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THE controversy over the female figure on the Jersey City Soldiers' and Sailors' Monument has been decided in court. It will be remembered that a design was selected in competition, which included a figure, by Philip Martiny, representing Liberty, in the form of a woman of vigorous appearance, holding a large sword. Some of the Grand Army veterans of Jersey City were scandalized at the thought of putting a figure of a young woman on a monument of martial character, and went so far as to apply to the courts for an injunction to restrain the Monument Committee from carrying out its contract with Mr. Martiny. Arguments were heard on both sides, and affidavits were submitted to convince the Court of the inappropriateness of the design; but the judge, who was the distinguished Chancellor McGill, held that a robust young female with a big sword typified war with sufficient distinctness for legal purposes, and dismissed the application; so that the monument will, we hope, be completed without further delay, in accordance with the beautiful model already familiar to the profession.

WE have received a letter, of a very common sort, enclosing an invitation to architects to compete for a hospital building in California. The invitation calls for plans, specifications and itemized estimate of cost, and gives notice that the architect will be required to give bonds to insure the completion of the building for a sum within the estimate. Our correspondent, who says that he has made a special study of hospital construction, complains of these hard terms, and thinks that we might say something in regard to them. As in so many other cases, the best and only thing to be said about the matter is that if architects do not like to have such terms proposed to them, they should not accept them. Our correspondent says, that no architect of position and responsibility will have anything to do with such a competition, and that its terms will be accepted only by builders' clerks and small draughtsmen. This is undoubtedly true, and the obvious inference is that people who offer for professional service such terms as only ignorant or interested people are willing to accept will get, and very often wish to get, only such service as such persons can render. In most cases of the sort, one of these worthies has already secured the job by private arrangement, and the "competition" is merely a device by which innocent architects are utilized as cat's-paws for carrying this private arrangement into effect; so that it is the policy of the promoters to make their terms so distasteful to the profession as to keep out men of experience and standing, who would be likely to discover and resent any underhand proceedings, and attract only those who, through their poverty or uncertain position, will keep to themselves any scandals that they may suspect. The most unfortunate thing in regard to such "competitions" is that now and then some architect of a certain reputation "tries his luck" in them, longing for something to employ his skill upon, and hoping vaguely for some possible benefit; and, although the more able and respectable he is, the less is his chance of employment, the fact of his participation is used to delude other architects and the public, and to perpetuate practices which could easily be suppressed if the profession would treat them resolutely. There is no question that the people who pay for important buildings wish to have them properly designed, by competent and honest men. If they found that none of these would have anything to do with them except upon certain terms, acknowledged by the profession to be reasonable and fair, they would compel their Commissions, or Building Committees, to offer such terms; and the present system, under which, through the weakness of a few architects of decent respectability, schemes of wholesale robbery are carried out under the cloak of pretended "architectural competitions," would be overthrown.

IT is announced that the course known as "Fine-Arts Three," in Harvard University, which Professor Norton has made one of the most noted and popular in the University, will be given hereafter by Mr. Edward Robinson, Curator of Classical Antiquities in the Boston Museum of Fine-Arts. Fine-Arts Four, which has been given by Professor Norton and Professor Moore, in alternate years, will be given every year by Professor Moore. Professor Norton will continue the course known as Italian Four.

IT is very common for owners of buildings, particularly in New York, to claim, either by special contract or on general principles, some control over the sign-boards which their tenants put up. They argue, with much justice, that an ugly sign, by injuring the appearance of the building to which it is attached, may reduce very appreciably the rental value of their property, and those of them who are wise insert a clause in their leases reserving to them the control which they desire. Without such a clause, clearly defining whose taste is to be consulted, or imposing specific restrictions, there may be controversies on the subject between the parties interested, as happened not long ago. The exterior of a certain building on Forty-second Street is decorated in a highly æsthetic manner, being painted a pale orange yellow, with dashes of green and pink, and the owners, not unnaturally, fear to have the effect of so delicate a "symphony" disturbed by harsh or incongruous intrusions. There is a tenant in the building, who is, apparently, less sensitive to color-harmonies than the owners, and his untutored attempts to put up suitable signs have not met with favor from them. On the contrary, they have been so distressed by the appearance of the signs that they have sent men by night, with brushes and pots of turpentine, to wash them out. This proceeding seems to have reacted on the moral nature of the tenant, who declared, after a few repetitions of it, that he would paint his signs of whatever color he chose, without regard to the advice, exhortations or threats of the owners. Things went on in this way for five months, when one of the parties found means to summon the other into court, and there the whole question was argued, the owners claiming the right to control the color and appearance of the signs, and the tenant denying this right. Long arguments were made on both sides, but the decision of the court was reserved, and will not be made known until next week.

THE vacation travelling-scholarship instituted a year ago by the Boston Architectural Club has been awarded for the present year to Mr. Albert C. Fernald. Mr. Fernald is very well known in Boston offices as a skilful draughtsman and assistant, and many good wishes will accompany him on his trip, which is to be devoted particularly to the study of the architecture of northern Italy.

THE Portable Hoisting-Engineers' Union is gaining the reputation of suffering from more "grievances" than any other body of men in the building trades, and, apparently agreeing with the poet about the evil effects of keeping their sorrows to themselves, they manifest their emotion by throwing hundreds, and sometimes thousands, of other men out of work, and keeping them out until their own private unhappiness is assuaged. As a very small number of hoisting-engineers can hoist materials for a very large number of other mechanics, and as the latter cannot work on buildings unless their materials are brought to them, it is evident that the engineers, by close organization, have building-operations in New York, and the workmen employed in them, practically at their mercy, and they have for several years used their power remorselessly, either of their own motion, or under the direction of the Board of Walking-Delegates, which has found the Hoisting-Engineers' Union a ready and powerful instrument for carrying out its schemes. There has been so little building business in the country this season that the crop of May strikes has been a meagre one, but the hoisting-engineers were unwilling, apparently, to let the month pass without making themselves conspicuous, and a demand was made upon one of the companies which owns and rents hoisting-engines, for an advance in the engineers' wages from four to five dollars a day, and a change in the number of hours which should constitute a day's work. The company granted both these requests, but with a condition, that the Engineers' Union should give up its connection with the Board of Walking-Delegates, and should cease to take part in "sympathetic strikes." The men refused to accede to this condition, and a series of strikes has been ordered, which may bring work to an end on seventy-five large buildings in New York, where members of the Engineers' Union are now employed. The prospect is now, however, that the employers will resist, and make an attempt, for which conditions are particularly favorable just now, to break up effectually the tyranny of the Engineers' Union. It is hardly necessary to say that five dollars a day, for such skill as is required to operate a hoisting-engine, is enormously high pay. Hundreds of such engines, in places outside of New York, are successfully operated by men who are glad to earn two dollars a day, and there has been no difficulty in obtaining non-union engineers to fill the places of the strikers. Of course, the real struggle will come when the Board of Walking-Delegates orders sympathetic strikes in all trades on buildings where non-union engineers are employed; but the larger unions in New York have already declared, more or less openly, against sympathetic strikes, and without their aid the Board could do nothing for the engineers. As we go to press we learn that the Portable Hoisting-Engineers and the Walking-Delegates have parted company, and we sincerely hope that this piece of good news may be really true.

THE School of Drawing and Painting of the Boston Museum of Fine-Arts will begin its twenty-third year next October. Under the will of the late J. W. Paige, a conditional bequest has been received of thirty thousand dollars, which will be paid over to the School as a permanent fund for the maintenance of a travelling-scholarship, provided ten thousand dollars more is raised before July 1, 1899. Six thousand dollars have already been subscribed, and the direction of the School appeals to the public for additional subscriptions, to make up the remaining four thousand, so that the bequest may not be lost.

NOW that the United States has become the largest iron-producing country of the world, the question of disposing of the furnace-slag from the furnaces must soon become pressing. In Europe, this slag, which is a compound of silica, lime and alumina, somewhat resembling Portland cement in constitution, is often mixed with an additional dose of such substances as are lacking, and ground into a tolerable substitute for cement; but it is doubtful if such cement would find more than a local demand here, and the slag bricks, which are much used in England, seem to offer advantages, particularly in the Southern cities, where good bricks are less common than in the North. According to *La Semaine des Constructeurs*, such bricks are made in France by first reducing the slag to a spongy sand, either by throwing water on it with a hose, as it is drawn, red-hot, from the blast furnaces, or by receiving it from the furnaces in iron wagons, and emptying these over a piece of wet ground. In either case, the steam produced by the contact of the melted slag with water blows the latter into spongy fragments, which need very little grinding to reduce them to a coarse sand, the particles of which are sharp and rough, so that they hold tightly to the cement which is afterwards added. To form the slag into bricks, three parts of the sand are mixed by machine with one part of cement, or hydraulic lime of almost any kind, and pressed into moulds. In some cases, the bricks are twice pressed, the re-pressed bricks having double the strength of the others. No burning is required, as the bricks become very hard by simple exposure to the air. Such bricks, although they will melt in a furnace, are refractory enough for ordinary flues and fireplaces, and are not injured by frost. They are naturally of a grayish color, and may be readily and smoothly cut. In using them, we are told that the only precaution necessary is to avoid soaking them in water. While bricks of clay are better for being laid wet, the slag bricks should only have the dust brushed or washed off.

THE American School of Classical Studies at Rome will be for the next year under the charge of Professor Peck, of Yale, Professor Norton taking the chair of archæology, and Professor Merrill that of Latin literature. The work of the School for the past year is regarded as very satisfactory, and the management of its finances has been judicious, but it will be necessary to raise funds for the next year's work by private subscription, mainly among the colleges.

EVERY few months we hear something about the value of cheese as a medium for painting. Many an old receipt-book recommends the mixing of whitewash with cheese and milk, instead of water, and cheese in some form enters into the composition of innumerable "waterproof paints" and similar articles. It seems, however, to have been reserved for the Germans to make a thorough investigation of the use of cheese in such ways, and, at the risk of advertising a patented material, we will say that, according to a little pamphlet on our table, a certain artist of Düsseldorf, who appears to be a chemist as well, professes to have discovered that the ancient wall-paintings of Rome and Pompeii, as well as those of Egypt, and also the paintings on mummy cases and masks in the latter country, were all executed with a medium containing caseïn, or, practically, cheese, in combination with wax, or white-of-egg, or water only. In fact, he finds that cheese in some form was the universal component of media for painting until the invention of oil-painting in the fifteenth century, and that, even then, for something like a hundred years the under-painting of easel pictures was generally done with the cheese medium, oil-color being used only for glazing. The extraordinary durability of the antique painting would be reason enough for trying to rediscover the methods used in it, and Herr Gerhardt has been able to compose mixtures of caseïn and water, with, for certain purposes, oil, gum or pitch, which hold colors perfectly, and afford a depth and richness nearly equal to that obtained with oil alone, and are free from any tendency to turn yellow or decay with age, and may be used on canvas, plastered walls, marble or stone. It is said that, unlike ordinary fresco colors, successive coats may be put, one over another, so that portions of the work may be glazed, just as in oil-painting; and, as the medium dries in a few minutes, effects are rapidly obtained. Another use claimed for the new medium is that of fixing drawings in pastel or crayon, in place of the shellac "fixatif." The caseïn fixatif is colorless, and is said not to dry with a dark edge, in case too much is applied.

ONE of the many mountain railways now in process of construction in Switzerland ascends the Gornergrat, and some curious phenomena have been observed during the progress of the work. When the road-bed had been carried to a height of about nine thousand feet, an epidemic broke out among the workmen. Many of them came to the physician attached to the road, complaining of headache, palpitation of the heart, difficulty of breathing and fever; and the overseers noticed that the men who remained at work were easily fatigued, and did not accomplish so much in a day, by about one-third, as they did on the lower levels. The Company's physician, Dr. Courton, sent the worst cases to Zermatt, where complete recovery took place in two or three days. Most of the men were Italians, from the province of Bologna, and the epidemic was pronounced to be simply "mountain fever"; but, as it was severe enough to interfere seriously with the enterprise, the Italians were replaced by men brought up in the Alps, and even these suffered to some extent.

