THE BRICKBUILDER.

VOL. III. BOSTON, FEBRUARY, 1894. No. 2.

AMERICAN ENAMELLED BRICK.

A paper read at the Annual Convention of the National Brick Manufacturers' Association.

Gentlemen of the National Brick Manufacturers' Association:

I HAVE been assigned the subject of "American Enamelled Brick," and I will endeavor to handle it from a practical standpoint, to the best of my ability, and in as short a manner as possible.

I will not attempt to deal with the history of the enamelled brick industry, except so far as is necessary to make my article clear and intelligible. Until within very recent years the usual method of enamelling brick in this country has been to cover the face of the brick with an opaque enamel, commonly called a "true enamel."

Within the last six or eight years the English, or slip-and-glaze, method has been adopted by a few manufacturers.

I will endeavor to contrast the products of the two processes, and then give you my views concerning the method followed by my own firm, and trust that I will be able to make my meaning clear, so that those who intend to engage in this industry may be able to use my advice intelligently, whether it meets their own particular views or not.

I will first take up the subject of enamelled brick, and will briefly set forth the facts which led us to adopt the other method. I will state frankly that I do not claim to be an expert in the true enamel line, and will not attempt to go into a discussion of the methods employed for fear of giving you false information, or misleading ideas.

Before we engaged in this business we, of course, examined all the available enamelled brick jobs in our immediate vicinity. We found the majority of them laid up in brick of domestic manufacture. In most cases they were red brick, enamelled. The contrast between the domestic brick and the imported article was marked, and, while both had their defects, the imported brick were far superior to those of home manufacture.

We found the English, or glazed, brick more uniform in color, and also that they withstood the hardships to wish they were exposed much better than the enamelled brick. I have seen some very handsome samples of enamelled brick, and must confess that the manufacturer of enamelled brick can turn out some samples that in many respects are much more handsome in the hand than those of his glazed brick competitor; but when it comes to a laid-up wall I have failed to find a single instance in which the general appearance of the wall was not in favor of the glazed brick. Both classes of brick craze to a certain extent, both will peel, and both will vary in color.

In the glazed brick we found these defects less frequent than in the enamelled brick. The enamelled brick presents the more glossy surface, but the glazed brick gives the more level face. In the enamelled brick you must necessarily have a more or less rounded corner on the enamel. The reasons for this are its extreme fusibility and the thickness of the coating required to hide the face of the brick.

The cause of the rounded edge on the enamel is found in the fact that any molten material cannot be caused to flow out squarely to a square edge, any more than could so much water, or other liquid.

In the glazed brick this defect, while it exists to a slight degree, is not noticeable unless attention is called directly to it.

The slip with which the face of the brick is covered, being infusible at the heat required, will stand up square and true along the edge. The glaze, being thin, cannot present this defect in any marked degree, though it can be detected by close examination.

The making of returns or corner brick also presents some difficulties that are patent to all who see fit to examine brick of this class.

In all enamel brick that have come under my notice I have seen very few in which the edge and end were of exactly the same color. These facts led us to adopt the slip-and-glaze process, and so far we have had no cause to regret our choice.

From information I have received I have been led to believe that the manufacture of enamelled brick is attended with more difficulties than that of glazed brick, and what experience I have had in the business seems to verify it. I will now drop the subject of enamelled brick and leave all discussions as to their merits and demerits to those who are more competent of discussing them; but the facts which I have stated can, I presume, be verified in almost any one of our large cities by any one interested. He will have enamelled brick and enamelled brick, and glazed brick and glazed brick, some better and some worse; and from the appearance and apparent durability of the material he can draw his own conclusions. Poor glazed brick are very poor; poor enamelled brick are in the same boat, and he will find many of each class upon which to pass judgment.

In the manufacture of glazed brick the most essential point to decide is that of a suitable clay. To produce a good article it is necessary that the clay should stand a fairly high degree of heat without warping or twisting, and as the heat required is very near, if not quite, the melting point of cast iron, it is obvious that iron in those forms in which it would be likely to cause spots on the face of the brick is very injurious, and, unless it can be easily gotten rid of, will ruin any clay for enamelling purposes. An excess of lime will also give trouble. I presume you are all acquainted with the effect of pebbles containing lime, and further comment is unnecessary. When iron or lime is combined with, or evenly diffused through, the clay, they are not nearly so objectionable, though not desirable. They are both fluxes at the heat mentioned, and if lime is counteracted by an excess of finely divided or combined silica, we can stand more of it than we can in highly aluminous clays. If the clay contains too much alumina, it is apt to cause "crazing," and also to cause glaze to "curdle" or draw up.

Too much combined or very finely divided silica will cause what is known as "shivering."

In the case of "crazing," the body of the brick is too strong; and, in the case of "shivering," it is too weak.

When the silica contained in the clay is partly combined in the shape of comparatively coarse particles or stones, it will do no harm unless greatly in excess, provided it is finely ground before use.

The shrinkage of the clay is also an item to be considered. This can be regulated by the addition of finely ground burned clay, known as crush, grit, or grog. Never use sand to lessen shrinkage. Its use is very dangerous, and is liable to cause peeling, while crush will be found to be very reliable. All crush should be finely ground. Coarse crush, while it will answer the purpose better probably than fine, will give a wavy appearance to the face of the brick, owing to the fact that the clay will shrink in burning, while the crush will not; and those particles near the face of the brick will hold it up at that particular point and cause a slight elevation there, which will render the effect of reflected light anything but pleasant.

In my own experience I have never seen any single clay that I could unhesitatingly recommend for the manufacture of glazed brick without the addition of a clay of a different nature, or some material to give it either the proper chemical or physical characteristics. It must possess certain physical characteristics in order to admit of the manipulations necessary to product the article economically. So far I have never succeeded in successfully treating a dry or semi-dry brick by this process. I must admit, however, that when one does happen to turn out a good sample of semi-dry glazed brick it is very handsome. But we found the percentage of good brick very low, and consequently have abandoned it.

Hand-made, soft, or stiff mud brick are best adapted to this process, and the clay must, of course, be adapted to one or another of these methods of manufacture. This will, of course, determine the physical characteristics of the clay so far as the making of the brick is concerned.

I take it for granted that all of you can determine the physical qualities necessary for these processes, as well as for the following process of pressing.

When this is satisfactorily disposed of, the question of contraction in drying of slip, glaze, and brick must be considered. If both the slip and the glaze are applied to the brick when dry, this question needs no consideration here, but must be considered when slip and glaze are prepared, and they, not the body of the brick, must be made to suit this particular case.

When slip is applied to the green brick immediately after pressing, it is necessary to use a slip containing a considerable amount of tough clay, in order to secure the proper working qualities, and here the question of contraction in both slip and brick must be considered. The brick in drying must contract enough to admit of the use of such a slip in order to give you a smooth face, clear of "pinholes" and other defects caused by the shortness of the slip.

So also must the contraction in burning be practically the same as the contraction of the slip. This difficulty can be conquered by alteration of either body or slip, or both, as may seem advisable.

It is in the kiln that the chemical defects nearly always show themselves, and the proportions of silica, alumina, and other elements which usually enter into the composition of the clay must be properly adjusted in order to insure success.

As before stated, an excess of alumina is not desirable. It causes warping of the brick, both in drying and in burning, and makes the body of the brick too dense for the proper application of a glaze.

The density and consequent strength of the body are the great sources of crazing, and, when this effect cannot be overcome by carefully burning, it will in all probability be due to an excess of alumina, or lime, or other fluxes in the clay. Alumina also gives a dull appearance to the glaze in many cases.

Silica causes shivering and peeling. Shivering and peeling are to a great extent the same defect, though they are produced by different causes.

Shivering is caused by an excess of silica alone, while peeling is produced by the same defect in the clay, but is, I think, developed in the worst form by an excess of silica together with an excess of fluxing elements, which attack and combine with a large percentage of the silica at a certain heat in the kiln, thereby causing a sudden shrinkage. This will cause a rupture between brick and slip, and develops peeling in its most aggravated form.

It is evident, therefore, that the most important matter connected with this method of producing glazed (commonly called enamelled) brick is a proper clay or mixture of clays: and, owing to the well-known fact that nearly all clays vary materially in different parts of the same bed, I would always advise, when possible to do so, the use of a mixture of two or more clays, as less liable to affect the body of the brick by simultaneous variation in their component parts.

To emphasize this, I will give the following facts: Analysis of a sample of one of the clays used by us showed, total silica, 79.15%; alumina and iron, 15.32%. Two months later the analysis of clay from the same bed showed, total silica, 69.26%; alumina and iron, 20.41%. Had we been depending on this clay alone, we would undoubtedly have gotten into serious trouble; but as we were using a mixture of clays it did not affect us so much. But at the same time its effects were very apparent in our brick, and, owing to this excessive variation in this particular clay, we were obliged to abandon it, though it had been giving us satisfactory results for more than a year. This variation was in both the combined and uncombined silica, and it happened to occur in just such a form that it was not noticeable in the working of the clay, and was not discovered until we found that our product was not up to its ordinary standard, and by that time we had several thousand brick in the kilns and in course of manufacture. While the loss in this case was serious, it was not a circumstance to what it would have been had we been using a single clay, and it had happened to vary so much in its chemical constituents. I give this experience in order to show the importance of having a constant body to work on.

Silica tends to brighten most enamels and glazes, while alumina is very apt to have an opposite effect. Variation in these two elements in the body of the brick will, therefore, destroy that uniformity of surface which is desirable in this class of brick, and no matter what process is used it will be found that the body will to a certain extent exert its influence for good or evil, on the face of the brick, be it glazed or enamelled.

In view of these facts I would strongly advise the intending enamelled brick manufacturer to use a mixture of at least two clays in such proportions as will give the desired result, and regulate the shrinkage by the addition of more or less fine-ground burned clay, which should be fine enough to pass through a sieve with a mesh not over one sixteenth of an inch square.

The amount of this material will depend upon its fineness, upon the toughness of the clay, and upon the result desired. The tougher the clay, the more crush it will carry, and the fineness of the crush used must be determined by the working of the clay. Make it as fine as you can to work properly both in drying and in burning.

It may seem superfluous to give so much space and take up so much time with what seems to be the only part of the business that would be understood by all of you, but it is the rock upon which more hopes have been wrecked than any other one thing connected with the glazed brick business. This is what usually floors our English cousin when he comes over here and attempts to work American clays.

This is what drives our American manufacturers into the devious ways of true enamels, double burnings, and other attendant evils. I do not mean to say that all ways leading to the use of true enamels are devious, but in my opinion the glazed brick will, when its necessary evils have been overcome, be found far more profitable to manufacture, when viewed from an economic standpoint, because it is usually more reliable, requires but one burning, and last, but not least, it sells itself.

Having given so much time to the body of the brick, we must necessarily cut the balance and least important part of our paper short.

A glazed brick is one whose face is covered by a colored slip. A slip is a mixture of the proper materials that is infusible at the heat employed in the glazing operation. The slip is covered by a substance somewhat of the nature of a glass that is more or less thoroughly fused. When this mixture becomes transparent or semi-transparent at the heat employed, it is called a glaze. When it remains opaque, it is called an enamel.

To be called either a glaze or an enamel, it must present that smooth, glossy surface which characterizes these substances, otherwise to all intents and purposes it remains a slip at that particular heat.

I make this statement to show the relation between these technical names, that we may not be confused by subsequent discussion which may arise. Therefore, it will be understood by all that when the word "slip" is used it means a mixture that is infusible at the heat used by the person who gives it that name.

An enamel is a substance that is more or less thoroughly fused but remains opaque at the heat employed by the person who gives it that name. A glaze, on the contrary, is a mixture that becomes transparent or semi-transparent (whether colored or not) at the heat employed by the person who gives it that name.

Having now attempted to give a clear idea of what I mean by slips, enamels, and glazes, and prepared a foundation upon which, I think, we may all stand during any discussion which may follow, I will proceed with my subject.

Slips are prepared by mixing clay, flint, feldspar, and other substances in such proportions that they will adhere to the face of the brick both in drying and burning, and the proportions of the different ingredients must be suited to the work in hand. They must be infusible at the heat employed, yet must contain enough fusible material to enable them to adhere to the face of the brick. These proportions vary materially, and no recipe can be given that will meet all cases owing to the different conditions governing them.

At the heat at which I am accustomed to working clay, flint and feldspar are the only materials to be considered with the coloring matter. Others may find it necessary to use other ingredients, but if such is the case I would advise more heat and less soft materials. They are likely to give trouble in burning. Slips should be thoroughly mixed with water to the proper consistency and sifted through a sieve not coarser than No. 100 brass, and finer if possible. The slip is applied to the face of the brick by dipping, and should be as thick as is possible to use it and give a smooth face. Don't be afraid of its pulling. If it does, either body or slip is wrong. I have seen bricks with a quarter of an inch of fine clay on the face, though it was not put on in the form of a slip, and it was impossible to cause a rupture between brick and clay without breaking one or the other. This clay was stuck on to the brick by a coating of slip that was made of exactly the same ingredients as the clay. In fact, in every instance the clay was simply the slip dried until it could be handled, and stuck on the face of the brick with a coating of slip between the two. I do not recommend this at all as a profitable method to follow, but mention it to show what can be done if brick and slip are properly adapted one to the other.

When a slip is to be applied to a dry brick, it must be necessarily thinner than for green brick, and this method is not to be highly recommended owing to the difficulty of handling the brick during the succeeding operations of glazing, cleaning, and setting. A slip to suit a dry brick must be very short, and has as a consequence very little strength when dry, and is liable to be clipped in handling.

Glazes and enamels are composed largely of the same ingredients as slips, with the addition of suitable fluxing materials. At the heat mentioned it will be unnecessary to use soluble fluxes, and lead will be volatilized and dissipated, thus rendering its use unprofitable and inadvisable.

At lower heats lead can be used to advantage, but soluble fluxes are always dangerous in raw glazes or enamels, and, if used to any appreciable extent, frequently act on the slip, and in the case of the enamels on the face of the brick. Being soluble, they are carried by the water into the brick and are sometimes a prolific source of cracks. If soluble fluxes are necessary, they should be calcined or "fritted" with a portion of the other ingredients before they are used. This destroys their solubility and prevents danger from the source mentioned.

At the proper heat frit glazes will be found unnecessary, but there can be no question as to the advisability of using them should occasion demand it.

All glazes and enamels should be thoroughly ground and passed through a sieve at least as fine as No. 100 brass, and finer if possible. Glazes should be as thin as it is possible to use them and produce the desired result.

The same rule applies to enamels, but enamels must be thicker than glazes owing to the necessity of hiding the face of the brick with the one coat. In some cases it is necessary to use colored glazes or enamels in the slip-and-glaze method, but the coating of the slip should in no case be omitted, nor is it necessary to burn the brick twice in order to accomplish your object. It can be applied, when necessary, while the brick is green, and with just as good if not better results, as at any other time.

After the brick is glazed and dry it is necessary to take off the spare slip, glaze, or enamel along the sides and on the heads. This can be done with any suitable tool. The next and a very important operation is burning. The heat at which I am accustomed to work is about the melting point of cast iron in the cooler parts of the kiln.

It is necessary to use a crowned kiln to reach this heat successfully and economically.

The method of setting varies, some setting the bricks open, in which case down-draft kilns are a necessity. Others use saggers, when up-draft kilns can be used, but the down-draft kiln properly constructed will be found most economical. In my own experience I have found saggers, all things considered, most economical, but have always understood that English manufacturers burned their brick open. The operation of burning does not differ very materially, except in some minor details, from that employed in burning other clay wares.

The brick must be dried out gradually until the kiln is red hot, or nearly so, from top to bottom, when a quick finish produces the most brilliant glaze.

