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A City Architect Appointment Controversy. The city of Milwaukee, Wisconsin, has been in the throes of a controversy between the mayor, who wishes to appoint a city architect, and the architectural profession there, which wishes the designs for schools and other municipal buildings to be furnished by competition. The mayor claims that the best architects do not compete, and the architects that it places the work too much under the control of the unscrupulous when in the hands of a political appointee. The situation is common, almost universal. City buildings should represent the best architectural talent of the city. It is rare that an architect of high attainments can be induced to take the office of city architect, both for financial and other reasons, and it is the low estimate placed upon architectural skill by the general public and the seeking to obtain architectural skill for nothing that defeats the prime object of a competition. Let the public first understand that good architecture means good buildings in design and plan. That architectural talent, like all other desirable things, should be paid for and then adopt the lesser of the two evils, a politically appointed architect on an inadequate salary or a competition, and adopt a competitive system that will be adequately paid for and intelligently adjudicated, with a general saving of cost to the city.

Causes of Lack of Interest in Chapter Meetings. The spreading influence of the American Institute of Architects is gradually drawing the attention of architects generally to the desirability of local professional association. As the rules of the Institute demand that the membership should generally come through local associations, the organization and reorganization of such is reported from many points. But the organization of a body of architects is one thing and its continued activity and increase in membership and usefulness is another. The organization in the State of Minnesota is a case in point. An association was in existence there, but with no connection with the Institute or other body, before the organization of the Western Association of Architects in 1884. Since that time a local body has been organized three times. The reason seems to largely lie in the lack of professional enthusiasm. Practically it is because the members will not recognize the great benefits to be derived from association and give the necessary proportion of their time and talents to the association meetings. Not in mere attendance and the payment of the small sums that are required for maintenance, but in seeking to make each meeting valuable, interesting and even entertaining to each member who attends. They should contain instructive matter from the active experience of practitioners. There should be music for those who enjoy harmony, humor should not be overlooked, for meetings should never be made formal, and a general air of helpful and fraternal good fellowship should prevail. The lack of these qualities in the meetings is the fundamental cause of small memberships and small attendance upon Chapter meetings, and no organization can possibly succeed that does not have among its members those who are self-sacrificing enough to devote time and thought to the success of the association meetings.

MODERN CONSTRUCTIVE METHODS.*

BY E. C. SHANKLAND, C. E.

THE most interesting portion of a building to the structural engineer is the foundation. In Chicago the very compressible soil made unusual care necessary in designing the foundations of the high office buildings.

The soil of Chicago is made ground to a depth of twelve to fourteen feet, then a layer of hard clay six to ten feet thick is struck, and upon this layer is placed the spread foundations. Below this layer is a soft clay extending down to a shale formation overlaying the rock, the latter being found at a depth of eighty to one hundred feet.

The first high buildings were put on spread or floating foundations made of steel beams imbedded in concrete. Each foundation was made of such a size that the load coming on the clay would not exceed three thousand to thirty-five hundred pounds per square foot. This often necessitated putting two or more columns on one foundation.

In figuring load on clay, only dead weight of building is taken into account, as it was found impossible to get a uniform settlement when live load was carried into the footings.

In one large and costly building in Chicago, built some years ago after plans by a celebrated Boston architect, the live load was considered in designing the foundations.

The result is that the walls of the building settled very much more than the foundations carrying the interior columns, and the floors are six or eight inches higher at the center than around the outside. In consequence extra men are stationed on the floors to help the truckmen push the trucks up the incline.

The settlement of the buildings put on spread foundations is from eight to twenty inches. This is allowed for by putting up the foundations when work is begun.

The settlement curves of the Masonic Temple, three hundred feet high, are shown herewith.

The first vertical row of figures on the left give the number of the column, the next row the inches of settlement, and the other spaces on the right show the years covered by the observations. You will note that the settlement is not great for about two months after foundations were put in place, but as the building went up and the loads on the footings increased the curve becomes very much sharper. You will also note that the greatest variation in the settlement of the columns occurred at the start when the difference in loads was greater; afterward the settlement becomes almost uniform, changing at northeast corner when the smoke-stack at column nineteen was increased in height, causing an increased settlement at this point.

No settlement has taken place in the past five months, as shown by the horizontal lines. It is, however, questionable whether any of the very high buildings ever entirely stop owing to the effect of the wind against them. The prevailing winds in Chicago come from the west and southwest, and the higher buildings when they lean at all, invariably lean east.

The Great Northern theater, hotel and office building was erected east of the Great Northern Hotel, built several years before. The hotel has a court in the center of the east side and the theater of the new building adjoining the court on the west.

Heavy fire-walls separate it from the office and hotel portions. These walls, each weighing, with the floor loads, sixty thousand pounds per lineal foot, meet the east wall of the present Great Northern Hotel at right angles. This east wall had been originally regarded as a party wall, and its footing had been constructed strong enough to carry a floor load from each side. The end of the theater wall where it meets the east wall could not rest on the footing of the latter, which projects nine feet six inches, as it would overload the footing, being only on one side, besides being too great a load. The old building had also practically stopped settling, and the new one would probably settle ten to twelve inches. The floor load, however, from the east side had never been put upon this footing, and in addition it was deemed safe to load it somewhat higher than it had been originally, as the east wall, fourteen stories high, had been resting upon it for four years. Plate girders were placed lengthwise in the theater wall, with their ends projecting through the old wall, and resting on 36-ton hydraulic jack-screws, which in turn were supported by I-beams lying on the footing and parallel to the old wall. The plate girders were of such a length, and so located, as to transfer to the old footing the desired weight. The screws were raised to their full height, so that they could be lowered fourteen inches if necessary. As the new building settled these screws were run down at regular intervals, until the settlement stopped. Levels are being taken on the building. After the settlement has entirely ceased, the screws will be surrounded with concrete and left.

A rather curious example of foundation exists at Duluth. The Duluth General Electric Company very recently installed a 1000-K. W. dynamo, and the vibration caused by it affected buildings five hundred feet away. The vibration of a 5-story building over five hundred feet away was very perceptible. The building is close to the bay, and I found on examination that the ground is swamp and made ground down to about sixteen feet, where a hard stratum is found. This made ground is filled with water and transmits vibrations in waves.

The buildings are built on piles driven into the hard ground, but the top sixteen feet are entirely unsupported laterally. One building, however, also about five hundred feet away, was found to have no vibration whatever, and it developed that when the foundations of this building were put in the whole area was excavated down to the hard ground, and filled with sand to the top of the ground.

In order to avoid the excessive and long-continued settlement due to spread foundations, piles were used, and latterly concrete caissons, going down to the shale overlaying the rock or going down to the rock itself, are supplanting both. When it is not found feasible to go clear to the rock the caissons are belled out at the bottom, generally to twice the diameter of the caisson itself; that is, a six-foot caisson is belled out to a diameter of twelve feet on the bottom and the angle of the slope of the bell is about thirty degrees with the vertical. When the caissons go to rock the belling is not necessary. The caissons are made by digging down from four to six feet, just as a well is dug, and then lining up the shaft with wooden lagging, the strips vertical, held in place by iron hoops made adjustable. Then another section is excavated and lagging put in, and so on down. When bottom is reached concrete is put in, and lagging removed one section at a time until hole is filled.

One building, now being erected, will rest on about ninety caissons from seven to ten feet in diameter, carried down to rock, which is from one hundred to one hundred and four feet below surface of ground.

A large State street department store, now occupying a 6-story building, has just started to tear down the old building, and erect a 16-story building in its place. The foundations for the new building, however, are all now in place, and have been put in during the past three months. Over sixty concrete caissons, from sixty to eighty feet deep, have been built without disturbing the old building, and without the knowledge of the thousands of shoppers who daily filled all the floors above. In some cases it was necessary to shore up the old building, and take out an old basement pier and put a caisson directly under it. At night the material excavated during the day was taken up to the street through an opening in the sidewalk, and hauled away in wagons.

Concrete caissons and piles are often used in foundations of same buildings.

There is no settlement, when caissons are used, beyond that due to the shrinkage of the material while being put in place.

The use of concrete, either in large masses or reinforced by steel, has made great strides in the past few years and continues to grow in favor.

The drainage canal used it in immense quantities and in some cases in a very bold manner.

After foundations next in importance comes the fireproofing of the steel frame of the building. Concrete floor systems are now being exploited in great variety. Some of the systems have merit, but all of them make too great claims.

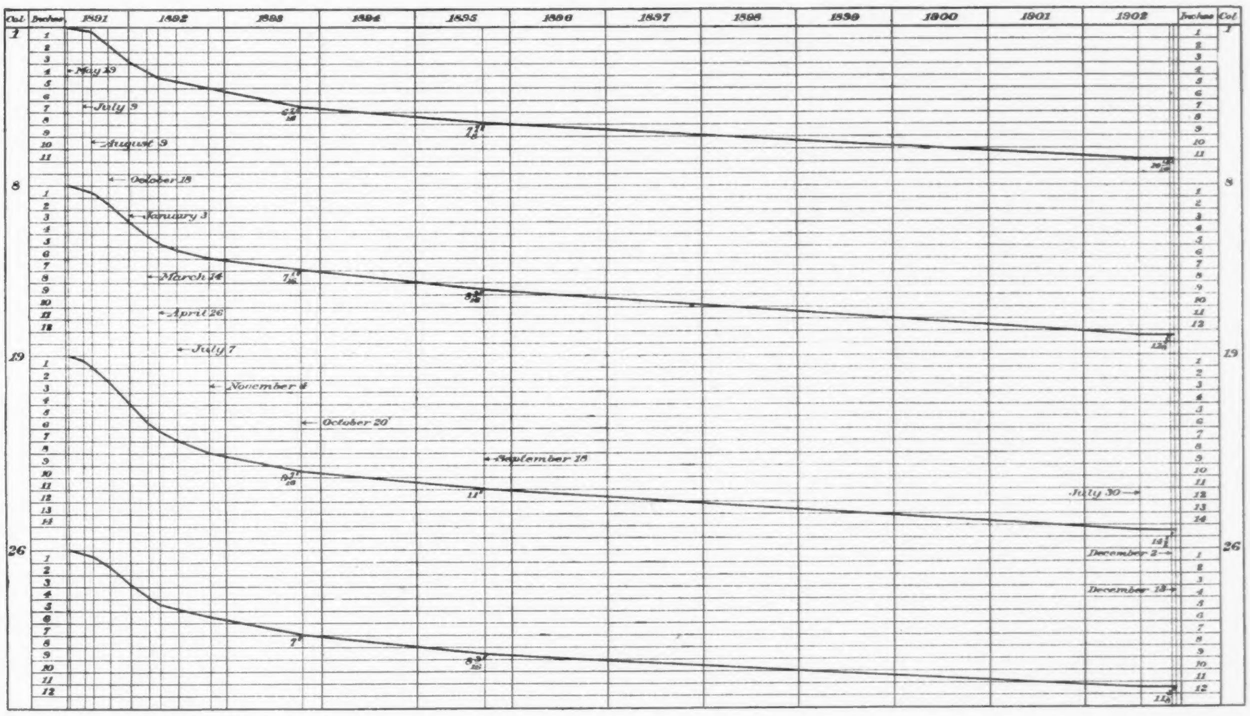
A concrete slab three or four inches thick, even if reinforced with steel in some form or other, should not be used in a very much greater span than we now use for steel beams with hollow tile arches between. It has been gravely told me by a concrete sales-agent that in case of 2 by 15 inch beams, say 7-foot span, it would be perfectly safe not only to deduct the difference in weight of floor between the 3-inch concrete slab they proposed to use and the weight of a 15-inch hollow tile arch, but in addition the

* Paper read before the Ontario Association of Architects, at Toronto, Canada, January 14, 1903.

section can be reduced twenty-five per cent on account of the help the concrete gives the steel. In other cases they state you can, with concrete, use 17 to 25-foot spans, and save all the steel thereby taken out.

