# THE AMERICAN ARCHITECT AND BUILDING NEWS.

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Entered at the Post-Office at Boston as second-class matter.

AUGUST 6, 1892.


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THE building strikes in New York have reached a rather interesting stage. It will be remembered that the original trouble was between the House-smiths' Union and the Iron League. One of the members of the Iron League, the Jackson Iron Company, had employed an engineer, who, on a certain occasion, refused to leave his work when a strike was ordered by the walking-delegates. Although his employers transferred him to another building, he was hunted out, and finally surrendered to the power of the delegates, paid a fine of fifty dollars for his insubordination, and was reinstated in his right to work for his living. A few hours later he was again commanded to leave his work, in order to injure a man who had picked up some tools left on the floor by previous strikers. He again refused, and was a second time marked for persecution. Again his employers befriended him, and transferred him from building to building, in the hope of evading the vigilance of his tormentors. He was, however, tracked everywhere, and notice was given to the Jackson Company that if he was not immediately and finally discharged the company would be "struck." The company, after various negotiations, which ended in nothing, decided to fight rather than desert their man, and war was declared upon them. The other members of the Iron League then came to the support of the Jackson Company by threatening to lock out all members of the House-smiths' Union after a certain day; and this union immediately succumbed, nearly all their men abandoning it, in order to keep their places in the shops. The walking-delegates then undertook to bring all the building trades, through the agency of the "Building Trades Council," which they control, into the contest to injure the Iron League. As has been their usual course in such cases, they began by ordering the teamsters of building materials to deliver no materials at buildings where the Iron League had contracts. This is in most instances an effective manœuvre, but the dealers in building materials, who have suffered a good deal from the walking-delegates, and have, in consequence, combined for mutual defence, finding their business attacked, joined in the fray. Of late years, the Dealers' Association has fought the delegates with considerable success, so that their participation in the contest would be of great importance; but within a few days they have been reinforced by the Brick Manufacturers' Association, which has already been completely victorious in a fierce contest with the unions, and possesses powers of "tying up" buildings in New York much superior to those wielded by the walking-delegates. The appearance of this factor in the struggle has made the situation of the delegates a serious one. According to the newspapers, they talk wildly of "striking every building in New York," and it is possible that some such desperate step may be attempted; but as this would probably destroy the power of the delegates forever, it is much more likely that they will within a few days find some loophole, in the shape of a "compromise," which they can utilize to save the remains of their authority.

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IF we were in the habit of making suggestions as to what our superiors should do, we should say that the Legislatures of the various States could not in any way earn and deserve more gratitude from their constituents and from posterity, than by appointing commissions, of not more than two or three members, and entrusting them with the duty of perambulating the highways of their State, preparing annual reports upon their actual condition, and the best means of improving it, and, if suitable means could be provided, of enforcing immediate repairs where the circumstances seemed to warrant it. The number of roads submitted to the jurisdiction of these officials need not be large. There would be no necessity for their concerning themselves with streets lying entirely within the limits of a city or town, and even those beginning and ending within the boundaries of a single county might, perhaps, be left to the care of those rather shadowy magnates, the County Commissioners; but there would be a residuum of long thoroughfares, such as our ancestors used to call turnpikes, extending through several counties, and even through several States, which ought to be rescued from the condition in which the neglect and jealousy of town and county boards have left them, and restored to their former usefulness as means for cheap and convenient communication. It is undoubtedly true that railways have robbed the old turnpikes of a part of their usefulness; but they have by no means taken their place entirely; and it is due, not only to the modest, but extensive traffic which now labors painfully over the ruts of these neglected routes, but to the towns along the line, which would brighten up wonderfully under the influence of such business as passes over common roads in England, where railways are quite as numerous as in this country, to put our great highways at once into reasonably good condition.

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IF once the highways in the more thickly settled portions of our older States could be put in proper order, we are disposed to think that there would be a good deal of pleasure travel over them, besides the ordinary traffic of farmers' wagons, stages and express-teams, and the conveyances used by travelling merchants and agents. To one whose travelling is mostly by railway, there is a great charm in an occasional week of leisurely driving over an ancient turnpike. The country, as seen from a carriage, is tenfold more beautiful and interesting than when viewed through the smoke of a railway train, and the charm of being one's own master, of starting and stopping where and when one likes, instead of scrambling in and out of a dirty car in obedience to the bawl of a conductor, is something to be long remembered. In England, where such travelling is popular, there are little inns at almost every village, where one can get a meal, or spend a comfortable night, while in this country one must do a good deal of planning in advance to be sure of arriving at a house of public entertainment at a convenient hour for eating and sleeping; but, on the old turnpikes about New York, Boston and Philadelphia there are still many of the antiquated "road-houses" left, in a condition which, if not to be compared with that of a city hotel, is at least not intolerable, and may, to the enthusiastic architect or artist, be considerably alleviated by the attractions which they offer in the shape of picturesque bits of antiquity.

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IN the neighborhood of Boston, the best, and least modernized highway of the kind yet remaining is certainly the road, formerly known as the "Queen Anne turnpike," which connects Boston with Plymouth. Some sort of path must have existed on this route in 1632, when Governor Winthrop and his party, after sailing in a "shallop" to Weymouth, went ashore there, probably at the point on the turnpike still known as Weymouth Landing, and proceeded on foot

to Plymouth, to visit Governor Bradford, returning by the same route. The distance from Plymouth to Weymouth Landing, by the turnpike, is about twenty-eight miles, and the Governor and his company left Plymouth "about five of the clock" in the morning, and "came that evening" to Weymouth; so that, although it is not likely that anything like a carriage-road existed, there must have been not only a cleared way through the forest, but a path admitting of comfortable and tolerably rapid marching. We are told that some of the Plymouth dignitaries accompanied Governor Winthrop, on his return, "about ten miles, to the Great Swamp." There is still a swamp on the line of the turnpike, in Pembroke, about ten miles from Plymouth, and the fact that Winthrop's party crossed it without difficulty indicates that a corduroy road, or some other sort of practicable causeway, must already have been constructed across it. Beyond the swamp, the distinguished Bostonians came to "the Great River," across which they were carried, St. Christopher fashion, "by one Ludham, as they had been when they went." The description seems to point to what is now called the "North River," between Pembroke and Hanover, which is the most considerable stream on the line of the turnpike between Plymouth and Weymouth Landing, as Winthrop's "Great River;" and it would seem that Ludham must have maintained a sort of primitive ferry, on a well-known and somewhat frequented route.

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IT seems to be, therefore, something better than mere conjecture which suggests the conclusion that the "Queen Anne turnpike," or the path which afterwards developed into a turnpike, dates from a period farther removed from the time of the Revolutionary War than the Revolution is from our own day. We are so accustomed to thinking of our country as new and modern, that it is hard for us to realize what an age of two hundred and sixty years means, yet, if we have interpreted the evidence correctly, our quiet Plymouth road had come into considerable use before Oliver Cromwell was called upon by Parliament to take command of the army; before Peter the Great was born, or Louis XIV had succeeded to the throne. At the time of Winthrop's journey, Henry of Navarre had only been dead twenty-two years; and Queen Elizabeth twenty-nine years; and some, at least, of those who travelled over it must have remembered the massacre of St. Bartholomew, and may have seen the Duke of Alva with their own eyes. From that time to this, the region through which the turnpike passes has been peaceful and thrifty. Many houses must have been built, even in very early times, along the line of so important a road, and, as there have been no political convulsions to destroy them by wholesale, it seems very likely that portions, even of the most ancient houses, still remain. The archæology of our seventeenth-century architecture is not very well understood, and few people could tell, from internal evidence, whether a Massachusetts farm-house belonged to the first or second half of the century; but the type of the period anterior to the Revolution is tolerably distinct, and scores of houses are to be seen along the road which must date back to 1700, or even earlier. In the livelier villages, such as "Queen Anne's Corner," Hanover or Weymouth, many of these seventeenth-century houses have been modernized, by the insertion of new sashes, the addition of porches, and so on, but on other portions of the route they seem to remain exactly as they were built. Of course, the wooden houses have undergone repairs, but at "Lovell's Corner" are some stone houses, which seem to preserve all their old work. Perhaps no short journey in the United States will furnish so many examples of the real "Colonial" work, and, although the rural portions of the road possess few large or elaborate mansions, there is plenty of interest and variety to be found in the farmhouses; while Dorchester, Milton, Quincy and Weymouth, at one end of the line, and Plymouth at the other, offer many beautiful, although little known, specimens of the richest architecture of the Colonial period.

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A NEW diversion for the amateurs of murder has been invented in France. The town of Rueil, a manufacturing village near Paris, possesses a theatre which is much frequented. During a performance in the theatre the other night a crash was heard, and the seats, which were supported by a framework, fell in a heap, carrying with them seven hundred persons, many of whom were injured, although none killed. Upon investigation, after the theatre had been cleared, it was found that some cowardly miscreant had loosened the bolts in the framework that supported the seats, so that they would be sure to fall when a heavy weight came upon them. A vigorous search was at once begun for the perpetrator of the mischief, and, if he is caught, he is likely to find that the French people are no longer in the mood to endure patiently the performances of midnight assassins.

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XYLOLITH, a peculiar German concrete, made of sawdust combined with other materials which we cannot specify with certainty, is finding, apparently, a secure place among building materials. It is furnished in plates, or tiles, of any size up to one square metre in area, and has something of the softness and non-conducting property of wood, without its tendency to shrink and warp. Naturally, such a substance is found very suitable for covering the treads and landings of iron stairs. It is not only much lighter than the stone treads commonly used in Germany, but does not become polished and slippery by use, and wears very well, the steps resisting abrasion better than those of solid oak. It is also extensively used for flooring market-halls, schools, post-offices, railway stations and other places where resistance is as desirable as non-conducting quality. In hospitals where the latter is an important requisite, but must be combined with imperviousness, the xylolith has been found useful, and is extensively employed in the new University Hospital at Heidelberg. As the joints are few and close, and are not disposed to open by shrinkage, the floor gives little opportunity for concealing disease germs; and, being close-grained and susceptible of polish, it is easily kept clean. It has also been employed, set in an iron framework, for the walls of small buildings, and, used in this way, it is found to resist fire so well that it is classed by the Berlin fire-police as a desirable material for use in the construction and decoration of theatres. It seems as if there might be a field for such a material in this country. We have plenty of sawdust, cement and silicate of soda at command, and something is certainly needed for our post-offices, railway-stations and hospitals better than either stone tiling or inch boards.

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WE have been gratified by receiving a notice from a "Landscape Gardener," who informs his friends, and the public generally, that he "is prepared to do all kinds of landscape gardening," and "also takes up and lays down carpets in the best manner." We hope that this excellent example of versatility in the application of one's talents will not escape the notice of our younger readers. The man who can do "all kinds of landscape gardening," or, on occasion, "take up and lay down carpets in the best manner," is clearly a more useful member of society than one who can only do one of these things, and it need hardly be observed that usefulness to society is a very important object in life. There was a time, not so very many years ago, when architects were able to turn their hand to a variety of occupations which, we fear, they now despise. For example, the architect and builder was, at that period, a personage of much note, and the species is by no means yet extinct. In England, we believe that an architect has happily combined with the practice of his profession the functions of an undertaker; and we are told that in our own southwestern country an architect should at least be able to prescribe for a sick horse, if he cannot attend to the disposal of the remains of mortal humanity. Mr. George Edmund Street, like many another English gentleman, often read the service in the church of which he was the principal support, and, although the experiment does not seem to have been tried here, we know architects whose extraordinary gifts of language seem to point them out as specially adapted to the double office of enchanting the ears of their friends and acquaintances with their eloquence on Sundays, and their eyes with, let us say, their "frozen music" during the rest of the week. To show how wide, yet unexplored, the field is, we would like to point out such double occupations, healthful, and respectable in every way, as architect and confectioner, architect and banker, or designer of bonnets as well as buildings, none of which, so far as we know, have as yet found favor in the eyes of our architects, and to hope that it is not false pride which has deterred them.

## MODERN ARCHITECTURE.[1] — VI.

LITTLE remains to be said of modern architecture in Austria, as it was quite carefully and minutely discussed in the articles on Austrian Architecture (see *American Architect* for October 11, 1890, *et seq.*). It is unnecessary to trace again the history of the remarkable transformation of the city of Vienna, after the removal of the old ramparts, by the creation of its magnificent boulevards lined with public buildings, churches, theatres and palaces; we will confine our work here to showing to what original styles these various modern edifices belong.

The different divisions of Austria have had their Gothic period; it was little else with them than a foreign importation — from Germany, from France and sometimes from Flanders. They were later brought under the influence of the German Renaissance; but in the sixteenth century their productions were mainly based on Italian models; the proximity

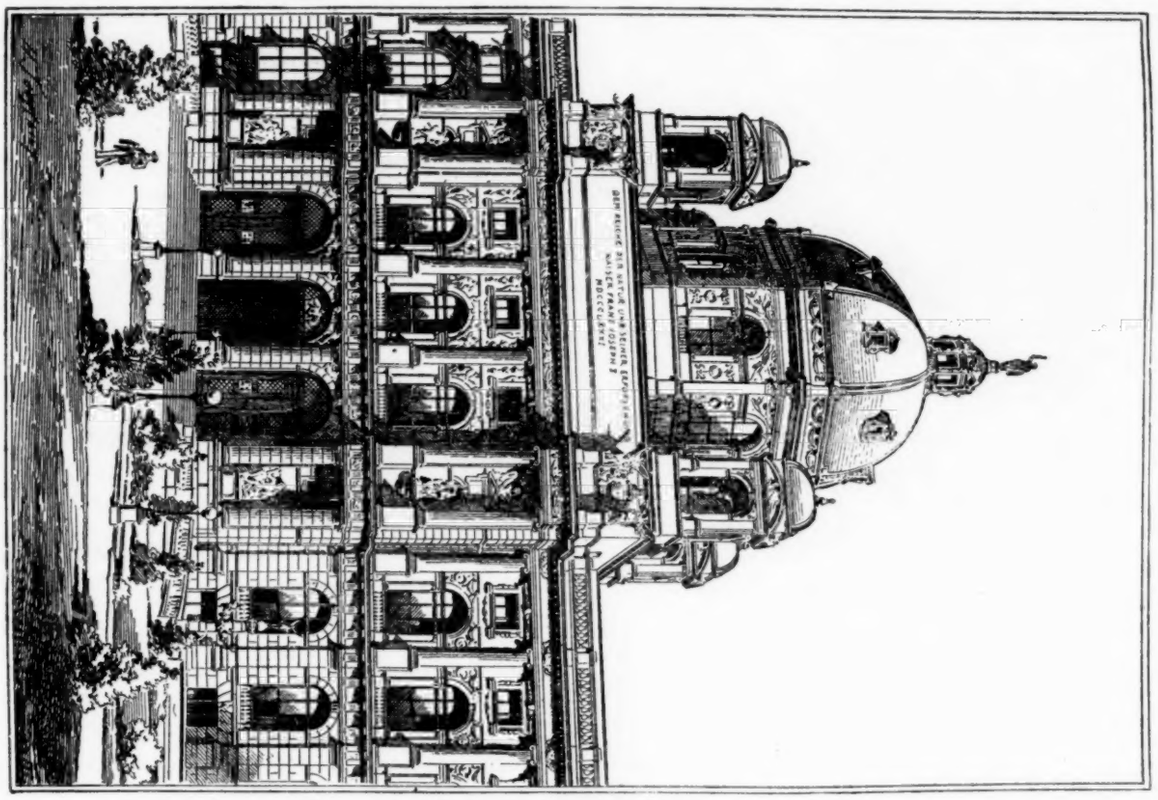

Fig. 33. Museum of Natural History, Vienna, Austria.