The cooling operation should receive close attention, as quick cooling and light firing, either separately or together, are prolific sources of crazing. The bricks, if properly annealed, will not craze if body, slip, and glaze, or enamel, are properly suited to each other.

I have taken up a great deal of time, yet I have only skimmed over my subject. There is so much to say and so little space to say it in that I feel many of you will feel disappointed, but not more so than I am myself at the meagreness of the information given as compared with the time occupied.

Phœnixville, Pa. JOSIAH MILLER.

GLAZED BRICK: THEIR ORIGIN, VALUE, AND USES.*

A PAPER READ BEFORE THE NATIONAL BRICKMAKERS' ASSOCIATION AT ITS EIGHTH ANNUAL CONVENTION, CONVENED AT CHICAGO, JAN. 2, 1894.

ABOUT 300 years ago a man who might well be canonized as the patron saint of workers in clay wrote, "The number of my years hath given me courage to tell you that, a short time since, I was considering the color of my beard, which caused me to reflect on the few days still remaining before my race should end; and this made me admire the lilies and corn in the fields, and several sorts of plants, which change their green color to white when they are about to bear fruit. Thus, also, certain trees burst into flower when they feel that their natural vegetative vigor is like to cease. . . . Wherefore, it is a just and reasonable thing that each should endeavor to multiply the talent which he hath received from God. . . . Therefore have I endeavored to bring to light those things which it hath pleased God to make me understand, to the profit of posterity."

In these terms does a poor potter, nearly ninety years of age, express himself in the preface to his writings and conversations with

* In presenting what we have gathered for your consideration at this time, we desire to say that we are largely indebted to Alphonso De Lamartine, also to the principal manufacturers of glazed brick in England and the United States, and especially to Mr. Henry R. Griffen, late Superintendent of Griffen Enamelled Brick Company of Oaks, Pa., and Mr. E. Matheson, Managing Director of Farnley Company, Leeds, England, for the technical information offered.

himself, in which he treats of his trials, his afflictions, and his life, for his own amusement and for the encouragement of others. The passage might be taken for an extract from the confessions of St. Augustine, or of Jean Jacques Rousseau, or of a writer and philosopher, great both in ideas and in style. This writer, this philosopher, is but a workman who has grown old between the trowel and the furnace, with his hands still soiled by the clay that he moulded all his days. We never felt more strongly than in studying the life of this man, that greatness does not depend upon position, but is a gift of nature.

The potter was Bernard de Palissy (A. D. 1510–1589). While young he kneaded marl and burnt bricks at his father's kiln, in the village of Chapelle-Biron, in Perigord. But the youth was moved by that desire of doing well whatever we do, which leads the reflecting man to surpass what he sees done by others, and which, at length, gives him the key to all the discoveries in intellectual or manual labor. While moulding his coarse clay, and gazing on the brick that had become hard and red in the fire of the furnace, he was thinking of the forms, the reliefs, the handles, the ornaments, and the figures of the vases, which already presented themselves to his imagination, and of the glazes and enamels with which he was one day to cover his masterpieces of earthenware.

Pottery — that is to say, the business of tempering, moulding, and baking earth, either in the sun or in the fire — is one of the earliest of human occupations. The mud which retains the footmark offers itself naturally as an element ready either for the sport or utility of the first inhabitants of the earth. Vases and cups, to hold the liquids necessary to quench thirst, were used by man as a substitute for the hollow of the hand, as soon as he had left off drinking at the pool like the beasts of the field. An improved kind of earthenware, fit for cooking food, must have closely followed the invention of fire. From the first clay jar or earthen cup to the colored glaze of the Etruscan vases, the enamelled porcelain of China or Japan, or the indelible pictures fixed by fire on the surface of the fire ware of Sevres, we may trace each step of the immense scale which separates the rude handicraft from the exquisite art.

On the fall of the Roman Empire the art of tempering, moulding, ornamenting, sculpturing, varnishing, and painting earthenware disappeared with the other arts. Christianity at its commencement opposed all these as being too intimately allied with idolatry. Temples, statues, tombs, urns, vases, and pagan vessels,— it proscribed all, that it might model the world anew. The Greeks of Byzantium alone preserved some of the traditional processes of this art of their fathers, and exercised them at Damascus, the greatest manufacturing city of the Levant, and from which the glazed and painted vases were spread over all the world as articles of regal luxury. These wares were, however, clumsy and tasteless; they evinced the decay of an art that was lost. But while the West was successively creating, losing, and endeavoring to recover the art of pottery, the ancient nations of the extreme East had been, unknown to us, for thousands of years making that painted, glazed, and semi-transparent porcelain which has been for ages the delight of the Chinese and Japanese. They have reached such a perfection of material, form, and color that even to this day our imitations can hardly compete with them; and if artistic civilization were to be measured by superiority in the manufacturing of earthernware, the West must bow before the East. Even the most ancient annals of China mention as unknown the date of the invention of porcelain.

But these wonders of the extreme East were still unknown in the West in the fourteenth century. Glazed earthenware appears for the first time in the pavement of the Alhambra of Granada, and in the mosques of the Moors of Spain. The art was introduced into Europe through Arabia. It was not until a century later that the famous Luca della Robbia, the Palissy of Tuscany, became celebrated for enamelled earthenware in Italy. A moulder of clay, he succeeded, after persevering labor, in covering and varnishing his works with a white glaze unaffected by what destroys the surface of unglazed earthenware. The manufacturing cities of Florence and Faenza, from which last is derived the French word *faience*, owed to him their trade and their celebrity. Painting soon took possession of his enamel as of an imperishable canvas, and the pictures of the great masters were copied, fired, and made everlasting on these disks of porcelain. Sculpture endeavored to rival its sister art, and grouped its statuettes and bas-reliefs round the vases, cups, ewers, and plates of baked earthenware.

Such was the condition of the earthenware manufacture when Bernard de Palissy was making tiles, bricks, and earthenware bottles to hold water, wine, and oil.

Bernard de Palissy is the most perfect model of the workman. It is by his example, rather than by his works, that he has exercised an influence on civilization, and that he has deserved a place to himself amongst the men who have ennobled humanity.

He is the patriarch of the workshop; the poet of manual labor in modern days; he is the potter of the Odyssey, the Bible, and the gospel, the type incarnate to exalt and ennoble every business, however trivial, so that it has labor for its means, progress and duty for its motive, and the glory of God for its aim.

He has thus won a legitimate place among the great men who have risen from obscurity.

Some will say, "But he has only moulded clay." What can it signify? Greatness does not depend upon the occupation, but upon the mind. If such a man be little, who, then, is great?

Some thirty years ago the Farnley Iron Company, and one of its neighbors in business at or near Leeds, England, finding that the fire clay found in connection with the coal seams in that district was particularly suitable for allowing an enamelled surface, began the manufacture of glazed brick.

For some years after the trade was started the bricks made were very inferior compared with those of the present day; the best bricks of that day not being at all equal to what are sold as second quality now. Notwithstanding this, the bricks found immediate sale with architects, especially in London, where they were used, partly for sanitary reasons (the glazed surface being washable and non-absorbent) and partly for light afforded in narrow alleys and courts. As the quality of the bricks improved with the experience of the makers, the demand still further increased, and they are now used in large quantities in all English cities.

It is estimated approximately the total output capacity of the Leeds district is about four to five millions per week. Of these numbers, not more than sixty per cent can be reckoned on as first quality, and thirty per cent second quality; the remainder, as thirds, are available only as building brick. These thirds are valuable where strength is required; the superior clay and hard burning make them of high value, because of their resistance to crushing loads.

It is worthy of note here that, in placing enamelled brick where they are to be subjected to heavy loads, care must be used in setting, that the superincumbent force does not press on the outer edge of the brick, as the enamel will give way if more than its share of the load is imposed upon it.

Probably about one sixth of the product of the Leeds factories is shipped and used in America, where they may be said to be the *standard* for good, serviceable enamelled brick, and the excellent quality to which they have attained must be equalled by our American manufacturers before they can justly claim to have first quality glazed brick.

It is a pleasure to be able to state that at this time there are at least two American manufacturers who have nearly attained to the excellence of the best English makers; in fact, they do equal them in the durability of this product, their success in getting clays and glazes to fuse being fully up to the English; and the only difference in the American and English brick is that our manufacturers have thus far failed in finding a clay with all the necessary qualities that will, after burning, have a surface as smooth as is the product of our English friends.

The only American manufacturers who have thus far succeeded in making a thoroughly good and merchantable glazed brick from the standpoint of the English standard are the Griffen Enamelled Brick Company of Oaks, Pa., and Sayer and Fisher Company of New York.

The experience of our American as well as the English manufacturers in getting the manufacture of glazed bricks started on a successful basis has been fraught with many sad experiences: and with them, as with the makers of other kinds of brick, the workings of clays and enamels have been "eye-openers." and in all cases success has only been attained at a great cost in money, and vexation of spirit.

There are various methods of glazing bricks: —

First, slipping and glazing while green, and then firing.

Second, enamelling green and firing.

Third, slipping green, firing, and then glazing and re-firing.

Fourth, burning, then enamelling, then firing again.

Fifth, burning, then clipping and glazing, then firing again.

The fourth and fifth methods avoid many difficulties of the first and second: the third method avoids about half of these difficulties.

The fourth method is both the best and poorest, except the fifth method; that is, the best brick can be made by that method, and the poorest are made, except those made by the fifth method.

A good fire-clay brick first burned, then enamelled with a good high heat enamel, and reburned at a high heat, will make a brick that is absolutely indestructible, but the expense of the fire clay, added to the double burning, is too much.

The fifth method is very bad, because it is as expensive as the fourth, and not so reliable.

The third method is as good as the first, but as expensive as the fourth and fifth.

The second method is still more difficult than the first and just as expensive. It presents all the difficulties of the first with the added difficulty of iron spots developing in burning, due to enamel being directly in contact with the impure fire-clay face of brick.

The first method is, all things considered, the most practicable; still the difficulties to be overcome are enormous. First you have three different materials, a brick, a slip, and a glaze, which must all stand the same heat, and must all shrink alike during the whole operation; then you must have a mixture for your brick that will not shrink too much, or the brick will warp; it must not develop iron specks; must not blister in enamelling; must not pinhole; slip must stick to it well; must not shiver; must not craze: must not crack in pressing; must be strong; must cut decently; must not discolor the enamel or glaze: many clays are barred due to the last condition. Many clays that are good in other respects will crack in pressing; many will craze: many will shiver; many will warp; many will give iron specks, and very many will not properly hold the slip. Some will blister, and some pinhole.

The latter, blistering and pinholing, are largely a matter of manipulation, and some clays simply show a tendency which proper handling will overcome.

One successful manufacturer says, "I have handled in my experience over two hundred different clays, and I do not believe that there are more than five or six of them that are good for enamelled brick, though many of them might be used after much experimenting. There are very few clays which I would pronounce impossible to enamel."

The same manufacturer says, "Our process is to make the brick, press them, dip them in slip, then in glaze, and burn."

The English makers generally, Sayer and Fisher Company, and the Griffen Company, use process No. 1. We do not know of any one using process No. 2. Somerset uses process No. 3. Zanesville makers, Excelsior Stone and Brick Company of Philadelphia, and Matawan Company use process 4. Phillipsburg uses process No. 5. The principal difficulties with process No. 1 are cracking, crazing, shivering, and warping.

The principal difficulties of process No. 2, if used, would be the same with addition of uneven color, due to brick body showing through enamel, more on some bricks than others.

Process No. 3, the same as No. 1, except warping: warped brick can be rejected between burnings, but expense is added.

Process No. 4, crazing, shivering, cracking, and color of body showing.

Process No. 5. The tendency to pin in this process is so great that it condemns it without going into other difficulties.

An enamel is a translucent glaze, and never reached absolute opacity; consequently if over a colored body its color is dependent on thickness of enamel, degree of fusion, etc.

A slip is absolutely opaque, and hides body of brick entirely.

Glazed brick become a necessity in our cities, for area and alley walls, where light is desired; but their use in baths, cafés, smoking-rooms, fish and butcher markets, railroad stations, grocery and butter stores, stable walls, cold storage and brewery vaults, etc., etc., where cleanliness is requisite and the daily use of water a necessity, should speedily follow the experience in their favor in the older cities of the world. By their use sanitary satisfaction can be secured, and at the same time beautiful architectural effects accomplished.

One modern use in Europe, worthy of imitation in American cities, is the construction of underground urinals which, while avoiding any obstruction above the street lines, afford a clean, well-lighted convenience. American visitors to London will no doubt have noticed these places, all of which are lined with glazed bricks.

The size of English brick (3 ins. by 9 ins. by 4½ ins.) seems likely to become the standard size in this country for glazed brick, as they can be made English size at not over fifteen per cent above cost of American size. The English size brick gain about 33⅓ per cent over the American size in laying, besides being about $8 per 1,000 less expensive in labor and materials in laying. The English size brick at, say, $115 per 1,000 are cheaper for the contractor than American size at $68 per 1,000; also you will find that the larger surface of the English size gives a better effect and appearance to the wall when laid: and there are fewer joints to aid in gathering dust and soot.

Those who have to do with the building trades in our Eastern as well as in our Western cities, to any extent, seem to be satisfied with inferior grades of manufacture. This, we believe, to be a mistake, and especially so as regards all kinds of brick, including enamelled.

If the story of Palissy's trials (to be found complete in Lamartine's "Lives of Celebrated People") trying to bring to perfection the art of enamelling could do away with the spurious and inferior work, even in the enamelling of brick, his story has not been told in vain. We are building for time, not for to-day alone. America in her buildings should learn a lesson from the Old World on what we can do for posterity. It is not for the dollar that we may save in buying or selling a poor stone or poor brick. In every walk of life, in art, in science, and in trade, we hope that the bells that rung out the year 1893, and rung in the new year 1894, yet in its infancy, "rung out the false and rung in the true."

George B. Engle, Jr.

Chicago.

HOW CAN WE BEST SECURE TRAINED HELP?

A PAPER READ AT THE EIGHTH ANNUAL CONVENTION OF THE NATIONAL BRICK MANUFACTURERS' ASSOCIATION.

I HAVE noticed in the columns of the *Clay-worker* during the past year, articles from several of the members of this association, in all of which the value of scientific training and special education for clay-workers has formed the theme. The point of view from which these writers look at the subject (R. Brick–D. Crossley) is naturally different somewhat in each case. Some recommend the use of the present educational apparatus of the country, and others think that better results would be had by establishing practical schools on the manual training system. But in all cases a substantial unanimity of opinion prevails on one thing, and that is the ability of science, and especially chemical science, to help the clay-worker in his daily work.

During the summer of 1883, and again in 1892, it was my fortune to be employed by the State Geological Survey of Ohio in investigating and preparing a report on the condition of the clay-working industries of that State. In the course of this investigation, I was, of course, thrown into intimate relations with the workers of all branches of the ceramic art, and thus had usually favorable opportunities to find out what the status of the clay-workers was in regard to the scientific aspect of their business.

It was a surprise to me in my first trip to find the use of chemical or other scientific information so small, but after nine years had passed, and I again made the rounds and observed the wonderful expansion and increase in prosperity, and the distinct but less visible improvement in the quality of the wares manufactured, I was, indeed, amazed to find that very little, if any, change had taken place in regard to the use of chemistry or other technical knowledge.