STATICS OF STRUCTURES. — THEORETICAL AND APPLIED.[1]—XI.

THE MOMENT-OF-INERTIA.

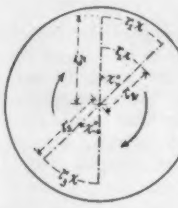

Fig 105.

209. A factor which enters largely into all calculations pertaining to the strength of beams subjected to cross-bending is the *moment-of-inertia.* On account of its complex derivation, however, it did not seem advisable to introduce the term at the very beginning. In place of it we therefore made use of the *moment-of-resistance*, which may be called a simplification of the moment-of-inertia. It was quite possible to demonstrate the meaning of the former without a reference to the latter (§§26–32).

The term *inertia* originated at a time when the fundamental physical laws regarding the motion of matter were not yet fully understood. It was then held that all bodies possessed a property which caused them to offer a resistance to being moved; or, once set in motion, to being stopped. This property was called "inertia." It is now known that this apparent resistance is due to external forces acting upon the bodies, such as gravity, etc.

210. To make the meaning of the term "moment-of-inertia," as now understood, sufficiently clear, we shall trace its derivation from the simpler conceptions of velocity, momentum, etc. These, in turn, are expressed in terms of the three fundamental units of *length, mass* and *time*, which may be represented by l, m and t.[2]

Velocity is the rate of motion of a body in a definite direction; it is therefore equal to the length traversed by the time taken. Its unit is

$$v = \frac{l}{t} \tag{35}$$

Velocity Acceleration is the rate of change of velocity. It is, accordingly, equal to the latter divided by the time taken, or

$$a = \frac{v}{t} = \frac{l}{t^2} \tag{36}$$

When a body moves with a varying velocity its average velocity for a given time is the average length per second traversed during this time. In the case of *uniformly accelerated* motion it is equal to one-half of the sum of the beginning and end velocities. Thus, let the velocity at the beginning be $v_1 = o$; *i. e.*, let the body be at rest. Let the acceleration per second be a; at the end of t seconds the velocity will, therefore, be $v_1 = a t$; and the average velocity, or the average distance traversed in one second, will be

$$v_a = \frac{o + a t}{2} = \tfrac{1}{2} a t \tag{37}$$

And the entire distance traversed by a body in t seconds, beginning from a state of rest and moving with a uniform acceleration a, will be t times the above, or

$$l = \tfrac{1}{2} a t^2 \tag{38}$$

Force may be defined[3] as the cause of a change in the velocity of any mass. Unit force is that push or pull which is required to impart to unconfined unit mass unit velocity during unit time, or

$$f = \frac{m v}{t} = \frac{m l}{t^2} \tag{39}$$

Such a force causes the body upon which it acts to move with a uniformly accelerated velocity; which can readily be seen by substituting in the above equation a for $\frac{v}{t}$ (Equation 36), giving

$$f = m a \tag{40}$$

The product of force into the distance through which it acts is called *work;* it is equal to

$$w = f \times l = \frac{m l^2}{t^2} \tag{41}$$

The capacity for doing work possessed by a moving body, due to its *momentum*, is called its *kinetic energy.* For a mass m, moving at a velocity v, it is equal to

$$e = \tfrac{1}{2} m v^2 \tag{42}$$

This equation is derived by multiplying the force which it was necessary to apply to the body to give it the velocity by the distance traversed; in other words, by ascertaining the work done on the mass, to which its kinetic energy is due.

The force required to give any mass a continuous acceleration is, according to Equation 40, equal to $m a$. But a mass moving with this acceleration traverses a distance equal to $\frac{1}{2} a t^2$ (Equation 38). Multiplying these two values together, we get

$$m a \times \tfrac{1}{2} a t^2 = \tfrac{1}{2} m a^2 t^2, \text{ or } \tfrac{1}{2} m v^2,$$

since, from Equation 36, $a t = v$, consequently $a^2 t^2 = v^2$.

211. When a body moves in a straight line the distances traversed by its molecules are all equal; when, however, the body rotates about an axis, they are unequal, being proportional to their *radii*, or distances from that axis.

While the time required to make one complete rotation is the same for all molecules of the rotating body, their velocities vary, for they traverse different lengths during this time.

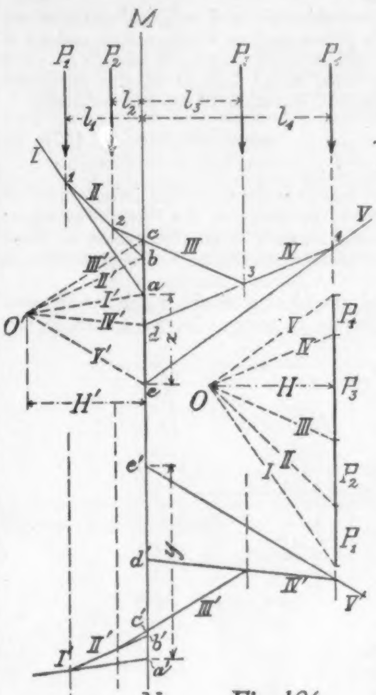

Fig. 106.

Since all the radii have to describe an angle of 360° during the time of one rotation, it follows that they describe equal angles during one second, the unit of time. The magnitude of this angle is called the *angular velocity* of the rotating body. By means of it the actual velocities of the various molecules may be found, provided their radii r_1, r_2, r_3, etc., are known; for, if the angular velocity is x, their actual velocities, according to a well-known geometrical proposition, will be $r_1 x$, $r_2 x$, $r_3 x$, etc. (Fig. 105).

212. The rotating body possesses a certain amount of kinetic energy; let us find its value. Since the molecules have various velocities, while Equation 42 contemplates but a single velocity, we shall attempt to make use of the angular velocity x. Accordingly, let us assume the rotating body compressed into and replaced by an ideal mass I, located at unit distance from the axis. The actual velocity of this mass will, therefore, be $x \times 1$, or simply x; and its kinetic energy

$$E = \tfrac{1}{2} I x^2 \tag{43}$$

If it were possible to find such a mass, the product of it into $\frac{1}{2} x^2$ would represent not only its own kinetic energy, but also that of the original body; further, having the same kinetic energy, it would also possess the same inertia. It is, therefore, called the *moment-of-inertia* of the original body about its axis of rotation.

Strictly speaking, a mass or weight cannot be called a moment, as that is always the product of weight or force into distance (§3); in the present case, however, the distance of the mass from the axis about which the moment is taken is unity; accordingly, the moment is equal to the mass times 1, or simply the mass.

213. The moment-of-inertia of a body is, therefore, equal to that quantity, which, when multiplied by $\frac{1}{2} x^2$, will give the kinetic energy of the body. To find a general value for it, let us ascertain the kinetic energy of the rotating body in terms of its molecules. If the masses of its several molecules are m_1, m_2, m_3, and their respective radii r_1, r_2, r_3, their kinetic energies will be (since $v = r x$, and $v^2 = r^2 x^2$):

$$\tfrac{1}{2} m_1 r_1^2 x^2,$$
$$\tfrac{1}{2} m_2 r_2^2 x^2,$$
$$\tfrac{1}{2} m_3 r_3^2 x^2, \text{ etc.}$$

Therefore the kinetic energy of the entire rotating body is the sum of the above, or

$$\tfrac{1}{2} x^2 (m_1 r_1^2 + m_2 r_2^2 + m_3 r_3^2 + \ldots\ldots)$$

214. The quantity in parenthesis is the sum of the products of all the molecular masses into the squares of their radii. If we denote this sum by $\Sigma\, m r^2$, the equation for the kinetic energy of the rotating body becomes

$$E = \tfrac{1}{2} x^2 (\Sigma\, m r^2) \tag{44}$$

Comparing this with Equation 43 we get for the moment-of-inertia

$$I = \Sigma\, m r^2 \tag{45}$$

That is, *the moment-of-inertia of a rotating body is equal to the sum of the products of all the masses of its molecules into the squares of their respective distances from the axis of rotation.*

215. I being the moment-of-inertia of a body, and W its mass or weight, the distance i, as defined by the equation

$$i^2 = \frac{I}{W} \tag{46}$$

is called the *radius of inertia*, or the *radius of gyration* of the body with respect to the same axis about which I was taken. Defined in words, *the radius of gyration is the distance from the axis to that point at which, if the entire mass or weight of a rotating body were concentrated, its angular velocity and moment-of-inertia would remain unchanged.* The equation is derived as follows: If i is the distance of the point of concentration from the axis, and W the entire concentrated mass or weight of the body, then the moment-of-inertia of the concentrated body is

$$I = W i^2$$

[1] Continued from No. 1161, page 102.
[2] In the "C. G. S." system of units, used in scientific work, the three fundamental units are the Centimetre, Gramme, and Second.
[3] No uniform definition has as yet been agreed upon by scientists.

But since I, in general, is equal to $\Sigma\, m\, r^2$, we get

$$W\, i^2 = \Sigma\, m\, r^2, \text{ or}$$

$$i^2 = \frac{\Sigma\, m\, r^2}{W} = \frac{I}{W}.$$

216. In statics the moment-of-inertia and radius of gyration are almost exclusively applied to planes, such as cross-sections, instead of solid bodies. Since the former have no weight, m must be assumed as representing the infinitesimal areas instead of the molecular masses in the inertia formula, and Equation 46 must be written

$$i^2 = \frac{I}{A}, \qquad (47)$$

in which A is the area of the plane.

217. Since the moment-of-inertia is the sum of an infinite number of products it is generally found by means of the integral calculus; and in the case of simple sections, such as parallelograms, or those composed of a number of parallelograms, this method is preferable to any other.

But there are also several graphical methods, which are of great advantage in finding the moments of sections having a more or less

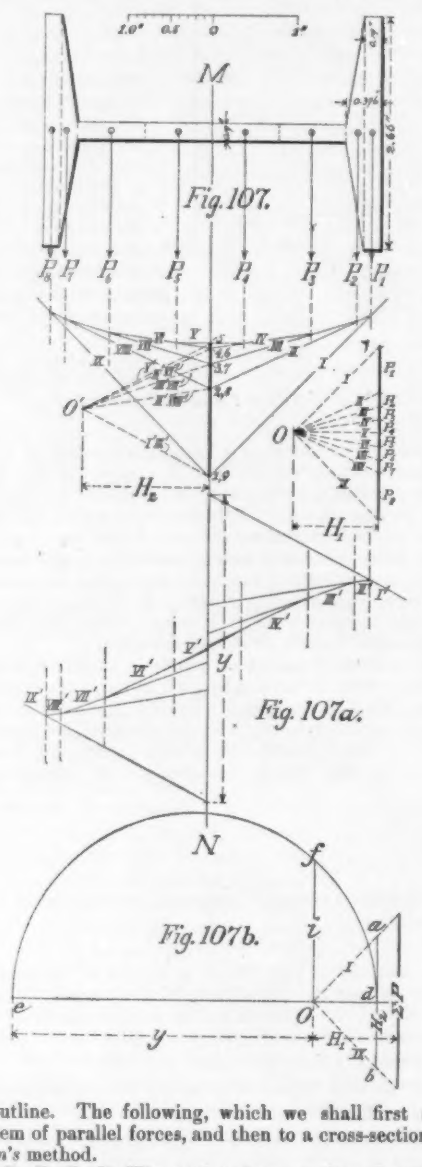

Fig. 107. Fig. 107a. Fig. 107b.

irregular outline. The following, which we shall first apply to a simple system of parallel forces, and then to a cross-section, is known as *Culmann's* method.

Suppose P_1, P_2, P_3, P_4 (Fig. 106) to be a number of parallel forces, whose moment-of-inertia is to be found about the axis M–N, from which their respective distances are l_1, l_2, l_3 and l_4.