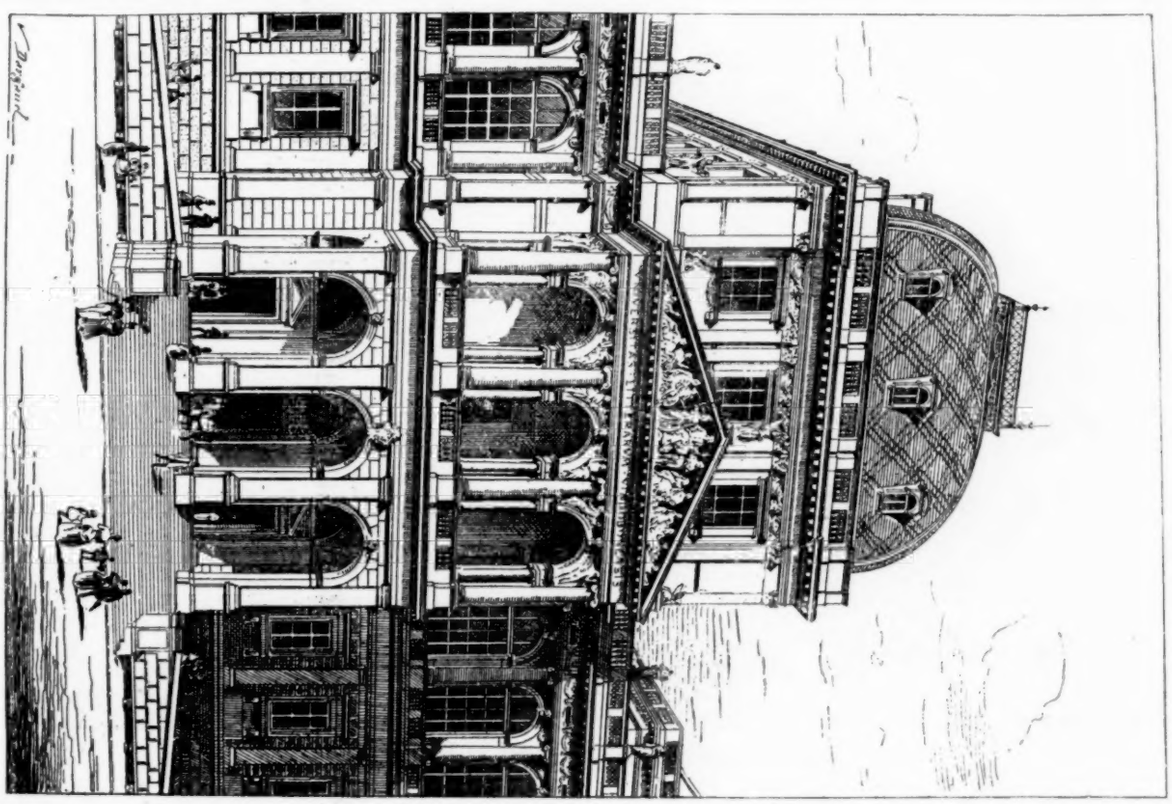

Fig. 34. Entrance to the University, Vienna, Austria.

[1] From the French of P. Planat, in Planat's *Encyclopédie de l'Architecture et de la Construction.* Continued from No. 866, page 64.

of the two countries, the ties of kinship uniting the ruling families and, moreover, the universally recognized sway of the Italian Renaissance, are enough to account for a supremacy

Fig. 33. Monument to Maria Theresa, Vienna, Austria.

which the immigration of artists from Italy maintained. To tell the truth, the different races comprised in Austria, races highly endowed as to art from various standpoints, seem never to have possessed the true creative gift in the realm of architecture. Though very susceptible to architectural beauty and scrupulously followed its lead and even went farther than their guide in this direction. Later on, in the seventeenth century, French influence came in to correct eccentricities and revive the feeling for calmer and more quiet beauties. Then, as in Germany, the rigors of the ultra-Academic period were felt, and, at length, Austria, like the rest of the world, reached the most independent eclecticism.

Traces of all these phases are preserved in the present architecture of the country. Turning to the productions of Herr Semper, it is easy to find specimens of a Neo-Gothic style — which reached its highest perfection in the Votive-Kirche of Vienna — of the Italian style of the Renaissance and of the

Fig. 35. The Ferdinandeum, Innsbruck, Austria.

Italian Barocco, or the French Rococo. We will not pursue this subject farther, but will give, on a larger scale, more detailed views of the Museum of Natural History, by Semper and Hasenauer (Fig. 32), and of the main pavilion of the University (Fig. 34), by Ferstel; these examples should be

Fig. 37. Palace of the Archduke Ludwig Victor, Vienna, Austria.

blessed with delicate and refined taste, they have as yet shown no creative power in this respect.

Consequently, when Italian art, in its decadence, ran into the excesses of the so-called "Jesuit" style the Austrians studied with especial attention, for they are by great architects and are designed in their smallest details with all the care that the unusual importance of the edifices called for.

The monument to Maria Theresa (Fig. 33), which stands

in the large square separating the Natural History Museum from the Museum of Fine Arts, seemed to us worth reproducing here; it is an interesting specimen of decorative architecture, animated by the introduction of detached figures

Fig. 36. Theatre at Carlsbad, Austria.

representing the most distinguished statesmen and generals of the reign of the renowned empress. The *ensemble* is very imposing; personally we have only a slight criticism to make: the equestrian figures are somewhat too independent of the general mass, they are perhaps not sufficiently incorporated with it; again, our eyes do not easily accustom themselves to the difference in the scales adopted for the principal statue and for the accessory figures. The intention was, of course, to give greater prominence to the statue of Maria Theresa, which ought to be the dominant one; it is, nevertheless, disproportioned to the other figures. If the latter were relegated to the rank of simple bas-reliefs, there would be nothing in the contrast to strike one unpleasantly; the statue at the summit would be the only one representing a person in life, the rest would be merely a series of pictures or portraits in relief. But, since the artist has endowed all with life equally, we cannot escape the impression that the empress-queen is depicted as colossal, or that her illustrious auxilliaries must have been dwarfs.

The Ferdinandeum, at Innsbruck (Fig. 35), is a sort of museum, built in the style of the Italian Renaissance which we have termed Academic; the proportions are good enough, although the superimposed bandeaux and cornices are of too nearly the same importance; here we find also the sculptured

Fig. 38. Künstlerhaus, Budapest, Austria.

and sometimes too heavily decorated friezes of which the Austrian architects quite frequently make use.

The theatre at Carlsbad (Bohemia) offers an example of Rococo adaptation similar to that observed in the celebrated Belvedere of Vienna; it is characterized by a certain somewhat heavy profusion, by an exaggeration of French caprice and by excessively curving forms which make it, in our opinion, plainly inferior to the French style of the same period; in the latter, amid all the eccentricities of fancy, proportion and taste are never lost sight of (Fig. 36).

The palace of Archduke Ludwig Victor, at Vienna (Fig. 37), is one of those gorgeous edifices that have been reared in the transformed capital by some of the great Austrian families. The imposing appearance of most of the Viennese private constructions is largely due to the extraordinary height of the stories and the roominess of the bays; in a word, space is not sordidly economized in Vienna as it is in Paris. When our eyes have once become accustomed to the foreign aspect, to the proportions which are novel to them, but which were

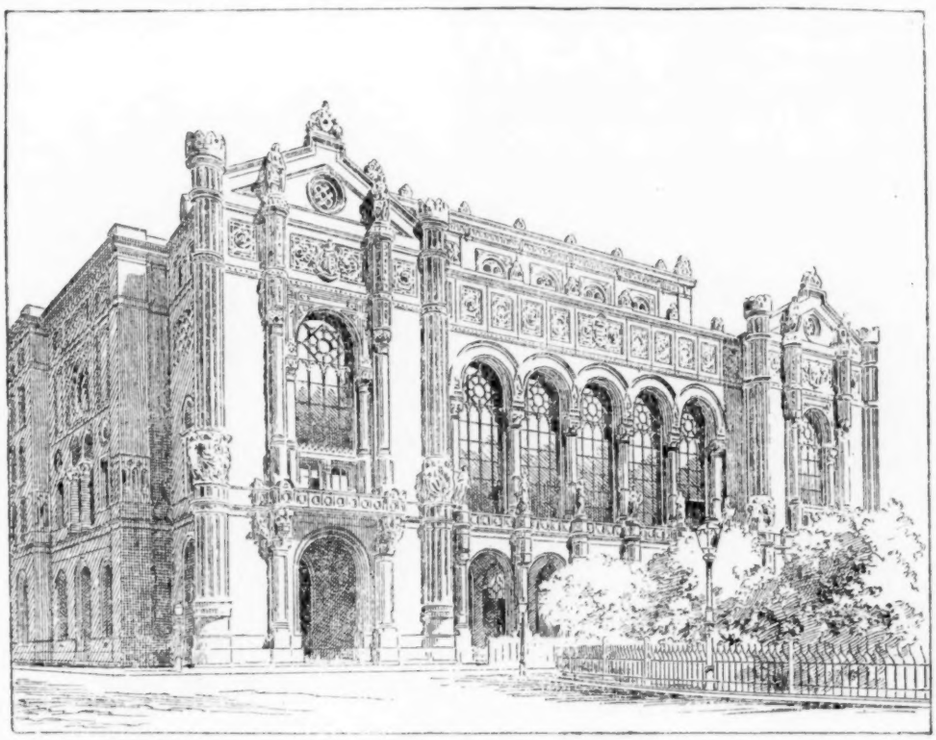

Fig. 39. Redoute Buildings, Budapest, Austria.

universally adopted in olden times, nothing is more offensive than the sight of the houses lining our Paris streets, rows of low, squat drawers ranging one above another like those of a chiffonnier.

It will not be out of place for us to add a few words here on the architecture of Budapest. The amazing growth of this city within a few years is familiar to all. The finest street is Andrassystrasse; it is very broad and crosses the entire city, terminating at the gates of the Varosliget, the Bois de Boulogne of Budapest, with grilles, hillocks, rocks, river and lakes. From end to end the street is flanked with new edifices.

Along the Danube, which is spanned by gigantic bridges, there are also many conspicuous constructions; but it must be added that here, as in all the other modern European capitals, we are struck with the absence of any genuinely original features. Edifices of a well proportioned and perfectly correct architecture might, it is true, be cited; the unfortunate thing about them is that they do not bear the Hungarian stamp rather than the German, the French or the Italian; they might be transplanted to any other city without attracting attention as the productions of a foreign art.

Andrassystrasse ranks among the most beautiful avenues of the modern world, in width and length, in the sumptuousness of its architecture, and for its vast horizons, as for its life and movement; it has the defect of being too much like one of the great arteries of Paris or Vienna. The Künstlerhaus (Fig. 38) will bear us out in this statement; it is Classic, it is

Fig. 40. House in Andrassystrasse, Budapest, Austria.

correct, but it is not original. In the Redoute Buildings (Fig. 39), a place for public gatherings, there is an evident attempt to avoid Academic precedents — an attempt deserving of notice; but the impression is not, by the way, very satisfactory; it is not easy enough to determine what the artist, struggling between half-oriental inspirations and wholly Occidental traditions, really tried to do.

The house in Andrassystrasse shown in Figure 40 is certainly not devoid of merit; the silhouette is pleasing and the combination of brick and stone is happily managed. Among many other residences of more varied aspect, we point to this especially, because it seems to be considered one of the most remarkable by the inhabitants of the Hungarian capital.

[To be continued.]

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The Variable Dozen. — As the derivation from the French *douzaine* implies, it is generally presumed that a dozen means twelve things, but in the Staffordshire potteries, and in the earthenware trade, in other places, a dozen to this day represents queen's-ware in Philadelphia, and crockery in that number of any special article which can be offered at any fixed price. That is, the price is fixed and the number of the dozen varies. For instance the pitchers which are called jugs in the trade are sold as 2, 3, 4, 6, 9, 12, 18, 24, 30, 36 pieces to each dozen, the price for a dozen being constant. The ordinary pitcher holding a quart is a twelve, or a dozen, while a pint pitcher is 4 to the dozen, and is so called when dealing with that size. Few of the articles of the trade, are sold in dozens of 12, plates being almost the only ones, and some of them being sold sixty, seventy, and even eighty to the dozen. Besides these curiosities in figures, the potters have peculiar names, such as cockspurs, twiffers, etc., that makes up a trade language of itself. The baker's dozen of 13 is a recognized figure in their trade; a publisher's dozen is usually thirteen copies. Among fishermen in Cornwall a long dozen consists of 26. — *Tit-Bits.*

## CONSTRUCTION.[1] — XI.

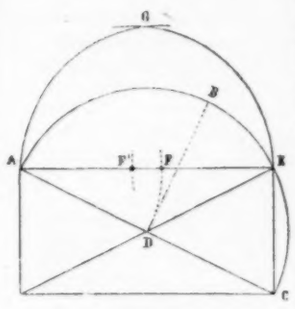


Fig. 48.