There are, perhaps, several principal reasons for this fact: first, I think, is the misapprehension which I find exists very generally among the clay-workers as to the way that chemistry or science can be employed in their business. Most of them think that what is recommended to them means that they shall employ a chemist in their factory to analyze their clays and test their product. In some branches of clay-working this indeed is a perfectly feasible and rational suggestion. But the number of such cases is very small. What most factories need is not a chemist to work every day in his laboratory, but a manager or superintendent who has had the benefit of a chemical course, and who understands the subject whether he has the practical skill to make analyses or not. Many men who are by nature kindly disposed towards the use of improved means in their business have considered this subject, and after looking the matter through they could see no gain in proportion to the monthly salary of even a young chemist. No wonder they thought that way. In most brick works and sewer-pipe factories a chemist, to do nothing else but make analyses, is no more required than a skilled electrician would be to take care of a dozen or so of electric lights. In other words, it is not a multiplicity of analyses that is wanted: it is management by a man who knows what analysis means and how to use it.

And this ought not to be at all out of the reach of even small clay works, for if brickmakers show a desire to put men of this class forward into their positions of trust, like burners, foremen, and superintendents, there is no doubt that there will be plenty of bright young fellows glad to qualify themselves for this work.

A second reason is found in the fact that so far no American college has yet offered a course in ceramics or has even announced that they are prepared to give special instructions in that branch of chemistry which deals with the problems of clay-working.

Now, chemistry is a very broad science: it is much too large a field for any one man to cover, even if he devotes his life to the study. But the general laws of chemistry, and the framework or skeleton in which all the vast array of detail hangs, are by no means so complicated but that any good mind can master and use them. The application of these laws and principles to any one kind of technological business is in itself a full field of study for any man to undertake. A chemist cannot master the technical chemistry of iron-making without much time and patient labor. Paper-making, glass-making, clay-working, fertilizer manufacture, cement-making, and in fact dozens of special branches, each require the use of a different set of facts, though all hang directly to the great and important framework before described.

Now, the technical chemistry of clays is not especially difficult or complex, unless it be made to include composition and use of glazes, enamels, and other compounds where the variety of chemical elements used to produce the different colors is very large. But while in general the chemistry of ceramics is not exceptionally difficult, nevertheless it is quite distinct and separate from any other kind of chemical work, and thus it happens that no college course supplies just exactly what a skilled clay-worker ought to know.

The degree of Engineer of Mines as taught in most of the standard schools of the country is much more nearly in line with the requirements of clay-working than any other course. But it fits a man equally well for the position of blast-furnace superintendent or gold miner; so it is easily seen that, though a graduate in this course knows the principles on which clay-working rests, still he has to learn all the details which make his knowledge useful and practical after he leaves school.

Also, to take the course of Engineer of Mines requires that the student shall be fairly well advanced before beginning it, and that he shall spend four years in taking his degree.

This in itself is necessary, because to fit a man to even enter so wide a range of professions as belongs to this course requires the pursuit of many studies and the use of much time. But to master the scientific work especially needed in ceramics alone need not be so long a matter.

The studies which are especially useful in this course are geology, mineralogy, chemistry, metallurgy, civil engineering, mechanics, and perhaps electricity.

Geology, especially in its economic aspect, is useful in defining the origin of clays, both as to the mineral itself and as to its location. We learn what the influences were which brought the clays into the deposits where we find them, and how to look for clays, how to trace and identify them.

Mineralogy instructs us on the composition of clay as a mineral. It shows us that pure clay is a very rare mineral, and that what we call clay is a mixture of a number of minerals.

It explains how the proportions of these minerals vary in different clays, and how some of them are called impurities on account of their effect on the nature of the clay.

Chemistry has already been described as the mainspring of all our knowledge regarding ceramics. Metallurgy is the application of chemistry to the problems of extracting the metals from their ores, but it incidentally brings in much that is of prime importance in ceramics.

The formation of silicates by heat, their fusion and thermal properties, the nature of fluxes and refractories, the nature and combustion of fuel, the construction of furnaces, kilns, and apparatus for generating heat, and many other subjects, are considered, which any one can see are directly useful to the work of clay-burning.

The engineering sciences, civil and mechanical, both contribute much that is useful to the clay-workers, but is knowledge which is connected with the construction of factories and the manufacturing operations, and the use of the materials made, rather than in considering the nature of the material itself. Civil engineering is the great art of construction, in supplying the demands of which most of our factories find their work. Naturally, knowledge of this study must be useful not only in the factory, but in keeping the products constantly abreast of modern improvements and the increasing demands of engineers and architects.

And certainly no practical clay-worker would consider an education complete without some instruction on the topic of mechanics, — the use of steam, the generation of power, how to convey and apply it.

Also the design, construction, and repair of machinery is a subject which he will learn by bitter experience in the shop, if he does not at school; for what clay-worker is there who has not put in many a night and Sunday in patching up his machinery for another trial?

Electricity has so far been of very limited use to the clay-worker. As a means of generating power, its development is proceeding so rapidly that none of us can tell to what extent it may be used in our time in our factories, and for this reason its principles ought to receive some notice in a technical course.

The use of manual training as an adjunct to technical education has been lately introduced in some schools. No one can dispute its value, especially to a student who has never had any experience in the practical part of the study he is pursuing. It enables a man to judge of the work, both in quantity and quality, which others are doing for him, and makes him quick to detect laziness and negligence in his employees simply by the light of personal experience. This is unquestionably valuable, and wellnigh indispensable to any man who has to handle the labor of others.

In a full ceramic course extending over a period of four years, manual training should be incorporated.

Some of the previous writers on this topic have contended that a clay-workers' school should be largely practical, and that it should contain machinery of all common types, — dryers and kilns, and everything that clay-workers use, — so that the scholar learn by experience the practical knowledge of the shop. In my judgment this plan is neither wise nor feasible. Men go to school to learn principles, not to learn the minute details of their life-work. No school of any kind pretends to turn out men competent to step at once to the front rank of practical technical work.

The idea and principle of education is to train the intellect so as to enable it to judge in later life of the correctness or fallacy of whatever comes before it. The best plan to learn practical clay-working is right in the brickyard or pottery.

So much as to the studies of a ceramic course.

As I have said before, no American college gives anything in this line.

While distributing some of the literature of the Ohio Geological Survey recently, I received a request for a volume for the professor of ceramics in the Imperial University of Japan, who is now in Berlin on leave of absence, perfecting himself in all that modern German chemistry and technology can add to his already rich store of information. It seemed to me a great reproach to this country that little Japan should teach branches of science which Americans have to go to Europe to study.

There are two things needed in connection with this subject. One is a formal ceramic course attached to some university able financially and scientifically to make it equal to that of any foreign school. This is no light matter; it cannot be done in a day, nor can it assume its place at the head of the American clay-working fraternity except by a process of growth.

The second thing needed is one which is easier to get, and more directly and plainly valuable to the practical clay-workers of the country. This is a short ceramic course, designed to take as pupils the able and clear-minded young fellows whom we have employed in our factories as burners, firemen, and high-grade workers, and give them in a two years' course all that can be condensed into that period of the sciences which I have before mentioned. These young men, the pick and flower of the clay-workers, would come to college full of the practical knowledge of the brickyard and pottery. They would have a good many erroneous ideas to knock out, and a good many prejudices to overcome, but, in two years' time devoted closely to the study of what they need most to know, they would go back to their work with new and enlarged ideas of its dignity and possibilities.

Surely there is nothing impracticable or visionary about such a scheme.

In Ohio we have a short mining course, devoted to the education of practical miners, who come to the school at the age of thirty or thirty-five years frequently, and who have been prevented from rising in their work simply from lack of the very technical education they are thus enabled to get; also, we have a short agricultural course, in which the young farmers can get in two years the heart and core of what the full and formal degree would give them.

There has never been a more beneficent application of the educational machinery of the State than in these short technical courses. It is the simplest and most successful way to raise the standard of technical industry, and if the plan has been tried successfully on miners and farmers, why should it not succeed on clay-workers? The importance of the industry certainly demands it, and the utter lack of such training in any regular course makes it still more urgent that a short practical course should be prepared. What can the N. B. M. A. do toward furthering this cause?

It is not for me, a new member, who is attending his first convention, and who is not yet familiar with the objects and aims and possibilities of this Association, to suggest any radical steps, even on a line so directly important for the good of the industry as this kind of education undoubtedly is. But there are others here who will be able to formulate some steps to put us on record as conscious of our need, and our willingness to assist the cause forward.

EDWARD ORTON, JR.

Columbus, O.

BRICK AND MARBLE IN THE MIDDLE AGES.

(Continued.)

CHAPTER II.

"For pallid Autumn once again
Hath swell'd each torrent of the hill;
Her clouds collect, her shadows sail,
And watery winds that sweep the vale
Grow loud and louder still."
— *Campbell.*

AT Basel we engaged a *voiturier* to take us to Baden, whence the old Swiss railway was to have the privilege of conveying us to Zurich. Our scheme for reaching Italy was to pass by the lakes of Zurich and Wallenstadt, and then, following the valley of the Rhine, to cross over the pass of the Splügen to Chiavenna, and so to reach Lake Como.

We left Basel at two o'clock in the afternoon, hoping to reach Baden by about nine; the weather looked threatening, but we took a cheerful view of this, as of everything else, as all good travellers should, and comforted ourselves with the thought that at any rate we could better afford to have a wet day between Basel and Baden than between Zurich and the Splügen.

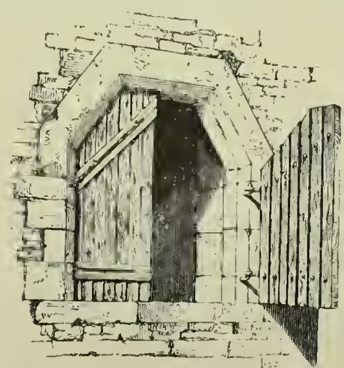
The view of the city as you leave it is certainly very striking; the cathedral spires are picturesque in their outline, and the number of churches with turrets and steep roofs combine with them to produce a most ecclesiastical-looking town. Nor need any one interested in architecture despair of finding much pleasure in a more careful inspection of its buildings. They are full of interest, though generally passed too rapidly by people in a hurry to get on to enjoy the pleasures which await them beyond.

The roofing of the cathedral is worthy of notice as being composed of variously colored tiles, arranged in diamond patterns over the surface of the roof, and giving a degree of richness to the coloring of this generally heavy part of the building which is very admirable.

In another fine church of the early part of the fourteenth century here, I remember being amused to see how quietly the storks possess themselves of all kinds of places for their nests, and think even the ridge of the steep roof of a church a proper place for their abode. The good people at Basel build their chimneys with flat tops for the express benefit of their long-legged friends, who, from their elevated and well-warmed abodes, look down sedately, and with a well-satisfied air upon their unfledged brethren below.

Why the people here love storks, the people of Venice pigeons, and the people of Berne bears, I leave to more industrious inquirers to decide, satisfied only to notice the fact that it is so, as each of these fancies adds one to the list of local peculiarities so valuable in the recollections of a journey.

The road from Basel to Baden is for the first half of the way very pretty; we came in, unfortunately, for rather drenching rain, and so lost all beyond the suggestion of some striking views. The towns through which we passed were not of much interest, though there were many picturesque and pleasant-looking subjects for the pencil. The most striking place on the road was Rheinfelden, a largish village (or perhaps I ought to say small town, as it rejoices in a Rath-haus of some pretension), surrounded by very high walls, and entered by tall stone gate-towers, pierced with pointed arches, and surmounted by upper stages of timber, with tiled roofs of quaint and effective character; and here and at Stein and Baden I noticed that almost all the houses were old and very little altered. I observed particularly the old shop windows of very simple design, closed with folding shutters, and taking one back to old times most decidedly in their design.



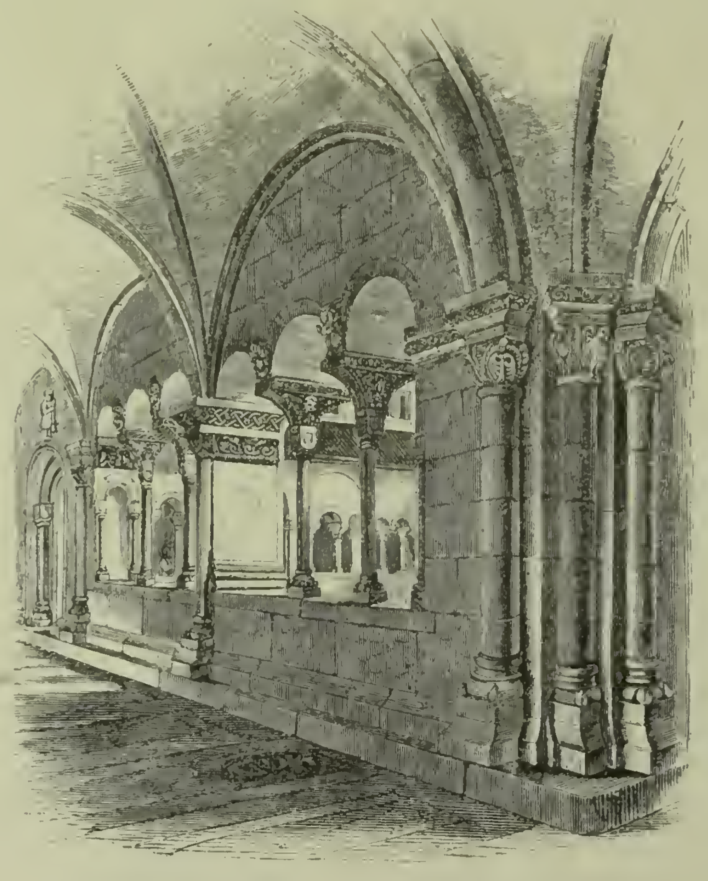
SHOP WINDOW, RHEINFELDEN.

Beyond Rheinfelden the road, which so far has skirted the Rhine rather closely, leaves it again for a few miles until it touches it for the last time at the small town of Stein.

From Stein we saw an imposing-looking church on the other side of the river at Sekingen. It has a great western front with two bulbous-topped steeples, and is of very considerable length. The division between choir and nave is marked by a delicate turret, and the whole church, as far as one can judge by a distant view, looks as though it would well repay a visit. There are six bays in the nave, five and an apse in the choir. The former has very simple windows, whilst in the latter they are rather elaborate. There is no aisle to the choir and no transept.

The rain continued incessantly until we reached the long, straggling village of Frick, a quaint and antique-looking place, where our *voiturier* stopped for an hour to bait his horses, who, however, at Rheinfelden had enjoyed a treat in the shape of a loaf of very brown bread, a kind of food second only, in the estimation of foreign steeds, to the precious *morceaux* of lump sugar with which Swiss *voituriers* are so fond of encouraging and petting them.

We were nothing loth to stretch our legs: and, finding that the church was worthless, — one of those unhappy, bulbous-roofed erections so common in some parts of the Continent, and the roof of even the eastern apse of which was twisted into a most ingenious and ugly compound curve, — we took up our quarters in the respectable hostelry and "Bierbrauerei" of the Angel, and devoted ourselves to the consumption of coffee and beer of no bad quality. Our host wished sadly to see us located under his roof for the night, but we were resolute in our determination to reach Baden that night, and so persisted in going, though to our subsequent regret.



CLOISTER, ZURICH CATHEDRAL.

It was soon dark, and the new moon, which shone cheerfully upon us, gave us just a glimpse occasionally of the scenery, which about Brugg, where we crossed the Aar, and again at Königsfelden, seemed to be remarkably good.

At last, at about half past ten o'clock, we reached what we fondly hoped was to be our resting-place. But Baden chose not to take us in, and to our horror, as we drove up to the chief and only available inn, we were met with the dismal announcement from the mouth of the civil landlord, that all the rooms were full.

