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ARCHITECTS were probably surprised to learn from the daily papers, the other day, that the Metropolitan Opera-House, in New York, which was supposed to be almost a model of fireproof theatre construction, had been "completely destroyed" by fire. As usual in such cases, the first reports turned out to be grossly inaccurate. Newspaper reporters seem to take a special delight in representing that fireproof constructions have failed to do what was required of them, with the idea, probably of exulting over the scientific men who devise such constructions; but this prevarication is very detrimental to the public interest, by confusing together the true and the sham fire-resisting construction, and spreading the idea that there is no such thing as construction really fireproof. The fact is that in the Opera House, as in most other structures of the sort which have been injured by fire, the fire-resisting portions did their work exactly as they were expected to do it, and the fire really gave the best demonstration that we have yet had of the soundness of the principles of theatre construction which are now accepted by architects, and which received their first important application in this country, under the skilful direction of Mr. Cady, in the building in question.

THE detailed accounts of the fire show that a most extraordinary use was being made of the building at the time. Apparently, a sort of scene-painters' festival had beengoing on there for some time. Not only was the scenery belonging to the Opera-House piled about in all directions, but new scenery for two other theatres, Hoyt's and the Casino, was being painted on the stage; and immense numbers of huge, freshly-painted canvases were stacked in the flies, and in the wings, while others were in process of preparation on the stage floor, as rapidly as the decorators and carpenters of the other two theatres, with the help of a part of the Opera-House staff, could paint them and put them together. To make this enormous accumulation of dangerous material as dangerous as possible to the building, the iron curtain between the stage and the auditorium was pulled up to its full height, so as to expose the whole interior to fire from the stage; and this notwithstanding that, by a piece of inexcusable carelessness, a temporary wooden floor, which was built over the whole area of the auditorium, on the occasion of a ball held in the building last spring, had been left in place. In some unexplained way, very likely by the lighting of a pipe among the easy-going individuals in charge of the place, fire caught among the paint-pots and varnish, and spread like a flash over the fresh, oily canvases and pine wood stretchers which were stocked or piled in enormous masses on all sides, as well as overhead. As might have been expected, it did not occur to any of these vigilant guardians of the great property to lower the iron proscenium-curtain, but all hands fled, every one escaping without injury from what must have been a blaze so sudden and violent as to have been little short of an explosion, with the exception of a boy, who had been sent on an errand to the fourth story, and, terrified by the sudden burst of flames, jumped down a shaft to the first story, and was taken out with a fractured skull. Meanwhile, the different portions of the construction behaved just as they were intended to do. The great skylight over the stage was shivered immediately by the heat, giving vent to the flames, and, by its powerful draught, holding them away from the auditorium. If the iron curtain had been down, it is not likely that the least damage would have been done by fire to the auditorium; but, with the proscenium-arch open, into a room ninety feet deep, a hundred wide, and a hundred and fifty high, filled with blazing oil and canvas and pine wood, it was hardly possible that the heat should not have had some effect; and the temporary floor took fire, smoking and staining the ceiling, while the balcony railings were partly destroyed, and the ceiling itself, which is of metal suspended from the iron roof, was somewhat injured. At this moment the firemen came in, and wrought, with streams of water from twenty-five engines, the havoc which seems to be unavoidable in such cases, soaking the walls, floors and upholstery, with what remained of the scenery, and even the books in the manager's library, and the dresses in the wardrobes. It did not take many minutes of this sort of work to complete the destruction of two hundred thousand dollars' worth of property, consisting mostly of scenery and dresses; the building, with the exception of the stage roof and fittings, and the decorations of the auditorium, being little injured. No doubt, the skill of the New York firemen had a good deal to do with keeping the loss within such reasonable bounds; but it is certainly highly creditable to the architect that his building should have resisted so well the fury of such a conflagration.

A CASE of contract has just been decided in England which possesses a peculiar interest, on account of the novel view taken by the judges of the obligations of one of the contracting parties. It seems that the corporation of the town of York invited tenders for certain sewerage work. One Bottems sent in a bid for building a section of main sewer, several miles long, following the course of the River Ouse. The tender was made in accordance with the plans and specifications, which said nothing about the character of the soil, the town engineers apparently intending to throw all risks in that respect upon the contractor. Notwithstanding this, Bottems made no attempt to ascertain definitely, by boring or otherwise, what sort of soil he would have to work in, contenting himself with walking over the line of the proposed sewer and examining the surface of the ground. He then submitted his proposal, which was to build the sewer in accordance with the plans and specifications for fifty-five thousand pounds. After the bids were in, this was found to be ten thousand pounds lower than any other estimate, and, on the advice of the engineer, the town authorities invited Bottems to reconsider his figures. He did so, but decided to make no change in his proposal. It was then accepted, and a contract entered into, by which the contractor bound himself to execute the work to the satisfaction of the engineer, to accept his decision as final in case of dispute, and to make no claims for extra pay on account of work ordered by the engineer, unless the orders were given in writing.

HARDLY had the contractor begun work when difficulties were encountered. The ground, where the excavation was begun, proved to be a spongy mud, so that the sides of the excavation had to be shored, and the brickwork of the sewer was several times crushed by the lateral pressure, and was, on the engineer's order, rebuilt. Less than half a mile of sewer had been built when still worse ground was met with. Instead of being spongy, the subsoil became soft mud, which would not stand long enough to allow the brickwork to be built in the trench. The contractor then notified the corporation officers that he could not go on with the sewer unless he were allowed to do it by day-work. Naturally, the corporation declined to give up its contract, and soon afterwards Bottems discharged his men and abandoned the work. The corporation officers, as the contract authorized them to do, took possession of the machinery and plant, and proceeded to finish the sewer themselves. Bottems then brought suit for extra pay for most of what he had done, on the ground that it was new work not contemplated by the contract. The corporation claimed that it was not extra work, and that the contractor had agreed to be bound by the decision of the engineer, who had already ruled that it was included in the contract. The case was tried and appealed, and both courts decided in favor of the corporation. Lord Esher, in the Supreme Court, observed, after the fashion of English judges, that "the real reason why he (Bottems) had come to grief was that he had not ascertained the nature of the soil before he entered into the contract." This seems to have been obvious enough, but all the judges took pains to express "the greatest possible sympathy" with the contractor, and regret that there was "no ground on which it was possible to relieve him," while Mr. Justice Mathew, in the lower court, although "with reluctance and regret" giving judgment for the corporation, said that he thought the plaintiff had been "hardly used." "I regret," said he, "that the corporation did not refuse his tender. I do not think that he and they were on a level, or upon equal terms, in coming to this bargain, and I think greater precaution should have been taken to inform him of the inevitable liability, of the inevitable loss and ruin which was before him if he entered into the contract upon these terms."

IT is not surprising that the plaintiff, after hearing a judge express himself so strongly in his favor, although he gave judgment against him, should have appealed, in the hope of finding the next court a little more effectively inclined in the same direction; but it is difficult to see how the corporation officers were to blame. Of course, having the other tenders, and the engineer's opinion, to guide them, they might infer that Bottems's bid was less than the work was worth, but, in giving him the opportunity to reconsider it, they did, it seems to us, all that the most scrupulous sense of honor could require. Unless the laws or charters under which they acted were different from those governing the conduct of other city officials, it would have been a very questionable proceeding on their part to have accepted a higher tender, or to have told Bottems to add fifty thousand dollars to his proposal before signing the contract; and there seems to be no evidence, nor even any claim, that they, or the engineer, had taken any borings of the soil, on the line of the sewer, or knew any more about it than Bottems did. As to the fact that Bottems's bid was eighteen per cent lower than any other, every architect knows that it by no means follows that he would lose money on his contract. An ingenious and enterprising contractor, in a large piece of work, will often make money in taking a contract at half the price demanded by the plodding devotee of routine methods of construction; and neither the engineer nor the town authorities knew whether Bottems might not have some new excavating machine, or improved piece of plant, by which he could accomplish such work much more cheaply than was possible by the methods familiar to them. Such improved machinery is being constantly invented, solely for the purpose of saving labor, and cheapening work, so that the contractor owning or inventing the new tools or processes can underbid competitors, and still make money. Although the *British Architect* thinks that it was "against public policy" to accept a tender "which the engineer knew was ridiculously low," it can hardly be denied that the invention of labor-saving machinery is, in the end, a public benefit; and to exclude a man who owns new devices of the sort from the opportunity of using them, because his tender for the work seems "ridiculously low" to some one who does not know about them, is a proceeding as little calculated to develop the inventive faculties as it would be to guarantee contractors who chose to take risks against loss, instead of requiring them to help themselves out of their difficulties by means of their own ingenuity and enterprise.

LA SEMAINE DES CONSTRUCTEURS is called upon for advice in a case which is not without parallel on this side of the water. A contractor complains that he has done a certain piece of work, and sent the bill for it to the architect for approval. The architect has made certain deductions, which he has agreed to, and approved the bill for the balance. On presenting the approved bill to the owner, the contractor says that the latter refuses to pay it, unless he will throw off about ten per cent. He does not pretend that the bill is unfair, and gives no reason for making the deduction, except that, as he says, he will not pay anything unless the discount is made, and, before he can be forced to pay by legal process, the contractor will have spent so much in counsel fees and court expenses that it will be cheaper for him to make at once the deduction demanded. The contractor wishes to know what he should do under the circumstances. *La Semaine* gives him very little comfort. It says that, while it does not advise him to throw off the ten per cent, it is true that the owner can compel him to spend much more than that in trying to collect his bill, and he must make his own choice as to the course he will pursue.

MOST builders and architects know this kind of owner, and cases of the sort are usually settled, we imagine, by submitting to the discount demanded. For all that, we believe that it is bad policy to yield to imposition of this kind. An owner who gave no excuse for not paying a bill, except that he would make the other party pay more than the deduction demanded in costs of collection, would have no chance whatever before a jury, and, if possible, still less before a judge; and, although the contractor's expenses might amount to a considerable sum before he got final judgment, the cost to the owner of resisting a just claim would be much greater, and he would surely have to pay the claim in the end. Owners, particularly the unscrupulous ones who make use of such tricks, know all this perfectly well, and if a firm determination is shown to collect the just amount of the bill at all hazards, it is usually paid before the litigation has gone beyond the inexpensive stages. At the same time, it is unfortunate that it should ever cost more to collect an honest bill than the whole profit in it, and it seems as if it might not be amiss for builders, the best class of whom are closely associated, to arrange for mutual help in such cases. Of course, it would be troublesome to ascertain what cases involved real oppression, and what were due to honest misunderstandings between the owner and the contractor; but the architect's certificate, or approval of a bill, is very strong *prima facie* evidence of its correctness, and it would perhaps be simple and satisfactory to admit cases, where the owner had refused to pay a bill approved by the architect, to consideration by a committee appointed for the purpose, with the understanding that, if the committee should so advise, the costs and counsel fees in suits necessary for collecting the bill should be paid out of the funds of the association. Meanwhile, however, we will make the suggestion that builders, as well as honest owners, will find it much to their advantage to stipulate in their contracts, in place of the arbitration clause, which is happily growing obsolete, that controversies between owner and contractor in regard to the contract shall be decided by a single judge, or by an auditor or referee agreed upon or appointed by the court. In this way the great expense of jury trials is avoided, and although we have seen one or two auditors who seemed incapable of comprehending technical points in construction, judges are almost always quick and clear-headed in such matters, and can be relied upon, in their decisions, to go as far in favor of the right man as the law will allow, without regard to the sophisms and prevarications of the lawyers, which mislead so many juries.

LA SEMAINE describes a novelty which we commend to the attention of landscape gardeners and park commissioners. There is now on exhibition in Paris, near the Trocadéro, a horticultural clock. This object consists of a bed of alternantheras, lobelias, echeverrias and the other properties of carpet-gardening, forming a huge disk, thirty-three feet in diameter, with the usual figures and dots of a clock-dial around the edge. On the dial move two long poles, decorated with flowers, and forming the hands of this novel clock, which keeps time with sufficient regularity. The hands are attached by a simple mechanism, sunk below the centre of the bed, and driven by a small water-motor. Where circumstances favored, we should say that an improvement on the carpet-bed dial might be made by surrounding a circular tank of aquatic plants with a sloping bank, on which the figures of the clock-dial could be made with the usual dwarf variegated plants, the whole being surrounded by a railing. It would be easy to set a box, containing the mechanism for driving the hands, in the middle of the tank, and the waste-water from the motor could be utilized as the regular tank supply.

LOMBARD ARCHITECTURE.[1] — I.

Fig. 1. Capitals from the Church of Aurona.

THE term "Lombard Architecture" should be understood as applying simply to the Romanesque structures of Northern Italy. The Longobards did not exert any direct influence on architecture in Italy any more than did the Franks in the two Gauls. The style which bears their name was so designated just as the division of the country where they made their principal settlement was termed Lombardy. It was not, then, until after the destruction of the State which they founded that Lombard architecture was established.

Its principles were based on constructional and decorative methods — the one Roman, the other Byzantine — which had been previously in vogue in the north of Italy. The Byzantine style had from its infancy found a home here, and many of its productions, some of which still exist, were monuments of considerable importance. It may be said that the architecture of Cisalpine Gaul was looking toward Byzantine art when the invasion of the Longobards occurred. Their inroads arrested for a time the development that had already begun, and which was again resumed later on, in the quieter times following the storms of this strangely brutal and turbulent conquest. But the coarseness of manners and debasement of culture consequent upon this irruption made their efforts felt. Awkwardness of construction, crudeness and heaviness of forms, a deterioration in the drawing of the human figure, and perhaps, also, a union of Roman and Byzantine types, all the closer because not intentional, may be considered as summing up the artistic features due to the Longobards in the manifestations of the new style. Their influence is reduced to that which savagery exercises over the arts. Though they contributed to the formation of Western mediæval art, it was indirectly through the ruins with which they strewed the land, and by the creation through successive convulsions of a new soil, out of which an original vegetation sprang from the promiscuous mixture of former germs.

The Latin basilican type, with timber roofing, seems to have been exclusively in use during the domination of the Longobards. The Church of the Holy Saviour at Brescia, built in the middle of the eighth century, and Santa Maria delle Caccie at Pavia, and San Vincento in Prato, at Milan, which apparently antedate Charlemagne's conquest, are the only more or less completely preserved edifices that can be referred to the Longobard period. Now, these are Latin basilicas. It was natural that the simplest and most economical type should be adopted at that time, and it was, moreover, maintained throughout the early mediæval period for most of the country churches of Lombardy.

For the construction of more sumptuous edifices, with pillars and vaults, an artistic effort, then impossible, and material resources not in existence in the Longobard period would have been required. Yet some attempts toward progress seem to have been made from the first half of the eighth century. The Church of Aurona, erected at Milan during the reign of Liutprand,[2] remains of which were discovered in 1868, was a basilica with the column replaced by the more robust support of a pillar comprising a square nucleus with four engaged half-columns. The pillar ***cantonned with columns*** — that essential element of mediæval architecture, but which was almost unknown to antiquity, except under the elementary form of an engaged column in a rectangular pier [*piedroit*] — thus made its entrance into monumental art. It was doubtless called-for by the use of transverse ribs, over the side-aisles at least. Another very interesting although less important innovation likewise appears in the same church; namely, the cubical capital. It was adopted in connection with the basket capital. Figure 1 gives a perfectly trustworthy restoration from the Brera.

We must come down about a hundred years later, or to the early part of the ninth century, before encountering the first church in the Lombard style, San Ambrogio of Milan. A brief description of it has already been given in this "*Encyclopædia*" by M. Planat, in which he has pointed out its great importance in the history of architecture. (See ***American Architect*** for July 5, 1890). A more detailed study of the edifice must be made here. The first question to be considered is that of its date, which has created a great deal of discussion, and the solution of which is of paramount interest to the student of Lombard art.

The recent restoration of the church made it possible to investigate thoroughly not only the upper portions, but all the substructures. It was demonstrated that, leaving out of account the later Renaissance rehandlings, nothing existed outside of the Lombard edifice except the remnants of one older basilica with primitive columns, which was erected by Saint Ambrose, and the three naves of which are exactly covered by the body of the Lombard basilica (Laudriani, "*La basilica Ambrosiana fino alla sua transformazione in chiesa Lombarda a volte*," Milan, 1889). So there is no trace of an intermediate structure between it and the basilica of the fourth century. Now, the principal parts of the Lombard monument were constructed at three different intervals (see the plan, Fig. 2). The tribune, comprising the main apse and the rectangular space in front of it, was built first, then the body, including the aisles and the two-storied vestibule, and lastly the cloisters, forming an atrium or porch. The resumption of the work at these various periods is distinctly marked in the masonry.

The tombs under the altar, together with the altar itself, furnish indisputable testimony as to the age of the ***chevet*** and the body of the church. They are three in number, two in marble surmounted by a third in porphyry. The lower ones were intended, according to St. Ambrose, to receive, one his own remains, the other the remains of Saints Gervais and Protais; when opened they were found to be empty. Abbé Biraghi, of the Ambrosian Library, had previously shown that such would be the case ("***I tre sepolcri sant ambrosiani scoperti nel gennajo***" 1864; Milan, 1864). The liturgical evidence scientifically examined by him led him to the conclusion that the bodies had been removed from the marble tombs during the episcopal rule of Angilbert II and placed in the porphyry sarcophagus above; this was confirmed in 1871 when the latter was opened and found to contain the three bodies as predicted. The magnificent gold and silver altar presented by Archbishop Angilbert, according to the inscription on it, was therefore erected on the occasion of the transfer of the remains which it covers. This was to be inferred from an old legend, but the fact is now established beyond a doubt.

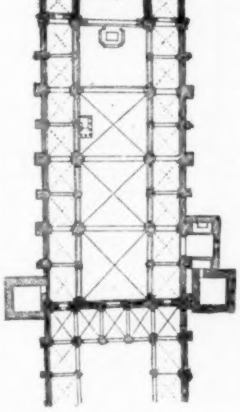


Fig. 2. Plan of San Ambrogio, Milan.