About 1230, then, they gave up this kind of vault upon a square plan, and established the pointed arches of high naves upon an oblong plan, or, in other words, each compartment had its complete vault. We can thus make the keys of the pointed, transverse and wall arches reach the same level or nearly so. The builders, wishing to have skew-backs with horizontal beds and reaching to the very point where these arches cease to intersect, observe that the simplest method to prevent any difficulties in drawing the outline of their skew-backs, consists in giving the pointed and the transverse arches the same radius. Given a vault upon an oblong plan (Fig. 48), in which the pointed arch *A C* (in plan) is a semicircle *A B C;* if we carry the semi-diameter *A D* around upon the base-line of the transverse arch *A E*, we obtain at *F* the centre of one of the branches of the transverse arch, and we draw the arc *A G*, which possesses the same radius as the arc *A B C;* laying-off the distance *A F* from *E* to *F'*, we obtain at *F'* the second centre of the transverse arch, and we draw the second branch *E G*. It is thus that the arches of the first Gothic vaults upon an oblong plan are drawn.[2]

Then the curves of the pointed and transverse arches being the same, their cross-sections are similar, and their skew-backs present no difficulty of outline.

Let us now see about outlining these skew-backs.

Let *A B* (Fig. 48*b*) be the directrix of the transverse arch and *A C* the directrices of the pointed arches.

*A* is fixed at the surface of the wall.

From this point *A*, taking upon the line *A B*, a distance *A D*

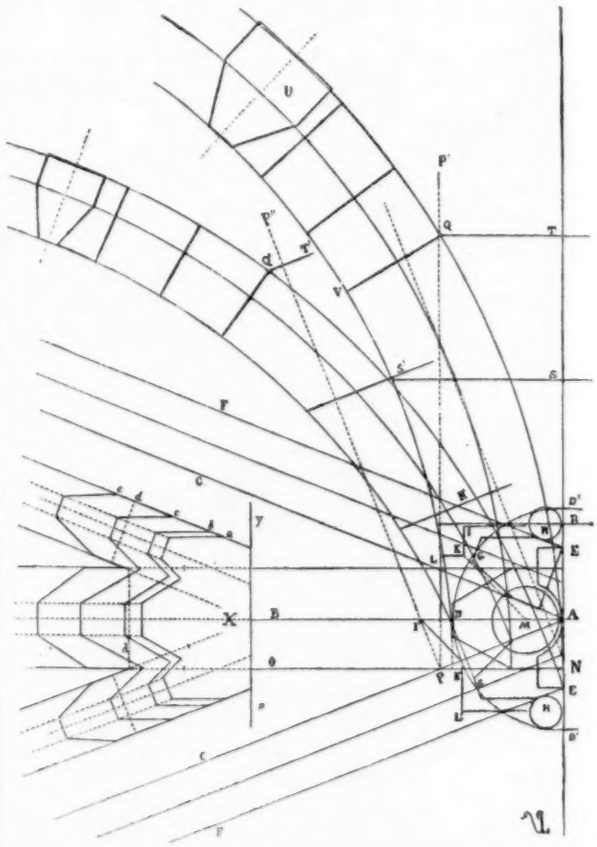


Fig. 48*b*.

equal to the thickness of the voussoir of the transverse arch, and considering *A D* as a radius, we describe the semicircle *D' D D'*.

[1] From the "*Dictionnaire raisonné de l'Architecture Française*," by M. Violllet-le-Duc, Government Architect, Inspector-General of Diocesan Edifices, translated by George Martin Huss, Architect. Continued from No. 863, page 30.

[2] It will be remarked, in fact, that these first vaults are rather flat, compared with those of the middle of the thirteenth century, and that their transverse arches are almost semicircular. Later these vaults appeared not solid enough; so they made the pointed arches more acute, or rather, raised their starting-point, in order to be able to raise the keys of the transverse arches.

We then trace the section of the transverse arch upon the horizontal plan.

We draw two parallels, *E F*, to the directrices *A C* of the pointed arches, leaving between these parallels a space equal to the width of the voussoirs of the pointed arches. These are the horizontal projections of the pointed arches.

Taking the points *G* at the meeting of the axis of the pointed arches with the semicircle *D' D D'*, as the intrados of the pointed arches, we draw the section of these pointed arches upon the horizontal plan.

We have then the lower bed of the first skew-back. In the vacant spaces that remain between the semicircle *D' D D'* and the pointed arches at *H*, we place the pillars which are destined to carry the wall-arches.

The contour of the lower bed of the first skew-back having been obtained, we can draw (and only now) the abacus of the capital, whether in a re-entrant square, as indicated in *I K L*, or in star form, as indicated in *I' K' L'*.

Under these abaci one can put only a single capital and a single column *M*, since our intention is to unite the arches as far as possible in a close group.

This capital, which is a console, a stone corbel supported by the detached column, sends out three corbels from a single astragal.

We must project in elevation the transverse arch upon the line *N O*, and the pointed arch upon the line *A C*.

It is clear that these two arches will cease to intersect at the point *P* upon the horizontal projection. From the point *P*, erecting a perpendicular *P P'* to the line *N O*, the base of the transverse arch, and a second perpendicular *P P''* to the line *A C*, the base of the pointed arch, that first perpendicular *P P'* will meet the extrados of the projected transverse arch at *Q*.

This *Q* shows then, the height at which the transverse arch is disengaged from the pointed arch. It is the level of the bed of the last skew-back.

It is necessary to divide the height *P Q* into a certain number of courses, according to the height of their faces. Let us suppose that three courses are enough; the upper bed of the first skew-back will be at *R*, the second at *S*, and that of the third at *T*. At *Q*, the arch disengages itself and we can draw the first section *Q V* tending toward the centre of the arch. Starting from this point, the voussoirs, whose section is drawn in *U*, are independent. It will be sufficient to proceed in the same way with the pointed arch, by drawing the beds *R' S' T'*, beginning at the base-line *A C*, as far apart from one another as are the beds *R S T*. The pointed arch being less thick than the transverse arch, there will remain behind its extrados at *Q'*, up to the point of intersection with the extrados of the transverse arch, a little space of horizontal bed that will be very useful for beginning to lay the filling-stones of the triangles of the vaults. This done we can give up to the head workman each of the beds of the skew-backs, drawing off upon a horizontal plan, as outlined in *X*, the sections that the beds *R S T* and *R' S' T'*, give in the projected arches.

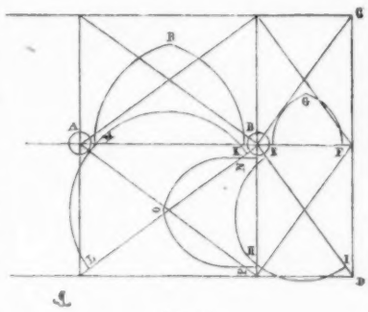


Fig. 49.

Then we obtain: 1st, at *a* the lower bed of the first skew-back, already drawn as the origin of the arches; 2d, at *b* the upper bed of the first skew-back, which gives the lower bed of the second; 3d, at *c* the lower bed of the third skew-back; 4th, at *e* the upper bed of this third skew-back with its bent sections marked at *d*. There is no need to say that at least the first two of these skew-backs, if not all of them, are fastened at the rear into the wall whose surface is *Y Z*. Should we wish to crowd the pointed arches still more against the transverse arch, it would suffice, in beginning the work, to bring the axis of the pointed arches, on the horizontal plan, nearer to the point *A*. Often these axes even meet at the point *A*. In order not to complicate the figure uselessly, we have supposed the arches to be plainly moulded; but if they are made with elaborate mouldings we should proceed in the same way upon the working-drawing, except in outlining the contours; for it is necessary to know, upon the different horizontal beds of the skew-backs, the sloping sections which are made upon these contours, in order to furnish the stone-cutter with moulds which provide for the more or less perceptible change of form of the mouldings at each bed.

To make intelligible, even to persons who are not familiar with

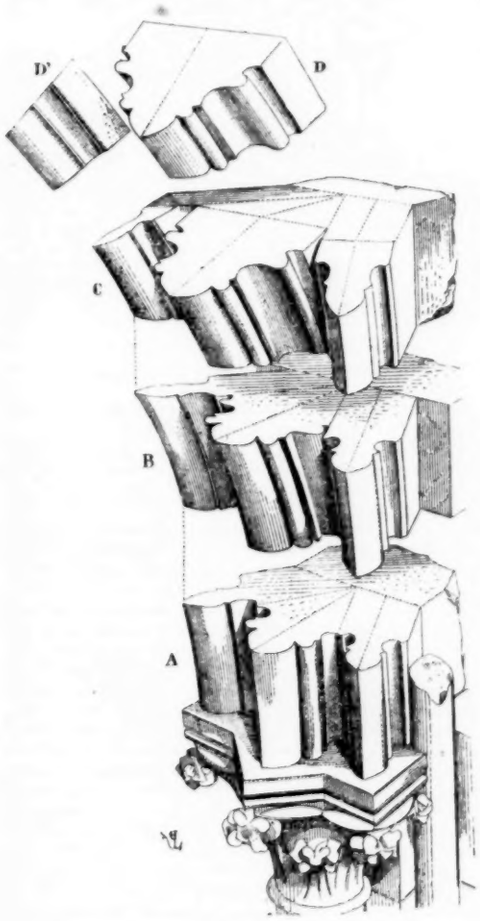



Fig. 48c.

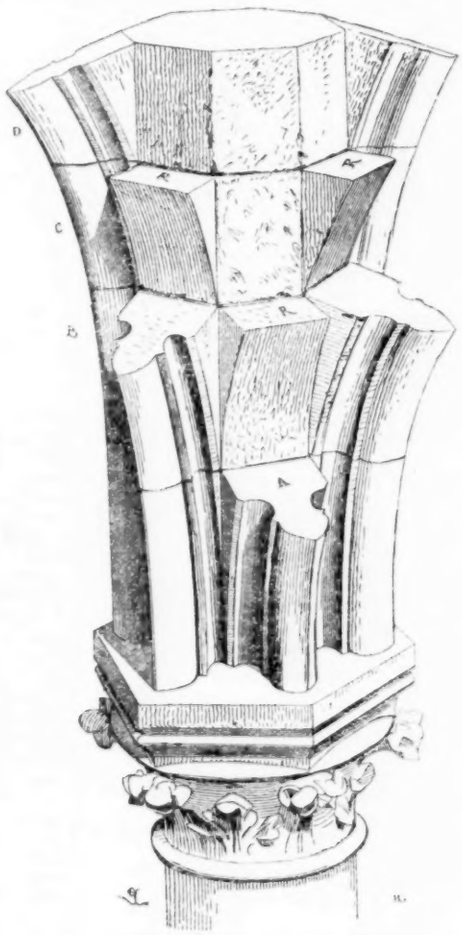



Fig. 49b.

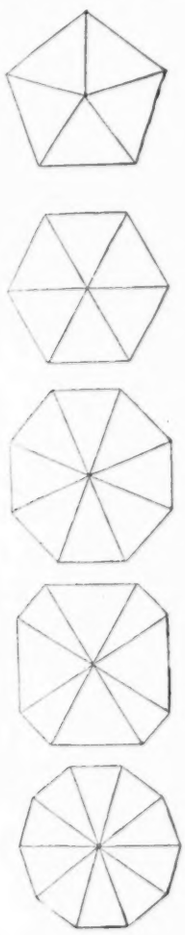


Fig 50.

descriptive geometry, the operation that we have just described, let us suppose (Fig. 48c) the three skew-backs of the preceding figure to be seen one above another in perspective and with their mouldings.

At *A* we see the first skew-back, at *B* the second, at *C* the third with its sections normal to the curves of the arches, at *D* the voussoirs of the transverse arches, and at *D'* those of the pointed arches

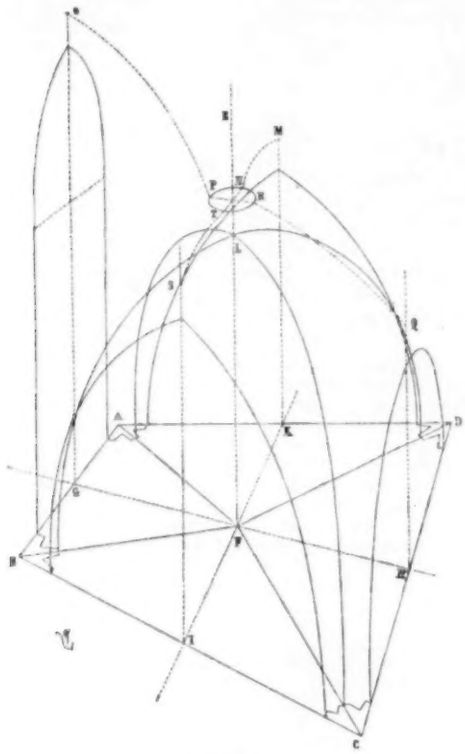


Fig. 49c.

separated from the skew-backs and henceforth similar to one another as far as the keystone.

It sometimes happens that the arches of a vault are of very unequal diameter, or that they start from different heights; this cannot trouble the workman in any respect, for at the point where one of these arches disengages itself from the others at the extrados, he makes a section normal to its curve and the voussoirs are laid in, while the other arches beside it can still remain united up to a certain height, and keep the beds of the skew-backs horizontal.

Thus, for instance (Fig. 49), let us suppose that we have to vault a hall divided by a row of piers, whose plan at one of its extremities gives us, between the piers *A* and *B*, a space much larger than that remaining between the pier *B* and the wall *C D*. Hence we shall have vaults with pointed arches, just as our figure indicates.

We project the transverse arch, *E F*, which gives us the pointed arch *E G F*; we project the pointed arch *E I*, which gives us the slightly broken arch *E H I*; we project the pointed arch *K L*, which gives us the semicircle *K L M*; and lastly project the transverse arch *P N*, drawing this arch in such a way that its key may be a little below the level of the key of the pointed arch *K L*, and that its curve may be almost semicircular, in order to lead the eye,

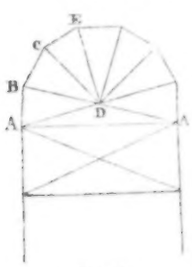


Fig. 51.