One question, however, they decline to answer. Ask them, instead of telling the vertical load it will support without collapsing, to turn their slab of concrete three or four inches thick and 17 to 25-foot span, on edge, and then load it. They invariably decline to test it this way. Now, in a 20 or 30-story office building lateral stiffness in the floors is more essential than carrying

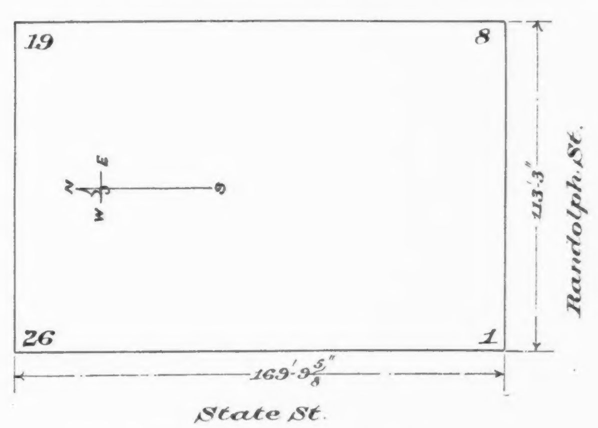
Levels Showing Settlement of Masonic Temple Chicago.



capacity. A thin slab of concrete laid on top of twelve or fifteen beams can not, by the very nature of things, add to the lateral support of those beams. But a 12 or 15-inch hollow tile arch laid in between the beams does make a stiff floor.

Experiments as yet have not demonstrated that concrete floors are fireproof, as compared with hollow tile which already has been burned.

While I have faith in concrete and believe it has great possibilities which will be demonstrated in the future, yet I think that



now, in order to compete with hollow tile, its advocates are making claims which can not be substantiated, and in the future they will have to be more conservative, not only in their statements but in their construction, in order to succeed.

Recent failures, one — in Jackson, Michigan — where the falling of the floors pulled down the outside walls; and another of four floors which collapsed in a $500,000 apartment building in Chicago, will undoubtedly prove beneficial in the lessons they teach. Many other failures in concrete floor construction have occurred in the past few years, but these are the most recent.

Another thing, a building is not necessarily fireproof because it has steel floor-beams and columns. Naked steel or cast-iron is not fireproof. Wood is far preferable, for if it is of sufficient size it chars on the outside, and the charring acts as a protection. Every bit of structural steel must be covered with a fire-resisting material in order to be fireproof.

The last engineering papers give an account of destruction by fire of two English spinning-mills, one resulting in the death of nine persons and the injury of a large number. The report sums up both disasters as due to the breaking of the cast-iron posts, but the same report says the cast-iron posts were left bare. In the absence of further information it is only reasonable to suppose that the true cause is that these columns were not fireproofed.

Another and possibly a greater danger than fire is rust. Examination of steel buildings, made recently, show that the danger is not as great as some alarmists would have us believe, yet it exists.

In a building built in Buffalo in 1895 all the outside columns were filled with cement grout after the brick and fireproofing had been put around them, thus making the pier a solid monolith with a steel core. This is now being generally followed in the best buildings.

FLOOR LOADS.—The building ordinances of the different cities cover all cases so completely that very little is to be said. New York and Chicago both demand one hundred pounds per square foot for each floor of an office building, or one to accommodate public gatherings.

WIND BRACING.—A great deal has been written about wind bracing in high buildings, and a great many methods of taking care of wind pressure have been brought forward.

Diagonal rods and portal bracing have been tried, but interfere too much with the floor space, and the former especially can not be carried out and made a perfect system.

In the Fisher building, Chicago, erected in 1894, the wind was taken care of on the table-leg principle. Around the outside of the building at every floor the spandrel sections were made of plate girders, thirty inches deep, run between the columns and riveted to them. Each floor was supposed to transmit pressure to all the columns of the building in that story, and so on to the ground.*

*Mr. Shankland's paper was illustrated by drawings and photographs, and samples of concrete, etc. The former, of the Fisher building and others, being familiar to the readers of THE INLAND ARCHITECT, are not reproduced.

THE RELATION OF THE ARCHITECT AND ENGINEER TO THE DESIGN AND ERECTION OF GOVERNMENT BUILDINGS.*

BY JOHN STEPHEN SEWELL, CAPTAIN U. S. E.

Probably every one here present will accept it as axiomatic that the design and erection of Government buildings should proceed according to some well-studied and businesslike system. This should be broad enough to cover the reasonable requirements of every individual case, yet sufficiently well defined to insure always the maximum economy and efficiency; it should also insure the placing of both responsibility and credit for all work where they properly belong.

That there is no existing system of general application is amply demonstrated by the history of Government buildings everywhere, both completed and building. Certain departments of the Government which have considerable building work to do, proceed in a more or less systematic manner; yet not one of them adheres always to its own general methods, and certainly no two of them handle the work in even approximately similar ways. Possibly one reason why the problem has not been definitely solved before this is that it is capable of more than one solution, and is, to that extent, indeterminate. However, there must be some one solution that is better than any other, and there seems to be abundant evidence that it is yet to be found. There is much complaint on the score of artistic merit, or structural excellence, or economical execution in many of the buildings erected under any of the existing systems; while most of those which escape adverse criticism have been handled in some special way, not susceptible of general application.

In what follows, it is not claimed that this best solution is necessarily to be found; it is only an indication of lines along which the writer believes a system could be developed, capable of handling all cases likely to arise in ordinary practice, with reasonable satisfaction to all concerned.

Inasmuch as both architects and engineers have much to do with the design and erection of modern buildings, and neither can do entirely without the other, it would seem to be a matter of prime importance that they be definitely settled in their proper relative positions, in the beginning. This is a matter of more importance in Government work than in private work, because of its greater extent under one ownership. The writer's plan, without elaboration of details, is simply this: the engineer should be a Government official, with authority to disburse funds and make contracts; the architect should be in private practice. The architect, selected in some proper way, should, in general, be responsible for the design of the building, and the Government, through its own engineers, should erect it. If the Government could develop a corps of salaried architects, with sufficient artistic ability, it would be manifest economy to do so; but the very nature of the case seems to make this impossible, and there is undoubtedly a very general sentiment that a "plan factory" is not conducive to the highest artistic excellence in building design. With this sentiment, the writer is in thorough accord so far as artistic features are concerned, though he believes that a well-conducted "plan factory" is an excellent thing when it comes to structural and other engineering work; so that he would always advocate the retention of a good architect in private practice, for the design of a Government building. He would, for all important work, limit the selection to architects of well-proven ability. But on less important works, the competitions, or methods of selection, should be so devised as to give the younger men a chance to win if they can. It is not necessary to go into details on this point, since this paper is merely an expression of opinion on the part of an individual, and not a probable basis for official action.

Now, coming to engineers, there is no doubt that, by a proper system of selection and tenure of office, the Government could get an abundance of competent engineers at moderate salaries, to look after the execution of its building work. These men could easily be trained so as to do away entirely with the general contractor, and even with many of the sub-contractors, at a financial profit to the Government, and with considerable improvement in the standard of work. They would also be in a position to standardize many of the features of building design, which are now sadly in need of it. For instance, among the many so-called systems of fireproofing on the market, some leave little to be desired, some are very good, some fair, and many are wholly bad. A corps of building constructors, employed by the Government, would be in a position to definitely settle which were wheat and which were chaff, and draw the line between them. Certain column sections are structurally good, others structurally bad; under present conditions, quite a percentage of the latter find their way into Government buildings. The same is true of other details in all lines of building work, and this could be corrected by a construction corps such as that herein suggested. Above all, such searching inspection could be provided, that the standard of workmanship would be materially raised. Contractors would be forced to learn that good work can be executed as cheaply as bad, and it is not too much to claim that the general elevation of the standard on Government buildings would exercise a similar and much-needed influence on private work. A corps of building constructors, all well-trained and competent engineers, could, therefore, determine the best types for the various structural features of different classes of buildings; they could standardize specifications for both workmanship and materials; they could prepare the engineering plans themselves, if that proved advisable, or, if not, they would at least, by the results of their investigations with the resources at their command, greatly simplify the architect's work on all but the purely artistic parts of the design. They would make all the contracts, control the various contractors, and be responsible that the approved design was properly and economically executed. But the architect's duties should so far overlap those of the constructing engineer, that it should be his province to consult with the engineer on all points affecting the artistic value of the building, and on these points his authority should be superior to that of the engineer, except in those cases that occasionally occur, where an effect is mistakenly sought at the expense of sound construction. In any event, the engineer, if he happens to take a narrow view of the artistic, should not be allowed to spoil the design, any more than a general contractor, in a like position. * * *

Naturally, a good many questions of detail will at once be raised in considering the probable workings of any proposed new system. Possibly it may be worth while to raise one or two now, and attempt to answer them.