The removal of the bodies of the saints was necessitated by the reconstruction of the church. The old pavement of the tribune, the height of which is indicated by the bases of two engaged half columns that were uncovered at the time of the restoration, was below the surface of the ground about the altar. It, therefore, antedates the raising of the soil; while the body of the aisles is posterior to it, as is shown by the Lombard pillars in the last bay, the bases of which rest on this higher ground. The restoration must have therefore been begun in the ***chevet***

[1] From the French of F. Dedartein, in Planat's *Encyclopédie de l'Architecture et de la Construction.*

[2] One of the capitals of the Church of Aurona bears the inscription, "*Hic requiescit Dominus Theodorus archi episcopus. . . .* This Archbishop Theodorus, brother of Aurona, or Orona, foundress of the monastery, occupied the chief see of Milan about the middle of the eighth century. The church must, of course, have been built when he was interred in it, and it is inadmissible that the mortuary legend was added later, after a reconstruction of the edifice. Few other monuments of the early Middle Ages are, therefore, as authentically dated as his. — F. D.

before the time of Angilbert and, doubtless, at the close of the eighth century, after the basilica had passed into the hands of the Benedictine monks. When they undertook later to rebuild the aisles, it was deemed necessary to raise the pavement and that led to the transfer of the bodies to the upper tomb. We know that this change was made in the early part of the reign of Angilbert II, who was over the church of Milan from 824 to 859. Did the reconstruction for the sake of which it was undertaken follow immediately or was it delayed until, say, a century or two later, as certain archæologists hold? There are good reasons for supposing that it was done at once. In fact, the episcopal rule of Anspert, who occupied the see of Milan from 868 to 881 and was buried in San Ambrogio, formally attributes the construction of the atrium to this prelate. We have already seen that this was a separate work attached to the vestibule. The main body of the church, including the vestibule, must consequently have been built by Angilbert, if it be conceded that the present atrium is that of Anspert. Not only is there no documentary proof to the contrary, but, as has already been remarked, in excavating the substructures no traces were discovered of any intermediary edifice between the basilica with primitive columns and the monument of to-day. So far as our knowledge now goes, the greater part of San Ambrogio must have been built in the course of less than a hundred years: the tribune, in the eighth century; the aisles and the vestibule in the middle of the ninth; and the atrium, which has been more or less thoroughly restored, at the close of the latter century.

These conclusions are borne out by the local history of the period. The ninth century appears to have been an especially favorable time for the erection of an important Milanese edifice. Lombardy was well governed and comparatively peaceful and prosperous. It was not exposed to the approach of the Normans or the Saracens, and the Hungarians did not devastate it until the following century. The archbishops of Milan were influential, rich and powerful at the time. They made magnificent gifts, as the remarkable altar presented by Angilbert to San Ambrogio attests, and that they were great builders is seen from the epitaph of Anspert. If we consider San Ambrogio by itself, we find that it was precisely in the ninth century that the archbishop's zeal for the church was displayed most perseveringly and with the greatest splendor; this appears from the donation of the gold and silver altar, the construction of the atrium, and also from the fact that from Peter I, who died in 801, to Andrea, who died in 906, all the Milanese metropolitans, with the one exception of Angilbert, the supposed reconstructor of the church, were buried at San Ambrogio, while their successors were interred in the cathedral.

Let us now pass to a description of the church and a careful examination of its architecture. The disposition of the whole (see the plan, Fig. 2) is that of a three-aisled basilica with side galleries, and having groined vaults instead of a timber roof. As all the vaults are on a square plan, and the width of the nave is double that of the aisles, each central bay corresponds to two lateral divisions.

The originality of the structure consists in the roofing system; a new organism, new forms and a new character are derived from it. The groined vaults exhibit two distinctive features: they have prominent ribs, and are raised at the top after the manner of domes (Fig. 3). All of them, large and small, are modelled at the edges on four semicircular arches, two longitudinal, two transverse; some of the former, like the latter, are free; the others are imbedded in the wall, and are then termed formerets. In addition to the outline framework, the large vaults and the small ones in the lower story of the vestibule have two intersecting or diagonal ribs, which are likewise of circular curve. The constructional system of these six-ribbed vaults recalls the great Roman vaults of the Empire, notably those of the Baths of Diocletian, where similar ribs made of brick are found (Choisy, "*L'Art de bâtir chez les Romains*," Paris, 1873). The difference between the two lies in the fact that in the Roman edifice the ribs are sunken in the masonry-work, while in the Lombard monument they project beyond it. In passing, therefore, from the Roman to the Lombard method, all that was required was to superimpose the vaulting upon the framework, instead of incorporating the one with the other. The transformation was easy, and in accord with the principles of mediæval architecture; it must have been effected first in Italy, as the Roman vault with sunken ribs is peculiar to that country.

While the origin of the projecting ribs may be connected with Italo-Roman methods, the other typical feature mentioned above must be referred to the Byzantine constructional system. The Lombard groined vault resembles the hemispherical dome on pendentives. It would be identical with it, except for the ribs, if the latter were all semicircular and if the different sections of the vaulting surface were correctly constructed; but it is rare that the diagonal arches rise high enough to form the complete semicircle. Again, the vault is roughly built, and exhibits abrupt breaks in the curves. These defects are not, however, glaring, as they are hidden by the ribs. In fact, the latter are not merely supports for the vault proper, but they contain in themselves the outlines that give the eye the impression of its form. All that is necessary, therefore, is that the ribs be properly constructed. The masonry between merely constitutes a spandrel, the curvature of which it is difficult to determine from below, and the correctness of its forms is, consequently, of only secondary importance. The use of prominent ribs was in every way suited to the inexperience of unskilled craftsmen. It facilitated the work of laying the vaults and masked the defective construction.

Groined vaulting supported on ribs and raised at the top was generally adopted for covering the aisles of Lombard churches. They were hardly ever, as in France, covered with barrel vaults, the use of the latter being restricted, as we shall see

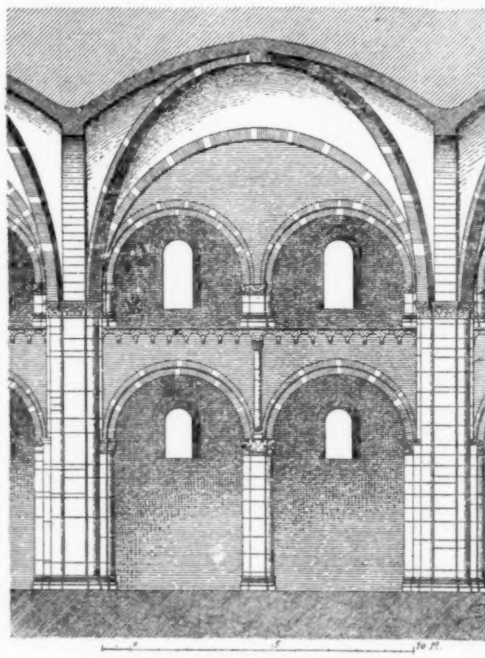


Fig. 3. Bay of the Nave of San Ambrogio.

farther on, to the arms of the *chevet*. Now, the introduction of prominent ribs into the vaulting exercised a considerable influence on the forms of the pillars, because of the necessary relationship between the outlines of the support and of the supported part. The jogs made by the arches at the springing of the vault required corresponding projections and depressions in the support. The pillar cantonned with columns is, therefore, the logical result of the adoption of the prominent ribs.

This series of forms is found at San Ambrogio. The pillar indentations are sometimes circular, sometimes rectangular, and frequently the two shapes alternate. The supports moreover are not of uniform size. The bays of the main aisle are divided off by large pillars which bear at the same time the vaults over the nave and those over the side aisles. In the interspaces are smaller pillars, alternating with them and supporting only the lateral vaults the number of which is double that of the central. The same alternation of large and small pillars occurs in the engaged supports of the outer wall and in the pillars, isolated as well as engaged, in the galleries above the aisles. It also occurs in the prominent external buttresses that counteract the thrusts of the vaults.

Such are the different organic effects resulting from the division of the edifice into three unequal naves and the sub-division of these into square bays with ribbed groined vaulting to cover them. In the vaulted Lombard basilica, as in every systematically disposed edifice, it is the superstructure which controls the organism; it is the conditions of the establishment and stability of these perpendicular walls that determine the essential architectural features. And the influence of the roofing system is not confined to constructional problems; it makes itself equally felt in the character of the decoration. In this respect the western mediæval differs radically from the Byzantine and from the vaulted Roman edifice. The embellishment of the latter is mainly dependent on the use of revetements, while, at San Ambrogio and in other monuments of the same style, the framework itself is minutely brought out and forms the ornamentation. The monument is no longer clothed; its members are no longer concealed; they are on the contrary allowed to appear freely and in detail, showing by significant forms their divers functions. It is this that constitutes their claim to interest the beholder.

This most rational disposition, moreover, fully attains its end. Glance at Figure 3, which represents one of the bays of the central aisle of San Ambrogio; what is better calculated to attract and hold attention than the network of overspreading arches supporting the division-walls of the aisles and ribs subdividing and supporting the vaults, which come together in a bundle in the pillars and extend down to the floor? What element is more essential to the edifice and what consequently is more important to consider in judging of it, than these organs the combination and stability of which assure its existence? They are, as it were, its bones and sinews, as the column and the architraves of the entablature are the bones and sinews of the Greek temple. Besides, in both cases, the fundamental decorative rôle is assigned to these significant members.

But, though the rôle is the same, how different is the expression! In the temple, the members are superimposed at right angles with one another, the architrave with the column, the beams of the frieze with the architrave and the cornice with the beams of the frieze. In the church we find continuity and union in the members. This is due to the curves of the framework, which is much more flexible in its disposition and more varied in its aspects than is that of the temple. In the latter, for example, the column is invariable or conforms, at the very most, to two or three different types. In the church, where it appears only as an engaged column, the proportions vary exceedingly. Sometimes it springs from the floor to the base of the great vault with a height equal to twenty or thirty diameters; sometimes, as in the pillars of the triforium, it is only three or four diameters in height. Its proportions depend solely on the dimensions and position of the arch resting on it. The circumference is regulated by the breadth of this arch and the height by its elevation. There is no longer any rule for fixing the proportions of the columns or pilasters. To tell the truth, there are in reality neither columns nor pilasters, but simply cordons grouped in bundles or isolated after the manner of mural bands and colonnettes. The same freedom is noticeable in the proportions of the capitals, and bases, and of the members in general. The more complicated organism has correspondingly more supple organs, and so it was possible for the architecture of the Middle Ages to pass from the Romanesque to the Gothic without any alterations in its principles.

[To be continued.]

CONSTRUCTION.[1] — XIII.

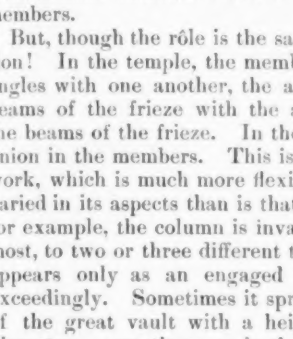


Fig. 64.

THE Gothic architecture may fail to please by its form, but if any one claims it is only the product of ignorance and chance, we shall ask leave to prove the contrary, and having proved it, to study and make such use of it as may seem best to us.

Accordingly, before closing this chapter on vaults, let us see how the Anglo-Normans transformed the dome of the West into a vault very far removed in appearance from the hemispherical vault. We have just told how the builders of Aquitaine, Anjou, Maine and England had been induced to add a rib to the pointed-arch vault, to hide the crossing of the filling-stones under the line of the keys; or, in other words, how they divided a square or oblong vault into eight triangles, instead of four. This point of departure has so great an importance that we ask leave of our readers to insist upon it.

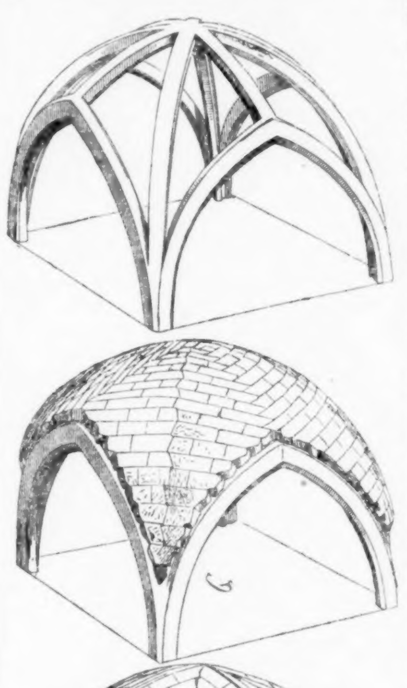


Fig. 65.

Let us suppose a pointed-arch vault made half by Frenchmen at the beginning of the thirteenth century, and half by Anglo-Normans.

The French vault will give (Fig. 64) in horizontal projection, the drawing *A*; the Anglo-Norman vault, the drawing *B*.

Hence nothing was more natural, than to connect *C*, the key of the wall-arch, to *D*, the key of the pointed arches, by a projecting rib, hiding the seam formed by the meeting of the triangles of filling-stones *E C D*, and *F C D*.

These triangles of filling are evidently derived from the dome, or, rather, they are four pendentives which meet in *C D*.

The vaults of Aquitaine, or the early Anglo-Norman Gothic, have also the keys of their wall-arches on a lower level than those of the pointed arches, and their framework is presented in Fig. 65.

This figure clearly shows that the Anglo-Norman vault is only a hemispherical dome, intersected by four pointed arches, for the diagonal arches are semicircular.

Upon this framework the rows of filling-stones are laid, as represented in *G*, while in France upon two diagonal and four wall-arches of the same dimensions and shape, the rows of filling-stones are arranged according to the drawing *H*.

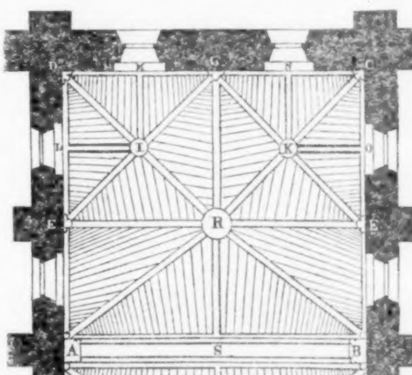


Fig. 66.

Then, although the principal ribs of vaults in France or in England may be identical in outline, in France the filling is evidently derived from the Roman groined vault, while in England it is taken from the dome.

Up to this point, though the principles of the construction of these two vaults are very different, their appearance is the same, save for the addition of the rib joining the keys of the transverse or wall-arches to the key of the pointed arches, an addition not absolutely the rule.

While in Ile-de-France and the adjoining provinces, at the end of the twelfth century, they were making only vaults with pointed arches, crossed by transverse arches, or, in other words, always engendered by a square plan, and closed by sloping spandrel filling, as seen in Figure 55, they were seeking in the West, to obtain the same

[1] From the "*Dictionnaire raisonné de l'Architecture Française*," by M. Viollet-le-Duc, Government Architect, Inspector-General of Diocesan Edifices, translated by George Martin Huss, Architect. Continued from No. 870, page 132.

real and apparent lightness, but always while keeping something of the dome.

There exists near Saumur, a little church, which indicates in the plainest way, the wavering of the Western builders, between the innovations of architects in the Royal domain, and the traditions of Aquitaine:—it is the church of Mouliherne; there the two systems confront each other.

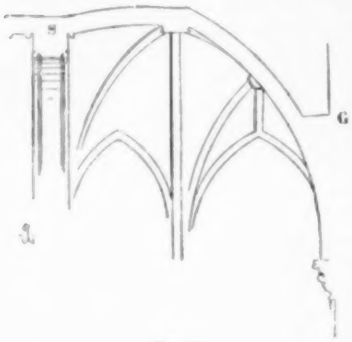


Fig. 67.

The first bay of this church with a single nave reaching to the façade, is vaulted according to the plan Figure 66.

From *A* to *B* is a large transverse pointed arch.

From *A* to *C* and from *B* to *D* are two broken pointed arches, which are only mouldings with semicircular section.

A second transverse arch *E F*, of similar section, crosses the two diagonals.

From *E* to *G* and from *F* to *G* are stretched two other secondary diagonal arches, meeting the principal pointed arches in *K* and *I*.

The four triangles included between the points *E*, *F* and *G* are closed, according to the Aquitanian or Anglo-Norman method, that is to say, according to the principle of the dome; the four other triangles, *E D I*, *D G I*, *G C K* and *C F K* are closed according to the French method, and yet the ribs *L I*, *M I*, *N K* and *O K*, joining the keys of the wall-arches to the meeting-points *I* and *K*, project below the rows of the keys of the fillings. These ribs are even adorned with figures carved in relief.

As to the triangles *A E R* and *B F R*, they are closed in the French way by slanting fillings. But as half of a transverse arch exists from *G* to *R*, the builder has felt it his duty to continue it as a projecting key rib, up to the summit of the great transverse arch *A B*.

Thus the section taken through *G S* gives the drawing (Fig. 67).

If one wishes to get an exact idea of the appearance of this vault, he must refer to the perspective view which we give in Figure 68.

In the Royal domain they would have been content to close the triangles of filling (Fig. 66), *E D R*, *D G R*, *G C R*, *C F R*, by rows of stones laid from the wall-arches *E D*, *D G*, etc., to the transverse and pointed arches *E R*, *G R*, *D R*, just as they have done with the triangle *A E R*.