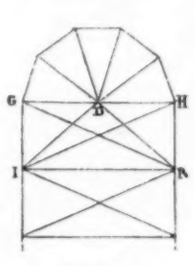


Fig. 51*b*.

without abrupt changes of level, from the great vaults included between *A* and *B* to the narrower and lower vaults included between the pier *B* and the wall *C D*.

It is desirable, accordingly, to raise the origin of that transverse arch *P N* still higher. It is projected in *P O N*. It is this need of avoiding abrupt changes of level in the different arches which has made us raise somewhat the key of the pointed arch *E I* above the semicircular. It is seen thus that from the great transverse arch included between the pier *B* and the wall the keys *R*, *M*, *O*, *H*, and *G*, whether of the transverse or the pointed arches, are successively lowered by an almost imperceptible transition in their execution.

We must now imagine the skew-backs of the various arches upon the capital of the pier *B*, and in Figure 49*b* we present the forms of these skew-backs. At *A* is the skew-back of the transverse arch marked *E F* upon the preceding figure; at *B* the second skew-back with the two sections of the pointed arch *E I*; at *C*, the third skew-back whose upper bed is entirely horizontal; and at *D*, the fourth skew-back with the sections of the two transverse arches *P N*, of the two pointed arches *K L*, and of the transverse arch connecting the pier *A* with the pier *B*. One will notice the supports *R* which are left in the courses of the skew-backs, behind the free voussoirs, to receive the stone filling of the vaults. We have then: the first skew-back, bearing the section of one arch; the second skew-back, bearing the sections of two arches; the third skew-back, with horizontal upper bed, bearing no sections; and the fourth skew-back, bearing the sections of five arches.

These methods give much liberty to the builders, and there is no surface, however irregular it may be, that cannot be covered with ease. More than that, the system of vaults with pointed arches allows the vaulting of halls, whose openings for instance, are taken at very different heights, or the building of vaults very much inclined.

For instance, let us suppose a hall (Fig. 49c) whose perimeter is the quadrilateral *A B C D*. We must make upon the side *A B* a clear space ten metres high, without raising the keys of the wall-arches upon the sides *B C* and *A D* to more than six metres or the key of the wall-arch upon the side *C D* to more than four metres.

The side *C D* being eight metres long, upon that side *C D* we will outline a semicircular wall-arch whose starting-point shall be fixed

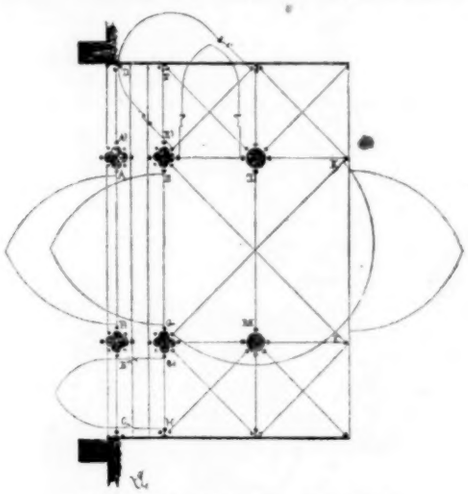


Fig. 52. Porch of Notre Dame, Dijon, France.

on the very ground; and on the other sides we will outline our wall-arches as we may prefer, whether pointed or semicircular.

Dividing the four lines *A B*, *B C*, *A D*, *D C*, each into two equal parts, we connect the middle points *G*, *H*, *I*, *K*, by two lines whose meeting at *F* gives the horizontal projection of the key of the pointed or diagonal arches.

Erecting the vertical *F E*, we take upon that line the height at which is to be placed the key *L*, and then we draw the circular arcs *A L*, *B L*, *C L*, *D L*, which are the pointed arches whose horizontal projections are on *A F*, *B F*, *C F*, *D F*.

Upon the frame-work of the wall-arches and the pointed arches, there is nothing else to do beyond making the fillings of the vaults, whose intersections or keys are represented by the dotted lines *M N*, *O P*, *Q R*, *S T*, account being taken of the thickness of the voussoirs of the pointed and the wall arches, and the central key being supposed to be fixed.

But we shall at once attend to these fillings and the manner of making them. Whatever be the plan of the surface to be covered, the problem to be solved is always this: First, to cause this surface to be divided by the diagonal arches so as to present a series of triangles, for with this system of vaults, one can cover only triangles; Second, to arrange the diagonal or pointed arches in such a manner that these arches buttress one another reciprocally at their summit, and that one or more of them cannot press upon the others so as to put them out of shape.

Thus, to cover a hall in the shape of a polygon, of five, six, seven, eight, ten or twelve faces, or even more, it is naturally sufficient to connect the inner angles of the polygon by lines meeting in the centre, as indicated by Figure 50.

These lines are horizontal projections of the pointed arches, and the sides of the polygons are those of the wall-arches, which may have their keys above or below the level of the central key, according as necessity directs. If it is necessary to cover a portion of a polygon at the end of a parallelogram, as we sometimes find in the

chancels of churches, for instance (Fig. 51), we shall arrange to have, in front of the broken part *B C* a compartment *A B*, equal to one of the sides of the polygon *B C*, in order that the key *D* may be equally distant from the points *B*, *C*, *E*, etc., and that the triangles *B C D*, *C E D*, may have their sides *B D*, *C D*, *E D*, all equal. In this case the arches *A D* buttress the arches *B D*, *C D*, *E D*, etc., and we always have only triangles to fill. Still there are exceptions to this rule, and one sees arches radiating from apses and buttressing their summits against the apex of a transverse arch (Fig. 51*b*), when, for instance, the apse-plan is a half of a dodecagon; but this method is a bad one, since the arches all pressing upon the unsupported key *D'* can make the transverse arch *G H* yield. In this case, experienced builders have fixed two branches *I D'* and *R D'* of a pointed arch, destined as a powerful buttress for the key *D'*. But if these vaults can be built by means of arches whose keys are upon different levels, they can also be built upon arches of very different diameters, whose keys are all upon the same level. It is sometimes necessary to level the keys, if, for instance, the case is one of a vault having a floor above it; this case frequently occurs in porches surmounted by galleries or halls on the first story.

The porch of the church of Notre Dame at Dijon is one of the best examples that we could choose. Its plan (Fig. 52), follows the plan of the nave and aisles of the church itself, but the central vault, instead of being higher, as in the church, has its keys at the

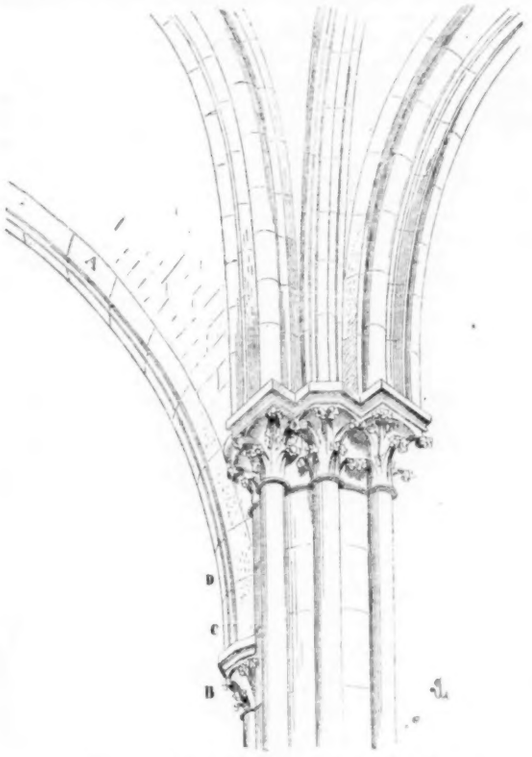



Fig. 53. From the Porch of Notre Dame, Dijon, France.

level of the vaults of the aisles, for it is necessary to receive on the first story a paving at the same level on the whole surface of the porch. Wishing to give solidity to the façade, the builder has doubled the piers at this point, and has built parallel transverse arches, separated by a cradle-vault, from *A* to *B*, from *E* to *G*, from *B'* to *C*, from *G'* to *H*, from *A'* to *D*, and from *E'* to *F*.

Next, the central part of the porch is covered by a vault on pointed arches *G K* and *E I*, crossed by a transverse arch *L M*. The aisles are vaulted with pointed arches on a square plan.

We have given upon our plan the projection of all these arches, whose keys are fixed upon this same horizontal plan. The diameters of these arches, being of very different lengths, it is impossible to have the arches start from capitals placed all on the same level. Accordingly, the capitals of the pointed arches, *G K* and *E I*, and of the transverse arches *E G*, *L M*, *I K*, are set lower than those of the arches *G M*, *M I*, *E L*, *L K*, and the pointed arches of the aisles.

If we then give a perspective view of the pier *M* (Fig. 53), we see that the transverse arch *A* starts from below the other arches and that its capital *B* conforms, by its position, to that difference of level. The drums of the pier carry the two skew-backs *C* and *D* of the transverse arch *M L* (in the plan) which disengages itself below the capitals of the other arches. As to these other arches, they rest their skew-backs upon a group of capitals sustained by monolithic pillars. The effects of the unequal thrusts acting at different heights on the arches are neutralized by the vertical weights carried by the piers, for these weights are considerable.

As far back as the middle of the twelfth century, in England, they reached very skilful and highly developed combinations of arches in vaults.

The Normans quickly became clever builders, and their structures

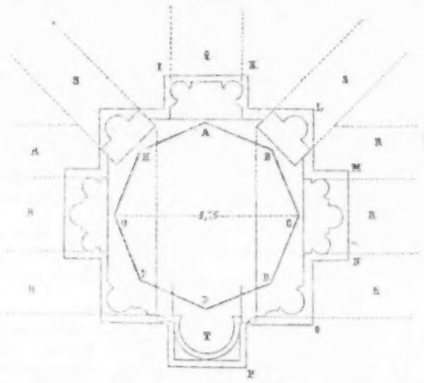
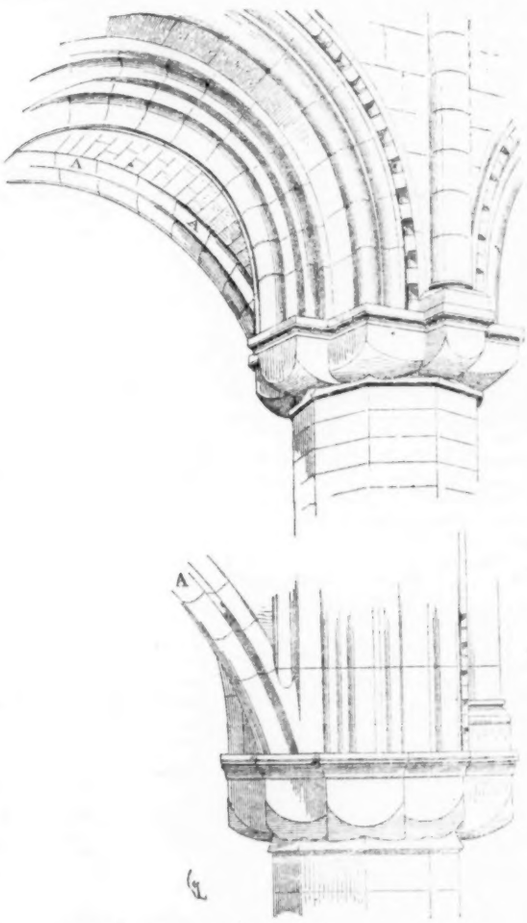


Fig. 54. Pier in Choir Aisle, Peterborough Cathedral.

of the Romanesque period are remarkable for the great independence and the exceptionally perfect execution therein displayed.

Even as early as the beginning of the twelfth century, they were building vaults with diagonal or pointed arches having projecting ribs, while in France, they built only Roman groined vaults, without pointed arches, but having curved surfaces in every direction, as we have previously seen. They knew the advantage to be gained from the skew-backs, and they divided their capitals, if not the vertical supports, into as many members as they had arches to maintain. Thus, in the Romanesque part of the Cathedral of Peterborough, the vaults of the aisles of the choir, which open into the transepts, are, for that period, conceived and executed with more wisdom and precision




Figs. 54*b* and 54*c*. Pier in Choir Aisle, Peterborough Cathedral.

than those in the royal domain of France, in Champagne, in Burgundy, or in the central part. These vaults rest upon piers, alternately cylindrical and prismatic, set with their angles upon the axes. The capitals extend the section of the piers to the lower bed of the various arches by means of corbels skilfully combined.

Figure 54 presents the horizontal section *A B C D E F G H* of a pier, the plan *I K L M N O P* of the abaci of the capital, the outline upon these abaci of the lower bed of the transverse arch *Q*, the archivolts *R* carrying the walls of the transept, the pointed arches *S*, and the base of the engaged column *T* which rises up to the timbers above, covering the principal interior space. In order that the keys of the pointed arches over the aisles should not extend beyond the level of the extrados of the archivolts and transverse arches, which are semicircular, these pointed arches are drawn upon an arch less than a semicircle.

(Fig. 54*b*) shows in perspective this capital and the terminations of the arches, while at *A* is seen a branch of a pointed arch.

The geometrical drawing (Fig. 54*c*) explains the origin of that branch of the pointed arch *A*, the skew-backs of all the arches, and the corbels of the capital.

[To be continued.]

## THEATRE BUILDING REGULATIONS.[1] — V.

### SKYLIGHTS.

Wrought-iron Lantern, from *La Construction Moderne.*

THE following appears to be common to all regulations, and is purely one for the prevention of the spread of fire through burning materials breaking the glass and falling into the building:

[*London.*] "All skylights and the sloping sides of lantern-lights shall be protected by galvanized-iron wire-guards, securely fixed on the outside of such skylights or lantern-lights."

### VENTILATION.

On the subject of theatre ventilation, I must honestly confess London is far behind the times, and the new rule of the London County Council leaves much to be desired; although wide and sweeping, it is not sufficiently definite; it only says:

[*London.*] "All parts of theatres must be properly and sufficiently ventilated in a manner to be approved by the Council, and all openings for ventilation must be shown on the plans, and described in the specification, which shall be submitted to the Council for its approval."