It may be asked, if this building bureau personnel is made up entirely of engineers, who will decide between the various architects in a competition? Who will pass upon the artistic merits of the designs? There should be a board of probably three eminent architects in private practice, retained to advise the constructing bureau in such matters, and their decision on artistic questions should be final. Of course, no one directly or indirectly interested in the composition should be eligible for membership on this board. The building once awarded to an architect, or firm of architects, they should be left entirely untrammeled in their work; the writer thinks this is more certain to follow if the constructing bureau is avowedly not composed of architectural experts. A little advice from the board of consulting architects should be a sufficient check on the design, if any is needed.

Inasmuch as architects, like the rest of mankind, are dependent for their existence upon a certain amount of the things that only money can buy, the question of compensation may also be raised. It is assumed that if the architect prepares all the plans and specifications, the usual percentage for such work would be a proper commission; it ought to be more liberal under the system herein outlined than any other, because so much of the engineering and structural design would be covered by the standard details and specifications of the constructing bureau. Fewer drawings would be required, and the specifications would demand not more than one-fourth of the usual amount of attention. * * *

In case the constructing bureau did away entirely with general contractors, as the writer thinks it should, there would be a very decided economy in having the drawings for the steam, sanitary and electrical work, and also for foundations, structural features and fireproofing, made by its own draftsmen; in this case, the drawings could be made to serve at once as a basis for contracts for materials, as well as to interpret the design. The writer thinks this might be arranged with justice to all concerned, by having the architect supervise the preparation of these drawings, and paying him the full commission, less only the usual cost of such drawings to the architect himself.

In any event, in Government work, the money must be expended according to law and regulations, and every penny accounted for with a rigidity almost unknown in private work. Contracts must be made in accordance with a mass of statutes, rules and decisions that bewilder one not brought up among them.

Finally, he would like to say that he has not, in intimating that improvement is possible in the existing order of things, meant to criticize any man, or any class of men, engaged upon Government buildings; he believes that most of them are zealous and capable, which only confirms him in the belief that they could produce better results, if organized under a better system.

[Many and possibly all of the features suggested in this paper are now and have for years been component parts of the Supervising Architect's office. Engineers, structural, mechanical, electrical, etc., any one of which is probably the superior for the work required of any to be found in the engineers' corps. As for developing a corps of salaried architects, that is just what the personnel of the Supervising Architect's office is to-day, and they are fully equal in ability and experience to those in private practice. The system of carrying out the work certainly could not be improved upon by any army engineer that we have heard of, as, at the present time, the men who administrate affairs under Secretary Shaw are trained business men, and the conduct of the Supervising Architect's office does not require any more tinkering than is always going on in the direction of more officered service. It has always been an illusion of the army engineer that he knew something more than any one else about the construction of Government buildings. The present paper is evidently a last attempt to insinuate the engineers' corps into the Government's architectural affairs, but the Supervising Architect's office has been so long in capable hands, and its work so successful, that there is little danger of any one taking the suggestions of this engineer for an architectural and engineering bureau seriously. It seems rather bad form for one branch of the service to seek to belittle another, but the army engineer only follows precedent in seeing nothing good outside of his own corps.— EDITOR.]

* Paper read before the thirty-sixth convention of the American Institute of Architects, at Washington, December 11, 1902.

THE EFFECTS OF WIND PRESSURE ON STRUCTURES.

BY ROBERT M. NEILSON.

[From the *Engineering Magazine* for January, 1903.]

As Mr. Neilson himself indicates in his opening paragraph, he is considering the subject of wind pressure on engineering constructions under conditions existing or to be expected in the British Isles. The fact, however, that his discussion is concerned with the general phenomena of wind motion and with the methods of investigation and deduction of formulæ, rather than with the determination of any absolute factors, gives the paper wide application. It is a comprehensive review of the best work that has been done in the field and a clear statement of some not very generally known facts.—THE EDITORS.

IT was the Tay Bridge disaster of 1879, more than anything else, that caused engineers in Great Britain to consider the effect of wind pressure on bridges and other structures. Previous to that event the consideration given to the subject was of a comparatively trifling nature. In fact, about the time of the introduction of iron-girder bridges it was thought by many that, if a bridge were strong enough to carry its own weight and its traveling load, it would be absurd to suppose that any wind pressure could rupture or overturn it. No attempt was therefore made in many cases to estimate the stresses caused by wind pressure or to provide for them in the design of the structure. Of course, it should be borne in mind that for the same factors of safety metal bridges were considerably heavier then than they are now.

After the Tay Bridge disaster, a committee was appointed by the Board of Trade to advise what provision should be made in future with regard to wind pressure. With the scanty data available at the time it is not surprising that some of the recommendations of this committee have not been supported by recent observations. One recommendation made by the committee and adopted by the Board of Trade was that structures in exposed places should be built to withstand wind pressures of 56 pounds per square foot, allowing a factor of safety for rupture of 4 for iron or steel and a factor of safety of 2 for overturning against the action of gravity. The fact does not seem then to have been much appreciated (although it was not unknown) that the action of the wind on large areas is very different from that on small areas. Pressures of more than 50 pounds per square foot have been indicated by anemometers or small registering gauges many times in Great Britain. Rankine gives 55 pounds per square foot as the greatest pressure observed in Britain, this being observed by Dr. Nichol of Glasgow Observatory. Fidler, however, mentions 65 pounds per square foot as having been registered on a gauge erected by the engineers of the Forth Bridge and, according to Bender, 71 pounds per square foot was recorded at Liverpool on September 27, 1875. We have no reason, however, for assuming that the average pressure on large areas is the same as on small. We have no record of a pressure approaching 56 pounds per square foot being actually measured as being exerted over a large area such as 100 square feet; and various observations made by different individuals have proved to us that in the observations in question the average pressure on a large area was different from that on a small one. Experiments were made at the Forth Bridge by exposing two gauges — one large and one small — to the same wind. The pressure per square foot exerted on the larger gauge, which measured 15 feet by 20 feet, was only from sixty to seventy per cent of that exerted per square foot on the smaller gauge, which was only 1½ square feet in area. There are many bridges and other structures now existing in different parts of Britain which were erected at a time when it was not the custom to allow much or anything for wind pressure and which could not withstand a pressure of anything like 56 pounds per square foot.

Sir J. Wolfe Barry made experiments on wind pressures on the Tower Bridge. A bascule of this bridge furnishes about 5,000 square feet of area and Sir J. Wolfe Barry calculated from the power required by the actuating engines, that, while small anemometers on the fixed parts of the bridge adjoining the bascules registered 6 pounds to 9 pounds per square foot, the wind pressure on the bascules was only 1 pound to 1½ pounds per square foot.*

That wind pressure per unit area decreases with the extent of the surface was noted in the eighteenth century by several experimenters, including De Borda and Hutton. The results got by De Borda in one set of experiments are given in the following table:

Surface in square inches.	Intensity of pressure.
9	100
16	109
36	119
81	129

There are two reasons why the average intensity of pressure on a large area should not be so great as on a small area. In the first place, the average velocity of wind is very much exceeded by local currents in the same wind. One of these local currents, striking the full extent of a small area, will cause a high pressure, while it will make little difference to the average pressure on a large area. In the second place, the flow of air is very much upset in the case of a large surface by the lateral flow of the air from the front of the surface, and the velocity of the air for a considerable distance in front of the large surface (or rather, the component of this velocity at right angles to the surface) is probably much reduced.

Mr. T. Seyrig has tabulated the particulars of a number of railway cars and wagons of the Southern Railway of France which have been overturned by the wind. From these particulars it results that the pressure exerted by the wind must have been from 26 to 34 pounds per square foot. It is noteworthy that in every case recorded there were other vehicles in the same train which would have required higher pressures to upset them and which were not upset. There were also wagons which were thrown off the rails and not upset; but, as the wind pressure to accomplish this can not be satisfactorily ascertained, these cases need not be considered. Professor Gaudard also has given particulars of the upsetting of trains in France — in this case between Narbonne and Perpignan — from which it appears that the pressures were from 30 to 50 pounds per square foot. It should be noted that this is a particularly stormy locality.

We have, therefore, fair grounds for the belief that the wind pressure on large areas need never in Britain be expected to approach 56 pounds per square foot. Constructing a bridge or other large structure to withstand a wind pressure of 56 pounds per square foot with the usual factors of safety, seems therefore to be incurring an unnecessary expenditure. If a structure is arranged to withstand an overturning moment due to a wind pressure of 56 pounds per square foot and has a factor of safety of 2, it will require a wind pressure of 112 pounds per square foot to overturn it. Now the maximum ever experienced in Great Britain is probably well within a third of this. It must also be noted that a mere puff of wind will not overturn a massive structure. In the instance just given a momentary pressure of even 112 pounds would in most cases not suffice; a continuous blast would be required to overcome the inertia.

The allowance for 56 pounds per square foot wind pressure is a serious matter with large bridges. Sir Benjamin Baker has calculated that, in some of the members of the Forth Bridge, the maximum forces due to dead load, live load, and wind pressure are as follows:

Dead load	2282 tons
Live load	1022 tons
Wind	2920 tons

It will be seen that the force allowed for wind pressure almost equals the dead load and live load put together and it must be remembered that the provision for wind pressure is responsible for some of the dead load. Sir J. Wolfe Barry, in his address to G section of the British Association in 1898, said:

It is difficult to imagine the amount of money which has been wasted in unnecessary provision against wind strains of 56 pounds per square foot on large areas in consequence of this hurried generalization from insufficient data. I know something of what the provision for 56 pounds on the square foot for wind cost at the Tower Bridge, and I do not wish to mention it; but if the public had been told that the dictum of experts arrived at, however hastily, in 1880, was to be set aside in the construction of that bridge all confidence would have been beforehand destroyed in it and I suppose no committee of Parliament would have passed the Act.

Fidler considers that wind which will exert a pressure for overturning carriages of 30 pounds per square foot will record on a dynamometer a pressure of 40 to 75 pounds per square foot. Anglin is of opinion that for large areas it is sufficient to assume a maximum pressure of 45 pounds per square foot over the whole surface. Still it can not be said that we have reliable information as to how much to allow for wind pressure on bridges and buildings. Much time and labor have been spent on experiments, but knowledge useful to engineers is still far from complete. Since the days of Sir Isaac Newton there have been many experimenters on wind pressure. The French general Didion did much in this way, and among others may be mentioned De Borda, Robins, Rouse, Vince, Edgeworth, Rumford, Piobert, Thibault and Hutton. As however different experimenters used different apparatus, there is a great want of uniformity in the results obtained. I may here give a few of the many formulæ that have been proposed at one time or another for calculating the wind pressure from the velocity of the wind.