So long as the Aquitanian and Anglo-Norman vault kept its

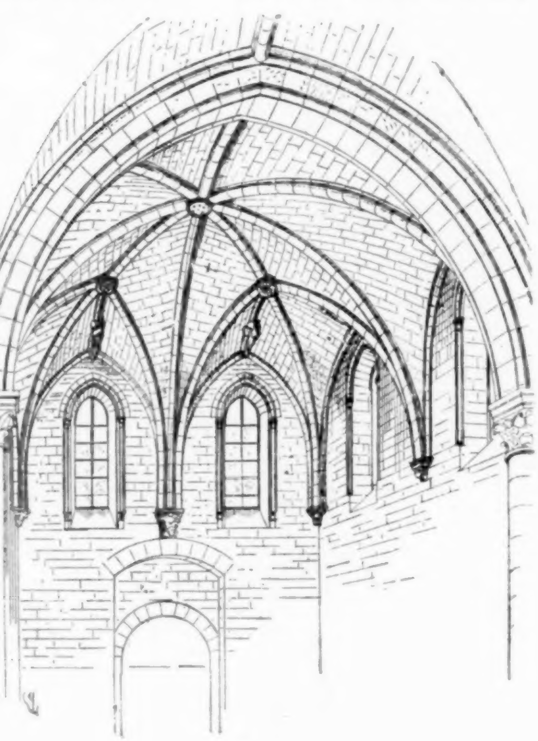


Fig. 68.

pointed arches very high, like those of the early French Gothic vault, the appearance of these vaults was almost the same; but in France they saw, from the end of the twelfth century, the advantage that there would be in raising the keys of the transverse and wall-arches to the level of the keys of the pointed arches; first, in order to be able to make the openings higher; second, to let the tie-beams of the timbers pass above the vaults without immoderately raising the lateral walls.

They wished to copy this improvement in the Anglo-Norman provinces. There a difficulty was presented: the principle of construction of the rows of filling-stones derived from the dome was ill-

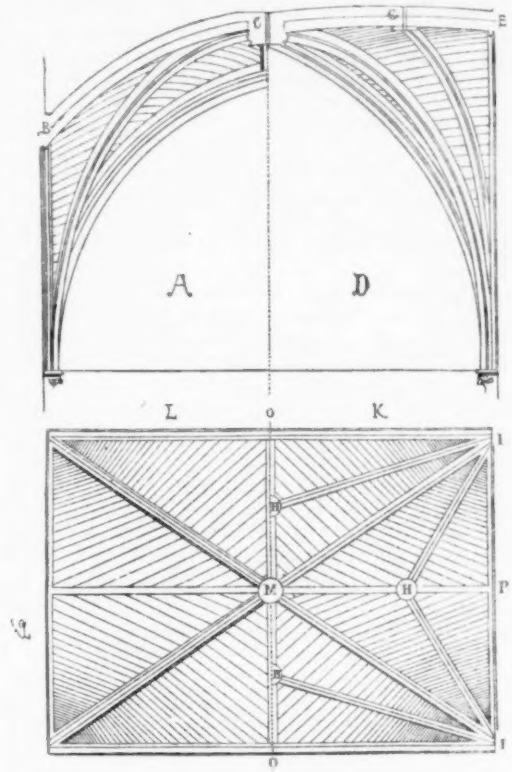


Fig. 69.

adapted to this innovation. We have just said that a rib had to be placed under the meeting of the ends of these rows of stones.

Now, let Figure 69 be the section of an Anglo-Norman vault.

When constructed according to the drawing *A*, the rib connecting the keys *B* and *C* could offer, by its curvature, a perfect resistance; but if built according to the design *D*, after the new French method, the projecting rib *C E* had not enough rise to present a sufficient resistance; if the vault was large, there was reason to fear that this rib would give way at *G*, about the middle of this length. To ward off this danger, the Anglo-Norman builders did not abandon their method of filling; they preferred to support this weak point *G* by new projecting rib, traced on *H I*, upon the horizontal plan *K*, and then instead of setting the arches of filling-stones as drawn in *L*, they placed them as represented in *K*.

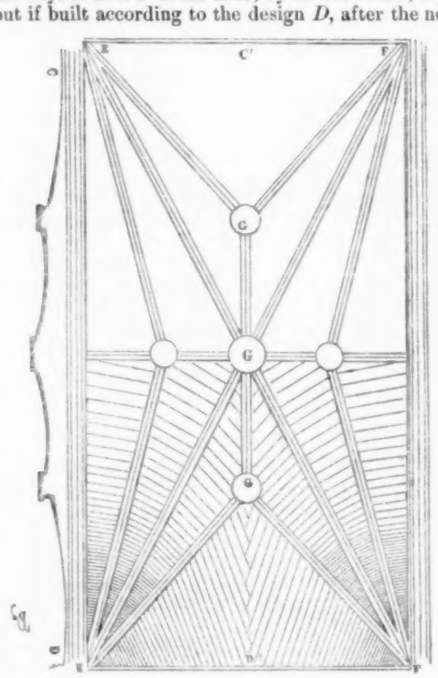


Fig. 70.

In examining the quarter of a vault, *O M P I*, one sees that its inner surface, through the arrangement of the rows of filling-stones, came very near giving a portion of a curvilinear concave cone.

Once upon this path, the Anglo-Norman builders thought no more about the French vault; they developed freely the principle that they had not originally admitted, except unconsciously; they saw in the Gothic vault only a network of arches, interlacing and supporting one another reciprocally, and supporting fillings all of which showed surfaces scarcely concave.

Already, in the middle of the thirteenth century, they were building the choir of the Cathedral of Ely, whose high vaults give the

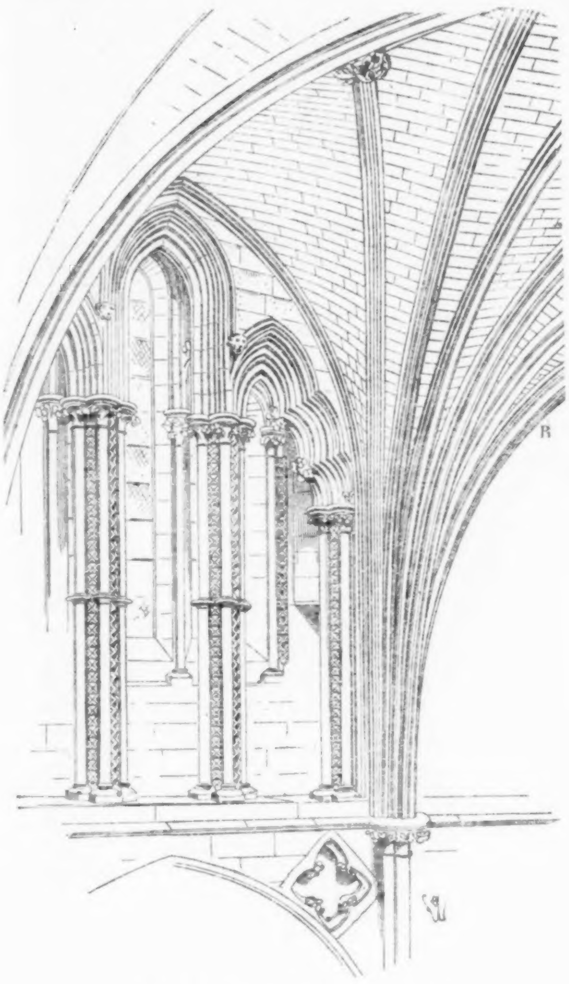


Fig. 71. From the Choir of Ely Cathedral.

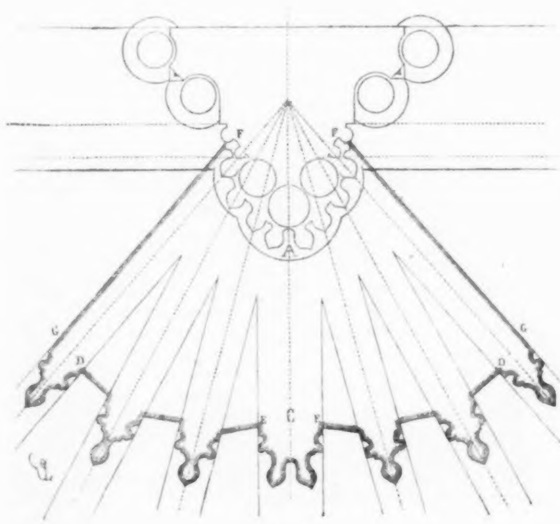


Fig. 71*b*.

horizontal projection (Fig. 70), and the section *C D* made through *C′ D′*. Relying on these crossed and counter-balanced arches they did not hesitate to raise the keys *C′ D′* of the wall-arches *E F* above the keys *G*, in order to make their windows very high, as seen in the section *C D*.

But the appearance of these vaults in the interior is very different from that of the French vaults.

We give (Fig. 71) the perspective view of one starting-point of the vaults in the choir of the Cathedral of Ely. It is seen that these arches or projecting groins give a sheaf of curves, a considerable portion of which present a concave and curved conical surface, and

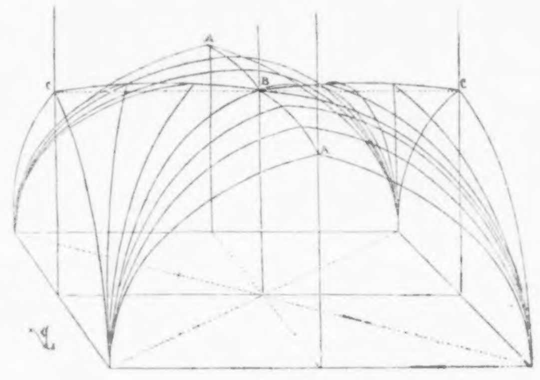


Fig. 72.

to render that effect more striking, the builder has taken pains to unite all these arches upon the abacus of the capitals, in a compact group, whose lower bed we indicate in *A* (Fig. 71, second), and in *C*, its horizontal section at the level *B*. But if that horizontal section forms a portion of a polygon inclining towards the branches from *D* to *E*, from *D* to *F*, which is the wall-arch, it rises (retreats) abruptly, for since the starting-point of this arch is much more elevated than that of the pointed and transverse arches and ribs, the filling-stones *G F* must rise vertically in a plane passing through *G F*. These walls then present, up to the starting-point of the wall-arches, a group of ribs detaching themselves from the construction, a compact mass, heavy in reality, but with a certain pretension to lightness.

Wishing to keep the keys of the wall-arches on a level with the keys of the pointed arches, as we have before remarked, and being perplexed, evidently, in their combinations, by these retreating and vertical surfaces, *G F*, the Anglo-Norman builders chose to raise the starting-points of the transverse and pointed arches and ribs to the level of those of the wall-arches.

The presence of the vertical surfaces *F G*, beside the curved surfaces *D E* was not logical enough for these *rationalists*. But while placing the starting-points of all the arches of the vault upon the same level, in order to avoid these vertical surfaces, the English architects still tried to have the keys of the pointed and transverse arches upon the same horizontal line; so it was necessary that these transverse and pointed arches should be very elliptical. Accordingly, they came, in England, to abandon in the transverse arches

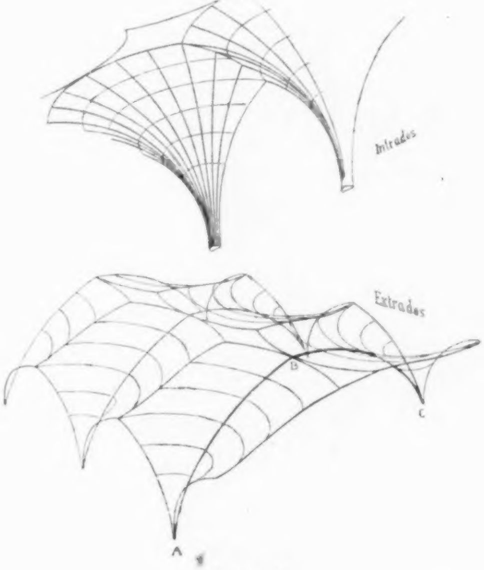


Fig. 72*b*.

the pointed curve, and in the diagonal arches the semicircle, and to adopt curves composed of portions of ellipses, keeping the true pointed curves only for wall-arches, as indicated in Figure 72, while the keys *A*, *B*, *C*, were all in the same horizontal plane.

From these sheaves of ribs forming, as it were, pyramids, or inverted curvilinear cones to vaults composed of intersecting curvilinear cones is no great distance; and the builders at the end of the fourteenth century, in England, soon arrived at that last result (Fig. 72*b*). But these vaults are not closed by fillings of masonry upon arches faced in stone; they are vaults composed entirely of large facing-stones, very shallow, needing diagrams, a complicated design, and certain artifices such as, for example, transverse arches buried in the reversed concavities of the roof, as we have represented in *A B C*, upon the design illustrating the extrados of the vault.[1]

Thus, by a series of deductions indeed very logical, the Anglo-Norman builders passed from the dome to the strange vaults composed of the intersections of curvilinear cones, and separated entirely from the French system.

In Normandy these vaults were never adopted, but of the English influence something remained. In that province they often abandoned, towards the end of the fifteenth century, the vaults composed of rows of filling-stones fixed upon arches. They wished also to use facing-stones.

The Normans, the Manceaux, the Bretons, willingly made vaults composed: either of large slabs of hewn stone, decorated with mouldings on the interior, and supported by their concavity, without recourse to arches, or else of stone ceilings set upon arches. In the church of Ferté-Bernard, near Mans, there are seen pretty chapels of the sixteenth century, thus vaulted (Fig. 73).[2]

These have slabs cut in panels, on the inside, and set over stone openings supported by pointed arches.

This system of construction is elegant and ingenious but one could wish here to see the windows square, for the pointed wall-arches have no longer any reason for existing.

The system of Gothic vaults had to come to this; which was necessarily its last mode of expression. To close the intervals left between the arches by ceilings, and, when necessary, multiply the arches until there were no spaces left among them which could not be filled by one or two slabs, this was to arrive at the limit of the system, and this was what they tried, often with success, at the beginning of the Renaissance, whether in religious monuments, or in civil architecture.

It is quite right to do this justice to the architects of the French Renaissance, that they knew how to employ with great freedom the

Fig. 73. From a Chapel in the Church of Ferte-Bernard, near Mans.

Gothic methods concerning the building of vaults, and that, in breaking away from the routine by which the masters of the fifteenth century were enslaved, they applied to new forms the resources of the art of building of the Middle Ages.

[1] See Dr. Willis's "*Memoirs on the Construction of Vaults in the Middle Ages*" and the translation by M. Cesar Daly, Vol. IV of *Revue d'Architecture*.
[2] The construction of these chapels dates back to 1543 or 1544.

At the beginning of the sixteenth century, architects very frequently employed the system of vaults composed of slabs resting on ribs, which allowed them to decorate these vaults with rich sculptures, and to obtain effects until then unknown. Arranging a sort of network of stone, with key pendants or floral ornaments at the points

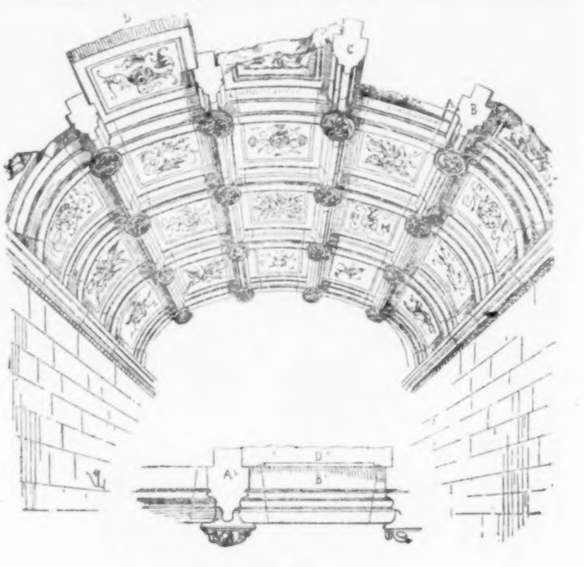


Fig. 74.

of intersection of the ribs, they placed sculptured slabs between them. This plan was often adopted, for instance, to cover galleries or flights of stairs with elliptical vaults (Fig. 74).

Every arch-stone of the transverse groin *A* has on each side of the little key pendant, a cavity *B* to hold the longitudinal arch-stones *C*; the slabs *D* simply rest in grooves upon these arch-stones as the detail *X* shows; *A′* is the cross-section of one of the transverse arches, *B′* one of the voussoirs of the longitudinal bands, and *D′* the section of the slab. This method is simple, and such a construction is good and easy to execute, as the slabs can be sculptured before being put in place; it presents all the elasticity that the Gothic builders had obtained in the composition of their vaults.

But the artist of the Renaissance forgot too promptly these excellent traditions, and if for a long time they still kept these forms, derived from a logical principle of construction, they treated these kinds of vaults as ordinary cradle-vaults, no longer considering the groins as independent ribs.

During the fifteenth and sixteenth centuries, the English and the Normans had succeeded, in the construction of vaults, in producing effects that were surprising for their ingenuity and their richness. The architects of Ile-de-France, Champagne, Burgundy and the Loire, preserved, even in those latter days of the Gothic period, more moderation; and during the sixteenth century they tried to reproduce the forms, if not the structure of the Roman vault.

When the individuality of a people is left to its own inspiration and is not falsified by a narrow spirit of system, it exhibits itself with entire freedom in their works of art, particularly in those which are to a great extent the result of reasoning.

The Normans have always been daring workers rather than inventors; they have been able at all times to appropriate the discoveries of their neighbors, and therefore to derive profit to themselves. One should not require of them those efforts of the imagination, those conceptions which belong rather to the southern mind, but rather ingenious and profound applications, logical and scientific execution, persistence and care in the carrying out of details.

These qualities are found in Anglo-Norman edifices built during the twelfth and thirteenth centuries. One should not require of the Anglo-Normans that freedom of procedure, that variety, that individuality which is found in French constructions.

Among them if a method passes for a good and practical one, they perfect it, extend its consequences, follow its progress, and cling to it. We, French, on the contrary, are always seeking, but we perfect nothing. The Anglo-Norman constructions are usually executed with more care than ours, but to know one is to know them all; one never sees shining out among them those original and bold inspirations which have haunted our architects from the earliest days of Gothic art; the true era of intellectual emancipation for the laboring classes of the North of France.

(To be continued.)

Great Bell for the Sacre Cœur, Paris. — A monster bell, one of the largest of its kind, specially cast for the new Church of the Sacred Heart on the heights of Montmartre, has been completed at Annecy, in Savoy. This immense instrument, which, when hung in its lofty position, will be audible all over Paris, weighs with its clapper nearly twenty-five tons. — *London Daily Telegraph.*

COMPARATIVE MUNICIPAL BUILDING LAWS.—XIII.

[*Note:*—In these tables bracketed letters invariably refer to preceding passages in the same column.]

Floor and Roof Timbers.