This leaves much to the imagination, and does not define the character, quantity, or quality of ventilation required. What one man may deem enough, another man may consider insufficient.

[*Paris and Austria.*] The Paris regulation is no more explicit; but a definite quantity is specified in the Austrian rules, viz: thirty cubic metres of fresh air must be provided per hour for each spectator; on days of performances the air must be thoroughly changed and when there is a matinée and evening show there must be an interval of at least two and a half hours between the performances in order that the air may be absolutely and thoroughly changed and purified.

[*Brussels.*] The roof over the auditorium of a theatre in Brussels must have openings of at least an equal area to that of the opening over the sun-burner (*lunette du lustre*) and the opening must be closed in such a manner as to permit of its being readily opened by means of some simple mechanism, placed in some accessible portion of the building. In case of there being no opening for a sun-burner, a sufficient number of openings must be provided in the ceiling to carry off any smoke which may penetrate into the auditorium, in the event of a fire occurring on the stage.

In none of these cases do I consider the regulations for ventilation sufficient. Too much is left to the imagination. Rules drawn up by the authorities should be as much for the guidance of the architect and manager, as for the protection of the public, otherwise how will the public be protected?

### LIGHTING. — GAS.

The rules for the gas system appear to explain themselves. The Council demands that

[*London.*] All theatres when lighted by gas shall have separate and distinct gas services and meters as follows: (*a*) To the stage; (*b*) To the auditorium; (*c*) To the staircases, corridors and exits, and that such meters shall be placed in properly ventilated chambers of fireproof construction.

All gas-brackets must be fixed, without joints; and all burners within reach of the audience must be fitted with secret taps, to prevent the public turning out the gas, and be efficiently protected by glass or wire globes.

All gas-burners within three feet of the ceiling shall have hanging shades of uninflammable material to distribute the heat.

All gas-pipes must be made of iron or brass.

[1] Continued from No. 863, page 25.

Where there is a stage or wings with scenery, the footlights or floats must be protected by fixed iron-wire guards, and the burners provided with glass chimneys.

The rows and lines, and gas-burners in the wings (which must commence four feet at least from the level of the stage) are to be protected by fixed iron-wire guards.

All gas-battens on the stage must be hung by at least three wire ropes, and be protected at the back by a solid metal guard and wire fixed to a stiff iron frame at such a distance from the gas-jets that no part of the scenery or decoration can become heated.

All movable lights have to be fitted with flexible tubes, and the gas in every case be turned off by the tap on the stage as well as by that on the flexible tube.

The flexible tubes must be of sufficient strength to resist pressure from without, that is, to prevent any one treading on the tube and extinguishing the gas, thus subsequently causing an escape.

An indicating gas-plate has to be provided at a convenient place at the side of the stage, so that every tap is distinctly labelled and any one can tell the portion of the system it governs.

Additional means of lighting, for use in the event of the gas or the electric light being extinguished, must be provided for the auditorium, corridors, passages, exits and staircases, by a sufficient number of oil or candle lamps, of a pattern approved by the Council, properly secured to an uninflammable base out of the reach of the public.

The lamps must be kept alight during the whole time the public are in such premises.

No mineral oils are permitted to be used in the lamps.

[*New York.*] Some fresh points in addition to these, which are all included in the foreign regulations, are to be found enforced in other countries, for instance in New York the gas-burners have to be provided with metal ducts or shafts to carry off the vitiated air. Provision is also made in New York for shutting off the gas from outside the building. Wire netting has to be placed underneath all suspended bracket lights surrounded by glass in the auditorium.

[*Berlin.*] One important point observed in Berlin is that lights and lamps must only be lit by means of enclosed and safe lighters, the use of lucifer-matches, or naked wax-lights, is strictly forbidden. Once in every three months in this city [Berlin] an examination is made of the gas-pipes, by recording the escape of gas when the main supply-cock is turned on and all other taps are turned off.

[*Paris.*] The rule in Paris as to the chandelier seems rather out of date, as chandeliers are seldom seen in theatres now; however, I will not pass it over unnoticed. The chandelier must be supported by an iron bracket and raised and lowered by means of a winch. The movement of the chandelier has to be regulated by counter-weights and it must be suspended by two wire ropes. A wire gauze has to be provided below to protect the spectators in the case of the fall of glasses or prisms.

[*Austria.*] In Austria all gas, oil or electric lights at a less distance than seven feet from the floor are placed in recesses or niches in the wall, and protected by wire guards or baskets so as to prevent injury by passers-by.

No fixed lights of any kind are allowed in the property-rooms of an Austrian theatre — a doubtful precaution, to my mind. The use of gutta-percha tubing is prohibited.

[*St. Petersburg.*] In St. Petersburg the rules are very much like those enforced in London. There are, however, a few points worth quoting. In all places where gas-meters are kept — which ought to be in underground vaults — proper ventilation is to be rigidly enforced. Where there are immovable lights on the stage they must be at least three feet vertically and two feet horizontally distant from any inflammable material. Footlights must be ignited from below — I fail to see why.

[*Paris.*] The lights in the staircases and passages of a Paris theatre must in addition to having glazed fittings (*appliques vitrées*) be furnished with wire globes. There are other minor details hardly worth noting here, such as the supply-pipes to the battens and floats being fixed at a higher elevation than that of the wing (*chassis*) the footlights constructed with reversed jets, the ground lines covered with basket-like coverings of close-mesh wire, and the necessity of keeping the instruments, cloths, etc., for trimming oil lamps in a metal box.

[*Brussels.*] Brussels provides that the lighting of theatres shall be so arranged that in case of an accident, the lighting of the auditorium, corridors, staircases and public exits will remain intact, notwithstanding the gas is cut off from the stage. The gas-plate on the stage shall only extinguish the gas on the stage, in the dressing-rooms, property-rooms and a portion of the auditorium. For this purpose there shall be provided separate supplies with sufficient number of by-passes from the main.

The wing lights (*becs des portants*) must have glass chimneys furnished with smoke-consumers, and arranged in such a manner that the breaking of a chimney will extinguish the jet.

Gas-jets with chimneys must have regulators, smoke-consumers and fixed wire trellis, those without chimneys should have metal protectors and those isolated be fitted with regulators and placed in fixed lanterns, and they must not be placed at a less distance than eight inches from any ceiling, unless the ceiling is protected by sheet-iron. Wood supports to which the lanterns are affixed must also be lined in a similar manner to a height of eight inches above the lanterns.

Safety lamps only are permitted in the gas-meter chambers.

ELECTRIC LIGHT.

The electric-light rules of the London County Council in reference to theatres are very full and require careful study as they have evidently been compiled with great care and thought. In no other country are there any rules specially drawn up for the use of the electric light in theatres, which are so comprehensive as these of the Council. Austria has two short rules which, however, are included in the London regulations, and there is, therefore, no necessity to quote them.

Where the electric light is used in a theatre in London, a certificate from a competent electrical engineer has to be supplied the Council every six months, as to the proper working order of the system employed. All theatres lighted by the electric light must have at least three separate and distinct circuits (*a*) for the stage (*b*) and (*c*) for the auditorium, corridors and exits, and these circuits (*b*) and (*c*) must be so arranged that half the lights in each division of the auditorium and half those in each corridor and exit shall be on (*b*) and the other half on (*c*) circuit.

When the current is supplied by a public lighting company these circuits must be taken separately from the street mains and under all circumstances complete metallic circuits must be employed.

Gas and water pipes must never form part of any circuit.

The number of lamps must be so sub-divided that no sub-circuit shall carry more than sixty-five ampères; and each sub-circuit must start from a distributing board.

CONDUCTORS.

The conductors used within the buildings must be of copper with a conductivity equal to not less than 98 per cent of that of pure copper, and must be so proportioned to the work they have to do that, if double the normal current be transmitted, their temperature shall not rise to above 150 degrees F.

All the conductors must be properly insulated with pure and vulcanized india-rubber. The insulation resistance must not be less than 300 megohms per statute mile, at 60 degrees F., after one minute's electrification, when tested with at least 400 volts, and after 48 hours' immersion in water.

The insulated conductors must be protected on the outside by stout tape or braiding, impregnated with a preservative compound.

If it is desired to employ other means of insulation than that specified in the Council's rules, special permission must be obtained from the Council; but no material may be used which is not waterproof or which will soften at a temperature below 170 degrees F.

In all cases conductors conveying currents of high electro-motive force inside buildings must be specially and exceptionally insulated, and cased in, and the casing made fireproof.

The positive and negative terminals connected to such conductors must not be nearer to each other than 12 inches, and must be efficiently protected from risk of contact.

Flexible conductors in connection with movable lights must be insulated with vulcanized india-rubber, and protected on the outside by a stout braiding; should any of these flexible conductors be damaged, it must be at once replaced.

No circuit of this nature shall carry more than 10 ampères, and each circuit must be protected by a double pole fuse.

Provision for protection from mechanical injury must be made to all the conductors and where they pass through walls, fireproof floors, or ceilings, they must be protected by iron pipes or by glazed stoneware or porcelain tubes, and precautions taken to prevent the possibility of fire or water passing along the course of the conductors.

In special cases, or where necessary for protection from the depredations of rats, mice, or other vermin, armored cables may be used, and these need receive no further mechanical protection.

Cables covered with lead are not permitted unless protected by external armor of iron or steel, metal fastenings for fixing conductors are not allowed except when some additional covering shall be used to protect the conductor (unless armored) from mechanical injury at the points of support.

Where casings are used, they must be of hardwood, and each conductor laid in a separate groove, with the covers secured by screws; so as to be always accessible, the casings must be always placed in sight.

Joints in conductors must be avoided, but when unavoidable, they shall be electrically and mechanically perfect. Soldering fluids must not be used in making such joints.

EXTERNAL CONDUCTORS.

These must be specially insulated and laid in iron pipes properly jointed and of ample size. These pipes, where necessary, must be protected, securely fixed and supported when underground.

SWITCHES, CUT-OUTS, ETC.

All exposed metal work, such as fittings, switch and fuse covers, etc., must be efficiently insulated from the circuits.

All switches, cut-outs, ceiling roses, wall and floor sockets and lamp-holders must have uninflammable bases.

All switches must be of ample size to carry, without heating, the currents for which they are intended and must be so constructed that it will be impossible for them to remain in any position intermediate between the "on" and the "off" positions, or to permit of a permanent arc.

The circuits have to be efficiently protected by cut-outs, placed in position, easily accessible to the staff, but inaccessible to the public.

The further rules as to cut-outs are that:

The main cut-outs shall be of such pattern and fixed in such a position as to admit of quick replacement.

All circuits carrying a current of 20 ampères or more shall be provided with a cut-out on each conductor, and the two cut-outs shall not come in the same compartment.

All cut-outs shall be so constructed that fused metal in falling cannot cause a short circuit or an ignition.

All cut-outs shall be so marked as to show what circuit or lamps they control.

All wall or floor sockets shall be provided with fuses in their fixed portions.

The sockets for the stage shall be of hardwood with metal guards, care being taken to avoid risk of ignition, and they shall be of specially substantial construction.

RESISTANCES.

Resistance for regulating the power of the lights have to be mounted on incombustible bases, and be so protected, and placed at such a distance from any combustible material, that no part of the resistance, if broken, can fall on such material. The principal resistances have to be placed in a specially built fireproof room erected for the purpose.

ARC-LAMPS.

Arc-lamps are forbidden inside a theatre without the special permission of the Council for their use. They are frequently employed in London theatres on the stage for scenic effect: where they are used special precautions have to be taken to guard against danger from falling glass or incandescent particles of carbon.

All parts of the lamps, lanterns and fittings which are liable to be handled (except by the persons employed to trim them) have to be insulated.

STAGE LIGHTING BY ELECTRICITY.

The special rules for stage illumination which are laid down, are perhaps the most important considering the special class of building for which these rules are framed, I therefore give them in full:

"Where there is a stage, special care shall be taken that all works in connection with the lighting of the stage are carried-out in as substantial a manner as possible.

"No metalwork in connection with the circuits shall be exposed or so fixed or constructed as to be liable to cause a short circuit.

"Lamps on battens, footlights, etc., shall be protected by stiff wire guards, so arranged that no scenery or other inflammable material can come in contact with the lamps.

"No readily combustible material shall be used in connection with any lamps on the stage in such a manner that it might come in contact with the lamps.

"No soft or readily inflammable wood shall be used in connection with the lamps on the stage, and all wood shall be protected by uninflammable material from the possibility of ignition by an arc between any two parts of the two conductors, or by heated particles from any conductor or part of a conductor which may connect together the two main conductors.

"Where a number of lights, as in the footlights, battens, etc., are supplied under control of one switch, and protected by one single or double pole cut-out, as the case may be, the conductors shall be maintained, throughout, of such a section that they will be effectually protected by the cut-outs against heating.

"The leads to the battens shall be specially guarded, particularly at the points where they join on to the battens, and a sufficient length shall be allowed to prevent the leads receiving any injury through any movement of the battens.

"The battens shall be suspended by at least three wire ropes attached to insulators on the battens.

"On no account shall the same battens be adapted for both gas and electric light."

SWITCH-BOARD.

As a gas-plate, in the old system of lighting a stage by gas, was needed, with the taps labelled as to the portions of the system they governed, so a switch-board, containing all the necessary switches, cut-outs and other fittings for the control and regulation of the stage lighting, has to be fixed in some convenient position overlooking the stage. This board must be inaccessible to all but the persons employed at such premises to work it.

The rules as to boiler-houses are similar to those of other countries: access to them should not be from the theatre, but direct from the open air, without any door connecting them with any part of the theatre, so that any escape of steam could not find its way into the auditorium.

Boilers, steam-engines, gas-engines and dynamos, when used for the supply of electricity to theatres must be placed in such positions as shall be sanctioned by the Council.

Gas-engines must be placed in rooms so adequately and continuously ventilated that no explosive mixture of gas can accumulate by any leakage through the engine in the event of any of the gas-cocks being left turned on.

A hood, connected with a pipe carried into the external air, must be fixed over the ignition-tube when this is used.

BATTERIES.

Primary and secondary batteries must be placed in rooms adequately ventilated, that no artificial means of ventilation such as a fan is needed. The batteries must be insulated.

TRANSFORMERS.