However, we dismounted, and found that there was no other inn in Baden proper, but that at the Baths there were several: at them our landlord assured us that he knew we should find no room, and so we thought it useless to return and try. Our only course seemed to be to feed our horses again and then go on to Zurich: and as Swiss drivers and Swiss horses never seem to tire of trotting on slowly and drowsily along the road, there was no difficulty in at once coming to an arrangement with our coachman.

Accordingly, at midnight we started again, hoping at some early hour in the morning to reach Zurich. It was sufficiently provoking to be toiling on slowly and sleepily for nearly four hours almost alongside of a railroad which would have taken us early the next morning in three quarters of an hour: but there was no help for it, and so we did the best we could, by sleeping whenever we were able, to pass the weary hours away.

At last, just as the day began to dawn, we came in sight of Zurich and its lake, and last, not least, we reached the great hotel. Here we pulled up, knocked desperately, awoke the slumbering porter — but, alas! only to hear again the unwelcome sounds which had greeted our ears at Baden! He suggested, however, that at the Hôtel Belle Vue we should probably find beds, and so on we drove, rather in despair at our prospects, though, happily, unnecessarily so, for the Belle Vue gladly opened its arms for our reception, and ere long we were, oblivious of all our toil, comfortably ensconced in bed. From our windows we had a pleasant view of our quarters; it was broad daylight, and the prospect was — as from such a position, looking up a lake, it always is — very fair and charming.

We were up again soon after eight, and were glad to find the morning fine, though the clouds were low, and we saw, consequently, nothing of the distant view of mountains which lends its greatest charms to Zurich. The town is, however, pretty and striking. The picturesque houses, with wooded hills on all sides beyond them, and very charming views of the lake, if they do not make its attractions first-rate, at any rate make them very considerable.

The main feature of interest for me was the cathedral, a fine Romanesque church, very fairly perfect, but mutilated in its interior arrangements by the Calvinists, in whose hands it now is. In plan, it has a nave with aisles of six bays, a short choir, and east of this a square-ended sanctuary, the aisles having apses, roofed with semi-domes. In the nave two of the aisle-arches make one groining bay. The transverse groining-ribs are of a simple square section, the diagonal ribs having in addition a large round member. The triforium is very large and fine, and is made use of for congregational purposes, being fitted up with seats, which, curiously enough, are all made to turn up as misereres. There are no transepts. The sanctuary arch is loftier than the choir arch, and seems to have been intended to be very distinctly marked. In the clerestory there are two simple round-headed lights in each bay; the choir is arcaded all round internally, and for frigidity of effect cannot be surpassed; the internal fittings comprise an immense pulpit, but, so far as I could see, not even an apology for an altar.

The exterior has two western steeples, and a north doorway, each jamb of which has three detached shafts, standing considerably in advance of the wall, which is entirely covered with diapers. The arch itself is semicircular, and very simple in its moulding; but this simplicity rather adds to than detracts from its general grandeur of effect. The whole is inserted in an additional thickness of wall, set on, as it were, against the original wall; and the extreme width of the doorway itself is no less than eighteen feet nine inches. The cloisters were remarkable, and very good of their kind: the arches rested on detached shafts, the capitals of which were elaborately carved in a very peculiar manner, but very effectively. The whole design was unlike any Northern Romanesque, and bore much more similarity to the best Lombard work. Unfortunately, the whole of this cloister was rebuilt in 1851, the carving having been re-worked or renewed throughout in imitation of the original. It will be seen, however, that, in spite of alterations, this is a very fine church, of a very early type, and peculiarly valuable in a country which, like Switzerland, has comparatively little left that is really good in the way of architectural examples.

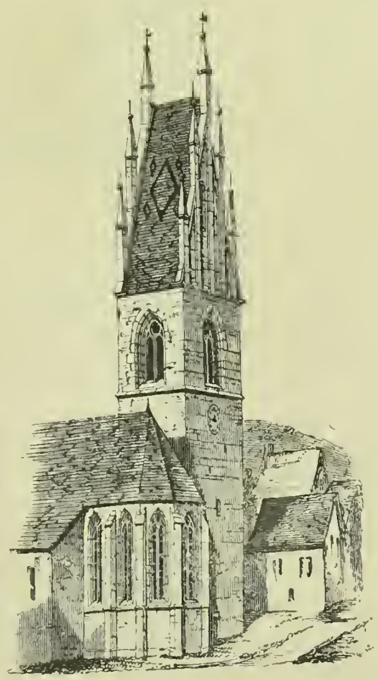
There are other churches in Zurich, but I believe not old, and at any rate I had no time to examine them. One of them is appropriated to the use of the Roman Catholics: and there is one desecrated, rising from the edge of the lake, aud forming a prominent object in the general view of the town as you leave by the steamer: this is of good outline, but has no details remaining of any value. The point chiefly to be noticed in the churches of Zurich appears to be the way in which their spires are all painted red, looking in the full sunshine very bright and picturesque.

The Swiss have a great feeling for bright color, and on our way from Basel to Baden we noticed one of the many instances of this in several turrets covered with brightly colored glazed tiles. A light green seems to be the favorite color, and is commonly used without mixture with any other. They look best with their lower side rounded, and when of small size; and are constantly used in turrets rising out of roofs which are entirely covered with plain tiles. I remember, two years before, noticing with extreme pleasure the beauty of some dark-green tiles used at Schaffhausen; and I have already had occasion to mention those on the cathedral at Basel with equal commendation. Unhappily, we have to lament that English people, in their insane hatred of bright colors, if they saw such tiles used in England, would be horrified at such a violation of the correct simplicity and uniformity of color to which the cheapness of slate has made them accustomed. Some modern attempts, however, at introducing colored tiles have not been so successful as could be wished; and of all, perhaps the least so is the roof of the new Maria Hilf Church at Munich, on which tiles of light-blue color are used in such large masses that at first sight it seems that half the roof is stripped, and that the pale-blue sky is seen instead of roof.

At ten o'clock we left our hotel by the steamer for Schmerikon at the head of the lake of Zurich. The weather still looked doubtful, though much better than on the previous day, and our host of the Belle Vue, taking a good view of this, as is a landlord's duty, conducted us to the boat with smiling anticipations of fine days to come.

The shores of the lake are, for the greater part of its length, literally fringed with houses all painted white, and contrasting violently with the trees, vineyards, and green hills by which they are backed. On the north, the shore is low and gradually shelving down to the water; on the south it is rather more precipitous, but after all not very striking. At the head of the lake heavy, dark, round clouds hung upon the hills, and left us in pleasant doubt as to whether or no we had fine mountains to discover when they cleared away; a doubt, as it happened, not settled as far as we were concerned, save by certain lively and not too trustworthy representations which we afterwards met with, in the shape of advertisements of the Zurich hotels, and which showed a line of snow mountains as the ordinary horizon of their visitors.

The churches on the lake are very numerous and very similar. The steeples are almost always gabled, and from these gables rise spires painted red, and very thin and taper in their form. The gabled sides of the towers are generally made useful rather than ornamental by the introduction of enormous clock dials. The only decidedly mediæval church which I saw between Zurich and Rapperswyl was at one of the villages on the north shore of the lake, I think at Meilen, but I am rather uncertain as to the name. Its design is both novel and very good; the pinnacles on the gable being unusual in saddle-backed steeples, and giving considerable picturesqueness of outline. The accompanying woodcut will show the general character of the design, and it will be seen that the tower is on the north side of the choir. The steeple roof is covered with grayish-red tiles, with a pattern marked on them with yellow tiles.


CHURCH ON THE LAKE OF ZURICH.

The steamers on this, as on most Swiss lakes, are somewhat tedious in their journeys, as they take a most zig-zag course, first calling on one side of the lake and then on the other, until one doubts whether one will ever reach the journey's end. At Horgen, of course, we discharged a large proportion of our English passengers, who were all bound for the Rigi, but their places were soon occupied by the umbrella-loving natives, who flocked in and out of the boat in great numbers at every station, and by the time we reach Rapperswyl we had no more fellow-countrymen in the boat, and, perhaps, like many Englishmen, to say the truth, we then first thoroughly realized that we were abroad. Much as one loves one's country, certainly one source of pleasure when abroad is the not hearing too much English spoken, or seeing too many English faces.

At Rapperswyl, famous for having the longest bridge in the world, there is a most conspicuous group of buildings on rising ground above the lake, very picturesquely thrown together; it consists of a church and a castle: the latter has several towers capped with pyramidal and saddle-backed roofs, and the former has two towers in the position of transepts, with saddle-back roofs gabled north and south, the southern tower being considerably the larger of the two. Altogether, the group is one of uncommon variety and picturesqueness of outline. Below, in the town, is a small church, with a most happily conceived, though very simple bell-turret rising out of the roof, square in its plan, but capped with an octagonal spirelet. This is a not uncommon plan in this part of Switzerland, and is always most agreeable in its effect. The views from the terrace by the side of this castle are of singular beauty. It is high enough above the lake to command a good view of its whole expanse, and to secure a not too distant view of some of the mountain peaks of Glarus. Rapperswyl is a good point to stop at, for the sake of a visit to the famous pilgrimage church at Einsiedeln, certainly one of the spots in Switzerland most curious and interesting, though its building have no claims to our regard on the score of architectural beauty.

Passing under, or, rather, through the bridge, we found that it was very narrow and had no side railing of any kind, so that it appears to be far from a pleasant contrivance for crossing the mile or two of shallow water which here scarce serves to keep up the appearance even of a lake: and perhaps it is upon the score of the absence of real dangers of drowning if one fell over that they dispense with any protection. At Schmerikon, which we reached in four hours from Zurich, we left our steamer, and immediately embarked on a barge, in order to go by the Linth canal to Wesen: but we found that, however expeditious this might be in descending, it was a kind of conveyance not to be recommended highly to any one wishing to ascend the canal, inasmuch as — unlike ordinary canals — this is neither more nor less than the glacier torrent of the Linth, bringing down the melting snow from the Glärnitsch and Todi glaciers, and rushing along at a really tremendous pace. To those, however, who have time, it may be commended as affording magnificent views of the mountains of Glarus, and of those which rise so grandly above the Lake of Wallenstadt.

As we entered the canal from the lake we were amused by the unsuccessful attempts of our crew to secure some wild fowl, two of which they succeeded in shooting, and then, without any kind of regard for the feelings of passengers panting to arrive at Wesen in the promised two hours and a half, they deliberately proceeded — of course in vain — to chase the unhappy birds, which, though wounded, were quite able to dive much deeper than their enemies could reach, and so the only consequence of the chase was a hearty laugh at the expense of the baffled sportsmen, half an hour's delay, and much lost ground to be made up.

The entrance to the canal was very striking: a low hill covered with larch and birch rose from the water's edge, and above this, the mountains, gradually shelving upwards, were terminated in a line of rocky ridges of very grand and rugged character. Whilst we were admiring the view a slight shower passed over us, and the sun, suddenly breaking out, produced one of those lovely effects of color so peculiar to mountain scenery; a rainbow seemed exactly to fill up one of the great basins formed by the undulations of the mountains, and, after bathing a great sweep of mountain side in the richest and most distinctly marked colors, gradually died away.

The canal, which at first looks more like a river, soon takes a bend to the southwest, and then, passing under a quaint wooden bridge, over which passes the road to Uznach, we found ourselves in what certainly looked sufficiently canal-like. The stream is so rapid that the walls built up on either side are preserved from being washed away by stone groins running out into the stream and acting as so many breakwaters to keep the water in the centre. Slowly and steadily our horses pulled us up, whilst we, mounted on the top of the cabin, were able to see over the walled sides of the canal and to enjoy the glorious prospect before us.

Before long our captain blandly informed us that he was going to stop for dinner at a wayside house, so we, anxious to make the same good use of our time, attempted to follow his example. Unfortunately the landlord, though very jolly-looking, had a very badly stocked larder, and we had to satisfy ourselves with bread, honey, and wine. It is true, indeed, that our host did produce same cold meat, — portion, as I imagined, of a goat dressed some ten days back, — but this was not eatable, and was valuable only as furnishing an opportunity to him of showing his perfect power of making the best of a bad thing. To season the goat he brought in vinegar and oil, and, putting them upon the table, exclaimed with some *empressement*, "*Voilà, monsieur; mais la vinaigre n'est pas bon!*" just as if this was the strongest recommendation he could give us! We laughed heartily, avoided the vinegar, and parted good friends with our host, thanking him from our hearts for having saved us the painful operation of making the discovery about its quality for ourselves!

Our not very satisfying repast finished, we embarked again upon our barge, and in the occasional intervals, when sudden and heavy storms of rain obliged us to seek shelter in the cabin, we were much amused in watching the proceedings of some men belonging to the boat, who spent the whole of the five hours consumed in the journey in an unceasing game of cards; I must do them the justice to say that they played very good-humoredly, and laughed without ceasing. Under no circumstances could we have seen the scenery more gloriously: occasional bright gleams of sunshine broke in upon and followed clouds of the most inky hue, and then came pelting down heavy showers, accompanied by howling wind, and darkness; and as we reached the opening of the valley, looking up beyond Glarus to the great mountains which close in its upper end, I think the effect was really more grand and terrific than anything I have ever seen. The mountains are of very fine outline, and of great height, as we saw by the more than occasional glimpses which we had of snow about their summits. By the time we reached Wesen the wind was so violent that we found it difficult to keep our places upon the top of the cabin; and we disembarked just before the dark, in time to see the fine mountains on each side of the Lake of Wallenstadt here and there through the storm clouds, and its waters beaten by the wind into not insignificant waves. We had to walk through the entire length of the village — picturesque, quaint little place, sheltered under the almost overhanging rocks at the side of the water — and arrived at last at the capital and thoroughly Swiss inn, the Hôtel de l'Epée, where we were to sleep.

Travellers now speed very differently along this country, and, I fear, see less than they ought of its beauties. Steamboats no longer attempt to pass beyond Rapperswyl, and the railway hurries one along by the beautiful Lake of Wallenstadt to the valley of the Rhine, only earning one's gratitude when one is in violent haste, and because by a branch line it makes a detour to Glarus and Stachelberg much more possible than it was when first I made the journey. On the whole, I ear, where railways pass through beautiful scenery, the tourist loses more than he can possibly gain, not only in the views of the country, but equally in the incidents of travel, which are becoming only too monotonous and similar everywhere.