Rouse's formula is

$$p = \frac{V^2}{200}$$

where p denotes pressure in pounds per square foot and V velocity in miles per hour. This formula was adopted by Smeaton (it is sometimes called Smeaton's formula) and has been used to a considerable extent.

Didion's formula in British units is

$$p = 0.0036\ V^2$$

the letters representing the same as in Rouse's formula. Didion's formula gives considerably lower pressures than Rouse's.

A formula of modern date is that of Mr. W. H. Dines who based it on the result of lengthy experiments carried out at Hersham in Surrey. Dines' formula is

$$p = V^2 \times 0.003$$

the letters representing the same as in Rouse's and Didion's formulæ. Dines' formula gives slightly lower results than Didion's.

Hawksley's formula is

$$p = \frac{v^2}{20}$$

where p denotes pressure in pounds per square foot and v velocity in feet per second. This formula is based on scientific reasoning, but the assumptions made are quite unwarranted. This formula gives higher pressures than any of the others here cited. The results of the four formulæ are compared in Table

* See the *Engineering Magazine*, November, 1898, page 289.

III. As, however, the pressure on a large area has been shown to be different from that on a small area for the same wind velocity, these formulæ are of little use for general application.

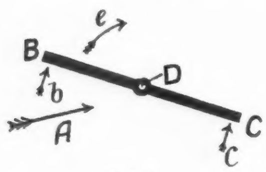


FIG. 1.
Effect of wind pressure on inclined plane.

Besides the question of total pressure it is important to know how the pressure is distributed over a structure. It seems to be evident from numerous experiments and observations that, when a plane surface is inclined to the wind, the pressure is greater at the forward than at the rear end. That is to say, if A, Fig. 1, represents the direction of the wind, and B C is a plane exposed to the wind pressure, the normal pressure exerted on the plane at B as represented by the arrow *b* is greater than the normal pressure exerted on the plane at C as represented by the arrow *c*. If therefore the plane be pivoted at its center D (the pivot being normal to the paper) it will tend to rotate in the direction of the arrow *e*, till it lies at right angles to the direction of flow of the wind. This explains why a throttle valve pivoted about a diameter in a steam pipe tends to close with a flow of steam.

Some interesting experiments were made about seven or eight years ago by Mr. J. O. V. Irminger, engineer and manager of the municipal gasworks at Copenhagen, and Mr. H. C. Vogt of the same city. The draft from a chimney 100 feet high was used to draw air through a duct measuring about 9 inches by 4½ inches. This is shown in section diagrammatically in Fig. 2. A plate P 1⅝ inches broad was extended across this duct and was so fitted that its inclination could be altered at will. This plate although flat was hollow and its interior, by means of a trunnion, was put into communication with one leg of a water gauge W, the other leg of which, by means of the tube T, communicated with the interior of the duct. The plate P was provided with several holes. Only one hole was left open at a time, the others being stopped, and the pressure inside the hollow plate was assumed to be equal to the pressure exerted on the plate in the region of the hole. The water gauge indicated the difference between this pressure and the pressure in the duct. The experiments showed not only that the pressure near the forward edge of the windward side of the plate when the latter was inclined was greater than that near the rear edge (the fact which has just been mentioned with reference to Fig. 1), but also that the normal pressure near the forward edge was considerably greater when the plate was inclined at 45 degrees than when at 90 degrees to the direction of air flow.*

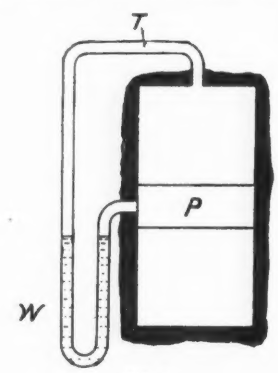


FIG. 2.
Apparatus for measuring wind pressure.

The fact is fairly well established that the pressure on the inclined roof of a house is greater near the eaves than near the ridge, and some experiments would lead us to believe that there may even be a negative pressure near this ridge, as shown in Fig. 3, where the large arrow indicates the direction of the wind and the small arrows indicate by their length and direction of pointing the intensity and sign of the normal pressure on the roof. The phenomenon of negative pressure is not at all inexplicable, if we consider the probable motion of the air over the roof as shown in Fig. 4. Experiments and observations have shown that there may be and probably always is a negative pressure or upward suction over the top of a gas holder during a heavy wind. Of course it will be understood that this is only relative to the ordinary atmospheric pressure as measured by a barometer. Mr. Irminger, of Copenhagen, by means of a registering pressure gauge, ascertained that during a wind that varied from 29 to 70 feet per second the pressure inside a gas holder 170 feet diameter and 90 feet high fell from 6.25 inches to 5.83 inches. This is equal to a lifting force of 2.2 pounds per square foot on the top of the holder. Every one is familiar with the corresponding upward pull exerted by a strong wind on an umbrella.

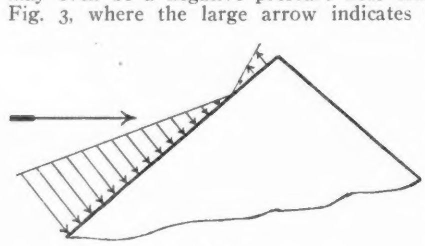


FIG. 3.
Illustrating wind pressure on a roof.

The nature of the pressure on a cylinder with a vertical axis is important, as this is the form of many structures which have to be constructed to withstand the wind. Experiments show that the positive pressure on a cylinder due to wind pressure extends over less than half its circumference (some experimenters put it at less than a fourth), the rest of the circumference being subjected to a negative pressure. Fig. 5 illustrates this, the large arrow indicating the direction of the wind and the small arrows the intensity and sign of the pressure on the cylinder. This diagram is intended, however, only to give an idea of the nature of the pressure on the cylinder and not to be correct quantitatively. For this we require further experiments. The experiments of Berthon seemed to show that the suction at the sides of the cylinder was greater than at the back, the intensity of pressure being somewhat as shown in Fig. 6.

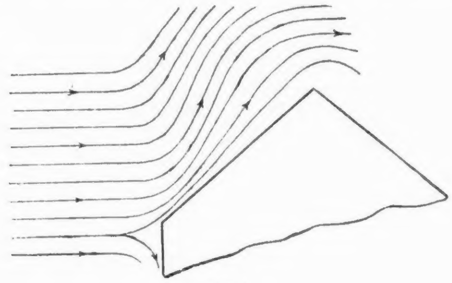


FIG. 4.
Wind striking a roof.

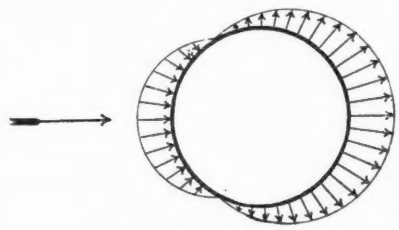


FIG. 5.
Diagram illustrating wind pressure on a cylindrical body.

(To be continued.)

* See the *Engineering Magazine*, July, 1899, page 671.

OUR ILLUSTRATIONS.

Houses, Grand boulevard, Chicago; Peabody & Beauley, architects.

Interior views New Auditorium Annex, Chicago; Holabird & Roche, architects.

Entrance Detail, New Auditorium Annex, Chicago; Holabird & Roche, architects.

"Y. M. C. A." Building at Ann Arbor, Michigan; Pond & Pond, architects, Chicago.

Detail of Entrance, Bachelor Apartments, Philadelphia; Frederick M. Mann, architect.

Church of our Lady of Mercy, Philadelphia; E. F. Durang, architect. Exterior and interior views.

The Weissinger-Gaulbert Apartment Building, Louisville, Kentucky; Kenneth McDonald and J. F. Sheblessy, architects. General view and entrance detail.

Photogravure Plate: Residence, Brookline, Massachusetts; J. A. Schweinfurth, architect.

PHOTOGRAVURE PLATES.

Issued only with the Photogravure Edition.

St. Peter's Episcopal Church, Germantown, Pennsylvania.

Police Station, Brookline, Massachusetts; J. A. Schweinfurth, architect.

Residence of R. A. White, Melrose, Pennsylvania; Albert Yarnall, architect.

Roxbury High School, Boston, Massachusetts; Andrews, Jacques & Rantoul, architects.

Interior Views, New Auditorium Annex, Chicago; Holabird & Roche, architects. Three full-page views are shown.

Correction.—The following letter is received in regard to plate of railway station at Savannah, Georgia, printed in December number:

Editor "Inland Architect":

I am in receipt of a copy of your valuable paper for the month of December, and I find in the paper, plate No. 5, Vol. XL, a cut of a railway station, "Depot for Southern Railway, Savannah, Ga., Edwards & Walter, architects." I beg to advise that this is a photograph taken from the Savannah Union Station facing on West Broad street. This building was erected for the Seaboard Air Line, Atlantic Coast Line, Plant System and Southern Railway Companies, and I have the honor to advise you that I was the architect for the building. I not only made the plans, but supervised the construction. There is evidently an error, and I will thank you to have the same corrected. The building cost $175,000. * * * * *

Yours very truly,
FRANK P. MILBURN.

A letter from Mr. W. W. Mackall, president of the Savannah Union Station Company to Mr. Milburn, corroborates the above, saying: "When the Savannah Union Station Company decided to build the depot it requested several of the leading architects of the country, including yourself, to submit competitive plans. The Board of Directors unanimously selected your plan and the credit belongs exclusively to yourself."

NEW AUDITORIUM ANNEX.

ONE of the most interesting buildings put up in Chicago during the year just closed is the new addition to the Auditorium Annex, to be known as the Congress Apartment building. The marble mosaicwork, the lighting and furnishing is all on such an elaborate scale as to warrant an extended description in these columns.

The architects, Messrs. Holabird & Roche, have designed an exterior plain and substantial to harmonize with the Annex, and proves another ornament to Michigan avenue. Wells Brothers Company, of Chicago, general contractors, have completed this building to the smallest detail, and as is their usual reputation, to the eminent satisfaction of architects and owners.

Entering from Michigan avenue, you are charmed by the brilliancy of the marble vestibule, hall and corridor, the latter connecting the new building with the Annex. Here is undoubtedly the most expensive and elegant piece of marblework in Chicago, and one of the best examples of this art in the county. The walls are of veined statuary Italian marble, set in panels and at appropriate intervals are placed fluted half columns of same marble, which adds great beauty to the effect.