Transformers used to transform either direct or alternating currents, together with the switches and cut-outs connected therewith, have to be placed in a fire and moisture proof structure.

Where the primary current is of high potential, such structure should be, preferably, outside the building.

No part of such apparatus is permitted to be accessible except to the person in charge of its maintenance.

No transformer which, under normal conditions of load, heats above 130 degrees Fahr. is allowed to be used.

Transformer circuits must be so arranged that under no circumstances shall a contact between the primary and the secondary coils lead an electro-motive force of high pressure into the building. The term "high-pressure" means in all cases pressure above 200 volts.

INSULATION RESISTANCE.

The insulation resistance of a system of distribution must be such that the greatest leakage from any conductor to earth, when all branches are switched on, the lamps and motors being removed, must not exceed one fifteen-thousandth part of the total current intended for the supply of the said lamps and motors; the test being made at the usual working electro-motive force. Provided that this rule shall not be held to justify a lower insulation resistance than 5,000 ohms, nor to require one higher than 5 megohms.

The Council stipulates that the generating plant and switching gear must at all times be under the control of thoroughly competent electricians, and following the example of many foreign regulations insists upon a correct plan of the wiring being always kept in the manager's office of the theatre for inspection by their officials.

[*Madrid.*] Spain has shown more vigor in her proceedings with regard to electric lighting in theatres than any other country up to the present day. The royal order published in the *Madrid Gazette*, on March 31, 1888, enacted that:

(1) The establishment of electric lighting shall be obligatory for all theatres of the capitol. The use of gas being *absolutely forbidden*.

(2) A period of six months from the date of the order shall be allowed for establishing the electric light in all theatres open in Madrid. The period in question to be employed as follows: during the first two months the license must be applied for, and this, if approved, must be granted before the expiration of the third month; the remaining time to be employed in carrying out the necessary installation of the lighting.

(3) The application for the license shall be addressed to the Mayor of Madrid, who, after causing the necessary inquiries to be made by experts, shall transmit the license to the Civil Governor, who shall submit it to the Consultative Committee of Theatres, and on receiving their report will return the license to the Mayor, who shall refuse or grant it according as the Civil Governor may direct.

Every application for a license shall be accompanied in duplicate by:

(*a*) Complete plans and drawings of the theatre and the adjoining houses on a large scale, indicated.

(*b*) A written description, signed by an architect and a civil engineer.

(*c*) A specimen, at least one metre long of the cable or wire proposed to be used.

(4) The person interested shall not commence operations until provided with the necessary license, which must be granted before the expiration of the third month after the issue of the Royal Order.

(5) On the completion of the works, the experts who have superintended them shall certify that all the conditions required by the license have been fulfilled, and these certificates shall be laid before the Civil Governor, who shall submit them to the Consultative Committee of Theatres, and if all is satisfactory, a license will be granted.

The Royal Order further enacted that the steam generators and other mechanical appliances should be placed in isolated and independent situations, and never in places accessible to the public or the artists; that the gas-motors should be fixed in safe, well ventilated vaults quite outside the building, that the compressed-air motors should be placed in vaults or covered courts, with all necessary precautions against danger to the theatre in the event of an explosion; that the stores of fuel should be kept in safe places, etc. Incandescent lights only are permitted to be used inside the building, and voltaic arc-lights on the outside only, except under certain circumstances for the stage, and then only by special permission.

The use of candles on the stage is prohibited by this order, lamps with strong glass, such as used by miners, being alone allowed: any breach of this rule is made punishable by a fine.

Lamps burning olive oil must be placed in sufficient number to light the foyer, staircases, corridors, vestibules and offices, and in such a manner that the exits may be distinguished with perfect ease. These lamps must have glass globes, white and red, to mark the several points at which the theatre may be quitted; they must be lighted before the entrance of the public and extinguished after their departure. The Civil Governor determines the number of lamps to be employed.

We are assured on the best authority that this decree was carried out without a single difficulty and that now every theatre in Madrid is lighted by electricity to the perfect exclusion of gas.

WARMING.

As the electric light is becoming common in theatres, the necessity of additional artificial means of heating is felt more. The Council have, therefore, evidently given greater attention to the rules for heating these buildings.

No fireplace is allowed to be formed in any portion of the auditorium or stage of a theatre.

All open fireplaces or stoves in any other part must be protected by strong, fixed iron-wire guards and fenders, part of which may be made to open for all necessary purposes of cleaning the grate, etc.

All heating-apparatus must be enclosed upon all sides by brick walls not less than nine inches thick, and be properly ventilated.

All hot-water pipes or coils must, where necessary, be recessed in the walls, or otherwise arranged so as not to diminish the clear width of the gangways.

Where theatres are heated by artificial means, the high-pressure hot-water system with sealed pipes is inadmissible, and either hot-air or the low-pressure hot-water circulation system must be adopted, having an open cold-water supply-cistern, and the pipes throughout the system of galvanized wrought-iron, with the exception of those in immediate contact with the boiler, which may be either of galvanized wrought-iron or copper.

The boiler must be made of wrought-iron, copper or mild steel, and provided with a dead weight or other approved safety-valve, which must be attached to the boiler by an independent galvanized wrought-iron or copper pipe, and not under any circumstances fixed to the circulating pipes, and it must be placed in such a position as will insure protection from soot and dirt.

The term "low-pressure" is defined to mean the pressure due to the vertical head of water between the boiler and the supply-cistern.

[*Paris.*] In different countries opinions differ as to the important question of warming theatres. For instance, we see in London low-pressure hot-water is insisted upon, while in Paris no part of a theatre may be warmed except by air-gratings (*bouches de chaleur*), with hot-air conduits constructed of earthenware two and one-half inches thick. The furnaces for heating must be placed in the basement, and the hot-air openings on the stage must be one foot above the floor. The openings for warming situated in other parts of the house must be six inches from all woodwork, such as floors, skirtings, wainscotings, etc.

[*Brussels.*] The pipes to convey the warm air, which is advocated for the heating of Brussels theatres, may be of sheet-iron enclosed in a second pipe, or else of stoneware (*grès*).

[*St. Petersburg.*] In St. Petersburg, steam, hot-water, or steam and hot-water combined, are permissible, but no other means of heating is allowed. Berlin, however, is another city where hot-air is used. Here store-rooms must not be warmed at all.

[*Austria.*] Ordinary close iron stoves are not permitted to be used in any part of the theatres in Austria. Hot-air is again the medium specified. E. A. E. WOODROW.

(To be continued.)

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PERTINACEOUS JOHN NASH. — When a pupil in Sir Robert Taylor's office, John Nash had an early opportunity of bringing himself into notice. Sir Robert, on one occasion, putting before his clerks some plans to which certain alterations were needed in an unusually short space of time, was annoyed at being told that it was impossible to do what he required. This being overheard by young Nash, he ventured to ask if he might undertake the task which had been declined by his superiors. Sir Robert, struck by the earnest manner of the boy, granted his request. Nash immediately went to his room, procured paper and candles, and, sitting up all night, labored incessantly at the drawings, and by the time appointed appeared before Sir Robert with the plans completed. As another illustration of Nash's perseverance in after life, and his determination never to be overcome by seeming difficulties, it is told that on one occasion, having to go to some out-of-the-way place in Wales, he disdained the accustomed road, which was circuitous, and resolved to seek a more direct path to his object. Setting out on foot, he encountered many hedges, ditches, and fences, most of which he passed but not without difficulty. At last meeting with a locked gate, awkwardly framed and inconvenient to mount, he was seen to retrace his steps several hundred yards, make a sudden run and attempt to vault over the gate. Failing in this, again and again he put forth his strength, and nearly accomplished his aim; at last stripping himself of his coat and waistcoat, by a longer run and a desperate spring he succeeded in clearing the barrier. He was then seen to climb deliberately over the gate, retrace his course, put on his clothes, and proceed quietly on his way. — *The Architect.*

## ARCHITECTURE AT THE INTERNATIONAL EXHIBITION OF ART IN MUNICH.

ON the first of June, the Sixth International Art Exhibition was opened in Munich, the town hanging out flags on the occasion, and the Prince Regent Luitpold, who is reigning in place of crazy King Otto, driving to the Crystal Palace, in gala, with outriders and a regiment of cavalry. All that is done in Paris and London with their millions of inhabitants is done in this little capital with its three hundred thousand inhabitants, and to Americans this proof of pluck, energy and enterprise is peculiarly sympathetic. The Exhibition is, indeed, an achievement to be proud of.

Even Berlin and Vienna have not got beyond yearly local exhibitions, while Munich competes with Paris as an international centre for annual displays of works of art.

The catalogue for 1891 enumerated 2,418 works. The first edition of the catalogue for this year, numbers 2,851; 1,999 of which are paintings in oil-colors, 391 water-colors, pastels and drawings, 262 sculptures, 145 etchings and engravings and 52 architectural designs. Two hundred designs and paintings are still to arrive — the paintings from Paris, and the architectural designs from Vienna. The actual number of the plans already exhibited is considerably greater than appears by the enumeration, several designs being often contained in one and the same frame. Nevertheless, the department for architecture must be pronounced unsatisfactory, and by no means international. England, France, Holland, the Scandinavian nations, Russia, Spain and America are unrepresented by a single work in this branch of art, while each has sent paintings sufficient to fill the walls of from two to four large rooms, the one exception being Russia — which country is sparing even in pictures, presumably because of the national prejudice against Germany. Yet American architecture is especially a subject of European interest; and the lofty buildings of American cities are written about in German newspapers, and are pictured in German illustrated weeklies and magazines. Hardly any productions of American art, in fact, are held to be of equal originality, and none, certainly, have aroused half so much attention. But not a design, nor engraving, nor photograph is present to gratify the just curiosity of foreign architects, and to increase the interest of the public in the building art: a circumstance that can be accounted for only by a want of circumspection on the part of the delegates who were appointed to collect works for the Exhibition. Such delegates, unfortunately, are often mere painters, and therefore do not possess either knowledge of architecture nor sympathy with the architectural movements of the day. They neglect the most gifted architects, in favor of second and third rate painters. A critic can only protest when looking at the results of their activity, and hope for a return of the Renaissance unversality, for an all-around culture, for men like da Vinci, Michael Angelo and Raphael: because with such men for delegates, how different the architectural department of art exhibitions would look. But in the meanwhile to do justice to what is offered, we count the walls, and find that twenty-two are covered. A majority of the plans are by architects in Munich, Berlin, Vienna, Karlsruhe and Leipsic; but there are designs by Polish, Belgian and Italian architects also.

Joseph Dziekouski, of Warsaw, exhibits in water-color a design for a Catholic church and altar, in the style of the North German Gothic, a style that owed its peculiar features to the use of brick, which was the sole material at the disposal of architects in the towns of the alluvial plains of Mecklenburg, Pommerania and Brandenberg. Why it should be exhibited in Germany, the country of its origin, is a question. The church is of too small dimensions and too simple a construction for supposing that the architect laid stress upon anything *but* the style. Well, we learn something indirectly, to be sure, by learning that a Pole entertains the idea that Gothic is novel here. The fact tells how very prevalent Renaissance and Moorish styles of building still continue to be in Poland, the architect's own country.

Germans are familiar with every form or modification of Gothic, and will hardly devote a second glance to the new Warsaw church. But Prylinski's "study sketches" of the Wavel are certain to awaken interest. The Wavel is the royal castle in Cracow that was built and occupied by the first seven dynasties of Polish kings, each dynasty altering parts of it or adding new portions to the old mass. Its chapel, especially, is a conglomerate, and constructively it is almost monstrous. But it affords specimens, nevertheless, of the richest, native Polish styles of decoration, as well as imitations of sumptuous Italian Renaissance and Baroco work, and for the sake of these native Polish bits, the whole is worth examination.

Very beautiful is Nichuiewski's design for a pulpit in another new Catholic church in Warsaw. This church is also Gothic in style and the material is brick; but the decorative portions are hewn out of a soft silver-gray sandstone, and the design possesses a winning and original distinction through the consequential restriction of colors to those of rose and gray. Thus the pulpit being of wrought-iron, is coated with silver: in elegant arabesques, its balustrades and steps winds upwards about a brick column, then form a platform, over which hangs a bell-like dome. Ladislaw Marconi's plan for a synagogue in Warsaw, is marked "First Prize"; but we found no new ideas in it. Lilpop's and Drikonski's vault chapel is too fragile and gay looking for an abode of the dead: such pretty structures belong on hill-tops, as out-look stations over lovely landscapes.

Far more monumental in aspect is Lambert and Stahl's plan for a crematorium in Stuttgardt, with close, massive walls and close-lying cupola; solidity, simplicity and a certain heavy grandeur characterize this solemn temple. But why lions *couchants* at the entrance? The traditional symbolic beast for tombs is the lioness with cubs, the ancient and mediæval belief being that the latter were born dead and were infused with living breath on the third day; hence a representation of the mother-lion in this act of breathing upon her young stood for the Resurrection. Lions *couchants*, with their symbolism as guards, were in place on the exposed fields of Marathon and other battle-grounds, where there was danger of the buried being insulted or torn from the earth by enemies. But they are out of place in modern, Christian burial-grounds. They emphasize the fact of visitation and distract attention to the living who may come to the spot, instead of concentrating it upon the fate of the dead who are entombed there. Enough other buildings are devoted to the living: let the one building that is hallowed to the dead be completely hallowed in every stone.

But to go back to Polish designs, we notice that nine-tenths of them are for sacred structures. Zachariewiez alone sends twenty-one plans for churches and synagogues. Paul Hoser, whose name is not in the catalogue, provides seven other plans for churches. Indeed the only architects from Poland who do submit plans for any profane buildings are Stephen Szyller and Lygmunt Hendel. The latter has a drawing of the restoration of Castle Tenczyn, near Cracow. Very curious in this castle are the bizarre forms of the towers and the copings of the walls. The latter correspond to West European battlements, but among other sixteenth-century extravagancies, they represent drapery extended between posts, etc. Hardly anything could be more in contrast with the plain and massive walls of the extensive castle: they are parodies of battlements, but genuine products of the fantastic, unpractical culture of the Poles; bits of trans-Vistula Baroco.