After drawing the load-line $a\,b$, and the rays I–V to it from the pole O, located at random, in the usual manner, the cord-polygon I–V is constructed and its sides prolonged to intersect with the axis $M\,N$ at the points a, b, c, d and e respectively. Then the triangles

$$1\; a\,b,\; 2\; b\,c,\; 3\; c\,d, \text{ and } 4\; d\,e,$$

formed by the axis and successive sides of the cord-polygon are similar to the force-triangles

$$I\,P_1\,II,\; II\,P_2\,III,\; III\,P_3\,IV, \text{ and } IV\,P_4\,V,$$

their sides being parallel. Therefore, if H is taken parallel to the lengths l_1, l_2, etc., we shall have

$$l_1 : a\,b :: H : P_1,$$
$$l_2 : b\,c :: H : P_2, \text{ etc.};$$

from which

$$P_1\,l_1 = H\,a\,b,\; P_2\,l_2 = H\,b\,c, \text{ etc.; or}$$

$$\sum_{x=4}^{x=1} P_x\,l_x = H\,(a\,b + b\,c + c\,d + d\,e)$$

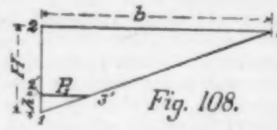

Fig. 108.

In adding together the lengths $a\,b$, $b\,c$, etc., it is to be noticed that those having an upward sense counteract those with a downward sense, so that the final sum is equal to the distance included between the two exterior polygon sides I and V, or $a\,e$. Placing $a\,e = x$, we get

$$\sum_{x=4}^{x=1} P_x\,l_x = H\,x \qquad (48)$$

(A similar proof was given in § 63, in connection with Figs. 23 and 23*a*).

218. Now, regarding the lengths $a\,b$, $b\,c$, $c\,d$, and $d\,e$ as a second system of forces, acting along the lines of the first, let us draw the rays I'–V' from the new pole O', and, parallel to them, the second cord-polygon I', II',–V', intersecting the axis at a', b', c', d', and e'.

Calling the new pole-distance H', we get, in the same manner as above,

$$l_1 : a'\,b' :: H' : a\,b;$$
$$l_2 : b'\,c' :: H' : b\,c, \text{ etc.}$$

Further, since $a\,b = \dfrac{P_1\,l_1}{H}$ (§217)

$$l_1 : a'\,b' :: H' : \frac{P_1\,l_1}{H},$$

from which

$$\frac{P_1\,l_1^2}{H} = a'\,b'\,H', \text{ or } P_1\,l_1^2 = a'\,b'\,H\,H'.$$

Similarly, $P_2\,l_2^2 = b'\,c'\,H\,H'$; and, finally,

$$I = \sum_{x=4}^{x=1} P_x\,l_x^2 = H\,H'\,(a'\,b' + b'\,c' + c'\,d' + d'\,e') = H\,H'\,y, \qquad (49)$$

if y is the distance intercepted on the axis by the exterior polygon sides I' and V'.

To recapitulate: the moment-of-inertia of a number of forces P about a given axis is found by first ascertaining the moment $\Sigma\,P\,l$, which is equal to the product of the first pole-distance H into the ordinate x intercepted on the axis by the exterior sides of the first cord-polygon and then ascertaining the moment $\Sigma\,(P\,l)\,l$, which is equal to the product of the first and second pole-distances H and H' and the ordinate y intercepted on the axis by the exterior sides of the second cord-polygon.

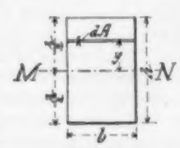

Fig 109.

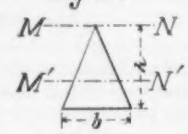

Fig. 110.

Fig. 111.

219. As a practical application of this method, let us find the moment-of-inertia of a 4″ — 7.5 lbs. I about its neutral axis M—N, passing through the centre-of-gravity perpendicularly to the web (Fig. 107).

Theoretically, expressed in the notation of the integral calculus, the moment-of-inertia of the cross-section is

$$I = \int l^2\,d\,A \qquad (50)$$

in which $d\,A$ is the area of a strip of infinitesimal width, taken parallel with the axis, and l its distance from the latter.

In practice, however, the cross-section is divided into a number of strips of finite width; if their areas are called A_1, A_2, etc., and the distances of their centres-of-gravity from the axis l_1, l_2, etc., the moment-of-inertia will be approximately equal to the sum of $A_1\,l_1^2 + A_2\,l_2^2 +$ etc.; and, if the section is divided into eight strips, Equation 50 will become

$$I = \sum_{x=8}^{x=1} A_x\,l_x^2 \qquad (51)$$

220. In general, these strips will have various breadths b and heights h. If we reduce them all to parallelograms having the same height H, and denote the various breadths of these parallelograms by P_1, P_2, P_3, we shall get

$$A_1 = h_1\,b_1 = H\,P_1;\; A_2 = h_2\,b_2 = H\,P_2; \text{ etc.};$$

from which

$$I = H \sum_{x=8}^{x=1} P_x\,l_x^2 \qquad (52)$$

Now, assuming the lengths P_1, P_2 — P_8* as a system of parallel

*These lengths P_1, P_2, . . . P_8 can be most readily found by a graphical method based on the proportion

$$P_1 : h_1 :: b_1 : H,$$

which is derived from the equations

$$A_1 = h_1\,b_1 = H\,P_1; \text{ or } P_1 = \frac{h_1\,b_1}{H}.$$

Thus, in Figure 108 some convenient length 1 — 2 is laid off as H; the values of b_1, b_2, etc., are laid off along 2 — 3, and h_1, h_2, etc., along 1 — 2′; P_1, P_2, etc., are then given by 2′ — 3′; for, by reason of the similarity of the triangles 1 — 2 — 3 and 1 — 2′ — 3′,

$$2' - 3' : 1 - 2' :: 2 - 3 : 1 - 2, \text{ or } P_1 : h_1 :: b_1 : H.$$

forces, their moment-of-inertia about the axis $M - N$ can be found in exactly the manner just described in connection with Figure 106.

The first cord-polygon I, II–IX, intercepts, on the axis, the length 1, 9–5. It will be noticed that, on account of the symmetrical arrangement of the forces P_1, $P_2 - P_7$, P_8, corresponding right and left hand sides of the first polygon intersect on the axis, so that each division of the new load-line represents really two forces, equal in length, but opposite in sense. Similarly each line from the second pole O' represents two rays.

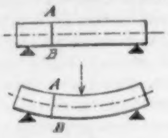

Fig 112, 112a.

If we call the first pole-distance H_1, the second H_2, and the length intercepted on the axis by the external sides of the second cord-polygon y, we get, according to Equation 49,

$$\sum_{x=8}^{x=1} P_x \, l_x{}^2 = H_1 \, H_2 \, y,$$

and, inserting this value in Equation 52,

$$I = H \, H_1 \, H_2 \, y \qquad (53)$$

H was made equal to 1″; now, scaling the other dimensions, we find H_1 to equal 1.1″; H_2, 1.5″; and y, 3.6″; so that

$$I = 1 \times 1.1 \times 1.5 \times 3.6 = 6''.$$

221. The radius of gyration of the cross-section is constructed as follows (Fig. 107*b*): —

Between the first and last rays from the pole O to the first load-line ΣP is inserted $a\,b = H_2$ (the second pole-distance), parallel to ΣP. The line $d\,O$, perpendicular to ΣP, is prolonged to e, $O\,e$ being made equal to y, the distance intercepted on the axis by the second cord-polygon. Next a semi-circle is drawn upon $d\,O\,e$ as a diameter, and the perpendicular $O\,f$ erected on $d\,e$ at O, intersecting the semi-circle at f. The distance $O\,f$ thus found is the desired radius of gyration, i.

For $i^2 = \dfrac{I}{A}$; but $I = H\,H_1\,H_2\,y$, and $A = H\,\Sigma P$; therefore

$$i^2 = \frac{H_1 \, H_2 \, y}{\Sigma P}$$

Now, in Figure 107*b*, by a well-known geometrical proposition, $O\,d : O\,f :: O\,f : O\,e$; from which

$$(O\,f)^2 = O\,d \times O\,e.$$

But, on account of the similarity of triangles, $O\,d : H_1 :: H_2 : \Sigma P$, from which $O\,d = \dfrac{H_1 \, H_2}{\Sigma P}$; and $O\,e = y$, by construction. Therefore,

$$(O\,f)^2 = \frac{H_1 \, H_2 \, y}{\Sigma P}, \text{ or } O\,f = i.$$

Scaling the distance $O\,f$, we find it to equal 1.6″.

222. The moments-of-inertia of the simpler shapes, such as the parallelogram, the triangle, the circle, etc., are all most conveniently found by means of the integral calculus. For example, let h (Fig. 109) be the height of a rectangular cross-section; b, the breadth; $m - n$, the neutral axis through the centre-of-gravity parallel to the shorter side; A, the area, and $d\,A$ the area of a strip of infinitesimal height, at a distance y from the axis; then the moment-of-inertia about $m - n$ will be

$$I = \int_{-\frac{1}{2}h}^{+\frac{1}{2}h} y^2 \, d\,A = 2 \int_{0}^{+\frac{1}{2}} y^2 \, b \, d\,y = \frac{b\,h^3}{12}, \qquad (54)$$

and the square of the radius of gyration:

$$i^2 = \frac{I}{A} = \frac{b\,h^3}{12} \times \frac{1}{b\,h} = \frac{h^2}{12}. \qquad (55)$$

Similarly, the moment-of-inertia of a triangle, for the axis $m - n$

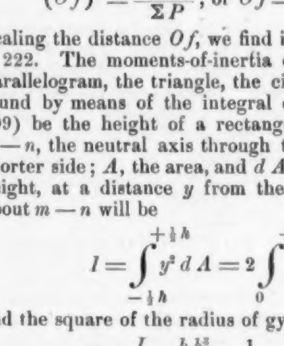

Fig. 113.

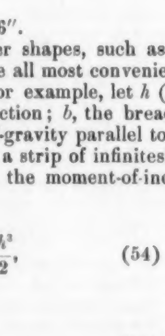

Fig. 114.

passing through the apex, parallel to the base (Fig. 110) is equal to $\dfrac{b\,h^3}{4}$; and the square of the radius of gyration to $\dfrac{h^2}{2}$. For the axis $m' - n'$, through the centre-of-gravity, parallel to the base, these values become $\dfrac{b\,h^3}{36}$ and $\dfrac{h^2}{18}$, respectively. For a circle, with the axis passing through the centre (Fig. 111),

$$I = \frac{\pi\,d^4}{64}, \text{ and } i^2 = \frac{d^2}{16}.$$

223. To ascertain the relation between the moments of inertia and resistance, let us take a cross-section through a beam subjected to cross-bending. Calling the stress on the section per unit area s, and the area of the extreme, or most-stressed fibre (§ 11) a, the stress on the latter will be $a\,s$.