The stairway at the right of the hall is worthy of special study, newel post, steps and risers all of same white marble. The illustration gives no adequate idea of the extreme beauty of this part of the hall. The floors of mosaic are a grouping of Belgian black, rouge royal French, white and red Italian marbles. The ceiling is of gold glass mosaic, set in borders of pearl and turquoise blue. The whole effect of all this veined white marble sculptured in Greek designs, floor of marble mosaic, ceiling of glass mosaic, is one of dazzling beauty. The marble contractors for the entire building, Messrs. Sherman & Flavin, Chicago, have put the best product of their large establishment into this work and it reflects great credit on the firm, its designers and artisans.

Probably no public place opened in Chicago of late years has occasioned so much comment as the Pompeiian Room. Whatever the comment may be, it certainly has aroused the interest of all artists and designers, however they may sympathize with this attempt to restore in this Western metropolis the beauty of man's habitation in the first century, A. D. The rooms, as laid out by Messrs. Holabird & Roche, left nothing to be desired in the matter of style, a room 60 by 100 feet, divided by Doric columns into three portions around three sides of a fountain pool. Above the pool an art-glass skylight, a floor of Roman mosaic, the columns to one-third of their height of verd-antique marble, the remainder of white Italian marble, with just a tinge of yellow, and beautifully marked with veins of gray, a wainscot of four feet and piers of same green marble. The green portions of the columns are a plain round, the upper white of the shafts are fluted in Doric style, the caps and moldings are bright gilt. Above the wainscot the walls and panels, high as a line with the top of the columns, are frescoed in arabesques and small wing figures, arranged irregularly on a rich red ground. The large section of the apartment reserved as a lounging-room, lying on the long side of the pool, is raised above the colonnade by an attic which opens over the skylight in a row of windows filled with art glass from Tiffany, representing gardens and arbors of the period. This clearstory forms on the remaining sides a broad frieze broken by the pilasters at set intervals. The pilasters support a cornice and ceiling in stucco, divided laterally into panels by broad beams ornamented with moldings in classic style; cornice beams and plain ceiling are decorated in red, blue and green, with a prevailing light buff ground. The panels of the frieze are filled with airy, dancing figures and landscape effects in soft, light tones; conspicuous on the ceiling are the large fruit borders, framing the panels. The borders are a literal reproduction of a Pompeiian fresco. The Tiffany art-glass skylight is a marvel of beauty, a glimpse of its purple, amber and green spanning the pool below is a recall to the vine-covered arbors and courts of the Campania. To furnish this in Pompeiian style according to all the extant relics we now have in museums and elsewhere, was a simple affair compared to the problem of making this fitment suit the requirements of a twentieth-century crowd. How was the room to be made inviting and comfortable? Chicago business men are not accustomed to lounging on couches at their feasts, in the manner of the Greeks or Romans. Neither couches nor the stiff benches with turned legs, so common among the antique relics, would be serviceable. This problem has been successfully solved by Marshall Field & Co. The modern world has few examples of ancient furniture in wood. Objects in metal are at hand, but the more perishable materials are lost. The ancient writers make frequent mention of the splendid coverings and drapes on couches and thrones. They also name the different costly and beautiful woods popular in the manufacture of tables and chairs, but little can be acquired from their descriptions in the way of design. So in the designs for the large lounging settles and chairs is used what antique detail seemed best fitted to modern use. The high curved backs are built on the line of the Greek klismos, the side and end members molded into winged griffins with leopard heads, the wings spreading backward from the arms, the claw feet resting on the floor, this portion in relief being overlaid with yellow metal. These large pieces, the larger eight feet long, are of dark brown oak, upholstered in rich red plush. The broad curved backs of the great settles are a triumph of the cabinetmaker's art.

DESIGNED BY JAMES CORDAY & CO., CHICAGO.

The smaller of the armchairs are built with open frames, fitted with leather cushions tied on in a modified form of a Roman couch; the carved work consists of turned moldings, rosettes on the sides, arms terminating in dog heads, all the ornaments being overlaid with yellow metal. The large center table is an exact copy in wood of the marble table found in the house of Cornelius Rufus, at Pompeii. It is in dark brown oak, the carving being worthy of special attention, and its beauty can not be questioned. The lighting resolved itself into the familiar bronze candelabra, reproductions of which are in the Naples Museum. Their electric lamps would doubtless startle the Greek artist who originally designed them, but they make a soft and sufficient light for illuminating this spacious room.

Set against the long wall of the lounging-room, flanking the mantels, stand four huge jars. They take the place of the great emphoræ used in the classic banquet halls of Roman houses. They are from the works of the American Terra Cotta & Ceramic Co., Chicago, home of the famous "Teco" ware. Their makers have termed them the "Ali Baba" jars. Their pleasant green color (almost like the patina on a bronze) blends into the walls and marble perfectly. Disposed between the columns about the pool are jardinieres filled with ferns and palms. The models were selected for their simplicity and color, which is a dull green, similar to the large jars and of the same pottery.

Those spaces opening beyond the peristyle at both ends of the lounging-room are set with some three dozen serving tables and chairs. The tables of bronzed iron, with verd-antique marble tops, are adoptions from a motif found in a small tripod in the Vatican Museum. Here, again, the leopard's head of Bacchus is employed, the legs terminating in the hoof of a centaur. The chairs are of oak, stained a dark green brown, and are after the Greek klismos in shape.

The distinguishing features of the Greco-Roman style are those little playful fantasies in detail, forever surprising in variety and suggestion. This feeling is here found in the Tiffany fountain which stands in the midst of the pool, the same that was exhibited at the Pan-American Exposition. In this weird and beautiful creation in myriad points of color, set by a most cunning craft in some kind of cement, the artist has endeavored to interpret in his material the beauty of the geyser pools of the Yellowstone. To fully appreciate the soft, mysterious attraction of this work, come into the room in the dusk of the day, before the evening throng has assembled, sit down in a shadowed corner, with only the soft light from the sky filtering in between the columns, feel the mystery of the white marble against the purple shadows, hear the low rush of the water in the basin; then look between the palm-screened colonnade where the fountain, left to its own company, is disporting like a wild creature caught off its guard. Then you will understand it and find it entertaining.

This room is gaining a far-famed reputation, and an attempt so substantial and elegant must stand in the first rank among things of its class, and compared with similar ambitious creations in other cities, the Auditorium management have every cause to be proud of their atrium and impluvium.

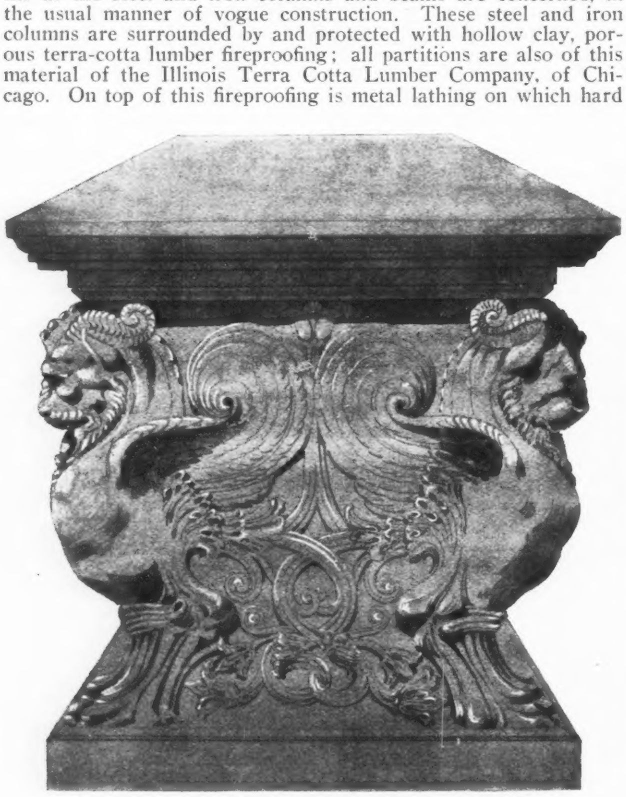
The living part of the house, a portion of which is divided into apartments of from two to seven rooms, is furnished elaborately, excellent judgment being used in all details to give pleasing color effects and to make thoroughly livable quarters. The entire furnishing contract was awarded Marshall Field & Co., and has been executed in a highly artistic manner, making this hotel equal in all appointments for comfort and beauty to any in this country.

The French and English dining-rooms on the Mezzanine floor, decorated by Mandel Brothers, Chicago, are two beautifully equipped rooms for private dinner parties. The French room, being the more delicate, has bird's-eye maple woodwork, ornamented in gold. The wall panels are covered with green moire silk and delicately painted with festoons and garlands of flowers. The ceiling panels are in allegorical design. The English dining-room is in mahogany, with a mantel of Georgia green marble. The wall panels are painted on canvas in fine landscapes. These rooms have received high encomiums for the artistic character in all details of design and finish, which were conceived and superintended by one of our most prominent decorative artists.

We would also call attention to the beautifully modeled electroliers in the hall and corridor. These are of bronze, with a slight touch of antique green in the finish; for design and execution they are not excelled, and the soft, mellow light adds charm to the marble and mosaics. These fixtures were designed especially for the hotel by James Corday & Co., Chicago.

How should a building of this kind be fire-protected? This is a momentous question, for on its decision rests the safety of the people and valuables it contains. It is a question that always demands the best thought and earnest consideration of the architect. The construction of this building has been carried out, so far as the steel and iron columns and beams are concerned, in the usual manner of vogue construction. These steel and iron columns are surrounded by and protected with hollow clay, porous terra-cotta lumber fireproofing; all partitions are also of this material of the Illinois Terra Cotta Lumber Company, of Chicago. On top of this fireproofing is metal lathing on which hard plaster is placed. Porous terra-cotta lumber is made from blue clay. By a peculiar process of mixing and burning the completed product is made porous. Experience has proven that the interior of a room or shaft protected by this material can burn fiercely for hours without endangering the rest of the structure. The fireproofing, being hollow and porous, gives the same protection as a chimney and is quite as safe. All pipes and wires are run through specially provided openings protected with this fireproofing, and no unsightly pipes or valves are visible.

AFTER DESIGN BY MARSHALL FIELD & CO.



AFTER DESIGN BY MARSHALL FIELD & CO.