Boston:—*a. In first and second-class buildings*, the ends of all wooden roof and floor beams shall enter the wall to the depth of at least 4″, unless the wall is properly corbelled, so as to give a bearing of at least 4″.

b. The ends of all such beams shall be so shaped or arranged that, in case of fire, they may fall without injury to the wall.

c. Every wooden header or trimmer more than 4′ long, carrying a floor load of more than 70 pounds per square foot, shall, at connections with other beams, be hung in stirrup irons and be joint bolted.

d. All tail beams and similar beams of wood shall be framed or hung in stirrup irons.

e. Cutting for pipes or other purposes shall not be done so as to reduce the strength of supporting parts below that required by law.

Baltimore:—Pipes let into joists shall not be more than 2′ from end of joist, nor cut-in more than 2″.

Every trimmer more than 6′ long, except in dwellings, shall be hung in wrought-iron stirrups of suitable dimensions.

Under partitions parallel with joists, joists supporting them are to be doubled.

Minimum size of joists in dwelling-houses 16′ front or less, first floor 2½″ x 8″ not more than 18″, on centres; second floor, 2½″ x 7″, not more than 16″ on centres. All joists properly bridged, of timber sound and well-seasoned.

Brooklyn:—

Charleston:—

Chicago:—*g.* Floor joists shall be properly bridged with cross-bridging.

h. In business buildings, all headers in floor framing more than 2′ from end of trimmer shall be fixed in proper iron stirrups.

i. Ends of joists or beams entering a brick wall shall be cut so as not to disturb brickwork by any deflection or breaking of joists or beams.

j. No pipes shall be let into joists or beams to a greater depth than 2″, nor more than 3′ from end of joist or beam.

Cincinnati:—*k.* Every trimmer over 6′ long in floors constructed to carry more than 70 pounds per square foot shall be hung in suitable wrought-iron stirrups.

All timbers shall have sufficient bearing on supports to secure stability.

l. Joists built into walls of masonry shall be bevelled at angle of 45° from junction of wall and upper edge of joists.

Joists carried on girders shall have a row of solid bridging not less than 1½″ thick, set in and solidly nailed over girder, to prevent passage of fire and smoke.

Cleveland:—(*k*); (*l*).

Denver:—*m.* Every trimmer or header more than 4′ long (except in dwellings) shall be hung with suitable stirrup irons.

n. The ends of all beams, rafters and joists entering a brick wall shall have a bearing of at least 3½″, and shall be cut on a splay of 3″ in their width.

(*j*) without permit from Inspector.

Detroit:—

District of Columbia:—Wells for stairs or other openings shall be framed. (*n*).

Kansas City:—*o.* All timber used in the construction of floors and roofs of brick buildings shall be straight-grained and free from large and loose knots or weakening shakes.

p. Every header more than 6′ long (except in dwellings) shall be hung in stirrup irons of suitable dimensions.

q. All tail beams shall be properly tusk-tenoned or hung to headers.

r. The ends of all floor and roof joists of brick buildings entering walls shall be cut on splay of 3″ in their width.

s. No floor timber of a brick building shall be cut into for piping more than 2″ without permit from Superintendent, and no cutting shall be made more than 2′ from support.

Louisville:—

Memphis:—*t.* All timbers used in building shall be good, sound material, free from rot or other imperfection whereby its strength may be impaired, and of dimensions suitable for purpose used. (*m*).

u. All floor joists shall rest on 4½″ projections.

All joists or beams resting on any side, end or party wall shall be securely anchored to wall in such way that, falling, they shall be free themselves from anchorage without damage to wall. (*j*).

v. No floor beams shall be supported wholly upon wooden partitions, but any beam (except head and tail beams) shall rest at one end 4″ in wall or upon girder.

Milwaukee:—(*g*); (*h*); (*i*).

Joists and girders shall be of proper dimensions to sustain load to be placed upon them.

Minneapolis:—(*m*); (*r*).

Floor beams shall have bearing at least 3″ at each end.

Except in dwellings, pipes shall not be let into beams more than 12″ from end of beam.

Nashville:—

Newark:—Floor beams shall rest 4″ on wall, and be bevelled back from bottom to top, so that top of beam does not enter wall.

New Orleans:—

New York:—(*j*); (*t*); (*v*).

Every header or trimmer more than 4′ long shall be hung in stirrup irons of suitable thickness for size of timber.

All girders supporting first tier of beams in dwelling-houses shall be supported by brick piers, or iron or locust posts of sufficient strength, on proper foundations.

Girders shall be of sufficient strength and diameter to bear safely the weight and any lateral strain to be imposed upon them, and in no case shall be less than sufficient to sustain the weight of 290 pounds for every square foot of floor or floors that rest upon them, exclusive of weight of construction.

Omaha:—(*o*), (*m*) and securely joint-bolted.

All trimmers and headers shall be double.

All tail beams shall be properly framed or hung to headers,

(*r*), and shall not rest on the wall to exceed 4″,

(*j*), without a permit from Inspector.

Philadelphia:—

Pittsburgh:—

Providence:—(*m*); (*r*).

Floor beams shall have a bearing of at least 4″ at each end.

St. Louis:—(*r*).

San Francisco:—All timber and lumber used in construction shall be sound and free from blemish.

Every trimmer and header more than 6′ long, except in dwellings, shall be hung in proper wrought-iron stirrups.

Girders, trimmers and tie-beams and other principal framing timber shall rest at least 8″ on walls or girders. (*r*).

Pipes shall not be cut into beams more than 3′ from ends of beams, nor deeper than 1″ in beams less than 10″ deep, nor deeper than 1½″ in beams of 10″ to 12″ depth, nor more than 2″ in beams of greater depth.

In all buildings where joists are more than 10″ deep there shall be a row of solid bridging set in and securely nailed. Said lines of bridging shall not exceed 25′ apart, and shall not be less than 2″ thick, so as to prevent the passage of smoke and fire.

Every beam, joist or bearing timber shall rest at least 4″ on wall or girder, exclusive of projections.

Wilmington:—The ends of joists and beams shall be cut to a splay of ⅛″ to 1″, shorter at top edge.

Cellars and Excavations.

Boston:—*a.* The Inspector shall designate the lowest grade at which the floor of the basement story may be laid.

b. Cellars on made ground (or where the nature of ground requires) shall be protected from water and damp by a bed at least 2″ thick over the whole of concrete, cement and gravel, tar and gravel or asphalt, or by bricks laid in cement.

c. The space between any floor or cellar bottom shall be well ventilated.

d. No cellar or basement floor of any building shall be constructed below the grade of 12′ above mean low water, *provided* the Board of Aldermen may issue special permit designating lower level in buildings, no part of which is used as dwelling.

e. Permanent excavations shall be protected by retaining-walls.

f. All excavations shall be so protected by persons making them that adjoining soil shall not cave in by reason of its own weight.

Baltimore:—All cellars shall extend underneath the whole house, and be ventilated from both ends.

In low, damp or made land, the bottom of cellar shall be covered with concrete or asphaltum at least 4″ thick, and where floor, there shall be 6″ air-space between concrete and floor joists.

[The word *cellar* in this ordinance (1892) shall be taken to mean a ground floor, room or basement in a dwelling-house, the floor of which is below the level of the pavement.]

No open area shall extend more than one-fourth of the width of the pavement, nor more than 3′ from the inside of area wall to building line. On alleys or narrow streets the Inspector is to designate the distance. Every open area shall be guarded by fence at least 3′ high, provided with gate to open inwardly.

Brooklyn:—

Charleston:—

Chicago:—*g.* Yards, areas and open, light courts must be properly graded, cemented, flagged, or well paved and properly drained.

Cincinnati:—*h.* Every cellar or part thereof used for dwelling purposes shall be at least 8′ in height from floor to ceiling, and not less than 4′ of that height shall be above surface of adjoining ground. There shall be an area at least 3′ wide across entire frontage, and said area shall extend 6″ below cellar floor and up to surface of ground. Every such cellar shall be properly drained and provided with flue. Each apartment shall have window of not less than 9 square feet, with movable sash.

Cleveland:—(*h*).

Denver:—*i.* All excavations upon front or side of lot adjoining street shall be properly guarded or protected by person in charge.

Detroit:—

District of Columbia:—*j.* Every excavation for a cellar, vault, area or other purpose or adjoining any lot shall be protected by an enclosed bridge or tight fence.

k. Areas must be protected by metal or stone hand-railing at least 42″ high, and, when across entire frontage of lot, shall have gates 4′ wide.

l. Every cellar or basement of a dwelling shall have a bed of hydraulic or asphaltum concrete not less than 2″ thick, spread over entire bottom, or shall be paved with brick laid in cement.

m. Every building without cellar or basement shall have in walls below floor level, front and rear, four ventilators, each not less than 5″ by 12″. No portion of woodwork shall be less than 6″ clear of ground.

Kansas City:—

Louisville:—

Memphis:—(*i*).

n. Open areas shall be protected by suitable railings.

o. The depth of cellar shall not exceed 16′, measuring down from sidewalk grade at property line. Any person excavating at greater depth shall fully protect all adjoining buildings, the foundations of which are at standard depth.

Milwaukee:—

Minneapolis:—No area (or stairway) shall project into the sidewalk upon streets having a boulevard of less width than 3′. Such projection shall be protected by smooth iron or brass railings.

Nashville:—*p.* All excavations upon front or side of any lot shall be properly guarded to prevent accidents.

Newark:—

New Orleans:—

New York:—(*i*). Open areas shall be protected by suitable railings.

Omaha:—(*i*).

Philadelphia:—Cellar door, porch or steps shall not extend more than 4′ into footway on street 50′ or upwards wide, and proportionately less on narrow street.

Pittsburgh:—Cellar door, jamb or step shall not project more than 4′ into footway, and cellar door in alley shall lie flat with pavement.

Providence:—Every building used as dwelling or hotel on filled land shall have bed of concrete made of hydraulic cement and gravel, or tar and gravel spread over cellar bottom, or shall be paved with brick laid in cement or asphalt throughout extent of building.

Excavations upon lot adjoining street shall be properly guarded and protected by person excavating. (*e*).

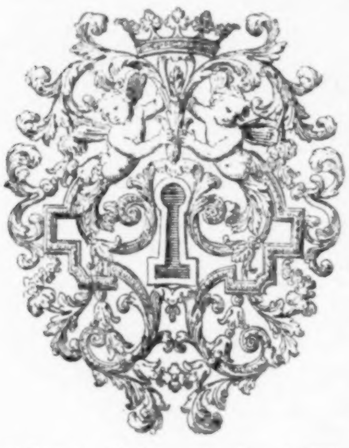
St. Louis:—Every person excavating in or adjoining any public street, alley, highway or public place shall fence same with strong fence at least 3′ high.

San Francisco:—

Wilmington:—

Compiled by H. A. PHILLIPS.

CASTS FOR THE METROPOLITAN MUSEUM OF NEW YORK.[1]



Lock Plate, after D. Marot. From Havard's "*Dictionnaire de l'Ameublement.*"

SOMETHING more than a year and a half having elapsed since the organization of the committee of gentlemen who set before themselves the task of forming a collection of casts to be presented to the Metropolitan Museum in the name of the people of New York, there are doubtless many interested in the project who would be glad to know how it is succeeding, and what has already been done. . . .

To begin at the beginning, the "tentative lists" of the collection, which were prepared by Professors Marquand and Frothingham and myself last year, and published by the committee, were intended to represent our idea of a complete collection in the respective departments which each of us undertook; that is, as the ultimate scheme towards which the committee might look forward, though not with the hope that it could be carried out in anything like entirety with the $100,000 which the committee proposed to raise. . . . It was the desire of the committee that its scheme — its ideal scheme, I may say, in distinction to what it was thought possible to undertake for the present — should include, in Greek or Renaissance sculpture for instance, every statue, bust and relief that would be of real service as a model for the artist, and every fragment that would serve a purpose in illustrating the history of the art, whether in a major or a minor phase. Even so slight a restriction as this at once excludes a vast number of works which we look at aimlessly as we stroll through the museums of Europe, because what they have to teach is taught so much better by other specimens of the same type and age. Therefore, in the Greek and Roman and the Mediæval departments, the principle of selection had to play an important part, still leaving the result, as I said before, beyond the immediate hopes or expectations of the committee.

Such being the case, our satisfaction may be imagined when it was found, after an investigation which lasted several months, and was carried on principally in Europe, that the collection represented in the "Tentative Lists," instead of being an ideal one, so far as the committee was concerned, was almost within its reach; and that if it should be possible to increase the $100,000 for which the members were asking to $125,000 or thereabouts, the Museum might possess the collection practically as it is planned there, exception being made, of course, of individual works of which, for various reasons, casts cannot be made. This naturally gave a new impetus to the project, and, although the original amount has not yet been raised, the subscriptions have been so generous — aggregating about $80,000 up to date — that the members of the committee have felt warranted in going ahead with the plan in its entirety, not spending more than they have, but confident that when this amount is expended they may rely upon public generosity to aid them in carrying the work to its completion.

EGYPTIAN ART.

To come now to what has actually been ordered or arranged for: we will begin, therefore, with the Egyptian. Unfortunately, it is impossible to get casts of a number of sculptures which would give this department especial brilliancy, either because they retain traces of color, which would make it hazardous to take moulds from them, or because they are of a material which would suffer in the process. Still, the collection will probably number forty or fifty works, so selected as to be representative of the sculpture of the ancient, middle and new empires and the Ptolemaic period. . . . But probably the figure which will be most cordially welcomed in this section is our little friend, the "Village Chief," the wooden statue which has long been familiar in histories of Egyptian art and manners, but of which only one cast has hitherto been made — that in the Trocadéro. The authorities of the Ghizeh Museum properly refuse to allow casts to be taken from the original now, on account of the perishable nature of the wood; but for the possibility of having a copy made from the one in the Trocadéro, which is in itself a unique object, we are indebted to the generous interest of Mr. Halsey C. Ives, the director of the art department of the World's Fair, of whose kindness and liberality I shall have occasion to speak later. The "Village Chief" is on the list of casts to be furnished for the Exhibition by the French Government, and we have been allowed to take advantage of the opportunity to secure a replica for this collection. With the new world of possibilities which solar prints have opened to us, it will be a simple matter to illustrate with large and satisfactory photographs those works of which casts may not be made; and if, in the ultimate arrangement of the casts belonging to the Museum, this and the Willard collection are combined, the Egyptian section will represent as much as can be represented through reproductive processes of the history of Egyptian sculpture and architecture.

CHALDÆAN, ASSYRIAN AND PERSIAN.

Of Chaldæan sculptures, all that now remain above ground might almost be counted upon the fingers of both hands. There are a few isolated specimens in the British Museum, illustrative of the period when this art was entirely under Assyrian influence; and, aside from these, we have only the few fragments brought to light by M. de Sarzec, which are now in the Louvre. Casts of two are already in the Metropolitan Museum, and to them we have added four which teach all that is to be learned from the series. They are interesting as showing the characteristics of a primitive art which was growing up at the side of Egyptian, but independent of it.

The collection of casts from Assyrian reliefs given to the Museum by Mr. Marquand is so complete that little will be added to it. It comprises almost everything of importance in the British Museum. We had hoped to add the colossal winged bull and lion which stand at the entrance of the Nimroud Gallery of that museum, as without some good specimens of those colossal beasts the conception which can be given of Assyrian sculpture, especially in its relations to architecture, must remain inadequate. Casts can no longer be made from these, however, and for the present the collection will be incomplete in this respect. The additions which will be made to the Marquand collection are few in number, and of importance principally in filling one or two gaps. There will probably be a considerable number of impressions of Assyrian seal-cylinders, selected with reference to their art rather than the inscriptions upon them.

The section of ancient Persian art will undoubtedly be a surprise to the public when it is exhibited, as it has already been to the committee. In the "Tentative Lists" there were but two items on this page, about the possibilities of one of which I was very doubtful. Thanks to two fortunate circumstances this section has unexpectedly developed into one of exceptional interest and importance. The first of these is the fact, which I did not know when the lists were prepared, that the authorities of the Louvre have allowed casts to be taken from the beautiful enamelled brickwork brought from Susa to Paris by M. and Mme. Dieulafoy, as the result of their excavations, and that there is in Paris an artist who can color these casts in exact imitation of the originals. Those who are familiar with the reliefs will remember how much they depend upon color for effect, and will realize how poor an impression of their magnificence could be given in a plain white cast. They will therefore be glad to know that the most beautiful section of the Frieze of the Archers — that containing five figures — has been ordered, and is now being painted by the artist referred to, M. Albert Laurent. . . .

The other circumstance alluded to is the project of having casts made of everything at Persepolis, which is worth preserving in this form. This project was originated by Mr. Cecil Smith of the British Museum, on his return from a recent expedition through Persia. Learning that it was impossible that these remains should ever be transported from Persepolis to the sea, and that vandalism would probably cause their entire disappearance in a few years, Mr. Smith determined to make an effort to have casts taken from them while there was yet time. Lord Savile and Mr. C. Weld-Blundel being interested in the matter, the three formed themselves into a committee for its accomplishment, as a private enterprise for the benefit of art and science. Through the influence of the British Foreign Office the necessary permissions were obtained from the Shah, and last winter Mr. Weld-Blundel, with two *formatori*, went to Persepolis, and began operations. As I happened to be in London at the time when these plans were maturing, I was able to offer the financial co-operation of our committee in carrying on this work; and through the arrangement made by Mr. Smith, the Metropolitan Museum will be entitled to the second copies of such casts as the committee may select from the moulds which Mr. Weld-Blundel brings back. The first copies of the complete set will naturally go to the British Museum. With Susa and Persepolis thus beautifully represented, the Persian section will surely be one of the special features of the collection.

GREEK AND ROMAN.