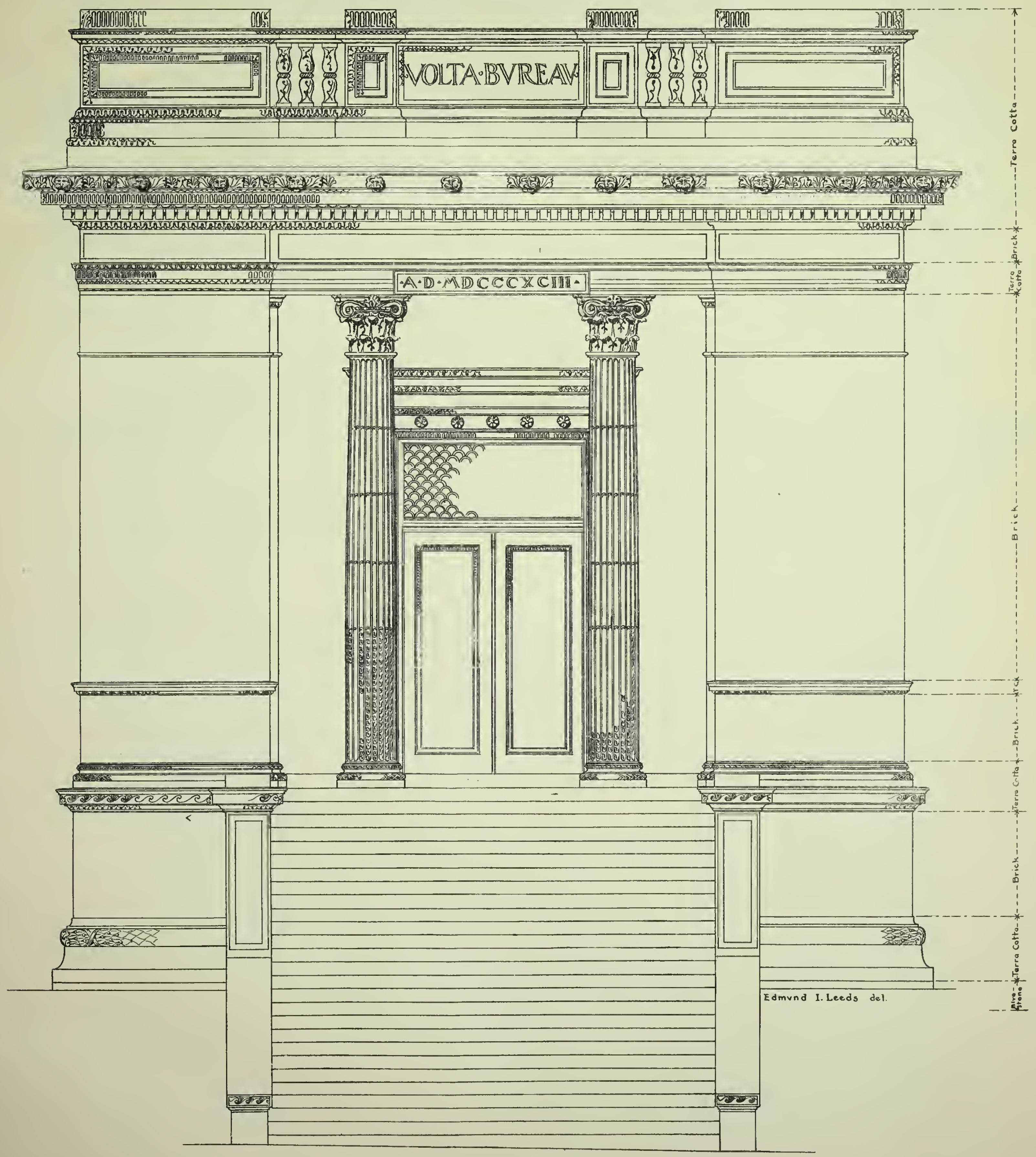
(*To be continued.*)

DETAIL OF WINDOW HEADS, VOLTA BUREAU, WASHINGTON, D. C.
PEABODY & STEARNS, ARCHITECTS. PERTH AMBOY TERRA-COTTA CO., MAKERS.

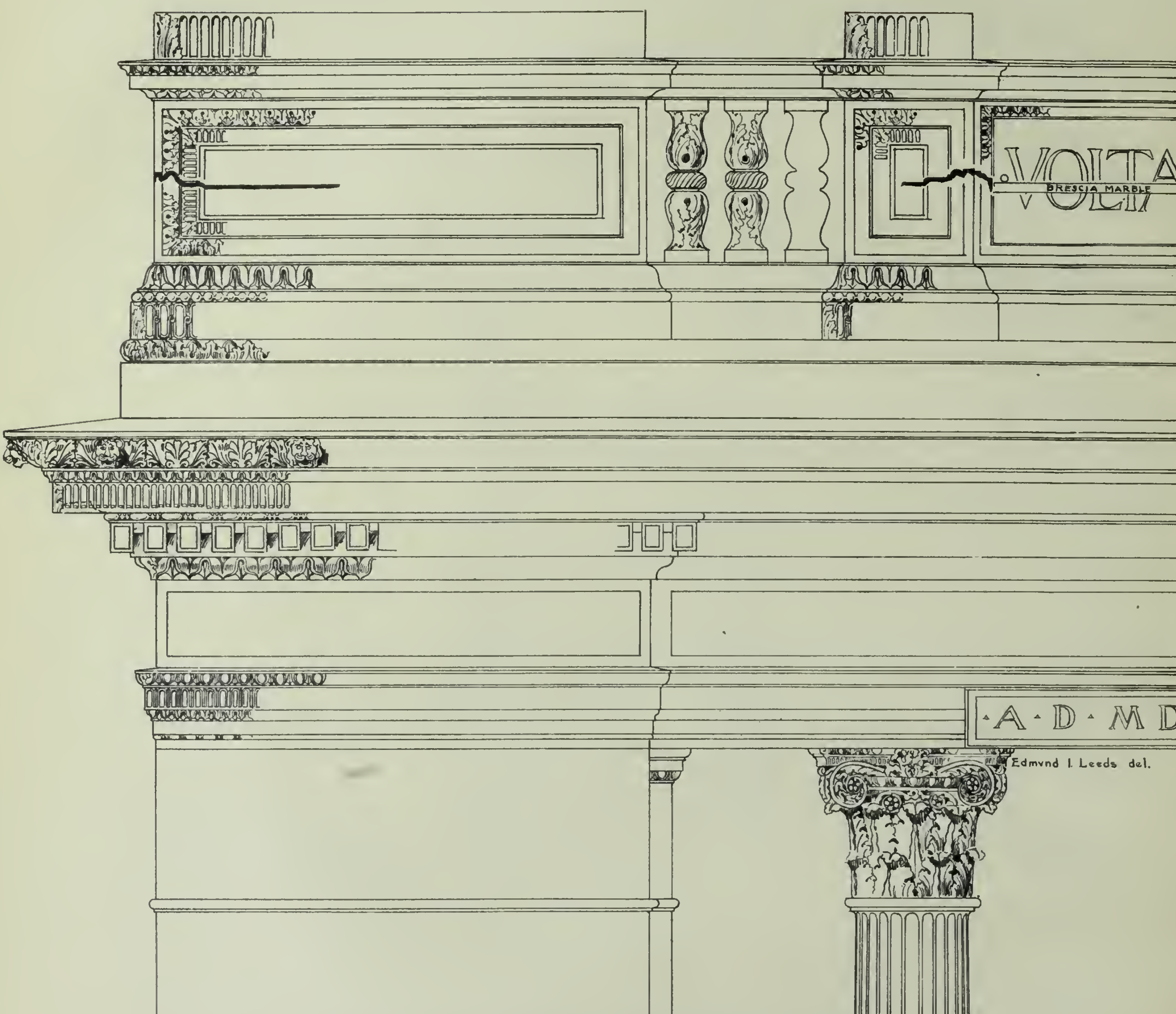
VOLTA BVREAV

WASHINGTON D.C.

PEABODY AND STEARNS ARCHITECTS.



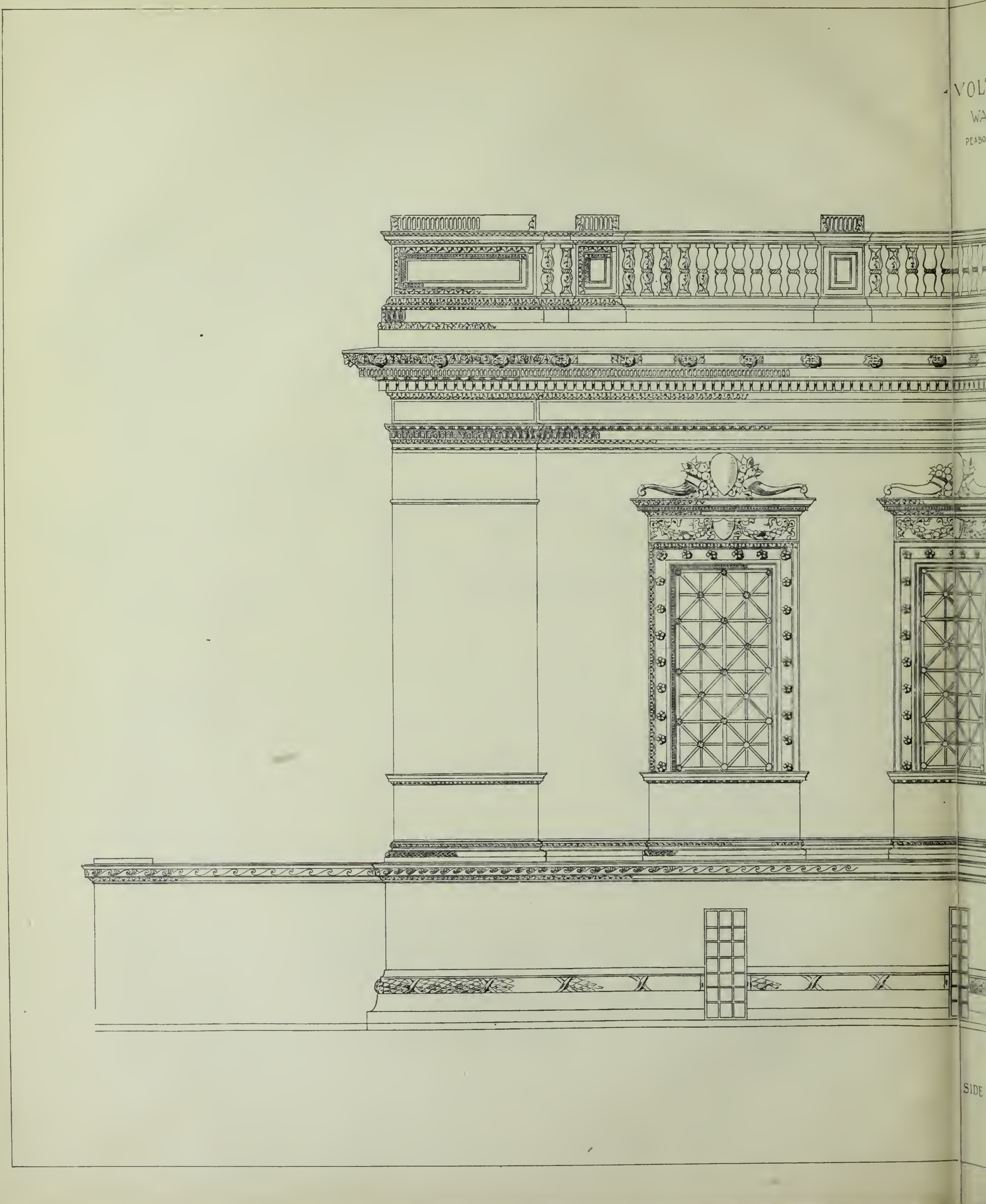
FRONT · ELEVATION



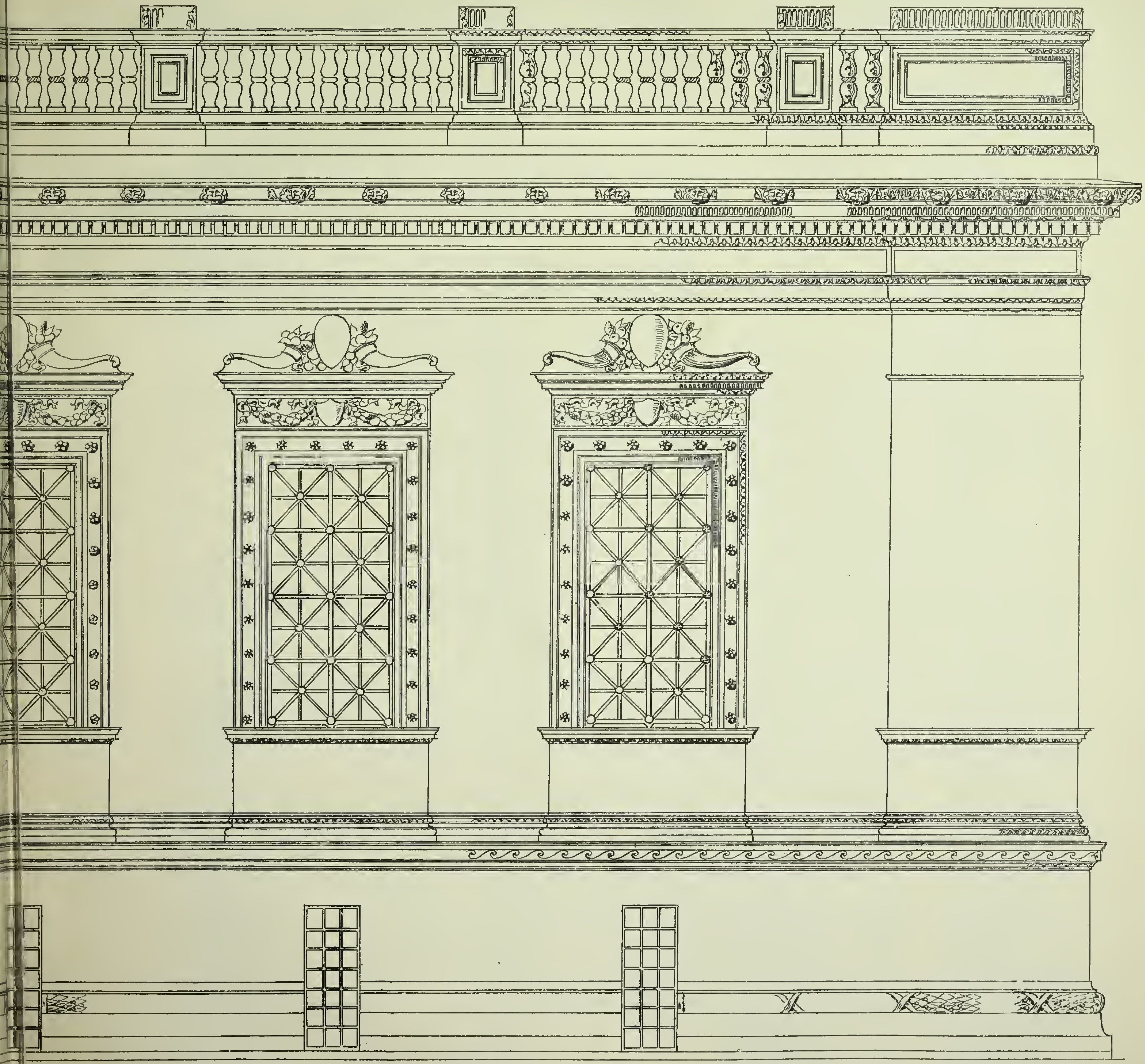
DETAIL OF CORNICE AND BALVSTRADE.

VOLTA BVREAV WASHINGTON D. C.
Peabody and Stearns Architects.


DETAIL OF WINDOW.
VOLTA BVREAV.
Peabody and Stearns Archts.
4'-6"
Edmvnd I. Leeds del.