One of the most interesting features of the construction of this building are the thirteen floors, including roof and basement, which consist of a system of hollow-clay tile arches sprung between the steel beams. On top of these arches is placed four and one-half inches of cement construction, which constitutes the floors, the only wood used being a strip two inches square laid in the cement around the edge of the rooms for the purpose of allowing the carpets to be held in place. The floor area of cement, laid by the Rudolph S. Blome Company, formerly Stamsen & Blome, of Chicago, is about one hundred and forty-three thousand square feet of concrete floors. This firm also constructed the concrete sidewalk and alley pavement. So carefully has the matter of fire protection been looked after that the soffits of the windows, one of the weakest points in a building while on fire, has had specially modeled terra-cotta lumber fireproofing flanges, to set well in the walls, thus avoiding any chance that the flames, pouring out of a window, might have of eating their way up to the floor above by any opening in the soffit. This building is without doubt one of the most advanced in fire protection that has been constructed.

The hardware was furnished by the Orr & Lockett Hardware Company, who supplied all the hardware for the Auditorium and the original Annex. It differs from that used on the other two buildings, being strictly colonial. The doors are all hung on ball-bearing hinges and the beautiful bubble-glass knobs make a pleasing effect against the mahogany doors. This too often neglected item of the proper hardware finish thus completes the embelishment of this superb interior.

PAINTS IN ARCHITECTURE.

THE PEELING OF PAINT.

An erroneous impression prevails among painters that zinc in paint causes it to crack and peel. The fact is that both defects are too common with all kinds of paint, and that when it occurs it is usually, more or less, the painter's fault. No properly designed and properly ground paint applied to fresh, well-seasoned wood in dry weather will begin to crack while the oil in it remains elastic, and no paint will fail to crack in time, if left to itself.

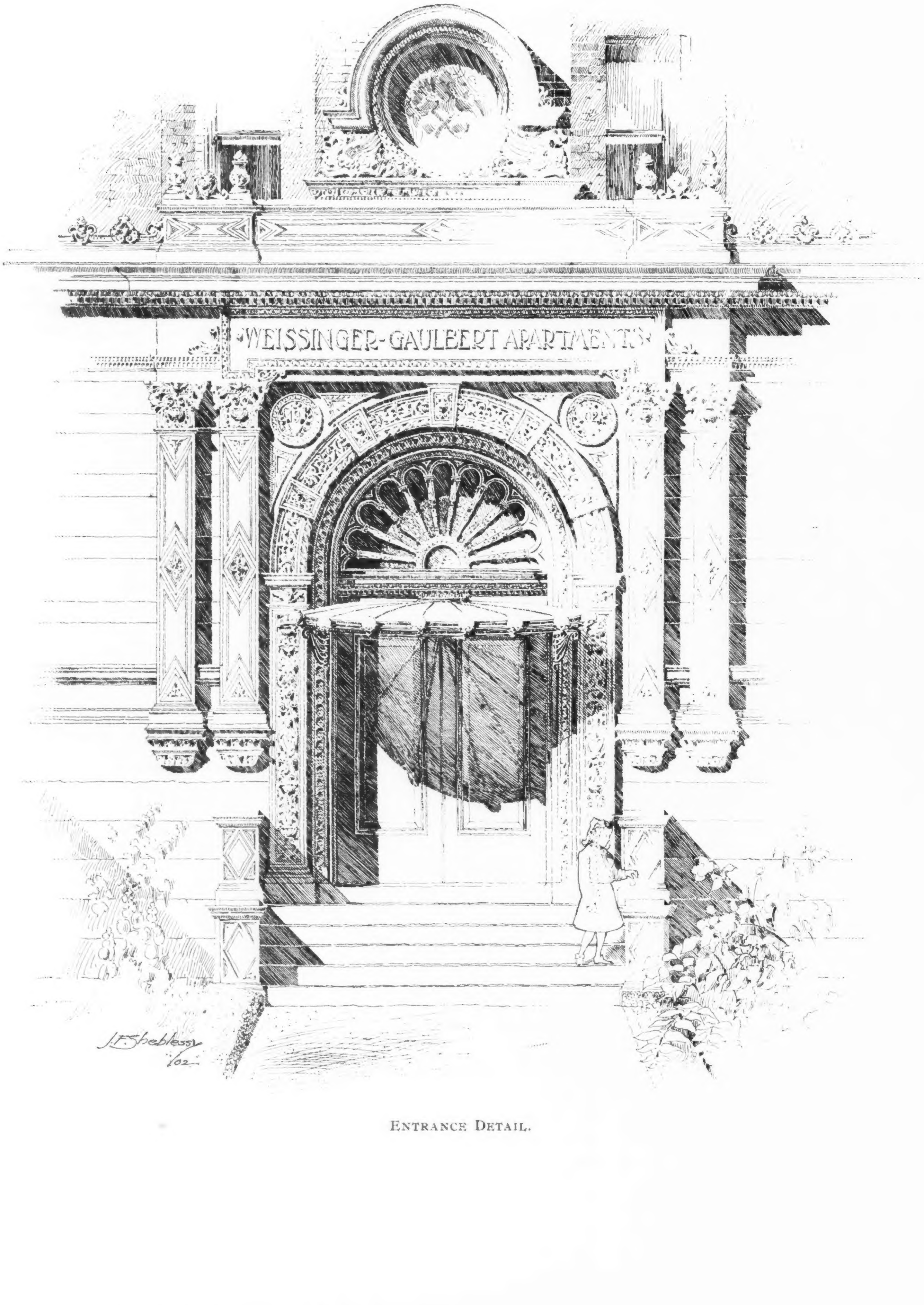
The whole question resolves itself into a matter of judgment as to the safe time limit for repainting. When the paint has become brittle and lost its hold on the pores of the wood, fresh paint will always pull it loose. Repainting should be done before that critical period arrives; then there will be no peeling, even if straight zinc be used. If the under coat has passed the danger point, scraping is the only remedy, whether the paint be lead, zinc or something else.

The painter who accepts a job of repainting without ascertaining the condition of the old paint and insisting on proper procedure, runs the risk of defrauding either himself or his customer, and we know it is usually the latter. If all painters followed the rule of a well-known New York suburban contractor, there would be fewer shabby jobs; if the old paint has passed the limit of safety, he will not accept the job of repainting unless scraping off the old coats be included in the contract.

Charles Jourdain.

MOSAICS.

The seventh competition for the John Stewardson Memorial Scholarship in Architecture is announced for the $1,000 traveling scholarship of 1903. The preliminary examinations will commence April 1 and the final examinations close on May 23. There will be required in the final examination a design for "an official building for a county." The candidates, according to the rules governing this scholarship, must be under thirty years and have studied or practiced architecture in the State of Pennsylvania one year.



ENTRANCE DETAIL.

ENTRANCE DETAIL, BACHELOR APARTMENTS, PHILADELPHIA.

FREDERICK M. MANN, ARCHITECT.

HOUSES, GRAND BOULEVARD, CHICAGO.

Peabody & Beauley, Architects.

ENTRANCE DETAIL.

VIEWS OF THE NEW AU

HOLABIRD & R

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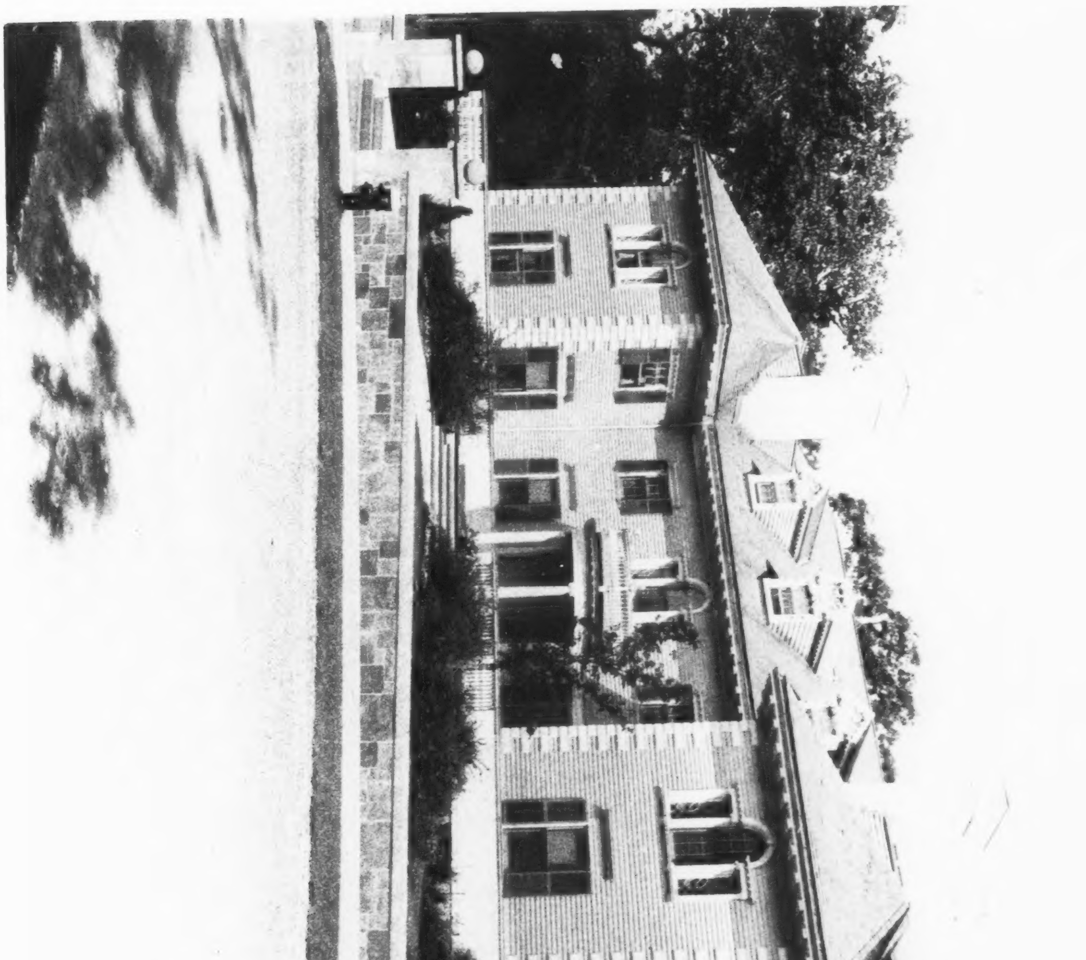
"THE ENGLISH ROOM"—PRIVATE DINING-ROOM.