To come now to Greek and Roman art, how shall I attempt to give any idea of the wealth of material which will delight the student and artist alike in this department? The collection of Classical sculpture will not be the largest in the world, as that of Berlin will still surpass it, probably by considerable. But there is a good deal in that collection which it was not thought advisable to include in this, at all events at the beginning, if for no other reason than that of size; for if a Classical collection as complete as that of Berlin were to be added to others as large as our Mediæval and Renaissance sections promise to be, the Park Commissioners might well begin to wonder whether it was the intention of the committee to leave any outdoor space whatever in Central Park. If the present plans are successfully carried out, the Greek and Roman department will be about as large as those of Strasbourg and Dresden, which rank next to Berlin in size, though it will include certain features not to be found in any

[1] Extracts from a communication to the New York *Evening Post* by Mr. Edward Robinson, curator of Greek and Roman Antiquities at the Boston Museum of Fine Arts.

of those collections. I say if the present plans are successfully carried out, the doubt being due to the fact that we do not yet know exactly what we can get from Greece itself and there are certain periods or types of Greek sculpture which are not adequately represented in the museums of any other country, such, for example, as the archaic, and the beautiful series of gravestones decorated in high relief which have been found in and near Athens. And we should naturally wish to include the fruits of recent excavations, such as those at Epidauros and Lykosoura, which have brought to light some beautiful specimens of the art of the best periods, utterly unknown, unless through small photographs, to those who have not had the good fortune to visit Athens within the last year or two.

The old cast-making establishment of Martinelli, in Athens, which for years has been turning out casts which were just poor enough to give a tantalizing impression of the beauties of the originals, died a natural death within two years, and its moulds were sold to the Italian Government. They will probably be put into such repair as is possible and be reproduced some time, but so far as I know nothing has yet been done with them. Meantime the Greek Government has been taking steps towards the fulfilment of a long-promised project, that of establishing a national foundry for plaster-casts, under government control; and a special impetus has been given to this movement by the Chicago Fair, it being the intention of the Greek Government to make a rich display of casts there, as its official exhibit. Dr Waldstein has been good enough to look after our interests in Athens, in connection with the preparations for that collection, and to make the most of the opportunity to secure for us all the casts we desire from that quarter. I do not yet know how successful he has been, but I understand that the work for Chicago is well under way, and there therefore seems good reason to hope that we may have a list of the most interesting works in Greece, reproduced from fresh, new moulds. He has written that it is the intention of the Greek Government to make a new mould from the Hermes of Praxiteles, and if this is done, the date of our order ought to secure us one of the first copies.

I shall not even try to enumerate the details of the Greek and Roman collection which we are sure of having, the subject being far too long. Among the more important and monumental works will be the groups from both pediments of the temple of Ægina, complete (including some fragments recently cast for the first time); both pediment groups from the temple of Zeus at Olympia, which we hope to have as they are set up by Prof. Treu, in Dresden — that is, restored sufficiently to hide the most distressing gaps and mutilations, — and of the Parthenon every fragment of which a cast can be had. What more beautiful or inspiring room can be imagined than that which it is to be hoped may some time contain the Parthenon casts of this and the Willard collections combined. . . .

As an example of the character of the colossal temple-statues of the Phidian epoch, we shall have a copy of the so-called "Ceres" in the rotunda of the Vatican, which, so far as I know, has never before been cast. In type, handling and feeling it has a strong resemblance to Attic works of the Phidian school, such as the maidens of the Erechtheum and those on the Parthenon frieze; and though the statue itself is a Roman copy, it shows the majestic simplicity of Phidian art and will serve admirably as a representative. Polycletus, Praxiteles, Lysippus, and the other great sculptors will be represented by all the works which have been referred to them or their style, except that statues of which many replicas exist, like the "Marble Faun" will be illustrated only by the best extant copy, unless there be some especial reason for adding others.

From the principal frieze of the great altar at Pergamon, there will be ten groups, which are all that have been cast up to the present. . . . There will be many others of the most splendid and characteristic works of the Hellenistic age, such as the Samothracian Victory, in the Louvre, with her prow, the Farnese Hercules, the so-called "Attalos group" of warriors, and so on. Animals will not be neglected, our finest "show-piece" of this character being the four horses of S. Mark's, which, like all the other casts, will be the full size of the originals. Another feature of the classical department will be a collection of casts from small bronzes, many of which are not only exquisitely beautiful in themselves but important in illustrating statues described by ancient authors, of which no full-size copy remains. Up to the present, about one hundred and twenty of these have been ordered.

The most unique, and in some respects the most attractive group of the classical section, will be the collection of Herculanean bronzes, which is to be the gift of the treasurer of this committee, Mr. Edward D. Adams. By special arrangement with Signor de Petra, Director of the Museo Nazionale of Naples, all the bronze statues and busts discovered at Herculaneum, and published in his book "*La Villa Ercolanese*," are being reproduced *in bronze*, under his immediate supervision, by Sabatino de Angelis, who is by far the best of the numerous Neapolitan copyists, his talent and feeling for his line of work being rare in any generation. The copies are to be finished in exact imitation of the present condition of the originals, in color as well as form, and each piece will be stamped with the approval of the director before it is shipped. This collection will number eleven statues, twenty-two large busts, eight small busts, and ten statuettes. It will be a great treat to see these Herculanean works set apart in a room designed for them alone, where their dignity and nobility will be more impressive than is possible when they are surrounded, as in Naples, by the bronzes from Pompeii, which, though charming and graceful, represent a distinctly lower plane of art. The Italian Ministry of Public Instruction has been extremely courteous in allowing moulds to be made from a number of the Herculanean sculptures which have never been reproduced before; and indeed has shown a readiness to accede to our requests for similar permissions in other departments, which will be profoundly appreciated by all who are interested in art-education in this country.

MEDIÆVAL WORK.

It is the periods between the end of the Classical and the beginning of the Renaissance which have given us the most trouble, and which are still the least advanced in the preparations for the collection. This is due to two causes: first, that, as there is very little general demand for mediæval work, only one or two cast-makers have made a specialty of it; and second, that much of the most interesting mediæval sculpture is so intimately connected with architecture, often of colossal proportions, that it is extremely difficult to make a representative selection which shall be practicable within the limits of a museum building. With surprisingly few exceptions, all that is to be had in the open market of mediæval casts consists of small details, bits of decoration, sections of ornament, and similar fragmentary pieces, which, useful though they are to the architect and draughtsman, in a museum would give but a poor impression of the grandeur of mediæval art. . . . I have had the valuable assistance of Mr. H. Langford Warren, the architect, who, having made a special study of the history of mediæval art, and having also made inquiries as to casts and cast-makers during a long tour through France and England, is admirably qualified to take charge of this department, and has been kind enough to place much of his time at the disposal of the committee. Still, Mr. Warren and myself were beginning to be discouraged at the chances of making anything like a worthy display of mediæval art, when another of the fortunate circumstances which have thus far characterized the growth of the collection opened a new and splendid field of opportunities. This we owe to Mr. Ives, of our indebtedness to whom I have already spoken. As is well-known, the French Government is taking an active interest in the Chicago Exhibition, and is doing everything in its power to make its exhibit worthy of the reputation of France in matters of art. In the province of casts, especially, the authorities offered Mr. Ives concessions of extreme value, the most important of which was permission to have copies made of whatever he might desire in the magnificent collections of the Trocadéro. With the liberality which has constantly characterized his administration of the office of Director of the Department of Art, Mr. Ives offered to extend this privilege to us, and to order for us such casts as we might select. This is but one of the many instances in which Mr. Ives has proved the truth of his assertion that he accepted the difficult office which has been intrusted to him because of the opportunities it would give him to advance the artistic and educational interests of the country at large; and I hope the good work he is doing in this direction will be appreciated as it deserves to be.

Acting at once upon Mr. Ives's offer, Mr. Warren prepared a list of forty important monuments represented in the Trocadéro, of which either the whole or details have been ordered, and these will form a splendid nucleus for the mediæval collection. It would be premature to announce just what they are at present, but they will illustrate some of the most interesting specimens of Romanesque and Gothic sculpture and architecture in France. As one example I may mention the porch of St. Gilles, in full size. There is also a prospect, or a possibility, of the Museum possessing a cast of one of the most beautiful Gothic portals of the thirteenth century. It is one which has never been reproduced before; but this is a question of dollars and cents, which still have to be considered, and consequently it has not yet been possible to take final action on the subject. It would be a superb gift for some individual or association interested in the collection.

English, German, Italian, and Spanish Gothic will also be represented as far as means and opportunity allow, but in these departments we are not yet prepared to make any announcement. The same is true of the earlier post-classical epochs. Of the Syrian churches, for example, we should be glad to have details illustrating the transition from the Classic to the later styles of ornament, but casts of these are not in the market, and an opportunity to have them made has not yet been found.

TREASURES OF THE RENAISSANCE.

Coming finally to the Renaissance, we are on sure ground once more, and can promise the most complete and beautiful collection of Italian sculpture that has ever been brought together. Here again one is embarrassed by numbers, in the attempt to convey any idea of what is coming. If I say that Donatello is to be represented by over sixty of his works, ranging in size from the equestrian statue of Gattamelata to the little relief of St. John, Michael Angelo by thirty of his, or the Della Robbias by over forty of theirs, this perhaps give a bewildering impression of completeness, but certainly suggests beauty imperfectly, and beauty will be the chief impression made by this collection when it is completed. In forming it, our plan has been to take each of the Renaissance masters by himself, showing all his monumental works, if possible, with such of his smaller ones as are of especial interest or importance in illustrating his style. . . .

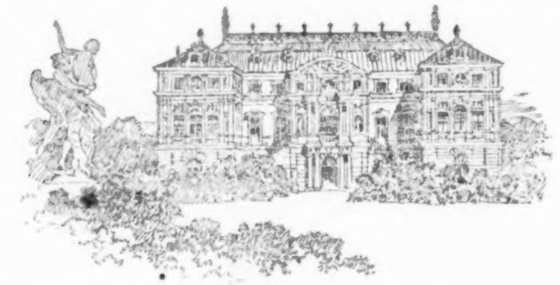
But it is useless to go on with the list. The most exacting lover of the Italian Renaissance may be assured that he will miss very little when so much of this collection as has already been ordered has been received and exhibited. The list includes about 300 objects.

The selection of German and French Renaissance sculptures will be equally representative, though naturally much smaller. The works of Krafft, Stoss, Vischer, Pilon, Juste, Goujon, Prieur, and the other masters of these two countries will be shown with as much fulness as circumstances permit. . . . The committee is also considering the reconstruction of one face of the Fontaine des Innocents, which is unquestionably the most beautiful monument of the French Renaissance, but it is still too early to promise anything definite with regard to this. Chronologically the collection will end, for the present at least, with a small series of the Versailles busts of Louis XVI, and his court, the committee having decided that it was wisest to avoid all possibility of misunderstanding which might arise from an attempt to pass upon the relative merits of contemporary works; and it has therefore fixed upon the end of the eighteenth century as the boundary line of the collection, feeling that it will have done its share of the educational work of the Museum if it places before the student and the lover of art the masterpieces of the past with the completeness which has here been sketched out.

WHERE SHALL THE TREASURES BE STORED?

If the reader has had the patience to follow the description thus far, he has doubtless asked himself more than once where all these things are to be exhibited — a query which, he may be sure, has arisen in other minds than his. Unfortunately, however, it cannot now be answered. At present nobody knows. When the new wing of the Metropolitan Museum is completed, the ground floor of it will contain as much of the collection as can be satisfactorily exhibited there, but this will represent only a fraction of the whole. The fate of the remainder, and ultimately of the entire collection, it is for the future to decide. There are of course those who will say that it would have been wiser for the committee to wait until it had adequate accommodations before undertaking the formation of such a vast collection; but it must be admitted that such a method of procedure is not characteristic of Americans in any great enterprise upon which they have set their hearts. Moreover, if the members of the committee had decided to wait until a building large enough for their purposes should grow up of itself, before they began operations, they would undoubtedly have waited a long time, and missed many excellent opportunities by the way. Being impressed with the desirability of endowing New York with a great collection, for the formation of which money was the principal requisite, they determined to go ahead, raise the necessary funds, get the collection together, and make the fact of its existence the argument for the necessity of an adequate building. Certainly no more powerful argument could be brought to bear. I believe I am not indiscreet in confessing that it is their hope that some time — and not in the distant future — a special building may be erected as an annex to the Museum proper, in which the Willard and Marquand collections may be combined with this, and all the casts of the Museum be exhibited according to schools and epochs, under the most favorable and carefully considered conditions of light, space, and arrangement. Should this hope be realized, and it is by no means an unreasonable one, New York will find herself in possession of a museum of reproductions unrivalled on either side of the Atlantic. . . . EDWARD ROBINSON.

DEVELOPMENTS OF ELECTRICAL DISTRIBUTION.[1]



Lustschloss in the Grosser Garten, Dresden.

THE present course of lectures is intended primarily for electrical engineers, and it is to them that my principal remarks will be addressed, but there are many present who have no intention of putting what they hear to practical use, and it will not be out of place if I indicate briefly some of the points that have to be attended to in electrical distribution.

The resistance offered by conductors to the electric current causes two sources of trouble. One is that energy is absorbed and wasted, and this may seriously affect the coal bill and the total machinery required in the central station. The solution of this difficulty is naturally to reduce the waste by reducing the resistance of the conductors. This means that we are to use larger copper conductors. But this increases the cost, and it is clear that there is a definite most-economical size, such that, if the conductors are increased in size, the increased interest on capital expenditure swells the cost; and if we diminish the size, the extra machinery required increases it, and the coal-bill rises. It is an important function of the electrical engineer to determine in every case this most-economical size of conductor. Large experience has generally led to finding the most-economical size to be such that the current density shall be not more than 500 ampères per square inch. The other trouble is that when many lamps are in use, and a large current is flowing, the electric pressure is reduced and the lamps are dim. The further distant a lamp is from the central station the lower is its pressure, and the difference in brightness of lamps is particularly observable in the distant lamps. Those near the station suffer no loss. To increase the brightness of distant lamps during the busy hours, the pressure at the station may be slightly raised. Thus we generally find in central-station distribution that in the busy hours lamps near the station are brighter than usual, and the distant ones are more dim. This is well shown by diagrams of pressure taken on different parts of distribution mains by self-recording apparatus. This solution of the trouble does not go far, however, as we cannot allow a large variation of pressure in any lamp. The Board of Trade at present allow the large fluctuation of eight per cent, and it is to be regretted that the supply companies generally avail themselves to the full of this latitude. This is shown by recording volt-meters.

For further improvement in the supply it is necessary to introduce feeders, which are conducting wires going from the central station direct to certain points on the network of distributing mains, where the variation in volts is found to be large. No lamps being connected onto the length of these feeders, the full pressure can be supplied at the point of distribution without other lamps being raised in pressure.

I do not intend to pass further in review the general principles of low tension distribution. The problem and the rules to be followed were completely worked out in detail in my previous Cantor Lectures; and after these seven last years of busy work, I have not one word to alter in all that I said at that date.

Nor have I the intention in the present course to do what might be an interesting proceeding, viz, to describe the various central stations which have been erected in these years, and analyze and criticise their modes of working. Some of the stations with which I have myself been connected as consulting engineer have been low tension and some high tension, and it might have been thought desirable that I should give you the results of my own experience. Moreover, as is well known, I have largely devoted myself to a careful study on the spot of a large proportion of the central stations both in Europe and America, and I might easily have found materials in this experience to occupy a few evenings with profit. I have, however, other aims in these lectures, and descriptions of central stations are not wanting to those who are sufficiently interested in them. I have myself given full details of the machinery and methods employed at some of the great European stations in a paper read before the Institution of Electrical Engineers in 1889. A very interesting account of central stations in Germany, by all the best manufacturers, was brought out in a handbook published last year at Frankfort for the Exhibition.[2] My desire is to carry into these lectures the same spirit that led to my previous Cantor Lectures, and to bring before engineers the points that require attention to make our work as perfect as possible, and to draw attention to the lines in which we may hope to overcome the great drawbacks which still hamper the industry, and prevent it from furnishing such economical results as the general conditions of the problems warrant us in expecting. It will, I hope, be found that there are engineering resources at our call which have yet to be invoked before we have reached the final solution of the problems.

As an example, I will point out to you one or two facts in the economy of the subject. One is that central-station distribution, as distinguished from isolated plants, involves a huge additional expense in distributing mains. The cost of these must, from the nature of the case, be out of proportion to their earnings until the consumers are much more closely packed than at present.

Another fact is that our machinery is lying idle three-quarters of the year, and earning no dividend. A third is that, owing to the limited period during each day that the maximum demand exists, we waste fuel in heating up most of our boilers for only a couple of hours' work in the evening. A fourth point is that, owing to the irregularity of the demand, we waste a great deal of steam by working our engines much under their full and economical load.

All these points will be fully elaborated in the lectures. The net result is that electricity in London costs twice as much as gas, that it costs more to obtain it from a public supply than when manufactured (for a large establishment) on the premises, that the method of debiting consumers is unfair on those who have the longest hours of working. You must not be deceived by the optimistic calculations of enthusiasts and interested parties. The electrical industry has nothing to fear from competition, and the surest way of gaining the confidence of the public, and of making sound progress, is to openly accept the true state of the case, and acknowledge the difficulties that hamper you, and then apply all the skill at your disposal to overcome these difficulties. In illustration of the points I have raised, I will here only state one or two points.

1. The streets in London are not lighted generally as they ought to be by arc-lights. We know, from a most extensive experience,

[1] Extracts from a Cantor lecture delivered before the Society of Arts by Prof. George Forbes, F. R. S., and printed in the *Journal* of the Society.

[2] Die Versorgung von Städten mit Elektrischem Strom.

that any one can set up a circuit of ten-ampère arc lamps with underground mains, and run them with good profit at a rate of £30 per annum, during all the hours that gas lamps are now used (4,000 hours per annum). The cost of the mere current for these from a supply company, at 7*d*. per unit, amounts to £58 6*s*. 9*d*., double what it would be if privately worked.

2. A careful comparison of the cost of lighting the Athenæum Club with its own machinery, which has been done for many years, with the charges from a supply company at 7*d*. per unit, shows that the present cost is £894 per annum, including depreciation on machinery costing £1,608, as against £1,452, which the company would charge us.