If this fibre is at a distance d from the neutral axis (§ 11) the moment of the fibre-stress about the latter will be

$$a\,s \times d$$

In the case of the other fibres a_1, a_2, a_3, etc., being at the distances d_1, d_2, d_3, etc., from the neutral axis, these moments will be

$$a_1\,s_1 \times d_1;\; a_2\,s_2 \times d_2;\; a_3\,s_3 \times d_3;\; \text{etc.}$$

But the magnitudes of the fibre-stresses are proportional to the distances of the fibres from the neutral axis (§ 12); therefore

$$s_1 : s :: d_1 : d;\; \text{or } s_1 = \frac{s\,d_1}{d};$$

$$s_2 : s :: d_2 : d;\; \text{or } s_2 = \frac{s\,d_2}{d};$$

$$s_3 : s :: d_3 : d;\; \text{or } s_3 = \frac{s\,d_3}{d}, \text{ etc.}$$

Expressed in these values the moments of the fibre-stresses about the neutral axis will be

$$a_1 \times \frac{s\,d_1}{d} \times d_1, \text{ or } \frac{a_1\,s\,d_1^2}{d};$$

$$a_2 \times \frac{s\,d_2}{d} \times d_2, \text{ or } \frac{a_2\,s\,d_2^2}{d};$$

$$a_3 \times \frac{s\,d_3}{d} \times d_3, \text{ or } \frac{a_3\,s\,d_3^2}{d}, \text{ etc.};$$

and their sum may be written

$$\frac{s\,(a\,d^2 + a_1\,d_1^2 + a_2\,d_2^2 + a_3\,d_3^2 + \text{etc.})}{d}.$$

Now, if the neutral axis is regarded as an axis of rotation[1] the quantity in parenthesis is recognized as the moment-of-inertia of the cross-section (§§ 213–214). Inserting for it the symbol I, the sum of the moments of all the fibre-stresses may, therefore, be written

$$\frac{s\,I}{d}.$$

224. If the beam is to be safe, this quantity (with s = safe extreme fibre-stress) must be equal to the sum of all the external load moments M (§ 31), or

$$M = \frac{s\,I}{d}. \qquad (56)$$

But for a rectangular cross-section $I = \dfrac{b\,h^3}{12}$, and d, the distance of the most-stressed fibre from the neutral axis equals $\dfrac{h}{2}$; accordingly

$$\frac{s\,I}{d} = \frac{s\,b\,h^2}{6}.$$

But $\dfrac{b\,h^2}{6} = R$, the moment-of-resistance of a rectangular cross-section (Equation 8); therefore dropping s from both sides of the equation

$$\frac{I}{d} = R \qquad (57)$$

That is, the amount-of-inertia of a cross-section divided by the distance of the extreme fibre from the neutral axis (which distance in the case of a section symmetrical about the axis is equal to one-half of its height) is equal to its moment-of-resistance.

225. The moment-of-inertia of a parallelogram as given by Equation 54 can be applied to all sections composed of a number of parallelograms, as, for instance, those of plate or box girders.

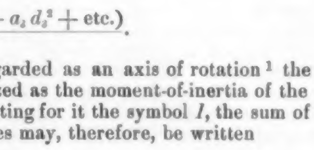

Fig. 115.

Thus, to get the I of the plate-girder shown in Figure 113, composed of a web-plate, four angles and two flange-plates, the moment of the top and bottom plates, or the two strips a and a', is first found by taking the moment of the entire parallelogram 1 — 2 — 3 — 4, and subtracting from it the moment of the parallelogram 5 — 6 — 7 — 8; that is

$$\tfrac{1}{12}\,b\,h^3 - \tfrac{1}{12}\,b\,h_1^3, \text{ or } \tfrac{1}{12}\,b\,(h^3 - h_1^3).$$

To this is next added the moment of the two strips b and b', which is equal to the moment of the parallelogram 9 — 10 — 11 — 12, less

[1] By comparing Figures 112 and 112*a*, it will readily be seen that the cross-section $A\,B$ turns or "rotates" about the neutral axis when the beam is loaded, but, of course, only to a very slight extent. It is on account of this slight turning that properties which pertain to rotating bodies are ascribed to the cross-sections of beams.

that of 13 — 14 — 15 — 16. After that the moment of the two strips c and c', equal to the difference between 17 — 18 — 19 — 20 and 21 — 22 — 23 — 24, is added; and finally, that of the strip d, equal to 25 — 26 — 27 — 28. Accordingly, the moment of the entire figure is

$$I = \tfrac{1}{12}\left[b\,(h^3 - h_1^3) + b_1\,(h_1^3 - h_2^3) + b_2\,(h_2^3 - h_3^3) + b_3\,h_3^3\right]. \quad (58)$$

(b and b_1 are taken exclusive of the width of the rivet-holes).

226. Another method, which we already had occasion to apply in § 41, consists in taking the moment of the entire parallelogram 1 — 2 — 3 — 4, and subtracting from it the moments of, first, the parallelogram 5 — 9 — 7 — 11 and 10 — 6 — 12 — 8 added together; then that of 13 — 17 — 15 — 19 + 18 — 14 — 20 — 16; and finally that of 21 — 25 — 23 — 27 + 26 — 22 — 28 — 24. This operation is given by the equation

$$I = \frac{b\,h^3 - \left[(b - b_1)\,h_1^3 + (b_1 - b_2)\,h_2^3 + (b_2 - b_3)\,h_3^3\right]}{12}, \quad (59)$$

which will give the same value as Equation 58.

227. As a numerical example, let us find the I of a plate-girder composed of a $36'' \times \frac{1}{2}''$ web-plate, two $12'' \times \frac{3}{8}''$ flange-plates and four $5'' \times 3\frac{1}{2}'' \times \frac{1}{2}''$ angles (Fig. 114). After deducting $\frac{13}{16}''$ rivet-holes from both flanges, we find, according to Equation 59,

$$I = \frac{(10.4 \times 36.75^3) - \left[(1.5 \times 36^3) + (7.4 \times 35^3) + (1 \times 29^3)\right]}{12} = 8{,}750''.$$

According to Equation 57, its moment-of-resistance would, therefore, be

$$R = \frac{8{,}750}{18.37} = 476''.$$

Assuming a safe stress of 13,000 pounds, the uniformly distributed safe load on such a girder for a span of, say, 20 feet, would be, according to Equations 6 and 10 transposed,

$$P = \frac{476 \times 8 \times 13{,}000}{20 \times 12} = 206{,}000 \text{ pounds or 103 tons.}$$

228. The moments of inertia and resistance of box-girders can be found in a similar manner. When, in very heavy work, the bending moments on a plate-girder vary considerably at different points of the span, the girder is made of various depths to correspond; in light work, however, the depth is made the same throughout, the web-plate and angles being continuous; while the moment-of-resistance is suitably varied by the number and length of the flange-plates. Thus, for a girder with a uniform load, the flange-plates would be made heaviest at the middle, and decreased gradually towards the points of support. The requisite lengths of the flange-plates can be readily ascertained by means of the bending-moment cord-polygon. Thus, if R_1 (Fig. 115) represents the moment-of-resistance of a girder with one plate, $R_1 + R_2$ with two, $R_1 + R_2 + R_3$ with three, and $R_1 + R_2 + R_3 + R_4$ with four, then the second plate ought to extend from a to b, the third from c to d, and the fourth from e to f. In practice it is customary, however, to allow the plates to extend about 18″ beyond the points thus found.

229. The height of the girder is usually established by the available space; otherwise it ought to be about $\frac{1}{15}$ to $\frac{1}{12}$ of the span for buildings, and $\frac{1}{12}$ to $\frac{1}{8}$ for bridge-work. The web-plate ought not to be less than $\frac{3}{8}''$ thick, and must have sufficient cross-sectional area to resist the shear (§§ 89–93). It must be secured against buckling by means of stiffeners, consisting of angles riveted vertically against the sides of the web and spaced not farther apart than the depth of the girder. These stiffeners must further be placed at all points at which concentrated loads occur, and over the supports.

The flange-plates ought not to project beyond the outer line of rivets to a distance exceeding eight times their thickness. The angles, further, ought not to be less than $\frac{3}{8}''$ thick, and if their legs are unequal, the shorter ones are to be placed against the web-plate. Three-fourths-inch rivets are generally used, spaced from 3″ to 6″ apart; the exact number is to be determined by the shearing and bearing values.

O. F. SEMSCH.

[To be concluded.]

THE THIRTEENTH EXHIBITION OF THE ARCHITECTURAL LEAGUE.[1] — II.

IT is with a curious feeling of reminiscent discomfort that we examine a drawing described as the "accepted design for the Jefferson Davis Monument at Richmond, Virginia"; not that we have any objection to the erection of monuments to any person whose memory can inspire subscriptions, but because no name recalls so sharply the civil strife which, as we hoped, every one in this country was now trying to forget. Regarding, however, Mr. Griffin's design in the abstract, it is an agreeable combination of dome and columns which will be worth seeing whenever it is carried into execution. Next to this come some more beautiful pen-and-ink drawings by Mr. W. A. Potter, and an interesting set of measured drawings and photographs, by Professor Goodyear and Mr. McKecknie, of Pisa Cathedral, showing in detail the singular variations from geometrical accuracy with which architects have already been made familiar. Notwithstanding the disbelief with which many architects regard Professor Goodyear's conclusions, and the enormous difficulties which, in our day, would beset an attempt to give æsthetic character to a stone building by intentional slight variations from geometrical precision, no one can deny the charm of the actual examples, and it does not seem quite unreasonable to hope that, as the source of the refined beauty of the Grecian Doric was discovered by the investigations of Mr. Penrose, closer study may reveal some definite principle in the irregularities of the Byzantine and Italian Romanesque.

One of the most interesting drawings in the exhibition is a perspective view of Mr. Robertson's thirty-story Park-Row office-building. In reality, the building is only twenty-six stories high, the extra four stories being contained in four turrets, which rise from the angles. As a design, the exterior is not particularly novel or remarkable, and the four-storied turrets, or cupolas, are probably of more value as advertisements of the building than they are as additions to its beauty; but the location would hardly warrant the expenditure of much money on architectural embellishment. A little way beyond is a remarkably pretty drawing, of a house at Detroit, by Messrs Nettleton, Kahn & Trowbridge, in a pure Dutch style; and Messrs. Green & Weeks show an exterior view of their design for the Buffalo Savings Bank, which is a remarkably good specimen of that extraordinary development of architecture now specially consecrated to savings banks, and is shown in a very pretty drawing. Farther on is a beautiful India-ink drawing, showing the elevation of Messrs. Howard & Cauldwell's design for the Newark High School, and a very French building, by Mr. Edward Pearce Casey, for the New York Fire-department.

The next drawing that particularly attracts us is a magnificent sepia drawing of the high-altar of the Cathedral of St. John the Divine, in New York, executed by Mr. J. King James for Messrs. Heins & La Farge. We are never quite sure that we like all the parts of Messrs Heins & La Farge's design, and we cherish the hope that the western towers will receive a good deal more study before they are carried into execution; but we meet at intervals with drawings, like this of the altar and the apse, which are full of promise. Nothing more dignified and sincere, in the way of church architecture, exists in this country, than the portion of the apse here shown, and we look forward with confident hope to the assimilation of the whole building to the noble and beautiful inspiration which appears in this portion.

In Number 780 Mr. A. I. Bell shows, in a very pretty pen-and-ink drawing, by Mr. Hobart A. Walker, a country house at Llewellyn Park, New Jersey, in a style rather new here, having the gables ornamented with real barge-boards, made of thick plank, and richly carved, as distinguished from the jig-sawed frills, the fragments of which strew the sand at the seashore resorts after every storm; and, in Number 698, Messrs. Little & Browne show an elegant city front, in Mr. Little's best style.

Next comes the alcove devoted to the designs for the New York Public Library, containing forty drawings. Naturally, the successful ones, by Messrs. Carrère & Hastings, attract most attention, and we think that professional visitors will generally agree that the award was deserved; but some of the other drawings are well worthy of study, as, for instance, Messrs. Haydel & Shepard's Fifth-Avenue front, which, if a little heavy, has great distinction. A few drawings of country houses and "proposed" buildings of various sorts complete the contributions of the New York architects, but Messrs. Cope & Stewardson send a very pretty drawing of a house at Princeton; Mr. Wheelwright shows his building for the Massachusetts Historical Society, and Messrs. Andrews, Jaques & Rantoul contribute their design for the Worcester Court-House.

[1] Continued from No. 1162, Page 4.