CHURCH OF OUR LADY OF MERC

E. F. DURAN



Negative by Fred L. Fales, Waltham, Mass.

Inland Architect Press.

RESIDENCE, BROOKLINE, MASS.

J. A. SCHWEINFURTH, ARCHITECT, BOSTON, MASS.

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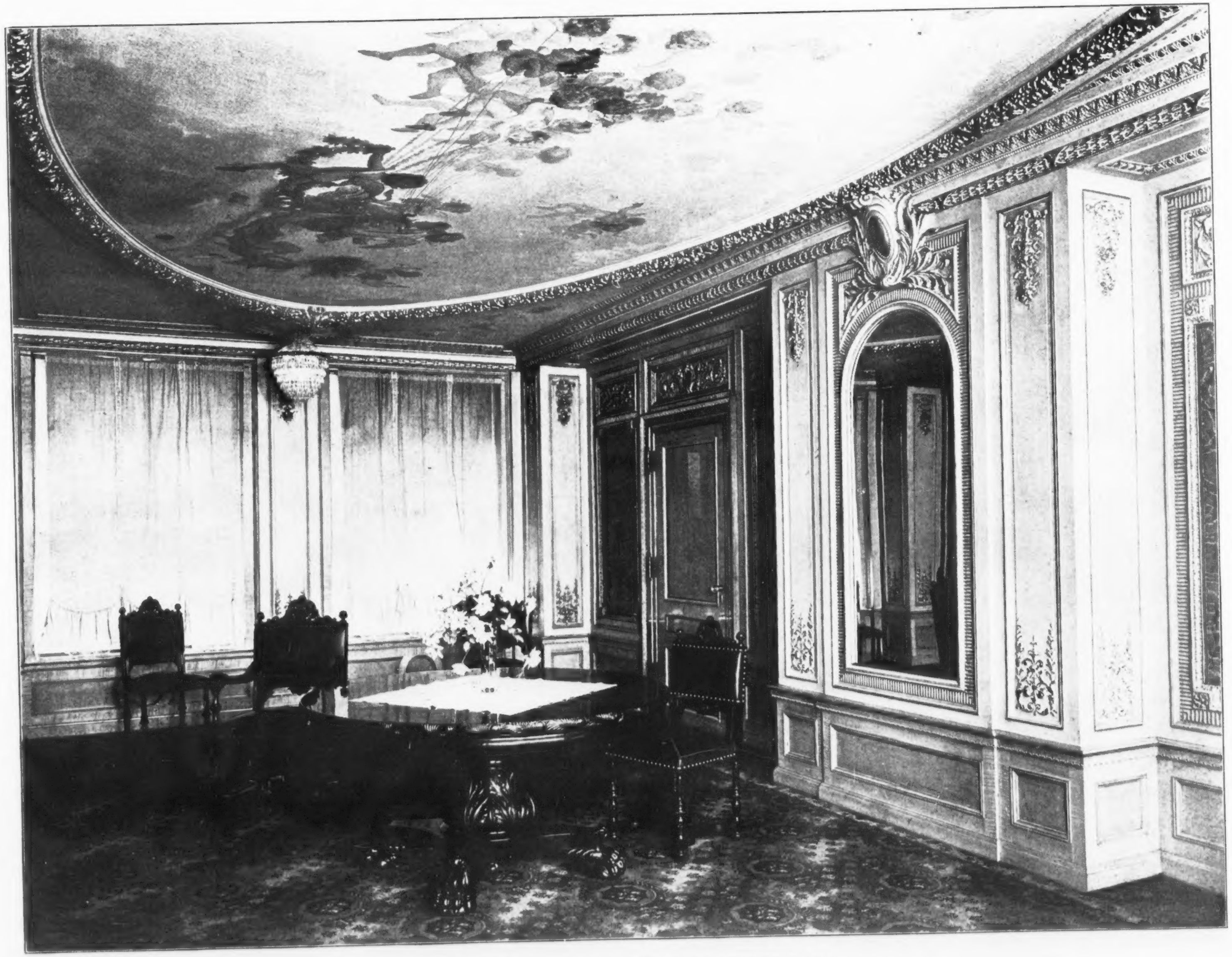


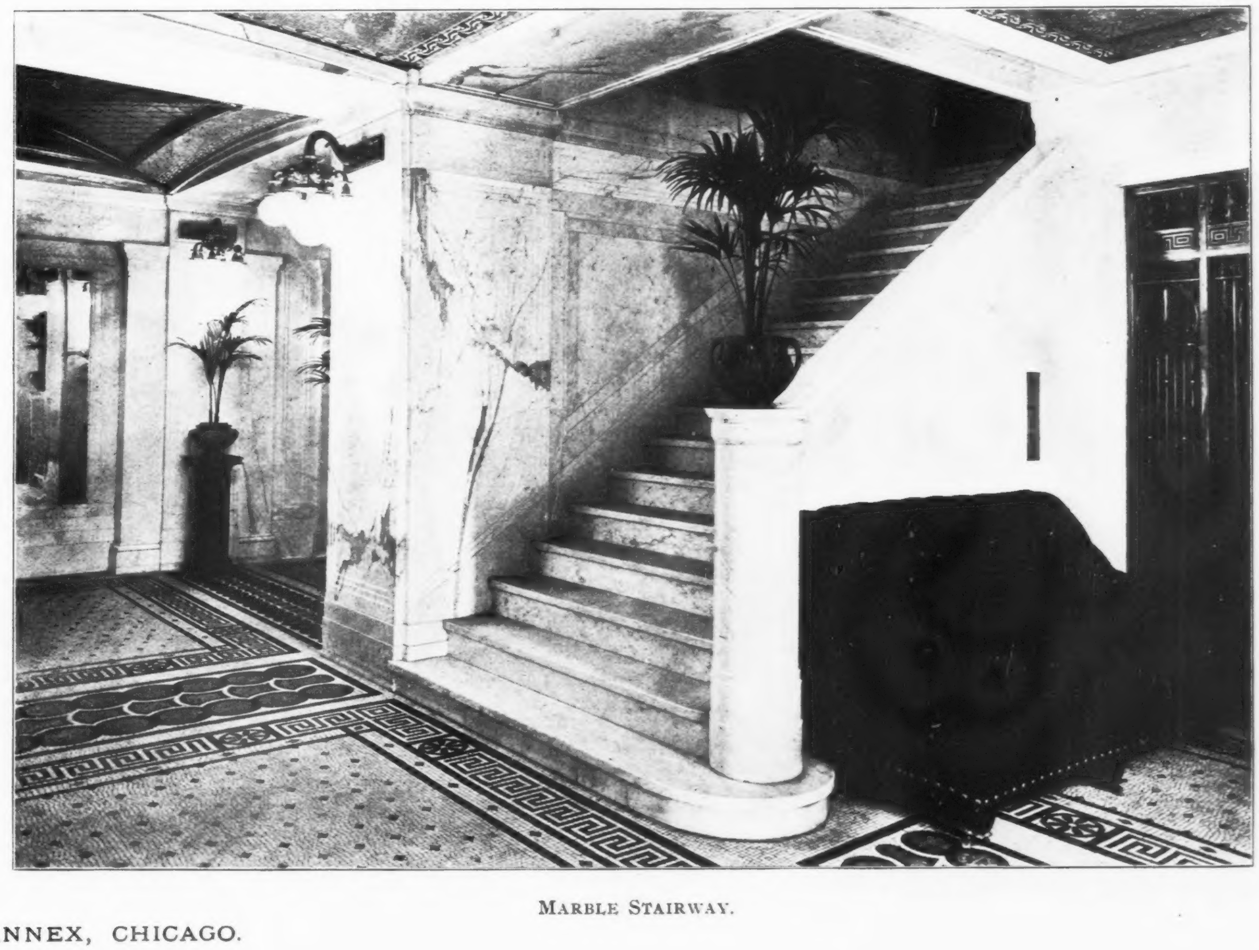
Decorations by Mandel Bros., Chicago.

"THE FRENCH ROOM"—PRIVATE DINING-ROOM.

INTERIOR VIEWS, NEW AUDITORIUM ANNEX, CHICAGO.

HOLABIRD & ROCHE, ARCHITECTS.

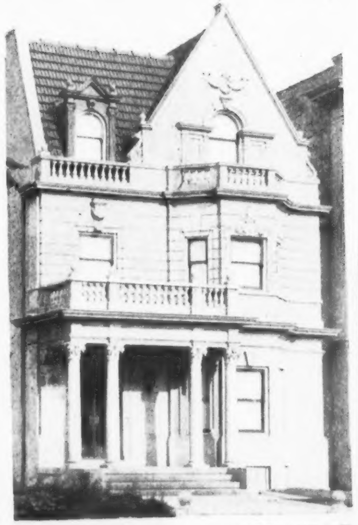
VIEW IN MARBLE CORRIDOR.



MARBLE STAIRWAY.