We must fairly recognize the fact that electricity is twice as dear as gas, and also that where we replace gas by electricity we must increase our expense in warming a house. When this has been granted, we must remember that we save much in decorating and in preserving our books, that we abolish vitiated and dirty air, and that we can keep our rooms cool. These are sufficient recommendations for those who value cleanliness and health, and will spur the ingenious among us to remove the confessed drawbacks.

In order to perfect our systems of distribution in practice, we must keep before our minds the ideally perfect, and depart from that course only at the gain of decidedly practical advantages, and we shall often find that, if due caution is exercised, we can gain much by very slight departures from the ideally perfect. This is the spirit which has actuated the evolutionists of the modern dynamo, and which enables us to be proud of our 96 per cent efficiency, while the steam-engine, with a hundred years of brain-work and millions of money spent on its development, has reached only 80 per cent efficiency in its mechanical working. Had it not been for the scientific men who took up dynamo construction at the beginning, we would have rested content with the 50 per cent efficiency originally offered by Brush and others in machines which were thoroughly well designed mechanically, and did their work thoroughly, if uneconomically. At first, designs of complicated character were introduced, in which the rapidly revolving parts, those requiring most mechanical strength, contained only the following materials: An iron spindle, a wooden hub, and an armature made of iron wire, wound with copper wire, the parts being joined and separated by millinery and paper and sealing-wax. The object of this construction was to minimize the losses. One weak part after another was discarded, until we now have a fairly strong and mechanical armature.

So in electrical distribution. Ten years ago we searched for the ideally best. In each case we made elaborate calculations of the probable consumption in different parts, and we tried to average the relative size of feeders and distributing mains and their points of connection as accurately as possible. We tried to select those points for attaching feeders that would use the least copper, and we tried to devise means of regulating electric pressure in the feeders, so as to waste no more copper or electric energy than was absolutely necessary.

Ten years of practice in central-station working has now stereotyped our practice a good deal; and while we do not always lead a conducting wire by the shortest route from each lamp to the central station; and while we do not always attach a feeder to the nearest part of the district it has to feed in normal conditions, still we always have these leading principles in mind while laying out a plan of electric mains, and we readily adopt the general average results of our experience in past work to simplify our system.

CENTRAL-STATION SUPPLY VERSUS ISOLATED PLANT.

At the date of my previous Cantor lectures the great question before our minds was whether central stations were economical. It was obviously far more convenient for the public to be supplied from a general source than for each one to generate his own electricity; in fact, the latter plan would be impossible, except in the case of large establishments. It was further obvious that the cost of both labor and coals in small plants would be far greater than in a central station. But the fact remained that, with central stations, we had all the additional cost of mains run through the streets, involving enormous cost, not only in copper, but also in taking up streets, finding a way among all the underground pipes, and making all good again. We had just learned, from the experience of the telephones, that the more subscribers there were after a certain limit, extending to greater distances, the less dividends could be paid. Consequently, there were many men at that date who did not think that central stations could compete against isolated plants for even moderate-sized establishments, and who saw no prospect of small consumers being supplied, except by neighbors clubbing together to generate electricity for themselves. Fortunately the verdict has hitherto generally been that current *can* be economically generated in, and distributed from, central stations, and the proof is in the enormous ramification of electric circuits now occupying the beds of the streets of London. I do not know the case of any town in the world where such enormous progress — designed for permanency — has been made in so short a time. From 1882 to 1889 the legislative enactments restrained and held, as in a leash, the spirit of the age (which is electrical). In the last-named year, Major Marindin, acting for the Board of Trade, held the great inquiry in London, besides minor ones in other towns, as to what powers were to be granted to what companies. From the moment that his reports were accepted, the forces which had so long been restrained burst forth, and the pioneers, like released greyhounds, darted after their prey, and the whole place was in the hands of the electricians. All the work was well done, and will remain: and we may well be proud of what has been accomplished.

But while thus congratulating ourselves, we must not overlook the fact that we are prevented by several causes from supplying electricity so cheaply as might be hoped. I have already given you the figures with respect to one large club, and I could give you many others to show that at present, for a large establishment using light for long hours, an isolated plant is the cheaper. It is particularly to be remarked that the average number of hours that a light is in use is barely two hours a day. Hence, during the greater part of the twenty-four hours, the mains in the street are lying practically idle, the boilers and engines are earning no dividend, while the managing staff would have no more work if all the customers used the light for longer hours. Hence, during the greater part of the day, the cost of producing an additional electric Board of Trade unit is little more than the cost of the coal, certainly not 2*d*. a unit, while for a few hours in the evening it is at least three times as much. You see, then, how hard a fixed price per unit is on clubs and other places where a steady large supply is wanted for long hours. This is one reason why the public supply to the Athenæum Club would cost £500 more than the cost of making it on the premises. This is why the cost of an electric-arc lamp for street lighting would be double what it would be if not obtained from a supply company. If we had any means of supplying electricity for a short time as cheaply as at the full output all the twenty-four hours, we should reduce the selling price to one-third of what it is now.

ELECTRICITY VERSUS GAS.

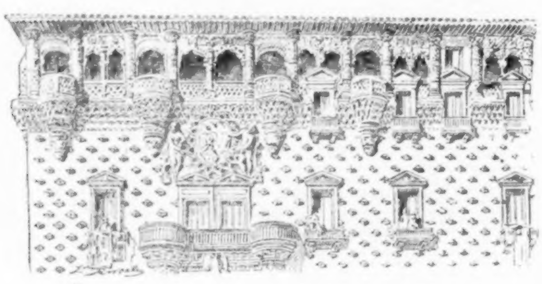
At the present time, electricity in towns often costs twice as much as gas, and it is not every one who can see that the gains counterbalance the extra expense. It certainly saves expense in decoration, it is far more healthy, and in valuable buildings like the British Museum, it alone can be permitted, as giving absolute immunity from fire where properly carried out. The same remark applies to all private houses. When a curtain or a dress is blown by the wind or otherwise brought into contact with a gas jet we have a fire. When this happens with an incandescent lamp we have absolute immunity. But by taking advantage of the facility of putting out a light in a bedroom when done with, great economies can be effected in careful households. There is one case in which electricity beats gas and other illuminants, not only in cleanliness, health and security from fire, but also in economy, and that is in country houses. I could bear this out by numerous examples. One large old castle in Scotland, where the risk of fire was great, and the electric light was introduced primarily for security from fire, offers a good example. Here there are 210 lights of 16 candle-power installed, the house has always been full, and the lights much used. The installation cost £1,800, and last year, the second of working, an accurate note of all the expenses, labor, coal, etc., comes to £75. Nothing approaching to this could have been got from gas manufactured on the premises, and, at the rates charged by supply companies, the cost would have been over £300.

BATTERIES.

I must conclude this part of my subject with some mention of a class of electrical apparatus which has been improved more than anything else in connection with low-pressure supply since I gave my previous Cantor lectures. The position which I then took up was this, that there was no plan for electric lighting so satisfactory as the secondary-battery plan, but it was hopeless to think of it until one important element was invented, namely, a practical secondary battery. That *desideratum* is much nearer realization. In the last ten years dynamos have been much improved, and so have lamps, but in no branch has the improvement equalled that in secondary-batteries.

These improvements are partly in the way of making the plates more substantial, and less liable to buckle or scale, or for the pellets to drop out, and partly in their management, the chief step in the latter direction coming from the discovery that batteries will stand any amount of overcharging, and really improve in the process, and also that they should never be allowed to run down, and that low specific gravity should be remedied by persistent overcharging, recourse to adding acid being only resorted to at rare intervals. To keep batteries in a high state of preservation in this way involves great expense, from the frequent overcharging, and also from the fact that, if we never take much out of the battery, we must have a larger outlay in them to do our work. At the present time, the only objection to batteries is their expense, and that is now far less serious than six years ago, when their life was very short. Secondary-batteries are often called accumulators, or storage-batteries, according to the purpose for which they are wanted. They are used for five different purposes — (1) As regulators; (2) to replace dynamos, and give workmen a rest at idle hours; (3) to add to the total out-put of a central station at a time of maximum demand; (4) as a reserve in case of breakdown, and (5) to transform down from high pressure in the streets to low pressure in the houses. All these are most useful purposes and seem so desirable that many companies have adopted them even at a greater cost of supplying the electricity. Of course you will always find the manufacturers of any such special plant saying that it does not increase the cost to use it, and when, as often happens, the manufacturer acts also as consulting engineer, you may expect the use of such plant to be more extensive than their costliness warrants. This has been the case in England in many cases, but it is not to be regretted by the general public, because these cases have given us much valuable experience. In this year, 1892, however, the improvements in storage batteries are such that it hardly costs anything more to use them than to do without them, and we see the desirability for storage of some kind in our central stations so much in actual working, that we may hope the time will soon come when some kind of storage will be possible for a large part of our generating plant, so that we will not require to fire up a lot of boilers just for a few hours work. When a battery is put across the mains at the central station it acts as a regulator, and keeps the current steady in spite of irregularities in the engine. This ought not to be an important point in central stations, but it is in isolated plants worked by a gas-engine. The battery in the central station, however, offers a splendid means of regulating the pressure in the feeders, which can then be supplied at any pressure with current, and the size of copper can then be chosen to fulfil the economical law of being proportioned to the current, and not to the barbarous law of making the resistance of all feeders equal. Much discussion has arisen about the value of accumulators in central stations, but it is remarkable that, up to the present time, the one great advantage has been overlooked, which is that you can use them in shunt on the mains as a means of regulating the pressure supplied to feeders. This action is the only solution that has been tried which gives perfect satisfaction. I do not believe that the introduction of accumulators into a central station has ever introduced economy, but in many ways it leads to a better service, and in no way more than in this which I have just indicated. So much is this the case that, except in the few cases where economy over-rides quality of light, or in some cases where a fall of water is the source of power, I do not think that any low-tension continuous-current central station on a large scale is complete without a small supply of accumulators. The other use of accumulators as transformers of high pressure into low pressure belongs to the subject of my next lecture.

WHAT ELECTRICIANS MEAN BY "EARTH."



Loggia of the Palace at Guadalajara, Spain.

PERHAPS, says Sydney F. Walker, in the *Electrical Review*, no science has a more puzzling nomenclature than electricity. Electrical engineers have named their units after the great men who have worked in their ranks, and by so doing have perpetuated the names of those men, as possibly nothing else could have done. But the names themselves, volts, ohms, amperes, farads, etc., are sad stumbling blocks to those who would like to know a little of the science, but who have not time to make a set study of it. But of all terms used by electrical engineers, probably "earth" is the most puzzling. Even the trained electrical engineer, the man who has spent a large portion of his life in the service of the science, has sometimes to think what is meant by "earth," in a particular case. How, then, can those who have not studied the subject follow its different meanings?

In the early days of electrical science, before we knew anything like as much of it as we do now, and when its use was confined almost entirely to experiments shown in the laboratory, we had not these difficulties. In those days "earth" meant earth, and nothing else. Electricity being looked upon then as something very much like water, only that it flowed in wires instead of pipes, it was natural to refer to mother earth as the great natural reservoir of electricity, just as she was supposed to be of water; and the resemblance was a very close one. As is well known, you can always procure water if you dig down far enough in the earth's crust, and the earth will always soak up or carry off, more or less readily, all the water that may descend on it. So, too, the early electricians found that by connecting one side of their frictional machines to earth — in this case the floor of the room — they could go on generating electricity as fast as it was discharged from the prime conductor. They found, too, that connection to the earth in the form of their own person was fatal to a certain class of experiments. Later on, also, when it was discovered that an electric current sent through a wire carried above the ground would return to the place of generation through the ground, the same idea prevailed. Old text-books tell the student to regard a galvanic battery as apparatus something like a pump drawing water from a well, able to draw an inexhaustible supply of electricity from the ground at one place, and to pour electricity into the ground, *ad infinitum*, at another place.

A study of old text-books, and even some modern ones, will play rare havoc with the ideas held about "earth," held in connection with electric-lighting supply, for instance. In charging the electrophorus, for example, the student is told to put the brass plate to "earth"; to discharge it, in fact, by touching it with his finger. And the plate was, and is, so discharged. Fancy trying to discharge a 10,000 volt transformer in that way.

About the time of the advent of the telephone, it began to be realized that the part played by "earth" as a return for telegraph circuits was not exactly what it had been supposed. It was gradually recognized that the return current passed through the surface of the earth's crust, using whatever paths might be open to it, very much in the same way that the current passed in the wire forming the other portion of the circuit above ground. The only difference between them was that, while the locality of the current passing in the wire was fairly certain, that of the current passing through the ground was not so certain. A portion of the return current from Manchester to London, for instance, might go round by way of Glasgow or Aberdeen, if there happened to be a path for it by either of those routes.

The development of the telephone, with its often troublesome "cross talk," which was traced to earth connections, in a great measure gradually drove the old ideas of the reservoir quite out of the field. Especially was this so when it was reported from America that messages sent in one telephone wire had been heard on another telephone wire separated six miles from the first, the only possible connection being the earth's crust, to which both wires were connected. Gradually it came to be recognized by practical men that "earth" consisted of the conducting matter, such as moisture, mineral veins, etc., held in the earth's crust, with any metals buried there. But then came another trouble over this question of earth. How did "earth" effect a lightning discharge? and what was "earth" for a lightning-rod? Surely the old idea held good here? Lightning came down the copper rod to "earth," and was discharged. Unfortunately, lightning does not always behave in this proper fashion. Professor Oliver Lodge has rearranged our ideas upon this point. He has even maintained that the "earth" our forerunners worshipped is rather a drawback than otherwise. Some of us still believe in "earth" for lightning-rods, though we prefer it of a different form usually to the old patterns; our views in the matter being based upon what we have learned as to the use of the conductors in the earth's crust and in connection with other apparatus. And, now, when we are congratulating ourselves upon having at last reached the dignity of supplying electric light from generating stations, just as gas has been supplied during the memory of the oldest of us, comes "earth" again, but it means something quite different, and yet the same.

Now, if a man standing on the ground touches an electric-light wire carrying a high tension current, and receives a smart shock, he is said to have "earthed" the line, or the electric-light service, through his body. So, too, when a naked copper wire, used for delivering current to a series of arc lamps, touches an iron lamp-post, and thereby interferes with the working of the lamps beyond, it is said there is "earth" on. Again, when the possibility of users of electric light, who are supplied by high-tension circuits, getting shocks is discussed, we are shown various devices for putting the circuit to "earth," should such a contingency arise. But in these cases the meaning of "earth," though sufficiently the same as in those previously noticed to warrant the retention of the name, is really quite different. "Earth" is not necessary in these cases, as it was in the early days of electricity, with frictional machines. Nor do we use "earth" to save us one cable, as we do with telegraph wires, and as we may with telephone wires. It is true that in a recent lawsuit over some electric-lighting patents "earth" was brought very much in evidence; but it was shown that what was meant was an uninsulated metallic return cable, and that the cable might be insulated if you liked. It is also true that certain electric tramways in America, and in this country, use what they call "earth" for their return current; but they do not mean "earth" in the old sense — they mean a set of conductors, the rails that happen to be on the ground. In electric-lighting work we get as far away from "earth" as possible. To any but electrical engineers of considerable experience a recent report that has been made by a Board of Trade inspector, must be exceedingly puzzling. Shocks were obtained from the water-service in a house in St. James's, and a gas-meter had one of its sides, which rested against a damp wall, eaten through by electrolytic action. The water and gas service is referred to as being several volts above the conduit in which the cables of the Electricity Supply Company were laid; and further on it is stated in one part of the report that earth, which should be absolute zero of electrical potential, had a difference of 190 volts with one of the supply-mains, the normal pressure of the service being 220 volts? What does all this mean? What does "earth" mean here?

In connection with electric-light supply, where two insulated cables are used, "earth" may be taken to mean any conductor, such as water and gas pipes, iron conduits, etc., that may be present in the ground, and which are all more or less in electrical connection with each other, by reason of the moisture which is held in suspension in the soil, as well as in bricks, wood and even in the hardest stones present. But, and here is the point where this "earth" varies from what we called "earth" before. These masses of metal, damp ground, etc., should have no connection with the electric-lighting service at all; they are at absolute zero, because they are, or should be, absolutely neutral. Whenever they become connected, either directly or indirectly, with any portion of the electric-lighting circuit, they are no longer at zero of electrical potential, because no longer neutral, and form part of the electric-lighting system, just as if they had been regularly calculated for and laid as the cables were; and the danger, when such a connection exists, is not from any reservoir having been suddenly tapped, as a water-bearing fissure may be in a mine, but in the suddenly bringing within the influence of the electrical pressure created at the central station, of a system of conductors that are of uncertain and varying measurements, and quite beyond the control of the engineer.

THE ILLUSTRATIONS

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

DETAIL OF THE TELEPHONE BUILDING, MILK ST., BOSTON, MASS. MESSRS. FEHMER & PAGE, ARCHITECTS, BOSTON, MASS.

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

HOUSE OF COLIN GARDNER, ESQ., MIDDLETOWN, O. MESSRS. G. W. RAPP & W. M. AIKEN, ARCHITECTS, CINCINNATI, O.

THESE plans were prepared for the remodelling of an old house 41′ x 49′ (the rear wall then being that of the butler's pantry) but the work had barely begun when the owner determined to demolish the entire building and erect a new dwelling, but to follow the lines of the old plan as closely as possible. The front vestibule has an elliptical domed ceiling and is paved with white vitreous tiles. There is a panelled wainscot and beamed ceiling in the main hall, the walls of which, above the panelling, are covered with Japanese stamped leather. The dining-room is also wainscotted and above is finished with tapestry paper, on the walls, and moulded plaster ribs on the ceiling. The opening between dining-room and stair-hall may be closed by a screen (ten feet long) panelled below and arcaded above, having turned and carved colonnettes separating alternate fruit and flower subjects in richly colored mosaic glass; this screen is hung from a moulded cornice and slides along the side of the stair-hall. The billiard-room has leather paper on the walls and the decoration of the ceiling is within an inscribed ellipse. The music-room has moulded plaster ribs, and a roccoco design in lower relief interlacing them, on the ceiling. The space under a portion of the main stairway is finished as an elliptical arch. The recess for the upper portion of stairway is treated as a niche, with shell-like decoration above. The front hall of second story is arcaded, the intermediate spaces having elliptical decorations, and it is separated from the rear hall by a glazed screen. The ceiling of kitchen is depressed at sides and raised at centre towards a register (and flue) for better ventilation. The hall, staircase and dining-room are finished in quartered white oak; the music-room and billiard-room in mahogany; and all of these have oak floors; the remainder of the house is finished in southern yellow pine. The tiles for hearths and facings of mantels were specially imported from Holland. The house is lit by electric light. The principal feature of the house, is the piazza, which is 14′ 0″ wide and 70′ 0″ long exclusive of the two returns, of 14′ 0″ at each end. The exterior is painted a light yellow, with white trimmings and very dark green blinds.