COST OF PILE-DRIVING WITH THE STEAM-HAMMER.[2]

MANY formulas have been given at various times, by experts, to determine the cost of driving piles with the drop-hammer, under various conditions and into different soils, but experience has proved them to be very unreliable. This being the case with an old and universally used machine it must be considered a problem of the future to suggest formulas for the cost of driving piles with the steam-hammer. While the writer does not claim that the steam-hammer will drive piles more cheaply under all conditions than will a drop-hammer, still where the two have been operated at the same time under similar conditions the former has been the more economical. No cases to the contrary have been reported where the modern machine has been used. Its greater first cost is of course a large factor to be considered and often prohibits its use where it otherwise would be selected.

A very good example of the work of the two kinds of machines is that done in the driving of piles for the foundation of a large gas-holder in New York City. With a 2,500-pound drop-hammer, four piles were all that could be driven in a day of ten hours, while a steam-hammer drove thirteen. They were each 70 feet long, 8 inches in diameter at the point and 15 inches at the head. A total of 800 were driven at a cost of two dollars each.

In New York harbor the drop-hammer drove 15 piles per day of ten hours, often breaking or otherwise damaging them, while the steam-hammer averaged from 40 to 45 without damage. The piles were 50 feet long, driven 24 to 26 feet into gravel and hard-pan. A total of 1,800 were driven at a cost of 80 cents each.

In Puget Sound the steam-hammer averaged nearly 200 piles per day where the drop-hammer could not put in over one-fifth that number, and even then many were damaged. The same crew did the work with both. These piles are 100 feet long, of Oregon fir,

[2] A paper by E. N. Pagelson read before the Engineering Association of the South and published in the *Papers* of the Association.

measuring but eight inches in diameter at the point and are driven butt end down for strength. They are used in the fishing industry. In this case the heavy blow of the drop-hammer caused the pile to spring sidewise, often to split, while the many lighter blows of the steam-hammer jarred the piles down.

In the following cases no comparison can be made directly, but engineers can recall instances in their own experience which may be used. In Chicago 40 Norway pine piles were driven 45 feet deep every ten hours at a cost of 55 cents each. Another firm drove from 60 to 65 piles, each 45 feet long, 15 feet deep into hard sand each day at a cost of about 30 cents each. In both cases they were driven for foundations.

A New Orleans firm reports the cost of driving 6,000 piles for wharf construction with a floating driver during three months as follows: —

	AUG.	SEPT.	OCT.
Average number per hour............	3.05	4.34	3.7
Average length per pile in feet.......	70	68	73
Average cost per pile driving.........	$1.70	$1.14	$1.28

This same firm used the same hammer for driving bents for a railroad trestle. The driver moved forward on the bents as fast as they were capped. The rate was 11 bents per day, piles varying from 20 to 45 feet and driven 15 feet deep. Total number of bents was 141 and four piles to a bent were driven at an average cost of 85 cents each. The hammer moved in pendulum leaders, driving the piles at quite an angle.

The hammers used in the above cases were made by a local firm and with one exception were of the following dimensions: Total weight 9,000 pounds. Weight of striking ram 4,800 pounds. Stroke 42 inches and about 60 blows per minute. The coal consumption is about 2,500 pounds per ten hours. The engineer can do his own firing. The crew needed is the same as for a drop-hammer.

The hammer used on Puget Sound was somewhat lighter: Total weight 6,100 pounds. Weight of ram 3,000 pounds. Stroke 30 inches and about 70 blows per minute. The parties using this hammer claim that the blows are somewhat too heavy for the long piles, and advise a lighter and much faster hammer. It seems that in this case in particular the short interval between the blows does not give the soil time to settle around the pile, which is the prime advantage in using the steam-hammer.

ARTIFICIAL BLACK MARBLE.

HAVING been requested to give information, in addition to that printed in the *American Architect* for December 11, 1897, concerning the manufacture of artificial black marble, its practical uses, etc., I have made further inquiry and submit the following: —

The process is not made known by the proprietors, but I have learned that asphalt (which, I stated in my former report, was mixed with tar) is no longer used; it seems that the soft white sandstone, after having been sawed and cut into the desired forms and smoothed, is only boiled in coal-tar.

It has happened that large stones have burst during the boiling process, either from too great heat or on account of having been carelessly and improperly placed upon the iron rails or grating in the bottom of the tanks. Now, a layer of the black tiles (described in the report before mentioned) is first placed upon the rails, in order to furnish an even foundation for the stones to rest upon and keep them from moving up and down during the boiling process, and also to protect the lower ones immediately above the fire from being overheated at the start.

I have seen lying in the factory yard a number of large blocks of this black stone which had broken in two during the boiling. They are as hard as granite, and, in this state, difficult to work; therefore, the stones are always cut into the proper forms before being put into the boiling tanks. I noticed that the black had thoroughly penetrated, and that the broken surfaces glistened like coal.

The coal-tar is not put in hot; it is gradually heated up to 700°, controlled by a pyrometer near the furnace. The black liquid penetrates to 20 centimetres (nearly 8 inches) from all sides. When blocks are too large, they are made hollow in the centre.

The oil which accumulates on top of the tar is drawn off during the boiling process by means of a tube leading into a recipient; it is afterwards distilled and produces naphthalene.

The use here of artificial black marble is, as yet, not very extensive, it being a new product, and anything new not being easily introduced; besides, the immense lava beds furnish cheap and good stone for many purposes, and white marble from Carrara (upper Italy) is used largely.

However, there has been one beautiful monument erected in the cemetery at Catania. It is 5.71 metres (18 feet) in height, and is made of the artificial black stone, inlaid with pieces of light marble. The effect is admirable. Only the outside and the pinnacle are of marble; the inner part consists of masonry of common lava stones. The difference in cost, as compared with a white marble monument of the same design and dimensions, is great. This structure has cost 1,310 lire (about $242[1]). One of solid white or Carrara marble would cost 7,000 lire (about $1,295).

The manufacturers have recently completed a beautiful chapel, or family mausoleum, about 40 feet in height, in the cemetery of Girgenti, Sicily, which has received the highest praise in the press. It is mostly of this black stone, ornamented and inlaid with white and colored marble.

As to resistance to heat, cold, rain, and the action of the elements in general, the manufacturers claim that their product is fully equal to the real marble, and can be used for any exterior building work.

One of the great advantages, besides the difference in cost, is that the sandstone is soft, and much more easily worked into the desired forms than marble. All the work is done before the stone undergoes the boiling process, excepting the final polishing after the pieces are cooled.

I have been shown beautiful pedestals, columns, garden tables, mantelpieces, washstands, urinals, and flooring, inlaid with borders or centerpieces of colored marble.

For flooring in certain places, and also for slabs for anatomical tables, it is specially recommended, being considered to have disinfectant properties.

I have not been able to obtain a fixed price-list, charges depending upon style of work, dimensions, etc., and these, if given, could not possibly be a guide for American manufacturers, considering that wages are so much lower here — probably not more than one-fifth of the amount paid American workmen in this line.

LOUIS H. BRÜHL, *U. S. Consul.*

CATANIA, February 21, 1898.

[1] Calculating the paper lira at 18½ cents.

THE ILLUSTRATIONS

[*Contributors of drawings are requested to send also plans and a full and adequate description of the buildings, including a statement of cost.*]

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CATHEDRAL CHURCH OF ST. BÉNIGNE, DIJON, FRANCE.

THE church of St. Philibert, now used as a storage barn, is also shown in this plate.

APSE OF NOTRE DAME, BEAUNE, FRANCE.

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HORS D'ŒUVRES.

[Additional Illustrations in the International Edition.]

SENATE CHAMBER: NEW YORK CAPITOL, ALBANY, N. Y. H. H. RICHARDSON, ARCHITECT.

[Gelatine Print.]

NORTHWEST TOWER: ST. PAUL'S CATHEDRAL, LONDON, ENG.

BROOME PARK, BARHAM, KENT, ENG.

BLENHEIM AND PUTTY. — It is said that the late Duke of Marlborough, in speaking of Blenheim Palace, said it was the only house in Europe that required £800 worth of putty a year to keep the window-panes in order.

NOTES & CLIPPINGS

Acetylene Gas Soot. — It has been discovered that the soot from an acetylene flame which is burned so as to be smoky is a very valuable product, while the yield is unusually large, from three to four times the weight, for example, that can be got from an equal quantity of schist oil. The acetylene soot is very light, and is remarkable for its perfect black color, there being no tinge of brown in it, and for its freedom from the tarry matters found in ordinary soot or lampblack. It has great body, and makes a splendid pigment and also extremely fine printing-ink. It may be used alone, or to enrich cheaper gases which are to be used for lampblack making, such as the gas of schist oil (the petroleum obtained by distilling shale). — *Invention.*

German Peat Bogs. — As sources of energy it has been proposed to use the peat bogs of North Germany, and what is now practically waste land is expected to become available for manufacturing on a large scale. The bogs of the valley of the Ems, for example, cover some 13,000 square miles, and the proposition has been made to erect in this section a 10,000-horse-power electric plant which would consume annually some 200,000 tons of peat, equivalent to the amount yielded by 200 acres. One acre of bog averaging ten feet in thickness contains about 1,000 tons of dried peat, and the amount produced on 430 square miles would afford as much heating power as the 80,000,000 or more tons of coal annually mined in Germany. The proposed plan contemplates using the energy on a canal and in the manufacture of calcium carbide. — *N. Y. Evening Post.*

A Magnet for Lifting Steel. — Electro-magnetic lifting devices have been in every-day use at the proof butts of the royal arsenal at Woolwich for over five years, and in the transport of heavy projectiles weighing as much as 1,800 pounds. Formerly to move a large number of shot was most laborious work, not only on account of the great weight but by reason of the difficulty of getting slings around the projectiles. The introduction of the electro-magnet in place of the slings has rendered the task easy and one which is quickly performed. In this case the body or core of the magnet is of inverted U shape and in one forging, and the winding is mechanically protected by stout iron flanges and is covered by thick brass strips. The magnet is exceedingly efficient, and requires about one-eighth horse-power to energize it for lifting a weight of 3,600 pounds. — *Cassier's Magazine.*

Damage paid for Draining a Pond. — Newton Cemetery Corporation is to receive the sum of $700 from the City of Newton in settlement of a peculiar claim, which has been pending for nearly a year. The trustees of the cemetery corporation and the public generally have long regarded the chain of natural lakes, fed by springs, as one of the greatest beauties of the cemetery grounds. Last year the water in the ponds began to fail and an investigation showed that the springs were being drained by the under drains of the sewers, which the city had just completed through that section of the city. This year the indications point to the complete drying-up of the sources of supply and a claim was filed with the City Government. The justice of this contention has been recognized, and the sum of $700 will be paid the corporation by the city. In addition to this, the lakes will be kept filled from the city's water supply. — *Boston Transcript.*

Ruskin at St. Ouen, Rouen. — The *Outlook* of London recommends those who think the old-fashioned verger is extinct to visit the Church of St. Ouen at Rouen. Edouard will surely meet you, and, taking you by the hand, will croon parentally over the glories of the great Gothic monument which he has known for sixty years. He speaks of it as a mother of her babe, brooking neither contradiction nor criticism. Yet with what respect does he recall a conversation with "The only man, an Englishman, who knows more of the cathedral than I. 'Edouard,' said the Englishman, 'I am angry with you. You always overlook, for you cannot see, the most beautiful effects of light in your church: come with me into the choir and I will show you.' And he showed me beauties of which I had never dreamed." "Who was this artist?" was the natural query. "You would not know him," said Edouard, simply; "he was an old English gentleman; his name was Mr. Ruskin."