German drawings have more diversity. They include plans for churches, palaces, colleges, theatres, hotels, public halls, tenement-houses, business blocks, interior decoration, private residences, banks, baths, and monuments. Among the latter are two colossal drawings in crayon of Bruno Schmitz's plan for a monument to Emperor William I in Berlin — the much-talked-of plan, for which a new national lottery was to be instituted, and which if carried out, requires that a small lake-like pond shall be dug in the heart of of the city, near the royal castle where now the street of business houses stand, that are known as the "Schloss Freiheit." The notion of the lottery raised a scandal, and it still raises our indignation as citizens. Yet abstractly, nevertheless, we wish that the plan might be put through. This equestrian monument is finely conceived, and the architectural background for it — the semicircular colonnade upon an elevated foundation with a grand portal in the middle, on a line with the grand portal and dome of the castle — is dignified and quiet. The Victories at the ends of the colonnade are somewhat theatrical and conventional in effect; but the low reliefs of the base between the columns, and the standing figures of Emperor Frederick, King Ludwig, Bismarck and Moltke before the columns are harmonious. The fountain falls in the form of a sheet of water from the foot of the portal in the middle portion of the long curving colonnade, down into an immense marble basin, and flows over the basin into the pond, on the city side, the statues of the Emperor, Bismarck and the other heroes of the Franco-Prussian War, being on the interior or castle side of the colonnade.

As for the pond, it must be thought of, in reality, as a broadened portion of a canal, the project being to widen the present bed of the river Spree, which, in Berlin, resembles a canal. Water, however, even when walled in, affords a welcome adjunct to monumental structures, and is to be preferred in cities to a stretch of stone pavement. Emperor William II is fascinated by just this part of the

plan. Who knows whether he will not have it adopted, in spite of the opposition of tax-payers? Who knows, for that matter, whether he will not expand the original project, and cause the pond to be made large enough for anchoring his yachts in?

The Landtag has granted two million marks towards the construction of the Cathedral, the plans of which are exhibited in Room No. 11. The site is that of the old Dom, which is now being demolished, and will include the oldest cathedral embankment of the Spree that was left unused when the present Dom was built. The plan provides for a great central space for preaching, with 1,795 seats on the main floor and 153 in the (northern) gallery, a smaller side chapel for baptisms and weddings, and, on the opposite end, a smaller side-chapel, likewise circular in form, as a memorial chapel. The basement is designed as a crypt for containing the coffins of princes of the royal family of Prussia. Portrait monuments, as it is calculated, will fill the memorial chapel in time, similarly to the chapels of Westminster Abbey in London or the royal chapel of Saxon princes in Freiberg Cathedral. A spacious, great central cupola and one smaller one on each side mark the three main divisions of the building without. Each cupola is raised upon two stories of smaller columns, in repetition of the manner in which the columns of the building are arranged, so that just as an overture contains an epitome of the whole opera, so does each cupola hint at the construction of the whole cathedral. Other minor parts are equally well studied out, and the plan, as a whole, must be pronounced as excellent an academic plan as can be conceived. It possesses the great academical traits: clear, simple distribution of space, clear and beautiful accentuation of this distribution, and decoration in the purest harmony with the construction. The architect is Julius Raschdorff, Professor of the Charlottenburg Polytechnicum, near Berlin, an architect whose reputation has attracted many American students to Berlin.

Renaissance, which is the style in which Raschdorff excels, is likewise the favorite, as it would appear, of Belgian architects. An exception is found, however, in Johann Baes, the designer of the new Flemish Theatre in Brussels, a building of much originality, if not of great beauty. Our attention was attracted to it first because of the practical arrangement of the interior spaces of the ground-plan; but the photographs of the façade and of sections of the gables were likewise surprising.

To describe these vividly in a few words, let the figure of a man lying prostrate on the ground be used; then the crown of his head would stand for the projecting façade of the theatre. From this point the line of building recedes on both sides backward to the shoulders. In the angles between the sides of the head and the shoulders occur two gables, one at the right and one at the left of the face of the building, very prominent gables that conceal the entire slants of the roofs behind them. Below the gables, beginning at the façade, but not crossing this (save in the uppermost and lowermost stories), are four tiers of broad iron balconies. They correspond to the four tiers of galleries inside the house, and are presumably a bold solution of the question: How shall play-houses be constructed in order that they may be emptied quickly?

The façade is divided by three lofty, blind arches, and in each, on the ground-floor, is an insignificant entrance.

Numerous other plans, particularly those of Dr. Durm, in Karlsruhe, for a new bathing-establishment in Baden, are worth inspection, and visitors to Munich in August will enjoy the privilege of seeing those of the builders of modern Vienna. As yet these last-mentioned plans are not unpacked. Countess von Krockow.

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## THE CEMENT "BACILLUS."[1]

As in our time some of the smallest of creatures have been recognized as disease producers and dangerous destroyers of the animal organism so there has now been discovered as a very dangerous enemy and destroyer of cement, an extremely minute object, but one of definite crystalline character, which we have learned to produce, so to speak, in "pure cultivation." This "bacillus" is the double salt formed under the influence of sea water or saline solutions containing sulphuric acid, *e. g.*, gypsum water and consists of lime, alumina, sulphuric acid and water of crystallization, with the formula $2\,Ca_3Al_2O_6 + 5\,CaSo_4 + 120\,HO$, according to E. Caudlot's researches, or (*a*) $Ca_3Al_2O_6 + 3\,CaSO_4 + 30\,HO$ and (*b*) $Ca_3Al_2O_6 + 3\,CaSO_4 + HO$,[2] according to my researches. I had already suspected the existence of this compound some years previously, when I showed that the injurious effect of an excessive proportion of gypsum in cement could not possibly be caused by the gypsum as such, because gypsum already slaked has quite as injurious an effect as burnt (*i. e.*, de-hydrated) gypsum, and I had, as I now know, produced the substance in question as early as the year 1883, but had not then exercised sufficient care in the physical examination of it, and, owing to its microscopic nature, had not recognized it as a crystalline compound. The method I had employed had furnished the double salt in such extraordinarily fine crystals that these could only have been recognized as such if magnified 200 times; while the method chosen by E. Caudlot, by which the salt crystallized slowly from a saturated solution, furnished it in crystals large enough to be recognized distinctly with the naked eye. Accordingly it was E. Caudlot, Ingénieur Chimiste de la Société des Ciments Français et des Portland de Boulonge-sur-Mer, who was unquestionably the first to recognize this body distinctly. I thereupon repeated the process I had previously adopted by introducing sulphate of alumina into lime water, kept at the point of saturation, and subjecting to careful microscopic examination the precipitate after it had been exposed for a considerable length of time to the influence of the saturated lime water, and found thereby the voluminous flocculent substance, the apparently amorphous powder, consisting entirely of minute needle-like crystals, to which, after drying over a sulphuric acid, the above formula (*a*) $Ca_3Al_2O_6 + 3\,CaSO_4 + 30\,HO$ corresponded. This apparently formless double salt I then dissolved in boiling water (with exclusion of carbonic acid) and now obtained from the solution the same distinct crystallization of the salt — in "pure cultivation" as I might say to continue the comparison — which E. Caudlot had obtained by his process.

The aluminic calcic sulphate, more correctly sulphate aluminate and sulphate, forms, when produced in this way, needle-shaped prisms or rods, in length up to 0.5 millimetres, in breadth from 0.02 millimetres to 0.05 millimetres, apparently belonging to the tetragonal system, and having in part the longer edges broken; it represents, therefore, actual bacilli. That these minute bodies, crystallizing in the hardened cement with such a great increase of volume, should be able, notwithstanding their infinitesimal size, to destroy its cohesion, can be readily understood when it is considered that to 162 parts by weight of calcic aluminate, $Ca_3Al_2O_6 + 3\,HO$, in the hardened cement, there attach themselves, according to formula (*a*) 447 additional parts by weight of sulphate of lime and water, or, according even to formula (*b*) 285 parts by weight. The formula (*a*) is, however, more probably the correct one, the crystals having been obtained from a cold solution. Since most Portland cements — to consider for the present only this kind of cement — contain 7 to 9 per cent of alumina and can, therefore, take up 28 to 36 per cent by weight of de-hydrated gypsum, or 60 to 80 per cent by weight of calcic sulphate and water (supposing the whole of the alumina to pass over into this calcic aluminate and sulphate) the powerful influence exerted on cement by solutions containing sulphuric acid can no longer appear strange.[3]

Corresponding with this is the fearful destruction I had already observed ten years previously in the best known Portland cements, when I exposed them after complete induration — but induration protected from the influence of carbonic acid — to a continuously saturated solution of gypsum, which solution, as regards the amount of sulphuric acid it contains, is about equivalent to sea water. On the other hand, however, the formation of this double salt in cement explains why a certain limited addition of gypsum to Portland cement increases the compactness and strength of the latter, since all compounds formed in the hardening process which produce greater density, must also enhance the strength so long as they can find room for themselves without violent destruction of the cohesion.

By exhaustive researches and observations, extending over several years, I have established the fact that the limit of safety in the addition of gypsum is, in the case of many Portland cements, as high as 4 per cent by weight of gypsum, or about 2 per cent of sulphuric acid; the regulations,[4] it is well known, allow only half this amount. With regard to this it will be perceived — indeed, it could scarcely be expected to be otherwise — that the different Portland cements will vary with respect to the proportion of sulphuric acid compounds that may safely be added to them; of course, the amount of gypsum added has always to be regulated according to the proportion of sulphur compounds already present in the cement clinker.

But to prescribe entirely sulphuric acid in cement, as has recently been done, is quite a mistake; the danger to the cement lies not so much in the sulphuric acid already contained in it, as in sulphuric acid acting upon it subsequently from without. I had already shown that an analogous calcic ferrate and calcic sulphate compound existed; since, however, I have not yet succeeded in producing this in a crystalline form, nor yet the basic calcic sulphate compound I had suspected and which has been described by Friedrich Schlott, and since it is to crystallizing compounds alone that I can attribute a violent destruction of cement, I prefer to doubt the occurrence of any such destruction through the formation of basic calcic sulphate or calcic ferrate and calcic sulphate, so long as no one shall have succeeded in producing these bodies in the form of well-defined crystals as has been done in the case of the undoubtedly proved cement "bacillus" of calcic aluminate and calcic sulphate. — *Engineering.*

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[1] By Dr. Wilhelm Michaelis, Cement Techniker, Berlin.

[2] The double salt first obtained had, after drying over sulphuric acid, thirty equivalents of water; the same recrystallized from a hot solution, and consisting then only of well-formed crystals, yielded, after drying over sulphuric acid, twelve equivalents of water.

[3] In the case which claims the chief interest, that of the action of sea water on cement mortar, in which the calcic sulphate is first formed from magnesic sulphate, the lime being derived from the calcic hydrate already present in the cement, the addition which takes place is 46 to 60 per cent by weight of sulphuric acid and water of hydration, and there is a simultaneous separation in the body of the cement of 11 to 15 per cent by weight of magnesic hydrate. In all cases every molecule of calcic aluminate is replaced by a molecule, at least three times its size, of the double compound of aluminate and sulphate crystallizing with irresistible force.

[4] The German Regulations for the Delivery and Testing of Portland cement.

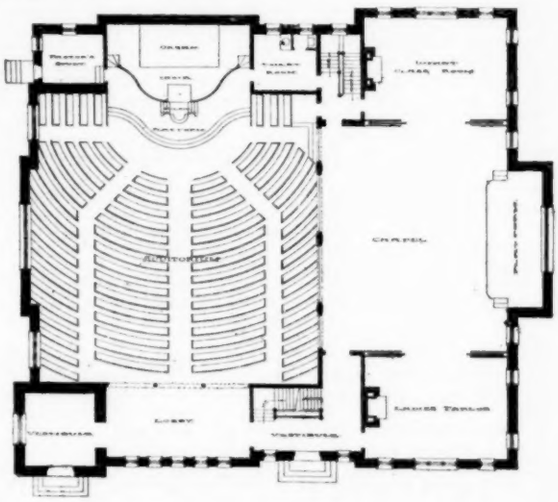
## ILLUSTRATIONS

*[Contributors are requested to send with their drawings full and adequate descriptions of the buildings, including a statement of cost.]*

ALLSTON CONGREGATIONAL CHURCH, ALLSTON, BOSTON, MASS. EUGENE L. CLARK, ARCHITECT, BOSTON, MASS.

[Gelatine Print issued with the International and Imperial Editions only.]

THIS church is built of Milford pink granite with brownstone trimmings; the interior being finished in red brick, with the the exception of the chapel, which is in ash. The seating capacity is 600, the chapel holding 300 additional. The church and



chapel can be thrown together, making one auditorium, which will hold about one thousand people. The cost was about $50,000, including the organ.

STABLE FOR JULIEN LE ROY WHITE, ESQ., NEAR BALTIMORE, MD. MESSRS. J. A. & W. T. WILSON, ARCHITECTS, BALTIMORE, MD.

THIS stable, which cost about $12,000, is built of yellow Pompeian brick with Indiana limestone finish. The roof is covered with stained shingle.

SOMNUS HALL, STETSON UNIVERSITY, DELAND, FLA. MR. GEORGE T. PEARSON, ARCHITECT, PHILADELPHIA, PA.

THE building is to be used for dormitory purposes in connection with the University, and is built of brick, with white joints, and is treated throughout in Colonial style.

STORE FOR THOMAS E. PROCTOR, ESQ., ESSEX ST., BOSTON, MASS. MESSRS. ANDREWS, JAQUES & RANTOUL, ARCHITECTS, BOSTON, MASS.

ACCEPTED DESIGN FOR THE CONGREGATIONAL CHURCH, ORANGE, MASS. MR. H. M. FRANCIS, ARCHITECT, FITCHBURG, MASS.

BRISTOL COUNTY COURT-HOUSE, TAUNTON, MASS. MR. FRANK IRVING COOPER, ARCHITECT, PITTSBURGH, PA.

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**[Additional Illustrations in the International Edition.]**

WINDOW OF THE HOTEL DE VILLE, RHEIMS, FRANCE.

[Copper-plate Engraving.]

A LOUIS XV DOORWAY.

[Photogravure.]

A LOUIS XVI DOORWAY.

[Photogravure.]

CHARTRES CATHEDRAL.