BLOCK OF HOUSES ON THE RIVERSIDE DRIVE, NEW YORK, N. Y. MESSRS. CHARLES BUEK & CO., ARCHITECTS, NEW YORK, N. Y.

NEW CLUB HOUSE FOR THE PSI UPSILON SOCIETY, BROWN UNIVERSITY, PROVIDENCE, R. I. MESSRS. HOPPIN, READ & HOPPIN, ARCHITECTS, PROVIDENCE, R. I.

STUDY FOR A GREEK-LETTER SOCIETY CLUB HOUSE. MR. W. F. WILLIS, ARCHITECT, YORK, PA.

OFFICE FURNITURE FOR DR. C. S. WARD, BRIDGEPORT, CONN. MR. C. T. BEARDSLEY, JR., ARCHITECT, BRIDGEPORT, CONN.

[Additional Illustrations in the International Edition.]

WINDOW-SHUTTER AND CUPBOARD-DOOR FROM THE MOSQUE OF SY-SARYEH, ARABIA.

[Copper-plate Engravings.]

THE CATHEDRAL OF ST. ROMBAULT, MALINES, BELGIUM.

[Gelatine Print.]

ALMOST every traveller brings away from each tour the memory of one overwhelming emotion and with us the most vivid impression of a recent trip is connected with this cathedral. It is an impression that any one may repeat and so we give the recipe, as follows: — Enter the evil-smelling little town late on a warm Sunday afternoon in Spring: select a nimble-footed *commissionaire* to wheel your luggage to the "*Cheval d'Or*," and follow him, dawdling as little by the way as the picturesque character of the scene will allow. Still in spite of effort, you will find yourself entering one end of the Grande Place just as *charette* and baggage disappear at the other. Not having the remotest idea where the hotel really is, you will hurry across the open space with your eyes unobserving of things about you but steadily fixed on the entrance of that particular little street down which you saw your belongings disappear. As you reach that you see the street empty but a door on the right just closing and, yourself, springing through it are brought up all standing in a little ten-by-twelve court-yard. Before you have time to speak, there sounds right above your head a peal of chimes than which you will hear few more melodious and, looking up, you see right above you — and it is the only thing the limits of the court allow you to see — with the low sunlight and soft shadows rich upon it, the tower of the Cathedral directly overhanging and threatening to let fall into the space about you some bit of stone crumbled from its top. The sight will make your heart jump as much in perturbation as in very joy and exultation at its beauty and unexpected impressiveness. The tower is one of great intended richness and in its unfinished state — it is only 324 feet high — is extremely effective. A better idea of scale can be had by knowing that the clock-dial measures 49 feet in diameter. The publication of Prout's drawing gives an excuse for using a negative which otherwise would never have seen the light.

THE CATHEDRAL, MALINES, BELGIUM.

THE Cathedral of St. Rombault, in Mechlin, or Malines, is the work of the fourteenth and fifteenth centuries, but it is only by a close examination that the differences of style are apparent. The principal nave was constructed in the fourteenth century, but it appears from a distich in Flemish that the vaulting was not completed until 1451. The choir was vaulted in 1487. The building is, therefore, a late example of Gothic, and the intentions of the designers were never realized, owing to the difficulty of obtaining money. That under such circumstances the Cathedral should be so grandiose in treatment is a convincing proof of the power of the forgotten architects. From whatever point of view it is seen, we are struck with the massiveness of the parts. The tower, which is about 320 feet high, is little more than one-half of its contemplated altitude. If carried out as proposed it would have excelled its numerous rivals. Yet the tower surmounts the principal entrance, and, with all its massiveness, rests on the walls of the building.

RIVER HOUSE, TITE STREET, CHELSEA, ENG. MESSRS. BODLEY, A. R. A. & GARNER, ARCHITECTS.

NEW MARINERS' CHURCH, ST. IVES, ENG. MR. EDMUND SEDDING, PLYMOUTH, ARCHITECT.

THIS new building is to be built amongst the homes of the fishermen of St. Ives, Cornwall, on a very picturesque site.

NEW PARK ROAD WESLEYAN CHURCH, ST. LEONARDS-ON-SEA, ENG.

WESLEYAN CHURCH, BEXHILL, ENG.

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.*]

SWISS CHALETS.

PHILADELPHIA, PA., September 1, 1892.

TO THE EDITORS OF THE AMERICAN ARCHITECT: —

Dear Sirs, — Can you recommend to us any work giving illustrations of Swiss châlets, or any set or list of photographs in which they may be found? Very truly yours, "PHILADELPHIA."

["*Les Constructions en Bois de la Suisse*" by Ernest Gladbach, published by Vve. A. Morel, Paris, is in its way an excellent book. Besides this there are Graffenried and Sturler's "*Architecture Suisse*" and Hochstetter's "*Schweizer Holzarchitectur*." — EDS. AMERICAN ARCHITECT.]

NOTES AND CLIPPINGS

THE WORLD'S FINEST RAILWAY STATIONS. — A small party of civil engineers dined together at the Manufacturers' Club a few days ago, and, over the coffee and cigars, the new terminal station of the Reading Railroad and the proposed new station of the Pennsylvania Road at Broad and Market Streets, were the subjects discussed. Apropos of this topic, Caldwell Fothingale of Trenton, who was one of the party, remarked: "I have been looking into the subject of fine railroad stations recently, and we Americans are by no means the only people who go in for very fine ones. Probably the most costly one on earth will be the Waverly station, which is the Edinburgh terminus of the North British Company, for in the company's negotiations with the municipal authorities, it was stated that the cost of the immediate approaches, station, etc., would be at least a million pounds sterling. The finest station in the world at present is that of the Indian Peninsular Railroad in Bombay, which cost in our money $1,500,000 and took ten years to build. The finest in Europe is said to be the new central station at Frankfort-on-the-Main in Saxony. Owing to the substructures some of the London stations have been very expensive, that at Cannon Street costing $1,200,000 and the Charing Cross Station $800,000. There is a new and very large station at Birmingham, England, that cost $1,250,000." — *Philadelphia Record.*

The Mont Blanc Observatory. — It may be remembered that M. Janssen, the well-known director of the Meudon Observatory and member of the French Institute, who last year made the ascent of Mont Blanc in order to examine the practicability of the scheme for establishing an observatory there, finding that at 40 feet below the surface of the snow there was no solid bed of rock for the foundations of a building, conceived the idea of constructing one which could be kept in its place by the snow itself. He accordingly formed an association, to which Prince Roland Bonaparte, M. Léon Say, M. Raphael Bischoffsheim, Count de Greffulhe, and Baron de Rothschild were liberal subscribers, and the funds thus obtained were spent in the construction of an observatory which, after having been put up in the grounds of the Meudon establishment, has been taken to pieces again and sent off to Chamounix, from which place it will be taken up to the summit of the mountain and put together under the supervision of M. Capus, the well-known explorer who accompanied M. Bonvalot, in his journey through Central Asia and Pamir into India. The new observatory is of timber and is about 25 feet in height, being divided into two compartments or stories, surmounted by a square platform, with an iron balustrade and a wooden scaffolding for the reception of the various meteorological instruments. There are several rooms in each compartment or story, for the use, upon the one side, of the director and his staff, and, upon the other, of tourists and their guides. These rooms will be provided with barrack furniture and with small stoves for heating and cooking purposes, the fuel used at first being anthracite. The two stories communicate with each other by means of a spiral staircase, while there is a straight ladder with a trap-door giving access to the room for the guides. Ventilation is provided for by means of tubes, while the windows of the upper story, with double framework and double panes of glass, afford views in various directions, among others towards Chamounix, with which it is intended to communicate by means of semaphorical signals when the atmosphere is sufficiently clear. All the timber has a thick coat of fireproof paint, and each piece of wood is numbered so as to facilitate the observatory being easily put together — a work which, it is hoped, will be completed by the end of September It remains, of course, to be seen whether the building will, as M. Janssen anticipates, remain in its place by the simple process of letting the planks, which are to form the outer walls, down some distance into the hardened snow. — *Invention.*

Rapid Building in Chicago. — The British Consul at Chicago in his latest report gives an example of the extraordinary rapidity with which lofty buildings are erected there. The Ashland Block, a construction of steel, stone and terra-cotta at the corner of Randolph and Clark streets, close to the City-Hall, seventeen stories in height, was built on an area of 140 feet by 80 feet in midwinter, and work was continued, day and night, by relays of men, strong arc electric lights being used by night; artificial heat was furnished by ten salamander stoves to enable the builders and masons to work at that season of the year, and protection from cold winds was given by several hundred yards of thick canvas. The skeleton of steel for each floor was first erected, each column, girder and rafter being lifted and placed in position by steam power; these were rivetted with red-hot rivets, and as the stories rose they were filled-in with square blocks of terra-cotta and brick. On December 6, last year, six floors were completed, and the steel skeleton for the next six stories was for the most part placed. On December 19 ten floors were completed, and the steel shell for three more stories was in position. Thus the entire construction of four floors of a building 140 feet by 80 feet, divided into numerous rooms, was solidly built in thirteen days, or one floor in three and one fourth days. About sixty iron and steel workers, one hundred brick masons and thirty-five terra-cotta setters were continually at work. The enormous quantity of iron and steel used in this new mode of construction, which was only first tried six years ago, has created quite a new industry, and the employés have already their organization under the term architectural iron workers. Steel has now almost entirely taken the place of iron, of which the first few of these tall buildings were constructed. The foundations are tiers of steel rails embedded in concrete, the beams stretching 10 feet or 12 feet under the street. This plan was found necessary on account of the nature of the soil, so as to bear the great imposed weight These beams are made at the Illinois steel-works, or come from Pennsylvania. This new method of building is said to be lighter and stronger than the old system, and to be absolutely fireproof. The greatest variation in the plumb line from base to top of these tall buildings has been found not to exceed half an inch. — *Exchange.*

The Brussels Labor Exchange. — Belgian philanthropists appear to have been more successful than their neighbors in starting a labor exchange. Sir Edmund Monson has forwarded to the Foreign Office an interesting report drawn up by Mr. Conyngham Greene on the Brussels "Bourse du Travail," or Labor Exchange — an institution that owes its origin to a charitable association in that city. The association referred to is described as independent of any consideration of party, and as aiming solely at the removal of all pretexts for mendicity by raising the moral tone of the unemployed. The Labor Exchange was founded by them with the object of facilitating an interchange of employment between capital and labor, and of improving the relations between employers and those in search of work. Its action is, in the opinion of Mr. Greene, beneficial, as it restrains the indiscriminate distribution of alms, and substitutes in its place a supply of remunerative employment. — *The London Daily News.*

One Application of the Eight-hour Law. — It's a poor rule that won't work both ways. A certain man in the furniture business readily acceded to the demands of his workmen for an eight-hour work-day, but when they wanted ten hours' pay for eight-hours' work he called them up and said: "My fr'ens, maype I do ash you like. I haf an order from Chegago for ten dozen shairs. Will ship him eight dozen and bill him ten. If he doan' kick on me it shows me dot der rules vorks both vhays, and ve vhas all rights." — *Boston Manufacturers' Gazette.*

Remains of the Ælian Bridge, Rome. — In the grounds near the bridge of St. Angelo, in Rome, opposite the Mausoleum of Hadrian, some workmen recently discovered unmistakable remains of the Ælian Bridge which Emperor Hadrian built in 135 a. d. to connect his mausoleum with the Campus Martius. Unfortunately the remains of this masterpiece of architecture had to be destroyed to make room for a new channel of the Tiber. A number of drawings and photographs have been made, however, by order of the Government. — *N. Y. Evening Post.*

TRADE SURVEYS

The foundation is being laid for investments of savings and accumulations. A demand is setting in for bonds and securities of countries, cities, gas, water and transportation companies and companies of all kinds. Brokers and handlers of securities report a great increase in inquiries for bonds and stocks and for shares in the smaller class of concerns. The crop of new enterprises of the past two or three years has, generally speaking, made good returns. These enterprises have been well managed. There has been need of them. Material for construction or supplies has been cheap. Most of the capital has been loaned by individuals, instead of being borrowed from banks. Supervision has been in the hands of practical men. Hence there is now an increasing flow of money in these little enterprises. Brokers say, and quite probably with truth, that there is more money offering for investments than there is room for in the particular field here referred to. In the general markets there is an unusual demand for money. The drain of gold continues, but the United States Treasury is gaining, and the increase is likely to continue at the rate of two million dollars per week for some time to come. Cheap silver is expanding its export. Exports of grain and provisions continue on a very large scale. The volume of general business is very large, and profits continue light, the volume for August being 8 1-2 per cent larger than for August, 1891. Trade indications are all favorable. Tradesmen are beginning to carry larger stocks. Manufacturers are once more entering upon production on a large scale, believing the markets will absorb all they turn out. This may again lead to overproduction, which, in view of the very close margins, would prove disastrous in a shorter time than in other years when margins were larger. Straws point in the right direction. For instance, seventy-six railroads in third week in August earned eight per cent more than during same week last year; bank clearings are heavier, and crop movements indicate a growing demand. The cotton crop was 9,035,379 bales, against 8,652,597 for 1891. Industrial deposits are increasing at the rate of eight per cent each year in volume in savings and other banks, a statement which goes far to bear out the references to the generally prosperous condition of the working classes. Building operations are expanding also. Much new work was undertaken during August. There is an extraordinary demand for brick, and prices for all standard makes are firm. Cements are also strong in price, and material for pavements has advanced. Lumber has hardened at wholesale in Northwestern and Southern markets, but it is not probable that retail prices will be advanced. Mills are crowded with work. Planing-mills are especially busy. Yellow pine has hardened in price because of the widening market for it in the North and West, an improvement which is most welcome to manufacturers, who have been selling close to cost for two or three years. The iron trade exhibits remarkable vitality, especially in plate and structural iron, the demand for which has assumed large proportions, accompanied with higher quotations. All the mills are crowded. The bar mills are also in a better condition than for two or three years. The sheet mills are sold ahead about two months. Large transactions in steel rails are probable very soon. The textile trades are also in excellent health. Very little dulness is observable. Prices rule low, but the demand compensates. The low rates are more due to domestic than to foreign competition. The carpet industry is quite prosperous. Hosiery manufacturers are all running full time, and stocks are light, even in the face of enormous importations. In the tobacco industry there has been great activity. Among clothing manufacturers unusual activity prevails, and large stocks have been accumulated for winter distribution. In the foundry and hardware trades there has been a steady increase of business since last spring, due to large building operations, large crops and to general prosperity, but in these, as in other lines, there has been serious depressions in prices. In the machinery-making branches there is much encouragement. All lines seem to have as much work in hand as is desirable. The bridge-builders are crowded. Boiler and engine makers have contracts running through six months; in many instances much machinery is wanted. Improvements have made it imperative to take out much that is old and substitute newer designs and better methods. There is, relatively speaking, less reserve capital than a few years ago, business men relying on collections to conduct business. The commercial agencies speak with much satisfaction of existing industrial and commercial conditions. A presidential campaign threatens very little the existing satisfactory conditions. The distributors of goods in the larger Eastern cities report a good trade so far, but speak as if a heavier fall trade than is usually experienced will come. One fact to bear out this prediction is that store-keepers all over the country have been all along carrying very light stocks. The only danger at present threatening is that producers in all directions may be tempted to make a larger output than there is an immediate market for, because of the lower margins. The first impulse under an increasing demand is to make more goods to compensate for the smaller profits. The outcome of this, if it occurs, must be an increase in the number of commercial failures.

