufacturing soda water, and other aerated waters, and liquids."—Nov. 11.

Samuel Salmon, of Houndsditch, for "Improvements in rendering certain materials applicable as a substitute for leather, paper, papier mache, and oil cloth, in various articles of manufacture." (A communication.)—Nov. 11.

George James Soward, of Huntley-street, Bedford-square, Middlesex, builder, for "Improvements in suspending window-sashes, shutters, and blinds, and in the construction of the frames for the same."—Nov. 11.

Charles Blackford Mansfield, of Clare-hall, in the University of Cambridge, esq., for "an Improvement in the manufacture and purification of spirituous substances, and oils applicable to the purposes of artificial light, and various useful arts; and in the application thereof to such purposes, and in the construction of lamps and burners applicable to the combustion of such substances."—Nov. 11.

George Taylor, of 2, Bartholomew-place, Kentish-town, gentleman, for "certain Improvements in machinery or apparatus for sweeping and cleansing chimneys, funnels, flues, drains, and other places."—Nov. 13.

James Chesterman, of Sheffield, machinist, for "certain Improvements in tape measures, and in cases used for containing the same; and in the machinery or apparatus for manufacturing or making such measures and cases, or certain parts thereof."—Nov. 13.

George Price Simcox, of Kidderminster, for "Improvements in the manufacture of carpets, and other similar articles."—Nov. 16.

William Edward Newton, of Chancery-lane, for "Improvements in the mode or modes of manufacturing or preparing certain matters to be employed as pigments." (A communication.)—Nov. 16.

George Phillips, of Park-street, Islington, chemist, for "certain Improvements in the purification of certain oils and spirits."—Nov. 16.

William Birkmyre, of Southdown, Cornwall, for "Improvements in smelting copper and other ores."—Nov. 16.

William Brunton, jun., civil engineer, of Poole, Cornwall, for "certain apparatus for dressing ores or minerals."—Nov. 16.

Piere Armand Le Comte de Fontainemoreau, of 15, New Broad-street, city, for "Improvements in manufacturing braids, plats, fringes, gimps, and other similar articles."—Nov. 18.

Piere Armand Le Comte de Fontainmoreau, of 4, South-street, Finsbury, for "certain Improvements in the process and machinery for making, uniting, and preserving metallic and other tubes or pipes." (A communication.)—Nov. 18.

William Rocke, of Dudley, Worcestershire, for "a new mode of heating and applying wrought-iron."—Nov. 18.

Alexander Parkes, of Birmingham, for "Improvements in the manufacture of metals, and in coating iron and steel."—Nov. 18.

Thomas Martin, jun., of New-cross, Deptford, machine maker, for "Improvements in the manufacture of drain tiles, and tubes, and other articles from plastic materials."—Nov. 18.

Thomas Walker, of Hanley, Staffordshire, for "a new and valuable mode of decorating articles of earthenware and china."—Nov. 20.

William Reid, of University-street, Middlesex, for "certain Improvements in communicating intelligence by electricity, and in the instruments and apparatus employed therein."—Nov. 23.

George Philbrick Swinbourne, of Pimlico, Middlesex, gentleman, for "certain Improvements in the manufacture of gelatinous substances, and in the apparatus to be used therein."—Nov. 24.

Richard Coad, of Kennington, Surrey, chemist, for "Improvements in the combustion of fuel, and in applying the heat so obtained."—Nov. 25.

Edwin Travers, of Oldham, Lancashire, cotton-spinner, for "certain Improvements in looms for weaving."—Nov. 25.

William Hutchinson, of Wakeling-terrace, Barnsbury-park, Middlesex, gentleman, for "Improvements in treating pasteboard and other substances, rendering them compact, and impervious to wet, frost, vermin, and other destructive agents."—Nov. 25.

George Holgate, of Spring-hill, near Burnley, Lancashire, cotton-spinner, for "certain Improvements in power looms."—Nov. 25.

Pierre Philippe Celestin Barrat, of Paris, in the kingdom of France, for "Improvements in machinery for tilling and working land."—Nov. 25.

END OF VOLUME X.