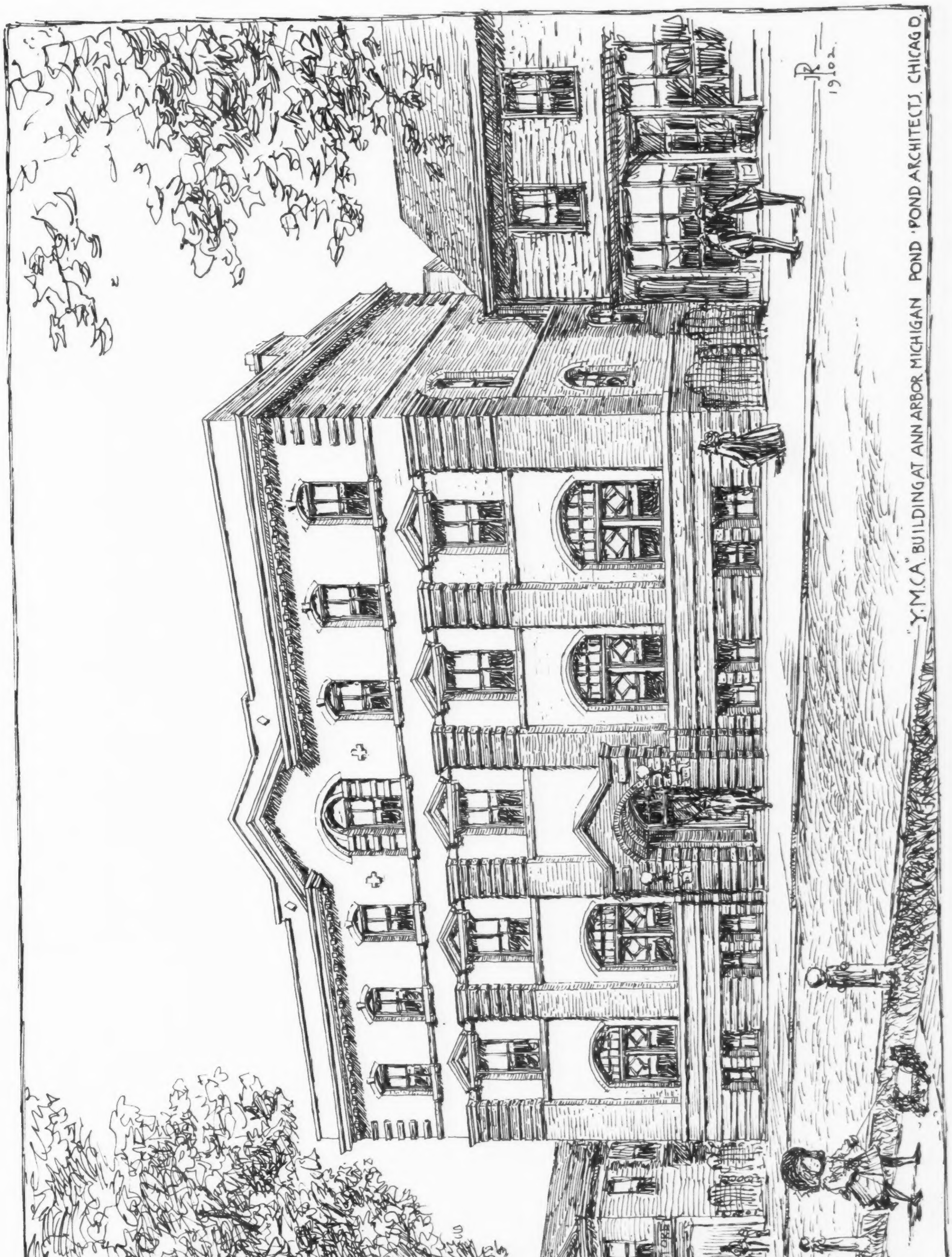
TORIUM ANNEX, CHICAGO.

HE, ARCHITECTS.

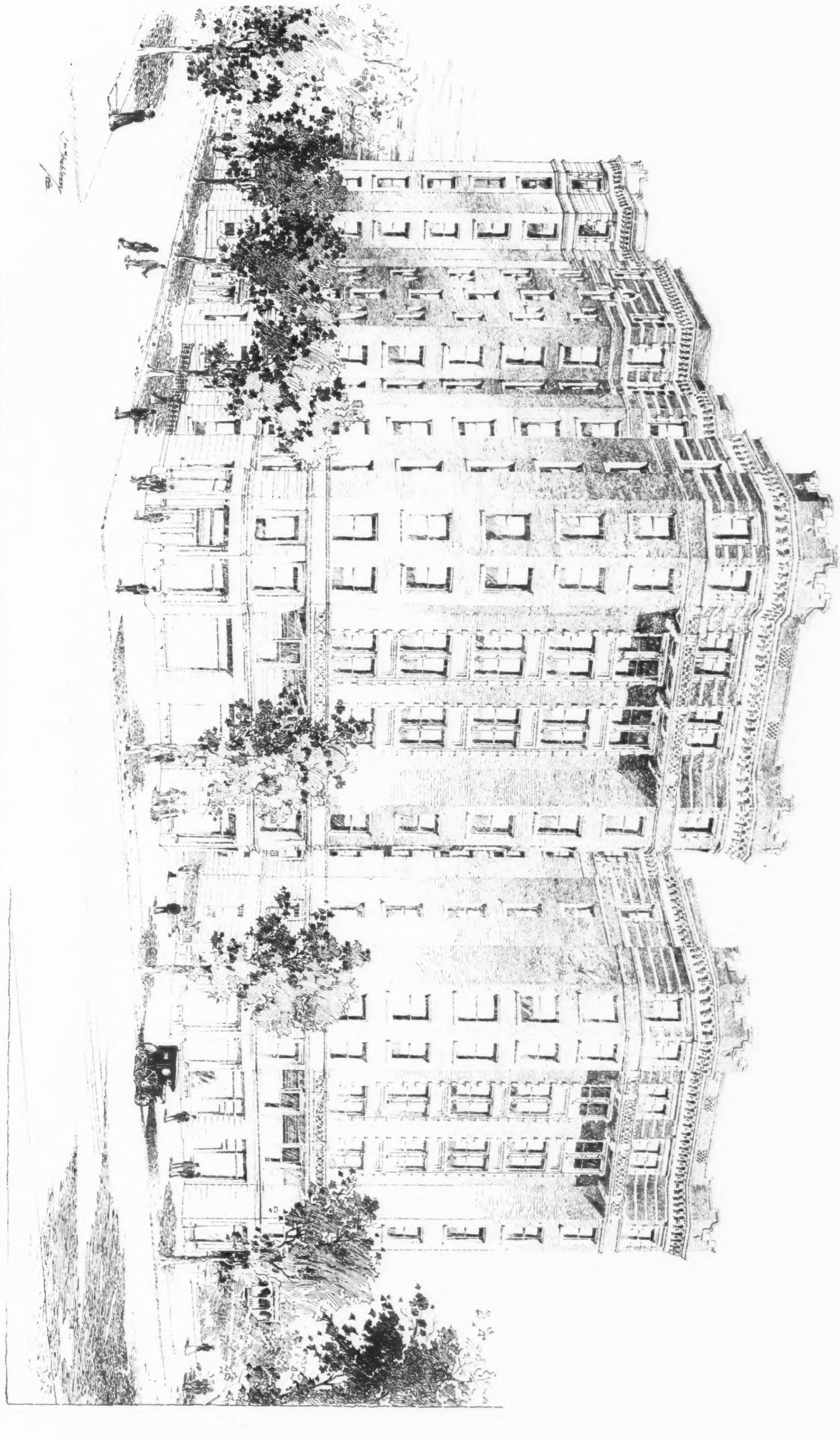


HOUSES, GRAND BOULEVARD, CHICAGO.

PEABODY & BEAULEY, ARCHITECTS.



"Y.M.C.A." BUILDING AT ANN ARBOR MICHIGAN POND · POND ARCHITECTS. CHICAGO



WEISSINGER-GAULBERT APARTMENT BUILDING, LOUISVILLE, KENTUCKY.

KENNETH McDONALD AND J. F. SHEBLESSY, ARCHITECTS

SPECIFICATION REMINDERS

BRICK

Enameled.

Fire.

Ornamental.

Paving.

Porous.

Pressed.

Sewer.

CEMENTS

Domestic.

Imported.

Portland.
Garden City Sand Co., 188 Madison St., Chicago.

Utica.

CLOTHES DRYERS

Chicago Clothes Dryer Works, 65 S. Canal St., Chicago.

CONTRACTORS

General.
Clarence I. Wolfinger, 164 LaSalle St., Chicago.

DECORATIONS

Interior.

Iron.

Lincrusta Walton.

Marble.

Plaster.

Stone.

Wood.

ELEVATORS

Electric.
The Winslow Elevator & Machine Co., 96-100 N. Clinton St., Chicago.

Freight.

Hydraulic.
The Winslow Elevator & Machine Co., 96-100 N. Clinton St., Chicago.

Passenger.

Steam.

Water Balance.

FIRE BRICK

Garden City Sand Co., 188 Madison St., Chicago.

FIREPROOFING

Monier Construction.

Tile and Concrete.

Wire, Metal and Lath.

FLOORS

Hardwood.
Acme Parquet Floor Co., 4703 Cottage Grove Ave., Chicago.
E. B. Moore & Co., 37 Randolph St., Chicago.
E. R. Newcomb, 14 Monroe St., Chicago.

Marble.

Mosaic.

Parquetry.
Acme Parquet Floor Co., 4703 Cottage Grove Ave., Chicago.
E. R. Newcomb, 14 Monroe St., Chicago.

Polished Maple.

Rubber Tile.

Tile.

White and Yellow Pine.

GLASS

Ornamental.
Schuler & Mueller, S.W. cor. Madison and Canal Sts., Chicago.

Plate.

Prismatic.

Sheet.

Stained.

HEATING

Electric.

Furnace.
Robinson Furnace Co., 107 Lake St.

Steam and Water.
William A. Pope, 79 Lake St., Chicago.

Steam and Hot-Water Boilers.
Kellogg-Mackay-Cameron Co., 110 Lake St., Chicago.

Valves, Boilers and Radiators.
Western Valve Co., 43 W. Randolph St., Chicago.

INTERIOR FINISH

Clarence I. Wolfinger, 164 LaSalle St., Chicago.

IRONWORK

Doors.

Jail-Work.

Ornamental.

Shutters.

Stairs.

Structural.

LIGHTING

Electric.
Wagner-Bullock Electric Mfg. Cos., 1624 Marquette Bldg., Chicago.

Fixtures.

Gas.

Gas Machines.

MOLDINGS

Brick.

Composition.

Iron.

Marble.

Plaster.

Stone.

Wood.

MOTORS

Electric.
Wagner-Bullock Electric Mfg. Cos., 1624 Marquette Bldg., Chicago.

PAINT

ROOFING

Felt.

Iron.

Shingle.

Slate.

Tar and Sand.

Tile.

Tin.

SAND

White.
Garden City Sand Co., 188 Madison St., Chicago.

SASH LOCKS

Harley Burglar Proof Ventg. Sash Lock Co., 92 La Salle St., Chicago.

STONE

Granite.

Indiana Oolitic Limestone.
Perry-Matthews-Buskirk Stone Co., Chamber of Commerce Building, Chicago.

Sandstone.

TERRA COTTA

Enameled.

Ornamental.

Porous.

TILE

Opalite.
W. T. Carter & Co., 305 Dearborn St., Chicago.

VENTILATION

Fan System.
Garden City Fan Co., Chicago.

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71 & 73 Randolph Street.

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Table and Pocket Cutlery.

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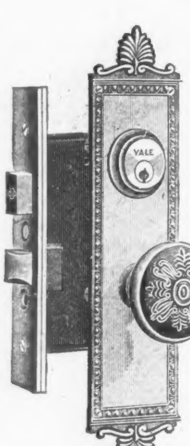

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