The Lorelei Statue accepted. — After many rejections the statue called "The Lorelei," originally designed to adorn a public square in the City of Düsseldorf, the birthplace of the poet Heine, has at length passed the gauntlet of the Municipal Art Commission of New York and will be set up at Mott Avenue and 161st Street, in the Borough of The Bronx. The statue was not good enough for Düsseldorf, nor for Mayence, nor for Boston, nor for Brooklyn, and it was rejected by the Municipal Art Commission under the Strong administration; but the present Municipal Art Commission on May 4th voted to allow the City to accept it. Emil Herter modelled the statue, and it narrowly escaped being accepted by the City once before. The act establishing the Municipal Art Commission became a law only two or three days before the Board of Aldermen voted to accept "The Lorelei," and the Commissioners promptly refused to approve the action of the Aldermen. The statue has three figures, representing lyric poetry, a mermaid and "World Sorrow." The Heinebund presents it to the Borough of The Bronx. Its previous rejections have been caused because of the belief of the various authorities who vetoed its reception that it was bad art. The Municipal Art Commission is at present composed of the Mayor, *ex officio*; Charles T. Barney, Henry E. Howland, S. P. Avery, John La Farge, Daniel C. French, C. F. McKim and A. A. Healy. — *N. Y. Tribune.*

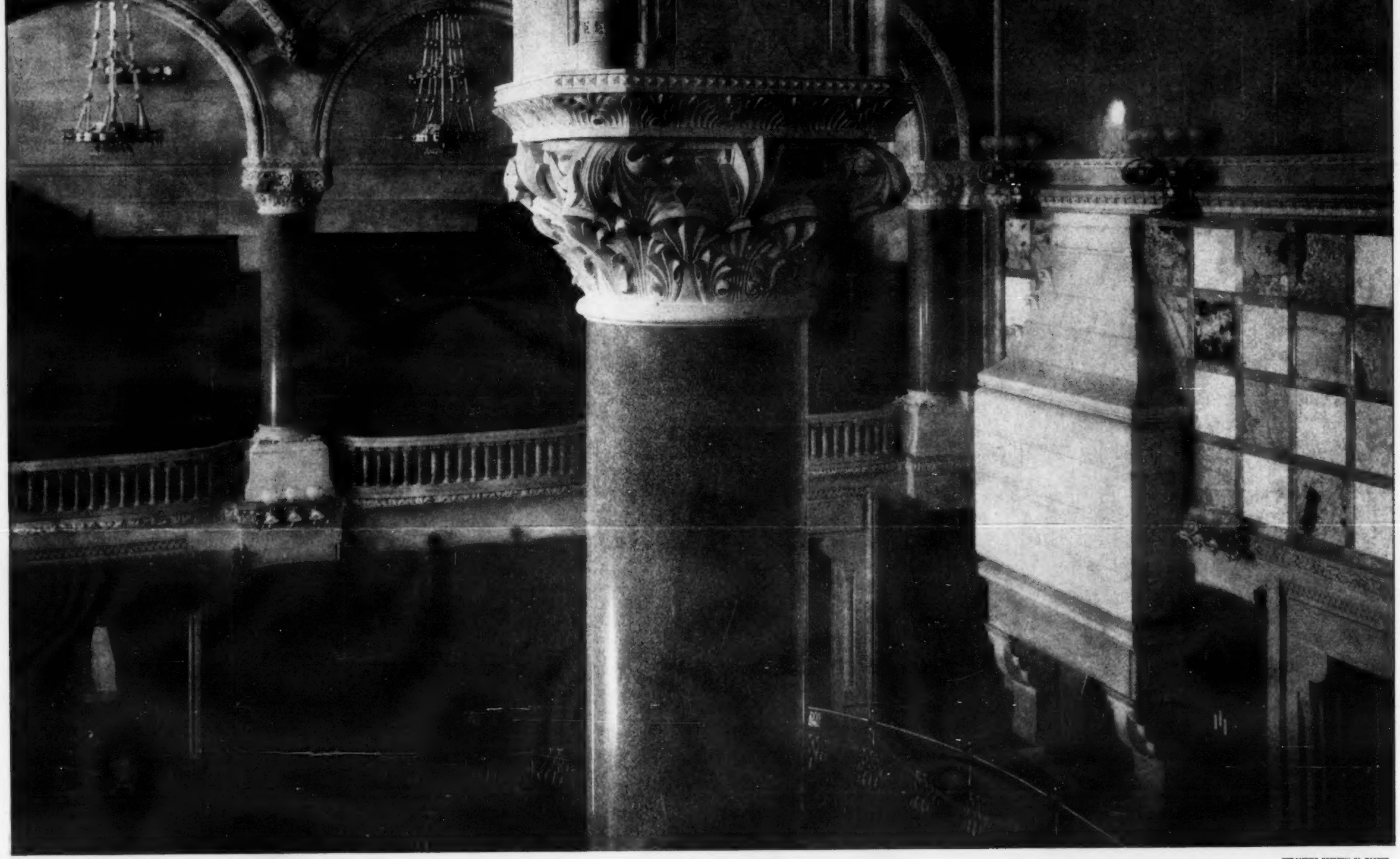
Sanitary Condition of Baltimore School-houses. — Parents of school children in Baltimore may learn from a report of an investigation of the schools in that city, made by Prof. S. Homer Woodbridge, Assistant Professor of Heating and Ventilation in the Massachusetts Institute of Technology, why their children have been ailing, and why they have not made satisfactory progress in the school tasks. Health and mental progress are incompatible with the conditions found to exist by Professor Woodbridge. In the older buildings heat is furnished by stoves, and there is no provision for ventilation except as the movable window-sashes may be used, with resultant draughts and colds. In the majority of the newer buildings heated by furnaces the conditions were found to be only slightly improved. Other defects pointed out are imperfect lighting, defective drainage, infected surroundings with their foul odors, passageways instead of school-yards, and serious overcrowding of rooms. "Pure air," the Professor says, "is as essential to the best work in school-rooms as are good text-books. Good and properly used light is more essential than modernness in furniture. There is more of patriotism in decent and wholesome school-house sanitation than in flag presentation and flying. The half-dollar which pays for a per capita year's supply of invigorating school-room air cannot bring so large an educational or other return if spent in any other way." More interesting is Professor Woodbridge's arraignment of the persons responsible for such school conditions as those he found to exist in Baltimore. "The authority which compels children and teachers to attend school is under moral, if not legal, obligation to provide all those conditions of school-house environment which are recognized as essential to the best health of their occupants, and to their educational advancement," he says. "If the aggregate of all expenses of sickness, and of the values represented in vital and mental energy lost; in broken health and premature death; in retarded educational development in scholars, and in the diminished intellectual force of teachers, is the result of bad air, taxpayers are justified in condemning the practices which are responsible for them as malfeasant, and in demanding that such faithlessness to high obligations be held as a crime. It is probable that at a cost of from $200 to $250 per room the buildings now heated by stoves could be provided with adequate means for combined warming and free ventilation. Where, however, the cost of public educational work is regarded as a necessary evil to be reduced to the minimum which an indifferent public opinion will tolerate, and when the principles of a city's political economy are satisfied by warming the master's room in a public school with a cooking-stove, and by refusing an expenditure of less than $20 in another building to shade the teachers' and scholars' eyes from the glaring light which tries and injures them, it would seem evident that the education your association seeks to promote must be extended to include city councils and school boards before such sanitary betterments can be made."—*N. Y. Evening Post.*

Hot Water in Arizona Wells. — The wells in parts of Arizona have recently become producers of hot water, and apprehension is felt by many of the residents of the region affected that they are about to become participants in a grand volcanic drama. In some of the wells the temperature of the well-water rose twenty degrees in a single night. In a few the phenomenon disappeared soon after its appearance. In a majority of the cases, however, the wells fairly steam from their newly acquired heat. The first known of this curious state of affairs was a report that the wells at Maricopa, on the Southern Pacific Railroad, thirty miles south of Phœnix, had suddenly become hot. It was four days thereafter that the phenomenon first was noticed a dozen miles west of that city. A test at one well showed a temperature of nearly 100 degrees. No difference is noted in wells in the immediate vicinity of Phœnix. The line of subterranean heat wave follows the general direction of the Sierra Estrella Mountains, a volcanic chain lying immediately south of the Gila River. Thence it appears to continue on in the direction of the Harqua Hala Mountains, near which are a number of large and modern volcanic cones and hills of drifted volcanic ash. Farther to the east the lava flows are so geologically modern as to have overwhelmed in a number of places the cliff dwellings of the ancients. — *Correspondence Omaha Bee.*

Making Cement Pipes in Situ. — A novel form of pipe for water or drainage purposes, recently invented by a Frenchman, is noteworthy. A trench is dug in the ground where the pipe is required to be laid, and is partly filled-in with good cement. Upon this soft substratum is laid a rubber tube covered with canvas, and tightly inflated with air. The trench is now filled-up with cement, so that the tube is completely covered with an inch or more of the plastic material. As soon as the cement sets the air is let out of the tube, and it is easily extracted from the pipe, of which it for a time formed the core. The tube can then be again inflated to serve for a fresh section of the pipe, which can be as much as six inches in diameter if required. It is said that a cement pipe of this thickness has been successfully laid by the new method at a cost of about one shilling per yard. — *Journal of the R. I. B. A.*

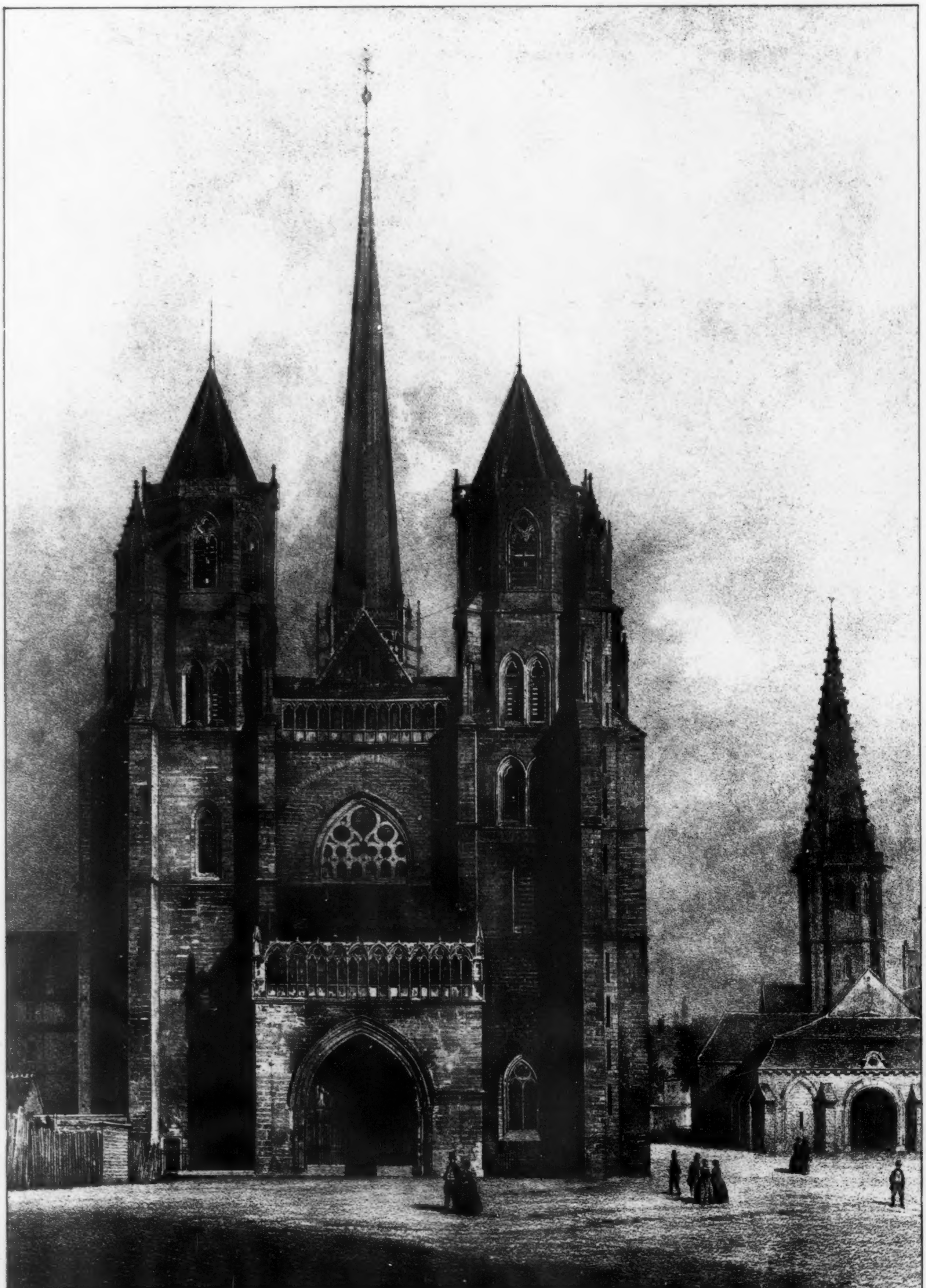
Antique Furniture in France. — Under date of February 21, 1898, Consul Skinner writes from Marseilles in reference to a law dealing with curio and old furniture merchants, promulgated on February 15, 1898, a knowledge of which, he says, may be of service to the many Americans who visit France with the expectation of buying articles of the above description, possessing artistic or historic value. The consul continues: The vital feature of the law is the obligation now resting upon all brokers, dealers in old furniture, linen, clothes, jewels, books, dishes, arms, and other objects, to keep an official register, signed by the commissaire of police or the mayor, containing "day by day, without blanks or erasures, the name, surname, character, and dwelling of those with whom said broker has contracted; also, the nature, quality, and price of all said merchandise; and said register must be forthcoming on demand." Penalties are prescribed for violation of the foregoing provision, the purpose of which is to prevent fraud in the exchange of old and second-hand goods, especially such as are sought by collectors.