IF a single view of Chartres Cathedral were to be produced in our days, the artist would probably select the south porch. But when Prout visited the building that part was unrestored, and was not as fascinating as it now appears. He preferred, therefore, to select a portion of the interior which seemed to be complete in itself, and was therefore better adapted for a plate than the whole of the vast building. It also did not present the difficulties which were presented by the stained-glass windows to a draughtsman who was not making use of colors. Owing to the influence of the windows, the finest photograph does not recall Chartres as it is remembered, because one's idea of the interior is, in a great measure, associated with them, and in a view we expect some suggestion of their beauty.

NEW CHURCH, SHALDON, TEIGNMOUTH, ENG. MR. EDMUND SEDDING, ARCHITECT, PLYMOUTH, ENG.

A CHURCH has long been needed by the parishioners of Shaldon, which has much grown in the last fifty years. The old church which is of thirteenth-century date, is a very interesting specimen of Devonian architecture, and as it was too small for the growing population it was unfortunately enlarged in the eighteenth century, very much to the detriment of the older fabric. But as this church is situated about a mile from the mass of the inhabitants, it has been found necessary to erect a new church in the midst of the parish.

CHACEWATER CHURCH, ENG. MR. EDMUND SEDDING, ARCHITECT, PLYMOUTH, ENG.

THE entire reconstruction of this church is well in hand, although some difficulty was experienced with the foundations for the arcades, which run to a depth of sixteen feet. The piers are of Polyphant stone, and the arches, quoins and aisle windows are of granite. The clerestory windows are of Polyphant. The whole of the walling inside is to be pointed, no plaster being used.

THE REGISTER OFFICE, EDINBURGH, SCOTLAND: SECTION AND PLAN OF FIRST FLOOR. MR. ROBERT ADAM, ARCHITECT.

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## COMMUNICATIONS

*[The editors cannot pay attention to demands of correspondents who forget to give their names and addresses as guaranty of good faith; nor do they hold themselves responsible for opinions expressed by their correspondents.]*

### MODELLING IN CLAY.

READING, PA., July 27, 1892.

TO THE EDITORS OF THE AMERICAN ARCHITECT:—

*Dear Sirs,*—Would you kindly inform me whether a book or treatise on modelling is published.

A treatise relating to the work itself and also the instruments necessary for the same.

We receive weekly the *American Architect* and thought, perhaps, you would be able to give some information on the subject. Would be very much obliged if you can give me a little hint or two relative to the subject of modelling.

Beg pardon for use of your time and remain yours truly,

W. F. MILLER.

[" *Modelling in Clay* " by A. L. Vago, published by Robert Clarke & Co., Cincinnati (price $1.00), is a simple and fairly practical guide.—EDS. AMERICAN ARCHITECT.]

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## NOTES AND CLIPPINGS

THE RIGHT OF EUROPEAN EXPLORERS IN EGYPT.—Apropos of the difficulties which have arisen in Egypt with regard to the rights of Europeans in general to excavate for antiquities, the *Journal des Débats* points out that in 1858 the Boulaq Museum was founded by Mariette. Maspéro followed him in 1881, and Grébaut took the position in 1887. In 1890 M. Ribot stipulated with the English that the museum, now removed to drier and safer quarters at Gizeh, should remain under French control. But the diplomat did not reckon with two influences, the professional Egyptologists and the tourists. For the Egyptologists who hope to impress a university at home by some remarkable discovery, the chief of the Gizeh Museum is the most disagreeable embarrassing fact. He is a patented, official savant, who has the privilege of digging in the best spots. They are not anxious to remember that as an Egyptian official it is his duty to consider Egypt first, and that foreign excavators may take away with them a large part of whatever they discover. Moreover such articles as are claimed by Egypt must be paid for by Egypt, and there is little money for such purposes. Hence the war of the British press against the Bureau of Archæology in Egypt. The London societies who subscribe large sums for explorations and surveys naturally consider that the present policy is that of the dog in the manger. There is the same trouble with Turkey and

Hamdi Bey, but less noise is made about discriminations against foreigners who are eager to dig in Palestine and Asia Minor than about those in Egypt. Tourists are taxed by Egypt for archæological expenses, and they want their money's worth. Director Grébaut, according to the *Débats*, has been worn out by the attacks of tourists and English officials in Egypt. He has resigned, and his functions have been divided between two new officials, one representing France, the other Egypt, but both Frenchmen. M. de Morgan is the director of the museum and M. Virey specially charged to guard Egyptian monuments from vandalism. M. de Morgan is a mining engineer who went to the Caucasus and opened many graves of the bronze age, publishing his discoveries in two handsome illustrated volumes. He is a brother of M. Henri de Morgan, the young dealer in archæological objects in New York, who was at first associated with M. Gaston Feuardent and since with Mr. Thomas B. Clarke. It is the latter who has imported most of the exquisite Greek figures and groups in terra-cotta from Tanagra and Corinth.

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TIMGAD THE POMPEII OF ALGERIA. — The *Temps* describes under the above heading, the visit of M. Léon Bourgeois, the French Minister of Public Instruction and Fine Arts, during his recent tour in Algeria, to the ruins of the Arab City of Timgad, which was built in the first century of the Christian era and devastated by the Moors in the sixth century, its destruction being completed by successive shocks of earthquake. Timgad is in the Province of Constantine, quotes the London *Times*, about sixteen miles from the ruins of Lambessa, formerly a military colony of the Romans and the camp of the famous Third Legion of the Emperor Augustus. Built upon one of the spurs of the Aures Mountains, Timgad was a place of fashionable resort like Pompeii and, like the Italian city, it has preserved the pavement of its streets, with ruts made by the chariot wheels, a forum with a number of ornamental statues, a basilica, a tribunal of commerce, several temples and public halls, a theatre with seats for the spectators, galleries, and entrance places for the public and the actors, fountains, baths, and a covered market with granite tables still in their places. To the southwest of the town rises a temple of colossal dimensions, surrounded by spacious porticos, upon a hill designated by the name of Capitol. This building, dedicated to Jupiter, is now being excavated, and the ornamental friezes, the balustrades, and the heads of the columns are already clear of earth, while the fragments of a colossal statue have also been brought to light. There is a broad, paved road, quite intact, traversing the city from east to west, with several triumphal arches spanning it, one of which, built by Trajan and with three gateways through it, is still intact. This triumphal way was the road from Lambessa to Tehessa, which possesses the first Christian monastery in the world, built at the close of the fourth century by the disciples of St. Augustine and recently excavated by the French Administration of Public Monuments. There is also in Timgad the Byzantine fort or citadel, built in haste by the troops of Solomon, the successor of Belisarius in Africa, out of the débris of the southern part of the city; several Christian basilicas, and various other constructions, which will in due course be excavated. It is hoped that the visit of the Minister of Fine Arts will result in more funds being provided for the work which is being carried on at Timgad and other places in the Province of Constantine, which is particularly rich in archæological remains of the Roman period.

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MME. BERTAUX AND THE ACADEMIE DES BEAUX ARTS. — A rather important question is being raised by Mme. Léon Bertaux, the Lady President of the *Union des Femmes Peintres et Sculpteurs*, who wants to be elected a member of the Academy of Fine Arts. The last lady Academician was Mme. Vigée Lebrun, who drew a portrait of Marie Antoinette, and, thanks to the royal influence, was elected in succession to Mme. Terbursch, although her candidature was hotly opposed because her husband — Lebrun — was a picture-dealer and an expert. By a singular coincidence, Mme. Léon Bertaux made a bust at Fontainebleau last year of Mme. Carnot, so that she should be able to obtain historical justice at the hands of the President of the Republic, who might be tempted to take a leaf out of the book of Louis XVI, in the matter of the lady sculptor's candidature. The old monarchy was, on the whole, far more favorably disposed to lady artists than the succeeding régimes have been. Fifteen ladies were received within a period of 100 years into the Académie Royale, founded in 1748 for the purpose of enabling artists to set at defiance the too close corporation of Master Painters and Sculptors. In 1793 the Académie Royale was suppressed. When the Institute was founded no women were put forward as candidates, but then there was no law against their admission. It is on this ground that Mme. Léon Bertaux takes her stand, and it remains to be seen if the Third Republic will show itself as generous to aspiring lady Academicians of the old monarchy. — *London Daily Telegraph.*

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AIR POLUTION IN ENGLISH CITIES. — A further set of observations of the condition of the atmosphere in Manchester and suburbs have been published. Included in the returns for the purposes of comparison are some observations made in London and Liverpool. The amount of sulphurous acid in milligrammes per 100 cubic feet contained in the air during a moderately thick fog in December, 1891, ranged in Manchester from 31.15 to 32.24, according to vicinity, and at University College, London, on the same day 20.5. On December 22, during a thick fog in London, the amount varied at University College from 14.7 to 39.1, and at St. Bartholomew's Hospital, 49.5. The amount which was found at Hamstead was only one-third the weight at University College. By collecting and analyzing snow and frosty rime about a mile from the centre of the town, it was seen that 386.6 parts per million of sulphuric acid was deposited in seven days, and about two tons of "blacks" per superfical square-mile. The amount of light delivered in one hour being represented as 20 in the Grindelwald, Switzerland, on December 27, was only 1.2 about one and a half miles from the city, and .8 in the city of Manchester. These figures speak for themselves, and show the effect of the consumption of soft bituminous coal used in this district. — *Industries.*

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THE REAL ESTATE SITUATION IN CHICAGO. — The dogs of Constantinople and the beggars of Italy are replaced as local features in Chicago by the real-estate signs and signs of all sorts. No city in the world has so many signs. They are strung on banners across the streets, written on the sidewalks, and they cover the fronts and sides of buildings. The real-estate signs lead all the rest. Hundreds of vacant lots line the beautiful boulevards that lead in to Chicago, and in each of those lots may be seen from 10 to 30 real-estate dealer's boards. Some of them are only a few feet square and others as big as little houses. It gives to the boulevards the aspect of being lined on either side with graveyards of a western and unusual pattern. — *New York World.*

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DR. FREEMAN AND THE DUKE OF CLEVELAND. — An amusing story is told in England concerning the late historian, E. A. Freeman. It is said that when he was examining Battle Abbey in preparation for writing the account of what he has called the great fight of Senlac, he found himself dogged by a person who, as he thought, somewhat officiously obtruded his offers of assistance. After vainly trying to shake him off, he broke forth with "I don't want your help. The Duke of Cleveland promised that I should not be interfered with by the gardeners." "Exactly so," was the reply; "I hope they have obeyed my orders. I am the Duke of Cleveland." — *New York Tribune.*

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ELECTRIC LIGHT AND FOG — The explanation of the reason why the electric light is so ineffective in foggy weather is said by a French scientist to be due to the fact that red light passes through dust and vapor in the atmosphere more readily than blue light. As the rays from the arc light are of a bluish tinge they fail to penetrate a heavy fog, whereas the ruddier light of the oil or gas lamp is not shorn of its brilliancy to such an extent as to prevent it being seen at a reasonable distance. — *Merchant and Manufacturer.*

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BAMBOO SHEETING. — Bamboo sheeting is a new Chinese manufacture which is extending in the province of Wenchow. The cane is split up so as to form a sheet, which, after being softened in boiling water, is pressed out flat. The sheets are used for veneering, making trays, fans, screens, and carved fretwork. — *Exchange.*

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## TRADE SURVEYS

THE volume of business throughout the country maintains itself at maximum limits for the season of the year. Heavy exports of gold have not produced any unfavorable effect. The distribution of money throughout the interior continues to meet all urgent demands. The surplus reserve continues to grow, but a steady depletion will soon set in. Railroad reports continue fair. Crops are large, and increasing traffic is probable. The dividends paid on railroad stocks during the past three years have been as follows: in 1890, 4.27; in 1891, 4.25; in 1889, 4.40. Notwithstanding that fact, there is much money seeking investment in railway securities. Bank clearings are at the present time thirteen per cent greater than at this time last year. Bonds are in more active demand on both sides of the water, but greater care is taken in the selection of securities. All the commercial indications are of a favorable character. In manufacturing channels the output is beginning to increase, in view of a heavy fall trade. Throughout the New England and Middle States there is very little restriction, excepting in the iron trade, and that will soon right itself. Throughout the West, agricultural, commercial and industrial conditions generally are quite satisfactory. Prices continue low. Freight-rates are regular. Shipments by lake and water are increasing. Considerable new land has been placed under cultivation this year, and the disposition is to take up more new land along the lines of nearly all railroads. In both agricultural and manufacturing districts there are healthful conditions. The smaller industries grow more rapidly than the larger. Returns are more favorable where small capital is engaged, and is due to the more careful personal supervision. Business interests anticipate an improvement soon after the adjournment of Congress. Agitation on the silver question will then cease to be a disturbing factor. Ocean freights continue high, and the traffic is heavy. Advices from foreign commercial centres show more activity. Reports from several Western cities this week show an increase in building operations over last year. Architects all agree in saying that the rest of the year will be a season of great activity. Building material is in very good demand, especially brick. Lumber is being distributed with more satisfaction, and an advance in the price of white pine has been announced in the West. The drawback to all of these favorable reports is the narrow margins realized in most lines of business. Merchants, manufacturers and bankers are not at all clear as to how the condition of things can be best remedied. Business methods are changing. New conditions are manifesting themselves. Improvements are being made. The cost of production is being steadily reduced. Lessened stocks of goods are being carried. Operating expenses in many directions are being shaded down slightly. But, with all these trifling efforts, the margin in business continues dangerously narrow. This fact, however, does not prevent anxiety to enter business; in fact, the statistics of this year's new operations show that possibly more money has found its way into industrial channels than last year. It is true, at least in a good many directions. There is considerable complaint among the managers of factories and shops throughout the New England States, but it is a question whether the complaints are well founded. The manufacturers of textiles have had a fairly good year. Nearly all other branches of industry are prospering, but with narrow margins. Anticipations for wider margins are likely to be doomed to disappointment. Many new industries are being established throughout the Far West, and new industrial centres continue to spring up there. The possibility of a still further decline in prices must be kept in sight, although the most careful business men who take a national view of things do not believe a permanently lower range is likely to come. The banking interests are doing their very best to accommodate the growing demands of money-lenders in the Western States, as is shown by the increase in the number of national banks, as well as in savings and State banks.

S. J. PARKHILL & CO., Printers, Boston, Mass.