BUILDE
VOL
WA
PEABO
SIDE

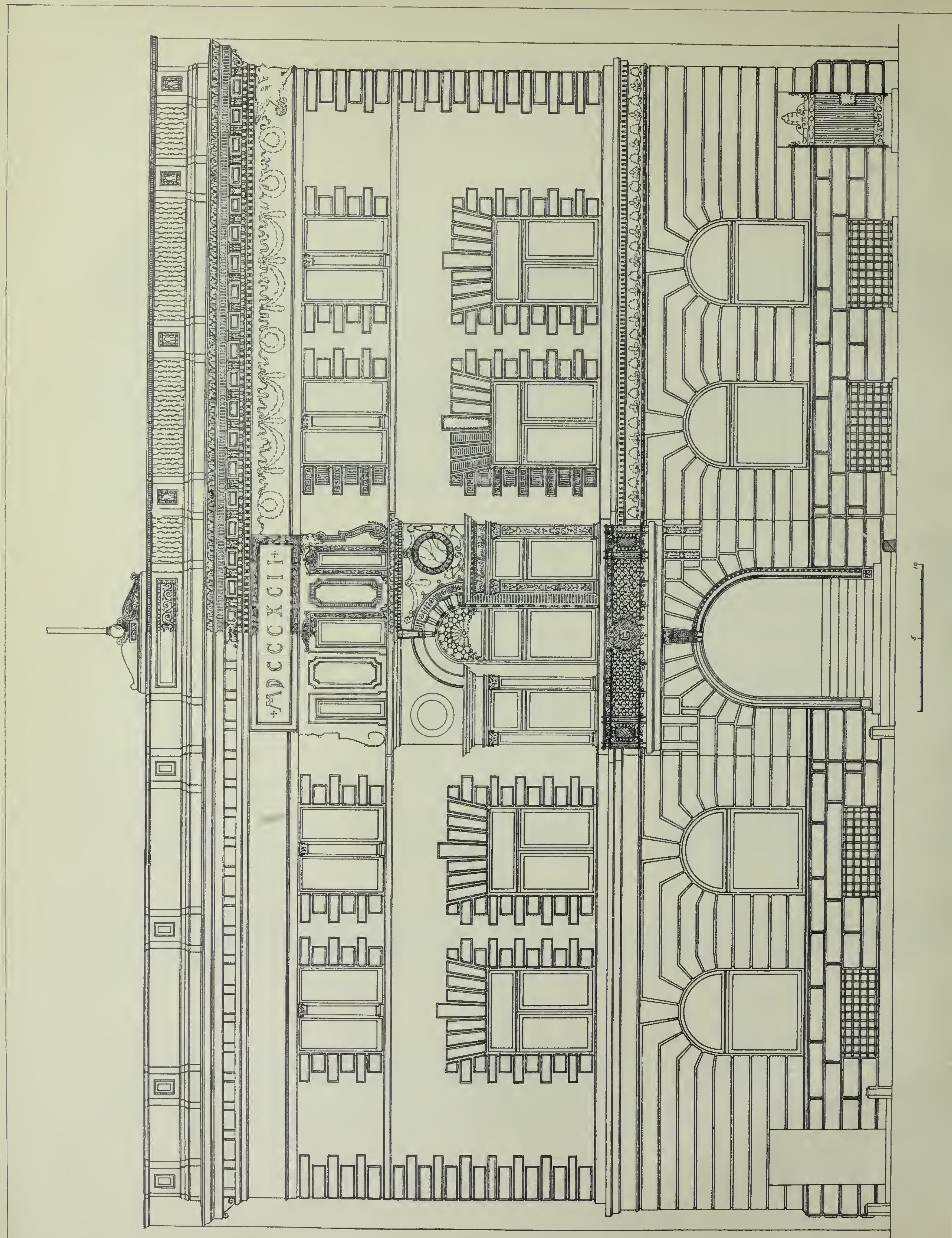
VOLTA · BVREAV ·
WASHINGTON D.C.
PEABODY AND STEARNS ARCHITECTS



Note There are iron grilles to all these windows.

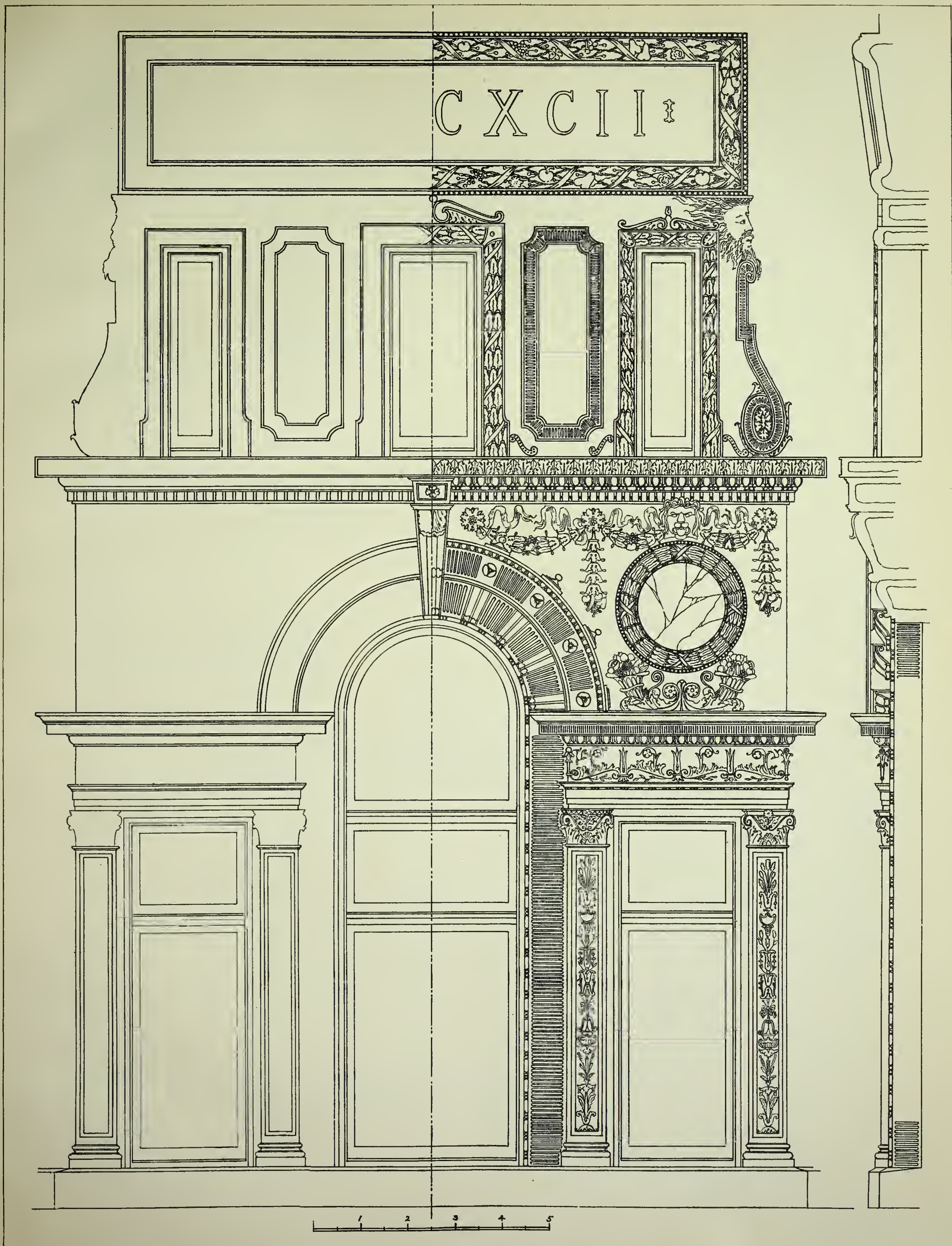
Edmvnd J. Leeds del.

SIDE · ELEVATION ·



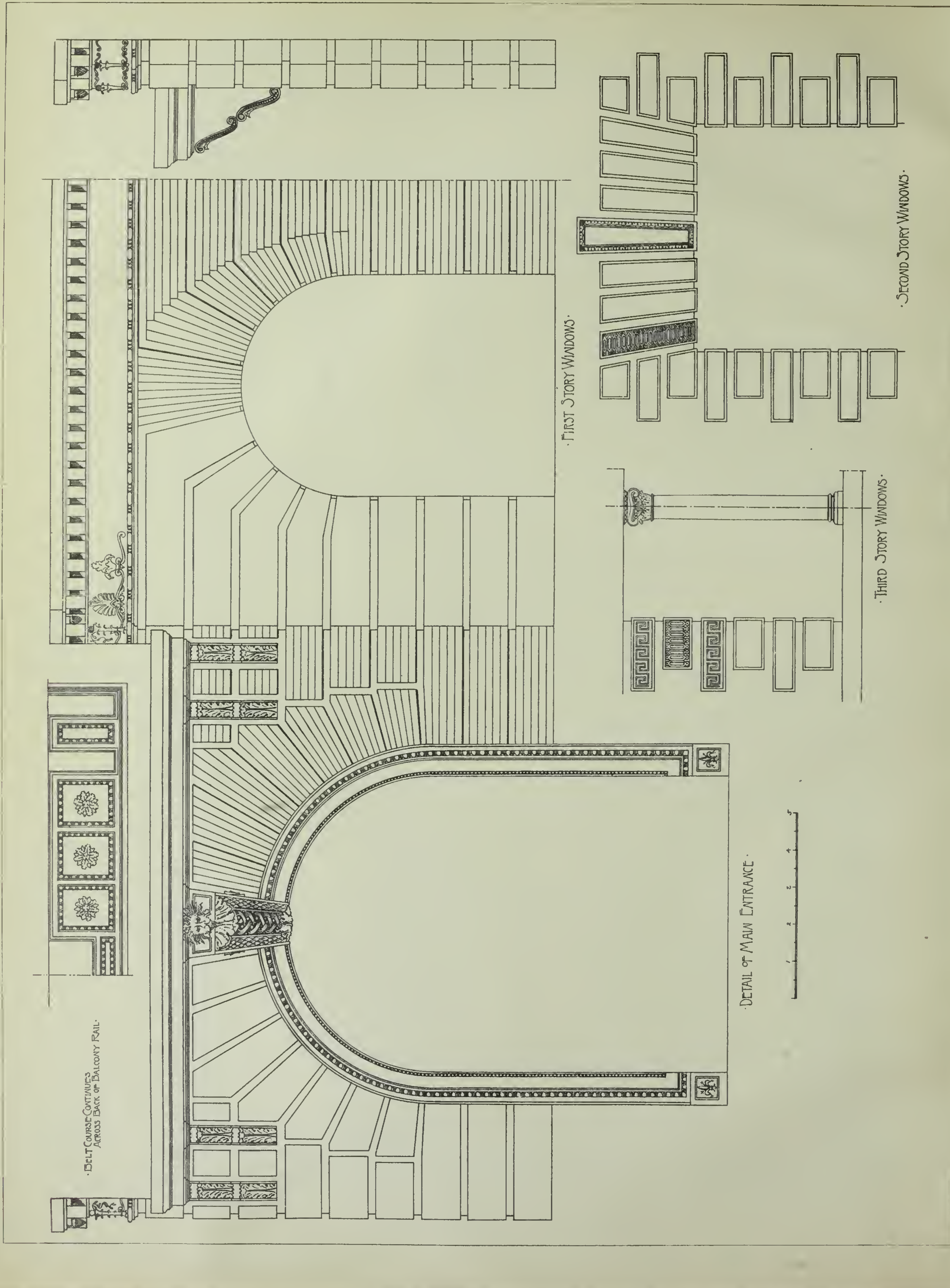
DETAIL OF CENTRE PORTION OF EUREKA CLUB BUILDING, ROCHESTER, N. Y.

NOLAN, NOLAN & STERN, ARCHITECTS, ROCHESTER.



FRONT ELEVATION OF EUREKA CLUB BUILDING, ROCHESTER, N. Y.

NOLAN, NOLAN & STERN, ARCHITECTS, ROCHESTER.



DETAIL OF EUREKA CLUB BUILDING ROCHESTER, N. Y.

ANNUAL CONVENTIONS.

THE NATIONAL BRICKMAKERS' CONVENTION.

THE Eighth Annual Convention of the National Brickmakers' Association of the United States, held in the Auditorium, Chicago, beginning Jan. 23, and continuing through the week, certainly must have been productive of results gratifying to the committee having the affair in charge, and the some three hundred and fifty members of the Association who were present.

Chicago's reputation for hospitality, and doing things generally on a broad and liberal scale, was well taken care of by Messrs. D. V. Purrington, W. H. Alsip, W. D. Gates, and others of the committee, representing the Chicago craft, whose special purpose it was to extend visiting members a royal welcome; while the convenience and general well-being of all were as usual looked after by that prince of good fellows, Theo Randall, secretary of the Association, who, by the way, is the William H. Sayward of the brickmakers' craft.

The banquet was a grand affair, which must have taxed not only the Chicago brethren's purses, but the resources of the Bonifaces who hold forth at the Auditorium.

The postprandial exercises were made particularly brilliant by the speech of R. B. Morrison of Rome, Ga., who, in the absence of George M. Fiske of Boston, responded to the toast, "The Old North and the New South," in a very eloquent manner; while Hon. Anthony Ittner of St. Louis rendered, in masterly style, Knox's poem, "Oh, Why Should the Spirit of Mortal be Proud?"

The toast, "The Ladies," was well taken care of by W. D. Gates of Chicago, whose droll, characteristic style has made him a great favorite as an after-dinner speaker at these annual feasts.

The business meetings held during the week were characterized by harmony and good-feeling throughout, and the close attention given by members to the several very excellent papers read, some of which we reprint in another column.

In fact, the interest manifested by members in the open discussions which followed the reading of these papers; the character of the remarks, in many instances taking the form of experiences which had been productive of good or poor results, intended as they were to be of assistance to fellow-manufacturers; the free exchanging of ideas and suggestions; the complete devotion to their profession; and the manifest desire of all to improve their own methods, and be in every way up to date,— stamped the members of the National Brick Manufacturers' Association as progressive, broad, and liberal, and well worthy to look after the interests of the coming building material.

CONVENTION GOSSIP.

'Rah for Chicago and Chicago hospitality!

Presidents may come, and presidents may go, but Secy. Randall goes on forever. Selah!

Messrs. Chesholm, Boyd & White had the winner of the blue ribbon on exhibition.

No need to send out for a chaplain when Mr. W. A. Endaly of Cincinnati is present.

We print in another column the very able paper by Joshua Miller of Phœnixville, Pa., on enamelled brick as compared with glazed.

We are indebted to Mr. D. V. Purrington, chairman of the Reception Committee, for many courtesies extended.

The century card of the Wallace Manufacturing Company, Frankford, Ind., was quite the taking thing of the convention.

There was no doubt in the minds of many that brick is the coming paving as well as building material.

Pres. W. H. Alsip is a college-bred man, who gave up the practice of law to enter the brick manufacturing business.

The brick paving in some of the larger Western cities has proven to be in every way superior to other paving materials used.

Many ladies, wives, and daughters of the members were present during the convention, and we agree with the gentleman from the South: they should have attended the banquet.

Congratulations to A. S. Blaffer, of New Orleans, the genial third vice-president, upon his escape from serious difficulty into which he was led by his characteristic gallantry.

First Vice-Pres. Edwin McGraw of Pittsburg presided very gracefully in the absence of Pres. Alsip. He is well placed in the line for promotion.

The exhibit of J. W. Penfield & Son of Willoughby, O., must have been made at quite an expense. But we are told that the results were quite satisfactory.

New Haven was well represented by J. Wheaton Stone of the McLargon Brick Machine Company, Capt. S. P. Crafts, and Isaac L. Stiles. Mr. Stiles has the honor of being second vice-president for the ensuing year.

Mr. Frank B. McAvoy, of the firm of T. B. McAvoy & Sons, brick manufacturers of Philadelphia, offered to pledge his concern for one thousand dollars towards the establishment of a course of technical education at some college or university as a preparation for the clay-working business.

Each year one of the ablest men is selected president. It is certainly wise to continue these men upon the executive committee after the expiration of their terms as president, as it thereby insures the best interests of the association being well taken care of.

The relative merits of the Simpson Brick Press and the Boyd Press formed a never-ending topic for discussion between young Simpson and John Maroney. When we left Chicago, neither had succeeded in convincing the other that he was wrong.

THE NATIONAL ASSOCIATION OF BUILDERS.