S. J. Parkhill & Co., Printers, Boston, U. S. A.



DETAIL OF SENATE-CHAMBER: NEW YORK CAPITOL, ALBANY, N. Y.

H. H. RICHARDSON, ARCHITECT.



FROM BARON TAYLOR'S "VOYAGES PITTORESQUES."

Heliotype Printing Co. Boston.

Facade principale de l'Eglise Saint Bénigne Cathédrale de Dijon

Et Saint Philibert.

HELIOTYPE PRINTING CO. BOSTON

FROM BARON TAYLOR'S "VOYAGES PITTORESQUES."

Vue intérieure de l'Abside de l'Eglise Notre Dame à Beaune.

The American Architect and Building News

ADVERTISERS' TRADE SUPPLEMENT.

No. 193. SATURDAY, JUNE 4, 1898. VOLUME LX. No. 1171.

SEYSSEL ROCK ASPHALT.

We have an aversion to changes, as evidenced by the many years in which our advertisement has appeared in this paper. The march of progress, however, forbids our keeping in the same rut and after having our office for nearly two decades at 35 Broadway, we have found it necessary for our customers' convenience, as well as our own, to remove to a modernly equipped building. To make the change as slight as possible we have only crossed the street and at the "Hudson" Building, No. 32 Broadway, we are prepared to welcome our friends in a sixteen-story "up-to-date," electric-lighted building, erected from the designs of Messrs. Clinton & Russell. Notwithstanding the "war scare," we have to report the asphalt business as in healthy condition, and we are shipping Seyssel asphalt to all sections of the country. Some of the work recently laid with this material embraces the U. S. Appraisers' Stores, warehouse 9-15 Murray St., Bellevue Medical College, the morgue and Paradise Park in New York City; the Public Buildings in Philadelphia, U. S. fortifications at Fort Delaware, Maryland, Quinnepiac Bridge, New Haven, Conn., several large buildings in Pittsburgh, Pa., three school-houses in Yonkers, N. Y., City-hall grounds, Rochester, N. Y. and brewery at Edwardsville, Pa.

We are advised that two contracts for the Architectural Service of the City of Paris, each of three years' duration, have been secured by the parent company; visitors to the Exposition of 1900 will, therefore, have an opportunity of seeing our work being done under that branch of the French Government.

NEW YORK MASTIC WORKS,
NEW YORK, N. Y.

HOT-AIR PUMPING-ENGINES.

The Ericsson and Rider Hot-air Pumping-engines are particularly designed to pump water into elevated tanks, from which it will flow by gravity to all lower points. Wherever the use of a tank is objectionable we can arrange the engines to pump directly through a line of hose and piping. This arrangement refers particularly to the wants of florists, truck-gardeners and parties using water for irrigation purposes in general.

Every engine is thoroughly tested at our factory, during which test it is carefully inspected and made to perform a much greater amount of actual work than we expect it to be called upon to do in the hands of our customers.

All our engines are built on the interchangeable plan, by a rigid system of jigs and gauges; all working parts are inexpensive, and any part of one machine will fit any other engine of the same size; consequently, should any piece be broken, a duplicate can be furnished at a small cost and without delay.

The very best materials are used in their construction; the working parts are of United States Government standard bronze; shafts, crank-pins, etc., are of steel. No expense has been spared to make these machines perfect, both in principle and in workmanship. All the pump cylinders are made of brass and will not rust. The pump-rods are made of Tobin bronze.

We furnish with every engine printed directions how to set and operate.

The Ericsson Hot-air Pumping-engine, with furnace, is designed for burning coal or wood. It is a substantially made cast-iron stove, thickly lined with the best fire-brick and provided with a dumping-grate. With the larger sizes it is generally preferable to use this fuel rather than any other.

This style of furnace, like the others, is readily detached from the engine without removing any other part of the machine, and either furnace may be substituted for the other with very little trouble.

When the vertical distance from the surface of the water to the surface of the ground is much over twenty feet, we make special arrangements for water-pumps, varying according to circumstances.

In most cases we apply our Artesian-well Pump, which has been constructed especially for this purpose.

These pumps are placed near the surface of the water, or submerged, as may be most desirable. They are connected to the engine by a straight vertical pipe terminating in a stuffing-box at the top, which is bolted to the cooler, all the water passing through the cooler in its upward flow to the tank or outlet, as in the case of the Rolling Valve Pump. Through this pipe and stuffing-box the pump-rod passes, and is worked from the compression piston. This pump-rod or plunger is made of steam-pipe connected together with couplings in the usual manner.

The extreme depth to which these pumps may be lowered depends on the size of the engine to which they are attached.

With a 6-inch engine they may be lowered 125 feet, with an 8-inch engine 300 feet, and with a 10-inch engine 500 feet.

Our Deep-well Pump is cylindrical in form. We make pumps to go into two, three, four, five and six inch tubes. The quantity of water obtainable is governed to a certain extent, but not always, by the size of tube. When Deep-well Pumps are used the engines deliver a smaller quantity of water on account of the weight of the rod.

SIZE OF PIPES.

The list sizes given for suction and discharge pipes are proper only when the total length of the pipes from the surface of the source of supply to the point of delivery does not materially exceed the total vertical height; but where the water is to be pumped through a great length of pipe, say 400 feet or more, it is usually well to use one size larger than size named. This is to provide for the friction which is incident to pumping water through a great length of pipe. It is well known that the friction of a moving column of water in a pipe adds to the work required of an engine, but we are sometimes asked why an engine does not pump the approximate quantity named in our catalogue 50 feet high through, say, 1,200 feet of pipe, and in some cases customers have felt that they were not being treated fairly when the engine failed to deliver the quantity named, as they did not take into account the extra work incident to forcing the water through the great length of horizontal pipe.

STOCK.

We carry at all times a large stock of engines, and can usually fill orders within a day or two from receipt of order, but for extra heavy work we prefer to take a little more time, in order to subject engines to severe tests, thus saving buyers from annoyance which might ensue in the case of a hurried test. The value of this will be obvious to all.

RIDER-ERICSSON ENGINE COMPANY,
22 CORTLANDT ST., NEW YORK, N. Y.

The Berlin Iron Bridge Company, of East Berlin, Conn., have just completed a fireproof boiler-house for the Hendey Machine Company, of Torrington, Conn.

THE GREAT CHURCH LIGHT.

Frink's Reflectors are too well and favorably known to need any special recommendation, but it might be of interest to those in search of lighting apparatus for a church or any other place to note what one prominent pastor thinks of them, as set forth in the following letter:—

CINCINNATI, O., March 31, 1898.

Mr. I. P. Frink, 551 Pearl St., New York, N. Y.:—

Dear Sir, — You will remember furnishing the reflector for the new edifice which I led in building at Hoosick Falls, N. Y. It gave such excellent satisfaction that it afforded me much pleasure to recommend same to many churches, and you have made a number of sales through my recommendations. I want to say that the two large reflectors you furnished for our Temple in this city have given universal satisfaction, and everybody is delighted. Without the use of a single sidelight, which is always a nuisance, our very large auditorium, or rather two auditoriums (for we use the entire Sunday-school rooms and main auditorium on Sunday nights), is brilliantly lighted. No grumbling because the old people can't see the words of the hymns. There is not a church in this city, with its 250 churches, so handsomely lighted as ours. Everybody speaks in your praise. I shall be delighted at any time to recommend your reflectors, and you are always at liberty to refer to me. G. R. ROBBINS,

Pastor Lincoln Park Institutional Baptist Church.

— *Journal and Messenger, April* 28, 1898.

THE Whitin Machine Company, of Whitinsville, Mass., have just completed a new casting-shop which will be entirely fireproof. It is furnished by the Berlin Iron Bridge Company, of East Berlin, Conn.

MINERAL WOOL.

OUR salesmen have occasionally been questioned by architects as to the claim that Mineral Wool has a tendency to disintegrate under continued use. We ask our readers to kindly look over the annexed copies of letters received on the subject, as the material would naturally receive more wear and tear in a day in a railroad car than it would receive in a dwelling in a quarter of a century.

Yours respectfully,

UNITED STATES MINERAL WOOL COMPANY,
2 CORTLANDT ST., NEW YORK, N. Y.

WE have found no such trouble as that referred to in your letter. We have just removed the covering of a car which had the wool put in over a year ago and has been running ever since. The wool was found elastic and fresh, and one would not know by its appearance that it had been used at all.

J. B. HENNEY, *Supt. M. P.*,
New York & New England R. R.,
NORWOOD, MASS.

WE have been using the Mineral Wool for many years between the floors of all our passenger-cars, and so far have found it perfectly satisfactory.

F. SHEPPARD, *Supt. M. P.*,
Pennsylvania R. R.,
ALTOONA, PA.

THE space between the false floor and the floor inside the car, about seven inches thick, is filled with Mineral Wool between the stringers. This Mineral Wool is laid with ordinary care and packed down a little with the hands, but not squeezed, so that in reality it lies fairly loose when the car is turned out. After one, two or more years' service, the car being examined shows a settling of the wool, possibly from one-half to one inch in this seven inches. It does not seem to have lost its elasticity or to have settled more than we would expect from the method of filling. It does not pack solid unless squeezed by more heavy substance, at least when used in layers not over seven inches thick.

THEO. N. ELY, *Gen'l Supt. M. P.*,
Pennsylvania R. R.,
ALTOONA, PA.

December 7, 1888.

HENRY FRANZ, ESQ., 2 CORTLANDT ST., NEW YORK, N.Y.: —

Dear Sir, — In answer to yours of December 6th, inquiring as to what use we apply Mineral Wool, would advise that we use it for packing between the wooden jacket and boiler on our locomotives to prevent jacket from catching fire. It answers a very good purpose. We have been using it for several years. Also use it as a non-conductor in covering steam-pipes in exposed positions.

Yours truly,

JAS. M. BOON, *Asst. Supt. M. P. & R. S.*,
West Shore R. R.

NOTES.

THE American Sugar Refining Company, of Brooklyn, N. Y., are placing a new fireproof roof over their No. 1 boiler-house. The roof will be fireproof, consisting of steel trusses covered with corrugated iron, and is being furnished by the Berlin Iron Bridge Company, of East Berlin, Conn.