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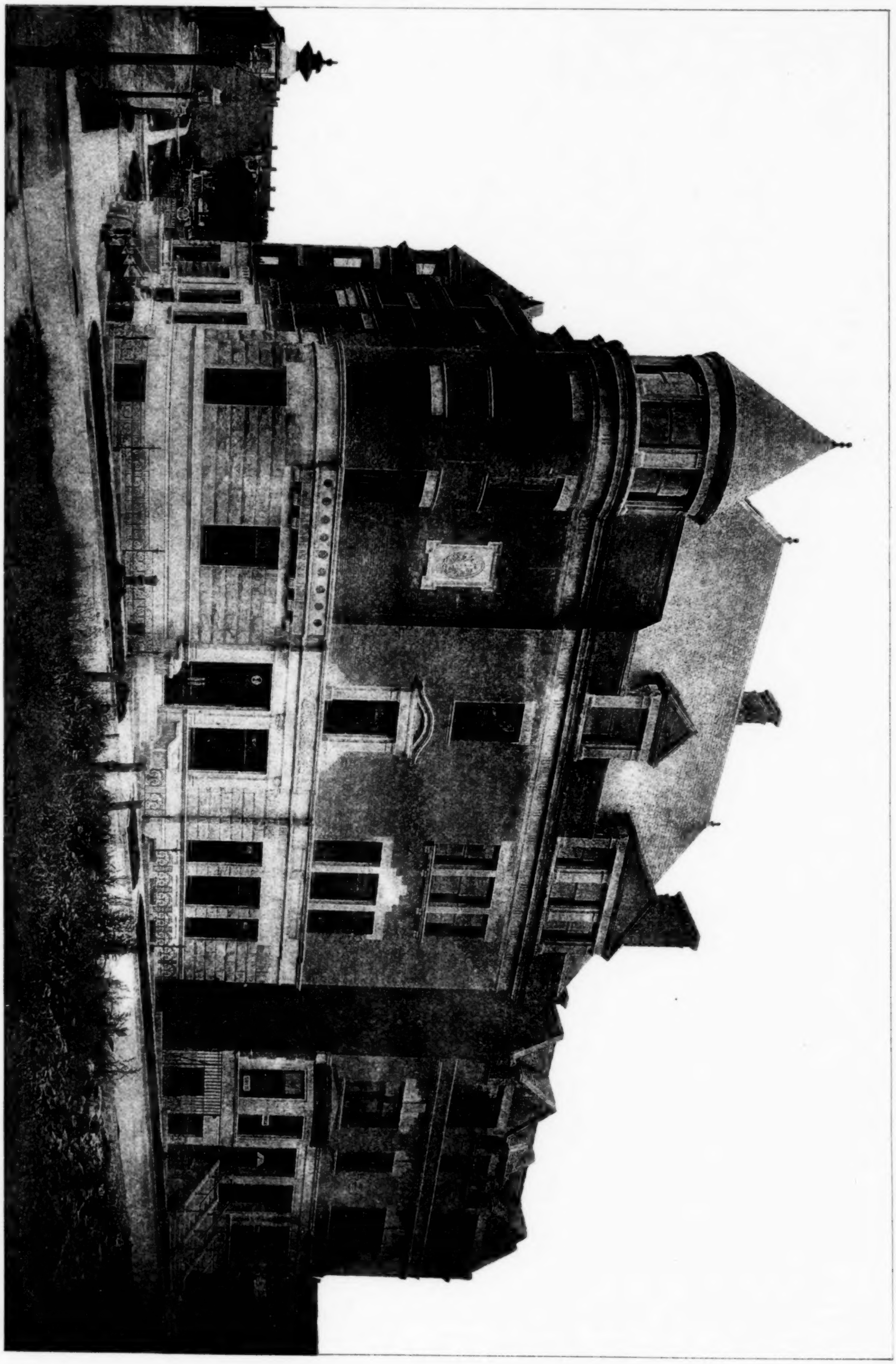

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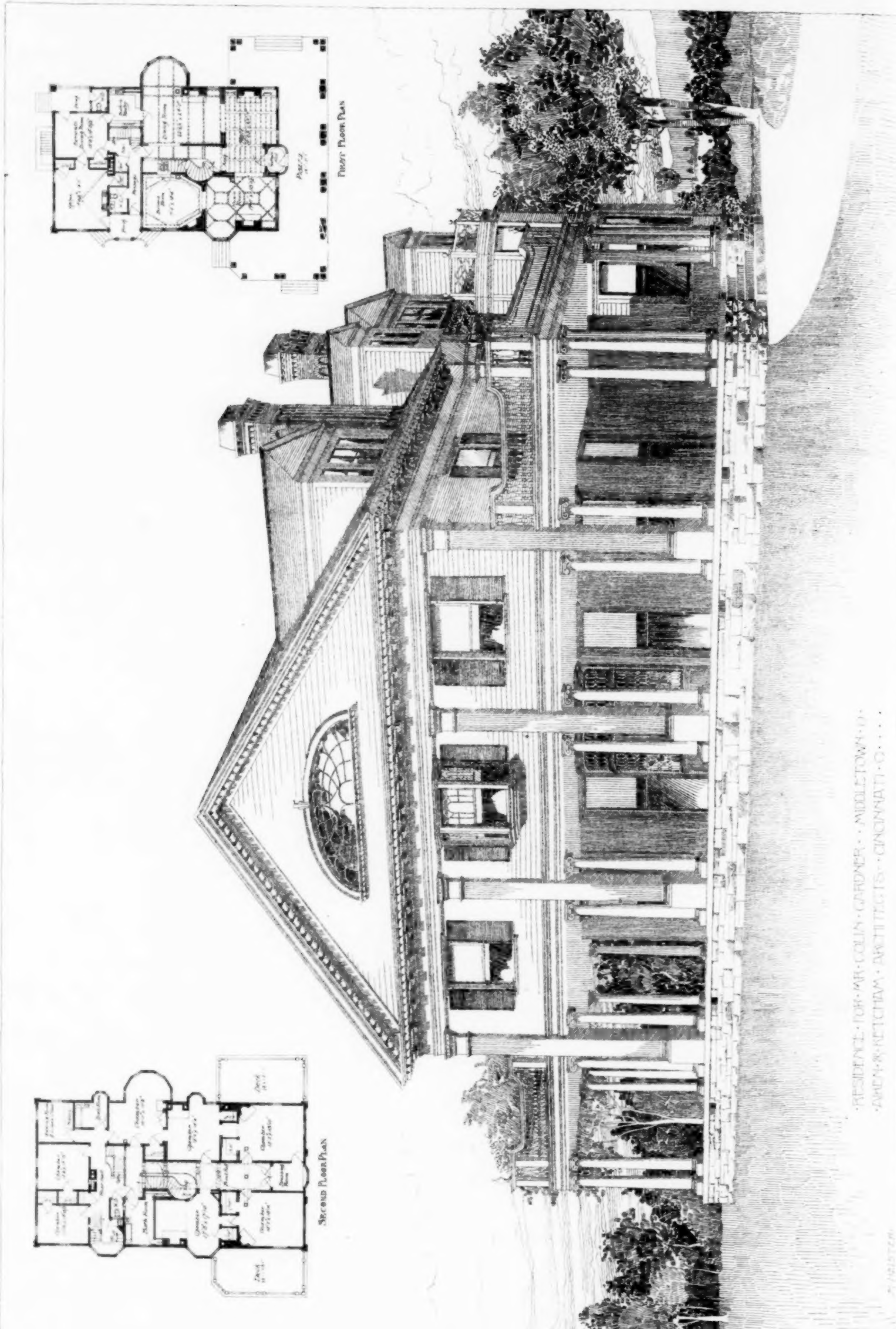

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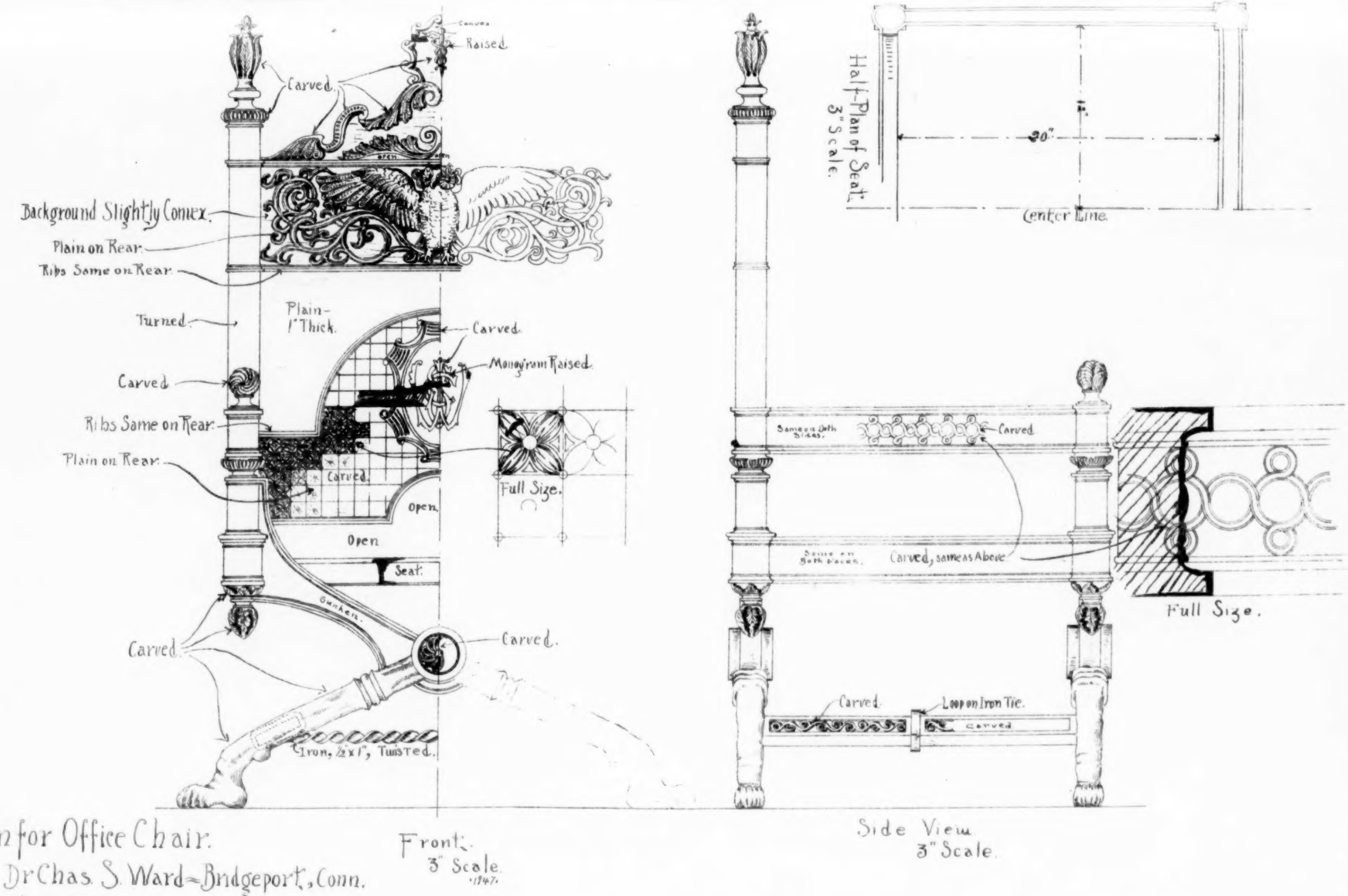

Design for Office Chair.

Dr Chas. S. Ward - Bridgeport, Conn.

C. T. Beardsley Jr. - Arch't.

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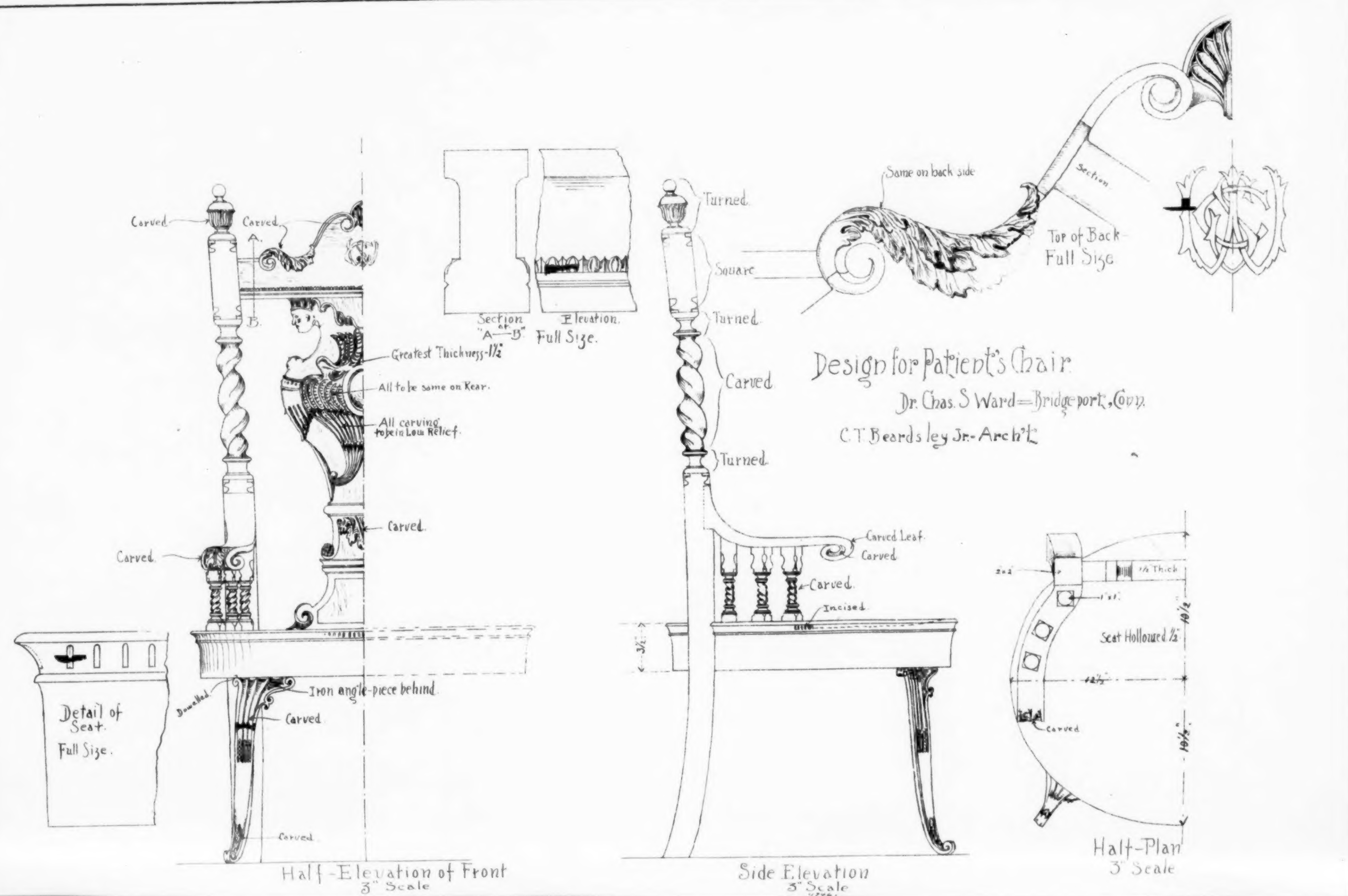
Design for Patient's Chair
Dr. Chas. S Ward = Bridgeport, Conn.
C. T. Beardsley Jr. - Arch't.
Carved.
Carved.
A.
B.
Greatest Thickness - 1½"
All to be same on Rear.
All carving to be in Low Relief.
Carved.
Carved.
Iron angle-piece behind.
Dowelled.
Carved.
Carved.
Detail of Seat. Full Size.
Half-Elevation of Front
3" Scale
Section at "A—B"
Elevation.
Full Size.
Turned.
Square
Turned.
Carved
Turned.
Carved Leaf.
Carved
Carved.
Incised.
3½"
Side Elevation
3" Scale
Same on back side
Section
Top of Back
Full Size
1¼ Thick
Seat Hollowed ½"
12½"
10½"
10½"
Carved
Half-Plan
3" Scale

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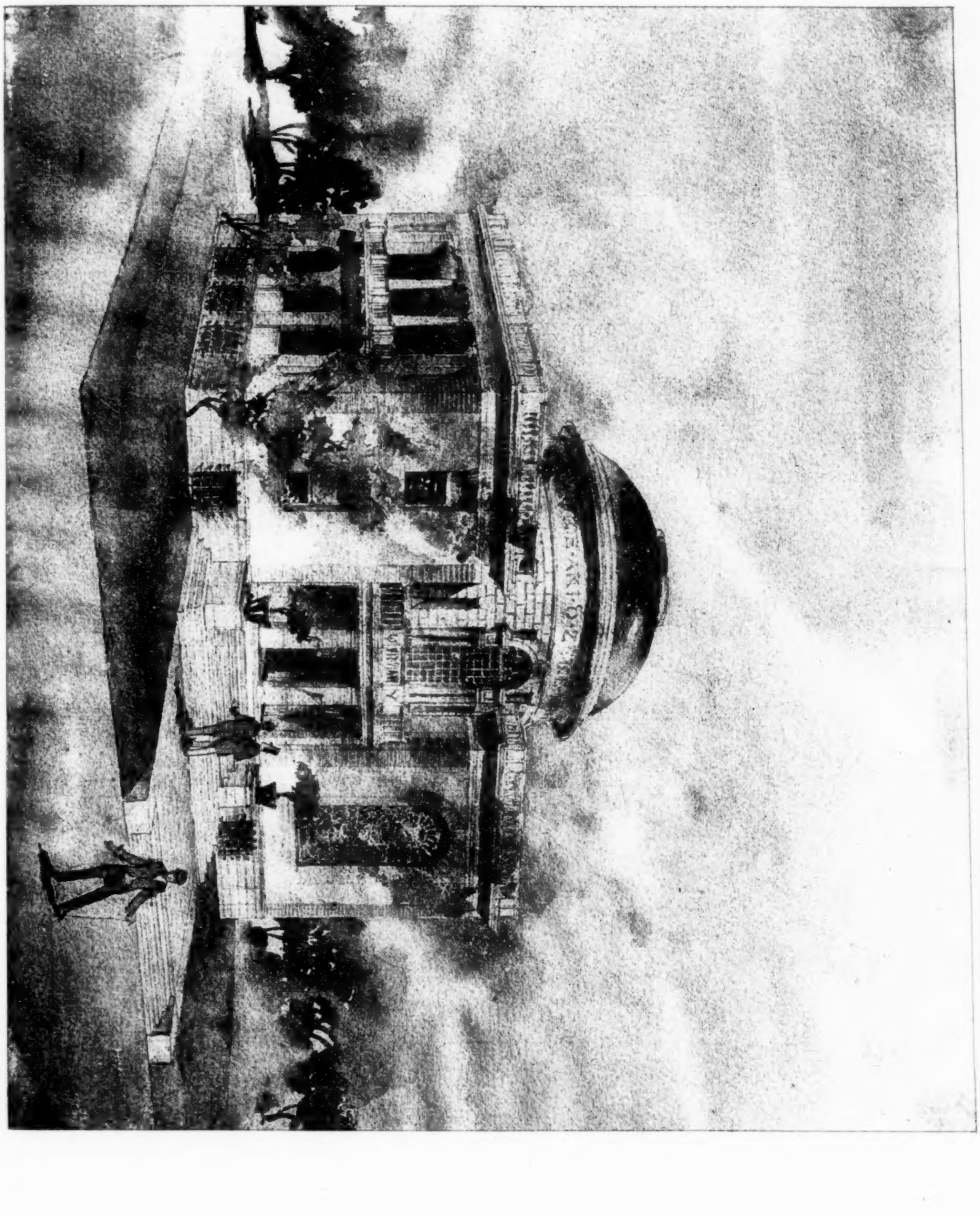

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