ON Tuesday, Wednesday, and Friday, Feb. 13, 14, and 16, the Eighth Annual Convention of the National Association of Builders was held at Cotillion Hall in the Mechanics' Building, Boston. The first day was largely taken up by routine business, but was characterized by Secy. Sayward's very able report, Mayor Matthews's address of welcome, and some lively discussion. After the committee on credentials had reported, it was found that ninety-five delegates were on hand. The important matter of the afternoon was the secretary's report, a long but very well prepared one, setting forth clearly the work of the association, and suggesting sundry directions for improvement. A motion to refer the report to a committee brought a Mr. McCarthy, of Chicago, to his feet, with a general denunciation of the association, and particularly its secretary, in the course of which he defied any member to name a single thing the association had accomplished. This brought Mr. Anthony Ittner up, but Mr. McCarthy insisted upon holding the floor, and before Mr. Ittner secured the chairman's recognition Mr. McCarthy had been apologized for by Mr. Stevens of Philadelphia, and his remarks had been repudiated by Mr. Ginderle, another delegate from Chicago. Mr. Ittner then took the floor, and made a very forcible criticism of Mr. McCarthy's position. The remainder of the afternoon was taken up with a large number of resolutions and reports. We regret that lack of space does not allow of our printing the secretary's report; but as it will be printed by the association, and published in other journals, we would refer our readers to these, with the remark that it is a paper well worth looking up and reading.

WEDNESDAY SESSION.

The chief topic for discussion during this session was arbitration, Hon. Carroll D. Wright, United States Commissioner of Labor, giving an address on "The Relations of Employer and Workman."

The attendance was a little larger than the day before, some snowbound delegates having reached the city. The first business of importance was a resolution introduced by Mr. Watson of Philadelphia, on the death of Col. Richard T. Auchmuty, the founder and maintainer of the New York trade schools. Mr. McCarthy of Chicago, Mr. Harris of Philadelphia, Mr. Wright of New York, Mr. Ittner of St. Louis, Mr. Blair of Cincinnati, and others eulogized Col. Auchmuty. Resolutions were also adopted on the death of James Boland of Buffalo, N. B. Hussey of Omaha, Hugh Sisson of Baltimore, and B. D. Whitcomb of Boston.

After the intermission for lunch, Hon. Carroll D. Wright was introduced.

MR. WRIGHT SPOKE

in favor of arbitration, but called attention to the fallacies of compulsory arbitration. He outlined the difference in the labor question between the present time and a generation ago, when it was merely a matter of wages and time. To-day it involves many important considerations, psychological, sociological, and industrial. It is a question which reaches every interest of man, which is as many-sided as the minds of men. Therefore, it is necessary to devise some method of harmonizing different bodies to one line of action; hence the value of true arbitration. With all that has been said of compulsory arbitration, it is a step backward. It means the enslavement of all the personal elements of industry. It would result in a more narrowing system than the Feudal. It means the development of the fighting nature of men. It means the death of industry. True arbitration brings men together for the purpose of comparing views and settling difficulties. It dignifies and ennobles industry, and embodies in its principles the reciprocal relations of men. To establish arbitration is to elevate the reciprocal relations to a plane of mutual recognition of the rights of all.

Individualism, which was the ruling spirit years ago, is supplanted by altruism. We have developed from a condition of fixed relation to one of contract, by which a workman can make such an arrangement as he chooses. Labor difficulties cannot be settled until each man recognizes the rights of the other man. The time is coming when neither party to a strike or lockout will feel that he is doing the right thing. Mr. Wright described the methods of compulsory arbitration and gave many illustrations to show its fallacy. He said that our mechanics have been taught they are free; they have been taught the principles that surround governments; they have been studying economic relations. Notwithstanding the objectionable features, one must recognize that in strikes and in lockouts there is much that is right on both sides. This results from the attempt of man to get the best of what he can out of his environment. "You should have a perpetual court of arbitration, to which you can refer. If you have a judiciously selected board of members on both sides of the great problem of industry, you have taken a great step towards the right; for you have recognized the rights of men, and those men have become just so much better as a result."

IN THE DISCUSSION WHICH FOLLOWED

Mr. Harris of Philadelphia said that the experience there was strongly in favor of arbitration. He instanced the good that had been done in the case of an association of bricklayers, independently organized, which had been brought to recognize the benefits to be derived from arbitration, after causing the builders no end of trouble by sudden strikes. There had been no friction since. Mr. Harris thought the workmen had more right to organize than the builders. Mr. Ginderle thought it became the employers to make more concessions than the employees did. He stated that in Chicago there had not been a masons' strike since 1887, when they first began to arbitrate. He advised arbitration before, not after, the difficulty. Mr. Blair of Cincinnati, chairman of the committee on arbitration, urged the formation of the several trades in each city into compact organizations, which could treat successfully with the men in their employment, who are strongly organized.

Mr. Sayward then explained

THE FORM OF ARBITRATION

of the association, and said he introduced it in order to bring out any suggestions leading to its improvement. He said the spirit of the agreement was the spirit of Mr. Wright's address, and asked why exchanges have done nothing with the agreement, which was the careful work of a capable committee. The convention ought to endorse it and instruct the filial bodies to introduce it. Mr. Hussey announced that he was in full accord with the spirit of arbitration, but wished to make the point that arbitration had no business to concern itself with the right of a non-union man to work, which was guaranteed him by the Constitution. He was in the same position as at the first session of the association. He held that no man and no body of men, whether master builders or union organizers, have the right to say that men shall not have the right to work, or that men shall not have a right to learn a trade.

Mr. McCarthy of Chicago was again heard from, as he promised the convention the day previous he should be.

Mr. Woodbury spoke with two years' experience on the arbitration committee, which has treated with bricklayers', stone masons', and laborers' unions. To his mind the form of arbitration proposed was the best way of settling all vexed questions that came before the board. There had been no strikes or lockouts of importance since the committee had been in existence.

Mr. Baker presented a resolution to the effect that delegates should urge upon their respective bodies the adoption of the association's form of arbitration. This was seconded by Campbell & Hopper of New York, with favorable instances of the force of arbitration, also by Mr. Sayward, and unanimously carried.

A large number of resolutions was referred to the committee on the same. Greetings from the National Association of Building Inspectors, in session at Steinert Hall, were received; and a vote of thanks was passed to the Massachusetts Charitable Mechanics' Association for the use without pay of Cotillion Hall.

FRIDAY'S SESSION.

VOLTA BUREAU BUILDING. BALUSTER.

This, the closing day of the convention was in many respects the most important, as the subjects of trade schools, the uniform contract, and the per capita tax were considered, and the election of officers was held.

Mr. Watson of Philadelphia and Mr. Ittner of St. Louis presented resolutions recommending the establishment of trade schools, Mr. Ittner asking members to obligate themselves to give young men graduating from such schools a finished trade in event of proscription by trades unions. Resolutions were finally adopted to the effect that the character of the work of the National Association is largely educational, and should not be limited to any one class; that the trades unions display antagonism to the association's plan for educating apprentices primarily on account of lack of understanding of trade schools; that the National Secretary be instructed to prepare a description of the plan, setting forth the fact that the time occupied by a course of trade training shall be deducted from the full term of apprenticeship, and that the remainder of the term shall be served in acquiring the necessary manual dexterity; that proper means for the distribution of this description among the workmen be taken, and that their co-operation with employers be urged in the establishment of trade schools.

The Uniform Contract was discussed with considerable vigor, but some of the speakers seemed to overlook the fact that there are two parties to every contract. For instance, Mr. Grace of Chicago thought amendments should be made without reference to the American Institute of Architects. The latter might kick, but they would have to come to terms finally. But in the majority of cases the speakers thought that the aim to secure in this contract was a thoroughly fair relation between the parties in a building contract. The matter was discussed until the dinner in the lower hall grew cold, and finally tabled. Mr. Sayward suggested that if all delegates who had suggestions to make would send them in writing to the committee much good would be accomplished. After all, as Pres. Hersey remarked on opening the discussion, the action of the convention was prescribed. The only action which could be taken was to recommend the delegates to the joint committee on uniform contract to urge the adoption of changes which, after discussion, were approved by the convention.

A vote on the per capita tax resulted in the adoption of three dollars by a small majority. Secy. Sayward favored reduction to two dollars on account of hard times, and offered to work for a fraction of his present salary to reduce expenses so that the lower tax would suffice.

Mr. Wingate introduced a resolution restricting immigration, which was opposed on the ground that the American boy can look after himself, and finally tabled.

The election of officers resulted as follows: President, Noble H. Creager of Baltimore; first vice-president, Charles A. Rupp of Buffalo; second vice-president, James Meathe of Detroit; secretary, William H. Sayward of Boston; treasurer, George Tapper of Chicago.

Mr. Creager, the president, belongs to the large brick manufacturing firm of Pitcher & Creager of Baltimore. He is the president of the Baltimore Exchange, and is very prominent in Baltimore business circles.

Mr. Meathe is a plumber, and president of the Detroit Exchange.

It was voted to hold the next convention at Baltimore on the third Tuesday in October, 1895. In the evening a smoker was given by the Boston Exchange, and delegates and visitors royally entertained. A banquet to the visiting ladies was held the same evening at the Vendome.

COMMISSIONERS AND INSPECTORS.

THE fifth annual convention of the National Association of Commissioners and Inspectors of Buildings was opened at Steinert Hall, Boston, on the morning of the 13th of this month.

Pres. John S. Damrell of Boston was in the chair. Mr. J. J. Barry of Boston presented a paper on the "Responsibilities, Qualifications, Duties, and Powers of Building Inspectors." In this Mr. Barry stated that a building inspector should have the same power to arrest transgressors of the law that a police officer has. Such power, he claimed, would make a man conservative, and injudicious use of it would be suitable cause for his removal.

Several inspectors stated that they had similar powers, and could at any time arrest work on a building, and that no building could be erected without their permission.

Inspector Entwistle of Washington read a paper on the buildings of that city, which was followed by a paper on the "Tower Fire Escape" by Mr. William J. Gillingham of Philadelphia. This was essentially the same paper contributed by Mr. Gillingham to our last month's number, and its discussion occupied the remainder of the morning session. It was received very favorably, and strongly endorsed by many of the inspectors. The subject of this form of escape will be further considered in future issues of THE BRICKBUILDER, in the department devoted to fireproofing. At the afternoon session Mr. Fitzsimmons read a paper on the "Relation of the Architect to the Building Department," which was warmly approved by the convention.

On Wednesday the Arsenal at Watertown was visited and the big testing machines inspected. Bunker Hill and the Navy Yard were taken in on the way back.

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

PUBLISHED BY

The Brickbuilder Publishing Company,

CUSHING BUILDING, 85 WATER STREET, BOSTON.

P. O. BOX, 3282.

Subscription price, mailed flat to subscribers in the United States and Canada	$2.50 per year
Single numbers	25 cents
To countries in the Postal Union	$3.00 per year

Entered at the Boston, Mass., Post Office as Second Class Mail Matter, March 12, 1892.

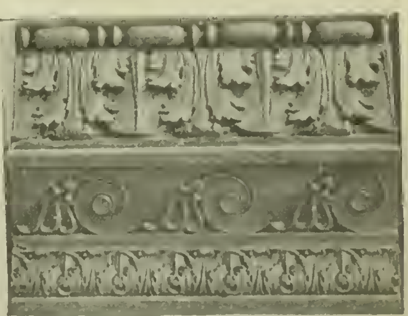
THE BRICKBUILDER is for sale by all Newsdealers in the United States and Canada. Trade Supplied by the American News Co. and its branches.

PUBLISHERS' STATEMENT.

No person, firm, or corporation, interested directly or indirectly in the production or sale of building materials of any sort, has any connection, editorial or proprietary, with this publication.

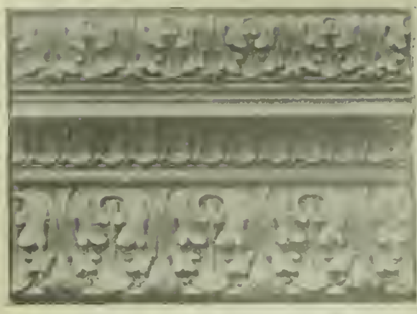
CROWN MOULD. VOLTA BUREAU BUILDING.

WE wish many of our architectural readers who are possessed with the idea that the brickmaker is very little higher in the industrial scale than the day laborer could have attended the Chicago convention. They would have found there as fine a body of representative business men and manufacturers as any industry in the United States could show. The brickmaker of to-day is a manufacturer in the highest sense of the word. Producers of lumber and stone, raw and finished, have comparatively few of the difficulties to contend with that the manufacturers of clay goods are constantly meeting. The obstacles of this industry, in forcing the manufacturers to overcome them, have developed a class of self-reliant, successful men that everywhere hold leading positions in the industrial world.



BELT COURSE. VOLTA BUREAU BUILDING.

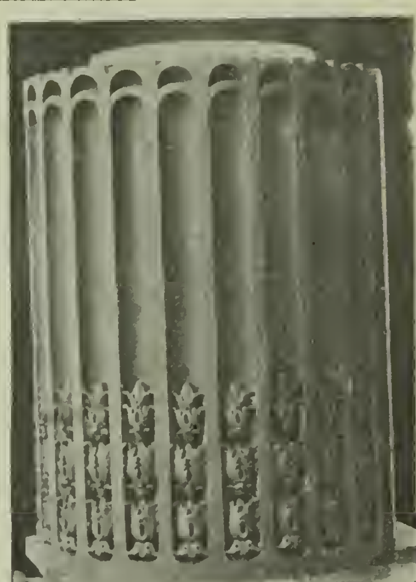
WE also wish to invite our architectural readers to read carefully the papers by Mr. Miller and Mr. Engle, on glazed and enamelled brick, published in this issue. What is therein contained is of vital importance to every architect, as the necessity for using glazed materials is increasing day by day. It can be said in this connection that



CORNICE OVER FRONT ENTRANCE DOOR.

these papers held the attention of the convention in a manner which proved beyond question the soundness of the views put forth in them.

THE desirability of some course in technical education as a preparation for the clay-working business has often been advocated in these columns, and we are pleased to note that the Chicago convention considered it with decided favor. Mr. Orton's paper, which preceded the discussion, is published in full in this issue, and ably sets forth the reasons for such a preparation and the ways in which it may be useful. It is a matter that we recommend to the governing bodies of technical schools, with a suggestion to look into the extent of the clay-working industry. We can think of no other representing so large an investment of capital, and so great a value of products, for which preparation is not provided by some one of the technical or scientific institutions; and yet it is an industry where special knowledge is indispensable.



DRUM OF COLUMN. VOLTA BUREAU BUILDING.

IT is encouraging to note that the sentiment of the National Association of Builders was opposed to the views advanced by some speakers when the uniform contract was under discussion, to the effect that the American Institute of Architects should be forced to come to terms and accept changes introduced by the Builders. This appears to us not only a one-sided, rather pig-headed way of looking at the matter, but one that is absolutely foolish, in that the architects have, and probably always will have, the whip hand. Competition is so strong that architects will have no difficulty in securing honest and capable builders to take contracts, the terms of which are fair. The view of Mr. Grace of Chicago should have been condemned by the National Association. It throws out the question of fairness altogether, and we are led to wonder whether Mr. Grace has not run up against some architect who insisted upon a contract being carried out according to specifications.

COMMUNICATION.

EDITORS OF THE BRICKBUILDER:

Dear Sirs, — In reading Mr. Boyden's article on "Hollow Brick Walls," in the December number of your paper, I was impressed by the following statement, and particularly by the part printed in italics (which are mine): —

"From exhaustive tests made during the building of the Allegheny County Court House and tower, — a most important work, the tower being three hundred and twenty feet high, — it was ascertained hat the strength of brick built in walls or piers is very nearly one third of the crushing strength when crushed between smooth surfaces, or imbedded in plaster; so that, in work where it is necessary to be near the margin of safety, *it may be assumed that well-laid brickwork will carry in a wall one third the crushing strength of a single brick.*"

It would prove interesting reading to many of your subscribers, I think, if a description of the above-mentioned tests were given, as the conclusions based upon them are certainly at variance with other tests and the practice of engineers. It may be that part of the brickwork in the above-mentioned tower carries twenty-four tons per square foot, although it seems improbable: and in any case, I do not think it is a safe load to place upon even the best of brickwork.