THE new power-station and car-house being erected by the Spencer, Warren & Brookfield Street Railway Company, at Brookfield, Mass., will have steel roof-trusses and covering furnished by the Berlin Iron Bridge Company, of East Berlin, Conn. The dynamo and engine room roofs of this building will be lined with the Berlin Company's patent anti-condensation roof lining, which is now almost universally used for roofs of this nature throughout the country. It prevents the condensation of moisture from the underside of the roof covering, which, if it should collect and drop upon the machine beneath, would cause considerable damage.

THE new building which the Waterville Cutlery Company are erecting at Waterville, Conn., will have a steel roof which is being erected by the Berlin Iron Bridge Company. The trusses are steel, and the covering is corrugated-iron lined with the Berlin Company's patent anti-condensation fireproof lining. The building is 21 feet wide and about 100 feet long, and is to be used as a forge-shop in one end, and in the other will be located the boilers and engines.

THE style of the well-known firm of workers in Mosaic which has hitherto existed as Aeschlimann & Pellarin has now been changed to Pellarin & Co. The change in style does not, however, affect the address and those who need their services can still find them at 37 Clinton Place, New York City.

THE Berlin Iron Bridge Company, of East Berlin, Conn., have just completed for the Conway Electric Street Railway Company, at Conway, Mass., a steel bridge to carry their electric line across the Deerfield River. This bridge is about 300 feet in length.

BUILDING INTELLIGENCE.

Reported for the American Architect & Building News.

HOUSES.

Meriden, Conn. — *Windsor Ave.*, 2½-st'y fr. dwell., 33′ x 54′, slate roof; $5,000; o., B. J. Ames; a., David Bloomfield.

Milford, Mass. — *Underwood Ave.*, two-st'y fr. dwell., 26′ x 38′, shingle roof, steam; $5,000; o., A. O. Hersey; a., Robt. Allen Cook.

Mt. Vernon, N. Y. — *Eighth Ave.*, 2½-st'y fr. dwell., 31′ x 40′; $6,000; o., Delia Van Horsen; a., Frank M. Wright.

Cottage Ave., two 2½-st'y fr. dwells., 30′ x 50′, pitch roofs, furnaces; $13,000; o., John Utz; a., Frank M. Wright.

Newark, N. J. — *Highland and Grafton Aves.*, two-st'y fr. dwell., 37′ x 38′, pitch roof; $6,500; o., Theodore T. Crane; a., E. A. Wurth.

Hunterdon St., nr. Springfield Ave., three-st'y fr. dwell., 23′ x 54′; $4,500; o., Henry Seipel; a., E. A. Wurth.

Hunterdon St., nr. S. Orange Ave., 2½-st'y fr. dwell., 32′ x 32′; $7,500; o., Louis L. Staehlo; a., E. A. Wurth.

Orange St., No. 518, three-st'y bk. & iron dwell. & store, 22′ x 63′; $7,000; o., Max Kaplan; a., J. A. Apgar.

New Rochelle, N. Y. — 2½-st'y fr. parsonage, 30′ x 42′; $5,500; o., Second Presbyterian Church; a., E. H. Sturges.

2½-st'y fr. dwell., 27′ x 36′, pitch roof; $5,500; o., Dr. D. J. Roberts; a., E. H. Sturges.

Newton, Mass. — *Thurber Lane*, two-st'y fr. dwell., 30′ x 44′, pitch roof, furnace heat; $5,000; o., H. C. Hawkes, Crescent Ave.; b., J. C. Perry.

New York, N. Y. — *Kelly St.*, nr. 167th St., 3 three-st'y bk. & fr. dwells., 17′ x 63′; $18,000; o. & b., Charles Tange, 50 E. 107th St.; a., Niels Toelberg.

Paterson, N. J. — *Park Ave.*, three-st'y bk. & st. dwell., 44′ x 60′; $12,000; o., Thomas Wilson; a., Charles E. Sleight.

Pelham, N. Y. — 2½-st'y fr. dwell., 35′ x 39′, pitch roof, furnace; $5,000; o., Mr. Walz; a., Fletcher & Thain, 42 E. 23d St., New York City.

Philadelphia, Pa. — *Chestnut St., Nos.* 4016-18, 2 four-st'y bk. & st. dwells., 25′ x 90′; $28,000; o. & b., J. Clark Moore, Jr.

Providence, R. I. — *Angell St.*, 2½-st'y bk. & fr. dwell., 30′ x 50′, shingle roof, hot air; $12,000; o., W. R. Tillinghast; a., Frederick E. Field, Custom House St.

(Houses Continued.)

Glenham St., 2½-st'y fr. dwell., 27′ x 50′, pitch roof, hot air; $5,000; o., Joseph W. Markaby; b., N. E. Building Co.

Richmond Hill, L. I., N. Y. — Twelve two-st'y fr. dwells., 20′ x 33′; $36,000; o., Alfred J. Merritt; b., Haugaard Bros.

San Antonio, Tex. — *San Pedro Ave. and Cypress St.*, two-st'y bk. & fr. dwell., 26′ x 60′, shingle roof; $7,500; o., Herman Staacke; a., J. Riely Gordon.

Somerville, Mass. — *Browning Road*, two-st'y fr. dwell., 32′ x 49′, shingle roof, furnace; $5,000; o., W. S. Sawyer, 16 Browning Road; b., A. M. Godfrey.

Springfield, Mass. — 2½-st'y bk. & fr. dwell., 32′ x 60′, pitch roof, steam; $10,000; o., James P. Gray; a., Louis F. Newman, 21 Elm St.

St. Louis, Mo. — *Berlin St.*, nr. King's Highway, 2½-st'y bk. dwell., 45′ x 52′, tile roof; $12,000; o., Dr. John B. Shapleigh, 3840 Delmar Boulevard; a., E. A. Manny, Turner Building.

St. Paul, Minn. — *Prospect Park*, two-st'y fr. dwell., 33′ x 50′, pitch roof, hot water; $5,000; o., E. A. Nickerson; b., Olof Swenson; a., Louis Lockwood.

Washington, D. C. — *Columbia Road*, 2 four-st'y bk. & st. dwells., 22′ x 49′, flat roof, steam; $28,000; o. & b., Arthur Cowsill.

Watertown, N. Y. — Three-st'y bk. dwell., pitch roof, steam; $25,000; o., Mr. Wardwell; a., Bradford L. Gilbert, 50 Broadway, New York City.

Weehawken, N. J. — *Delaware Ave. and King St.*, 2½-st'y fr. dwell., 35′ x 47′; $5,000; o., A. J. Grimes, Jersey City; a., Child & De Goll, New York City.

Yonkers, N. Y. — *Warburton Ave.*, 2½-st'y st. dwell., 33′ x 42′; $10,000; o. & b., Harriman & Hawley; a., George F. Barber, Knoxville, Tenn.

Lake Ave., nr. Broadway, 2½-st'y fr. dwells., 30′ x 56′; $6,000; o., B. W. Stillwell; a., G. Howard Chamberlain, 1183 Broadway, New York City.

Palisade Ave., cor. Belmont Terrace, 2½-st'y fr. dwell., 32′ x 50′; $5,000; o., Charles L. Noble; a., H. B. Jeffries, Syracuse.

LIBRARIES.

Galesburg, Ill. — Two-st'y & base. st. structure for a Public Library, 66′ x 132′, tile roof, steam; $40,000; o., City; a., Gottschalk & Beadle.

MERCANTILE BUILDINGS.

Boston, Mass. — *Fulton St., Nos.* 3-5, Ward 6, six-st'y bk. business block, 32′ x 60′, flat roof, steam; $25,000; o., Emma Kemble; b., Maguire & Penniman, Providence, R. I.; a., Gay & Proctor, 12 Pearl St.

Manchester, N. H. — *Elm St.*, three-st'y bk. block, 50′ x 100′, for stores & offices, comp. roof, steam; $15,000; o., J. T. McQuestion; b., Head & Dowst; a., Wm. M. Butterfield.

Plymouth, Mass. — Three-st'y bk. business block, 65′ x 70′, comp. roof, steam; $15,000; b., New Eng. Construction Co., 1 Beacon St., Boston; a., W. J. J. Garrity, Boston.

OFFICE-BUILDINGS.

Canton, O. — Three-st'y bk. & st. bank & office building, 28′ x 70′, flat roof, steam; $20,000; o., Home Savings & Loan Co.; a., Wm. P. Ginther.

Philadelphia, Pa. — *Ash St.*, nr. Tasker St., three-st'y bk. office-building, 20′ x 80′; $12,000; o., Wm. S. McCahan Sugar Refining Co.; b. & eng., P. Ehlers.

PUBLIC BUILDINGS.

St. Louis, Mo. — *Grand Ave. and Rutgers St.*, bk., st. & steel armory buildings, including Administration building, 30′ x 190′ & drill-hall, 179′ x 182′, tin & granitoid roofs, steam heat; $100,000; o., St. Louis Light Artillery Association; a., Louis C. and Wm. M. Bulkley, Turner Building.

STABLES.

Boston, Mass. — *John A. Andrew St., No.* 36, Ward 22, 1½-st'y fr. stable, 30′ x 35′, pitch roof; $1,000; o., Chas. S. Bullock; b., Gilmore & McKay, Jamaica Plain.

Cambridge, Mass. — *Gore St., No.* 129, two-st'y fr. stable, 29′ x 63′, containing 26 stalls; $4,000; o., John P. Squire Estate, 40 S. Market St., Boston; b., Walter Stimpson.

New York, N. Y. — *Tenth Ave., Nos.* 108-10, six-st'y bk. stable, 40′ x 96′; $30,000; o., Patrick H. Keahon, 840 Greenwich St.

One Hundred and Forty-second St., nr. 3d Ave., two-st'y bk. stable, 18′ x 30′; o., James McMahon, 3d Ave. & 142d St.; a., Charles Baxter & Son, 2580 Third Ave.

Philadelphia, Pa. — *Mascher St.*, nr. Norris St., two-st'y stable & milk-house, 72′ x 108′; o., P. Hernig; a., P. E. Rehn.

Sansom and Bonsale Sts., three-st'y stable; o., Albert E. Kennedy; c., J. E. & A. L. Pennock; a., Joseph M. Huston.

Providence, R. I. — *Roger Williams Park*, 2½-st'y fr. stable, coachman's apart. & billiard hall, 50′ x 60′, shingle roof, hot air; $6,000; o., W. H. Draper; a., W. R. Walker & Son; b., B. F. Smith, Pawtucket.

Somerville, Mass. — 1½-st'y bk. combination stable, 40′ x 160′, comp. roof; $15,000; o., Water Dept. City of Somerville; a., Aaron H. Gould, 42 Court St., Boston.

WAREHOUSES.

New York, N. Y. — *John St.*, cor. Cliff St., seven-st'y bk. & st. store & loft building, 71′ 11″ x 91′ 3″; o., Phelps, Dodge & Co.; a., Clinton & Russell, 32 Nassau St.

Maiden Lane, No. 87, eight-st'y bk. & st. store & loft building, 29′ 3″ x 106′ 6″; o., Bruce Estate; a., Jordan & Giller, 19 Park Pl.

Prince St., No. 98, eight-st'y bk. & st. fireproof store & loft building, 36′ x 100′; o., Westchester Realty Co.; a., Neville & Bagge.

University Pl., cor. 9th St., bk. & st. store & loft building, 23′ x 97′; o., Sailors' Snug Harbor, 31 Nassau St.; a., Robert Maynicke.

Philadelphia, Pa. — *N. Fifth St., No.* 475, seven-st'y seed warehouse, steel construction, bk. front, terra-cotta trim, 40′ 4½″ x 79′; o., W. Atlee Burpee & Co.

MISCELLANEOUS.

Woburn, Mass. — *Lake St.*, two-st'y bk. & steel building for electric-light plant, 94′ x 117′, comp. roof; $50,000; o., Woburn Heat, Light & Power Co.; engrs., Shaeaff & Jaastad, 85 Water St., Boston.

Topographical Index of Advertisers.

[*For pagination, see Alphabetical Index on Cover* 2.]