As the assumption of Mr. Boyden, printed in italics, is certainly contrary to results obtained from a large number of tests made on the crushing strength of brick and brick piers, at the United States Arsenal at Watertown, Mass., and as the general tendency of Mr. Boyden's article is to attribute a greater strength to brickwork than seems to be warranted, I would like to call attention to the following facts, which have been developed from various tests made on the strength of bricks and brick piers.

First. In the tests on the strength of seven brick, published in Mr. Boyden's article, it should be noticed that in every case the brick *cracked* under less than one half of its ultimate strength, and brick No. 3, which, was next to the strongest of the seven, cracked under only thirty-five per cent of its ultimate load. The same condition is shown by nearly every set of tests on the strength of brick that I have seen.

Second. Tests on brick piers built of Sand's Cambridge (Mass.) brick (the results of which are given on page 178 of the *Architects' and Builders' Pocket-Book*, ninth and later editions) show that the strength of carefully built brick piers averages one tenth of the strength of a single brick, when built of common brick, in lime mortar, and about one sixth when built of pressed brick.

Piers built of common brick in Portland cement mortar were one fifth stronger than those laid up with lime mortar.

Besides the small ratio which the strength of the pier bore to the single brick, every one of the piers built of common brick commenced to crack under a load of less than one half of its ultimate load, so that the cracking strength per square inch of the piers built of common brick in lime mortar only averaged about one twentieth of the strength of a single brick. But we do not wish our piers to crack, and it would hardly be considered safe to load a pier to more than one third of its cracking strength, or *one sixtieth* of the ultimate strength of a single brick.

The average crushing strength of the seven bricks given in the table quoted by Mr. Boyden is approximately eighty-three hundred pounds per square inch, and one sixtieth of this would give one hundred and thirty-eight pounds per square inch for the working strength of the brickwork, or nine and nine tenths tons per square foot.

This value is a little more than that generally used by engineers for brickwork in lime mortar, or that given in the recent building laws.

The following tables give the greatest allowable load for brickwork, as specified in the Boston and Chicago building laws.

Boston Law. — Maximum load in tons per square foot: —

	WALLS.	PIERS, 6 to 12 DIAMETERS.
Brick laid in cement and sand, 1 to 2	15	13
" " " cement, lime, and sand, 1, 1 and 8,	12	10
" " " lime mortar	8	7

Chicago Law. — Maximum load in tons per square foot for brickwork in walls: —

Brick laid in standard cement mortar	12½
" " " ordinary cement mortar	9
" " " lime mortar	6½

On page 181 of the *Architects' and Builders' Pocket-Book* (ninth and later editions) the writer gives values for the working strength of brickwork, which agree very closely with the above.

Regarding the advantages of hollow walls, I believe them to be better than solid walls, when bonded with metal ties, and when not exceeding three stories in height; above that height I should prefer to use solid walls, lined with terra-cotta furring blocks.

F. E. KIDDER.

THE EUREKA CLUB, ROCHESTER, N. Y. MESSRS. NOLAN, NOLAN & STERN, ARCHITECTS, ROCHESTER.

SEE PLATES 14, 15, AND 16, ALSO DESCRIPTION BELOW.

THE ILLUSTRATIONS.

PLATES 9, 10, 11, 12, and 13. ELEVATIONS AND DETAILS OF THE VOLTA BUREAU, Washington. D. C. *Messrs. Peabody & Stearns, Architects, Boston.*

This is one of the richest examples of terra-cotta work in this country. The ornament is not only well designed but admirably applied, and made to count for something by the plain, unbroken surfaces of the walls. Just what the detail is may be seen by the photographs reproduced on the preceding pages, which show nearly every decorative feature on the building. The terra-cotta work was executed by the Perth Amboy Terra-Cotta Company. The bricks from which the building is built were made by the Partridge, Powell & Stone Company, the corporate name of which was on Jan. 31 changed to the Excelsior Terra-Cotta Company. This company now combines the manufacture of architectural terra-cotta, in all colors, with the special colored front brick that has heretofore been its principal product, thus enabling architects to purchase brick and terra-cotta of one factory, insuring a successful combination of colors as well as avoiding the annoyance of making two contracts for materials so closely related. Our best wish to the Excelsior Terra-Cotta Company is that the same success attend this combination that has characterized a similar combination in other cases. The company's offices are at 105 East 22d Street, New York.

PLATES 14, 15, and 16. ELEVATION AND DETAILS OF THE EUREKA CLUB BUILDING, Rochester, N. Y. *Messrs. Nolan, Nolan & Stern, Architects, Rochester. Drawings by J. Mills Platt.*

There may be many larger and more extravagantly furnished clubs than the Eureka of Rochester, but there are few more complete and thorough in their appointments. From top to bottom every care has been exercised by the architects to get the most perfect results; and, as the fame of this building is already established, we have gone to considerable trouble to secure the names of the more important sub-contractors, that our readers in that section of the country may profit by the information when they have similar work which requires careful and conscientious execution.

First that claim attention are the materials of clay from which it is made. The Peerless Brick Company of Philadelphia furnished all front and special shape brick, as they have already done for a long list of buildings throughout New York State. The rich terra-cotta detail was executed by the Corning Terra-Cotta Company of Corning, N. Y., and is the best kind of evidence that this company is in line for the best class of architectural terra-cotta.

The Rochester Brick and Tile Company furnished the common brick, tile, etc. The mortar of the front brick and terra-cotta work is buff, colored with the mortar color made by the Ricketson Mineral Paint Works in Milwaukee, Wis.

Messrs. Whitmore, Ranler & Vercinus of Rochester supplied the cement manufactured by the Buffalo Cement Company, and also laid the cement walks and cut and finished the Gouverneur marble.

Messrs. A. Freiderich & Sons, 601 Ellwanger & Barry Building, and F. C. Seitz, 605 same building, did the general and mason and the carpenter contracting, respectively. The Messrs. Freiderich are also the contractors for a new $70,000 building on Platt Street, Rochester, for C. B. Woodworth.

The Tennessee marble wainscot, lavatory tile floors, tile and Pompeiian brick fireplaces and fittings, were furnished and set by J. C. Barry, 49 North Street.

Of the iron work, the structural was done by J. J. Young of Rochester, the ornamental by the Winslow Brothers Company of Chicago.

The inside finish and mill work was contracted for by John A. Smith, 175 Exchange Street, and the furniture was specially designed and made by the Hayden Furniture Company of Rochester.

It is upon them and the other interior furnishers given below that much of the success of the club depends; for the furniture, draperies, carpets, chandeliers, etc., in the large reception, dining, and ball rooms, the ladies' parlors, and the general club rooms, produce the strongest impression upon members and visitors. With the two above-mentioned houses must also be catalogued Howe & Rogers of 80 to 84 State Street, who put in the carpets and rugs: Gorton & McCabe, 43 State Street, who furnished the draperies and hangings: Albert Will, 28 Exchange Street (C. K. Summerhays, manager), from whom the gas and electric features were secured; Hamilton & Mathews, 26 Exchange Street, who supplied the hardware (a very important part of a fine building); and Henry Waltjen of 38 Exchange Place, who did the painting and decorating.

Of course the Graves elevators were put in, for why go away from home to get work other cities send there for? The same company also furnished the dumb-waiter service.

In a well-appointed club building like this there is much that is out of sight, often inaccessible, that must be put in to stay. One of the most important contracts of this sort is the electric instalment, for lighting, for bells, and often for power. Messrs. R. Schmitt & Co. of 51 East Main Street were intrusted with this work. The plumbing, while not inaccessible, is nevertheless a nuisance if put in so that access for repairs is often necessary, and the selection of W. G. Reid & Sons for such work as is here required is a decided compliment to their skill. Not less important is the steam heating, which was installed by Samuel Sloan, 24 Exchange Street: two boilers from the Sterns Manufacturing Company of Erie, Pa., and a large blower system by the B. F. Sturtevant Company of Boston, are the principal features of the plant.

Club men are good livers, and a club so well appointed in other respects as the Eureka must needs have a kitchen with every modern convenience. C. W. Trotter & Son, 46 North Clinton Street, Rochester, attended largely to this portion of the building, putting in a twelve foot, three-fire French range, copper cooking utensils, a carving-table, and a thirty-inch broiler. The refrigerators, meat boxes, and cool rooms were built in by the Wickes Refrigerator Company of Chicago. The firm of Goggan & Knowles, 50 Franklin Street, Rochester, did all the sheet metal work, and roofing.

One more feature needs to be mentioned, — the bowling-alleys and gymnasium in the basement; the former of the kind patented by Emil Reiskey of Rochester, and made with the gymnasium appliances by the Narragansett Machine Company of Providence, R. I.

The Eureka Club is about twelve years old, and has always been a prosperous, well-managed organization. It has at present 159 active members, comprising the best and most prominent of Rochester Jewish citizens. Mr. Abram Dinkelspiel is the president.

MESSRS. FISKE, HOMES & CO. treated the delegates to the National Builders' Convention to a very fine display of their specialties. There were three very noticeable things in the way of faience that attracted marked attention, — a large mantelpiece, a panel similar to the ones used in the Reading terminal at Philadelphia, and a frieze and ceiling decoration. Smaller pieces were advantageously displayed, so that, with the faience counters and railings that are a part of their office furniture, this material received a good demonstration of its possibilities. In the line of fire-flashed and Pompeiian terra-cotta some interesting exhibits were shown, and the application of Pompeiian bricks in special sizes to the construction of fire-places was illustrated by several carefully built examples in varying shapes and sizes.

FIREPROOF CONSTRUCTION.

A department devoted to methods of erecting and equipping buildings to prevent loss from fire.

THE AGE OF CLAY AND STEEL.

AT the banquet given by the Chicago Association to the National Brick Manufacturers' Association, the following toast by Mr. W. L. B. Jenney of Chicago calls for a leading place in this department: —

"*Mr Toastmaster, and Gentlemen of the National Brick Manufacturers' Association*, — 'What is a brick?' was the favorite question with a celebrated French professor of engineering, whom I once knew. His students soon 'caught on' to the only answer that the old gentleman would accept, under any circumstances.

"'A brick is a parallelopipedon of baked earth.' Any other form was terra-cotta. For him there was no such thing as an ornamental brick.

"I am informed that your society entertains a much broader view, and admits in its membership all the manufacturers of clay for building purposes. Those of you who are not so fortunate as to be residents of Chicago no doubt have remarked sundry peculiarities in our city. Most notable, perhaps, is the extreme modesty of the Chicago citizen. This is no joke.

"When a Chicago capitalist or a Chicago syndicate decide to erect a big sky-scraper, they do not brag about it for months, attracting attention to themselves on account of their wealth and their enterprize. Their modesty is such that the first intimation they give the public is a notice in the real estate column of the Sunday papers of a transfer of a big block of property, a cut and description of the building, and the name of the fortunate architect.

"The next morning, when that architect reaches his office, he will find waiting for him the representatives of the brick manufacturers of the neighborhood, each anxious, then and there, to make a contract for the brick of that building.

"Chicago is always short on time. We cannot afford to put a lot of stone-cutters at work pecking away at big blocks of granite, and spending two or three years in the erection of a building. The carrying charges are so enormous, consisting often of the interest on more than two millions of dollars, besides taxes, insurance, etc., that the whole thing must be done in twelve months from the turning out of the old tenants, the tearing down of the old structure, the erection of the new, to the installing of the new tenants, that a revenue may begin. We must have materials that can be manufactured by machinery; great quantities in a very short time. Clay and steel adapt themselves most admirably to these requirements. We must have a style of construction that can be erected rapidly, and so arranged that if the terra-cotta of the lower stories is not ready, which is usually the case on account of the excess of work in these stories in the shape of columns and other ornamentation, the setting of the terra-cotta can commence in the second or third stories without waiting for those below. The Chicago steel skeleton construction meets these requirements.

"In these tall buildings the skeleton is of steel. The walls, the floors, the partitions, are carried story by story, each story independently on the columns. The carrying lintels and brackets are wrapped around with clay in the shape of ornamental string courses and medallions. Terra-cotta pilasters cover the exterior columns. The plain surfaces are filled in between with pressed brick or terra-cotta ashlar. The whole is backed up with clay in the shape of common brick. The floors are of steel beams filled in between with hollow clay arches. The partitions are of clay tile. The fire-proofing is of clay. The whole is cemented together with another form of clay, for cement is little more than clay roasted and ground. So that we are entering upon a new building era, — an era of clay and steel. There was a stone age, — an age of savagery. Then followed a bronze age, — an age of barbarism. Then came the iron age, — the age of civilization. And now we enter upon an age of steel and clay, — an age of science, an age of advanced civilization, in which the technic arts are making most enormous strides.

"These great buildings of clay and steel are in every respect superior to the old style of masonry construction. They are fire-proof, cyclone-proof, and earthquake-proof. They are very substantial, and, moreover, are economical. These buildings are calculated and designed with the same science, the material is inspected with the same care, the construction is superintended with the same thoroughness, as in a great railway bridge of the first order across the Mississippi or Niagara. To some extent these buildings resemble the human figure. The bones and the sinews are of steel, the flesh and the ornamental exterior of clay. All the art, all the architecture, and all the beauty are in the clay. That this society should have chosen rather the beautiful exterior instead of the bones of the structure is easy to comprehend; one has only to glance around the room. By way of illustration, permit me to say that I am sure that there is not one of you but what would choose rather the rosy cheeks and coral lips of a beautiful, blushing maiden in preference to her bones."

THE *Wall Street Daily News* says that cheap building materials, principally those which go to make up a fireproof building, are causing an epidemic of tall office and apartment buildings. Ten years ago a strictly fireproof building would cost fully two dollars per cubic foot. But, with improvements in manufacture, the cost of steel for the framework and hard or porous terra-cotta for covering has steadily dwindled until the cost is now only about thirty-five or forty cents per cubic foot. Taking Mr. Kidder's recent article in the *American Architect* as authority, this is an adequate figure for a strictly fireproof building, that is not extravagantly decorated on interior and exterior. Of such buildings we can select, as fair examples, the Auditorium, Chicago, costing thirty-six cents; the Stock Exchange in the same city, 33.2 cents; the Schiller theatre, also in Chicago, 30.8 cents. These are all by Adler & Sullivan, who, like other prominent Chicago architects, are past-masters in the art of fireproof construction. Taking these as a basis, it is not unreasonable to place the cost of the average steel frame fireproof building at thirty cents; for it is not likely that materials will increase in cost. On the other hand, it is more than likely that their cost will be still further reduced. According to Mr. Kidder's figures, this is only twice the cost of a good-sized brick house with ordinary finish. A house, however, could be rendered practically fireproof with much less expense than a large office building, provided special materials did not have to be made.

As yet, however, judging from published lists of various fireproofing companies, only an occasional residence has been built of fireproof materials. In the construction of residences porous terra-cotta is particularly suitable. It is extremely light, a non-conductor, can be cut with edged tools, and holds nails and screws. As a protection to wooden construction it is admirable, and it can be made in slabs or boards, which can be cut to fit any desired space, and nailed into place, the plastering covering and protecting the nails.

Porous terra-cotta seems easily enough made, but those who attempt its manufacture with ordinary brick clay are pretty certain to meet with failure. The successful manufacturers use *fire clay* with some combustible material, usually sawdust. With a clay that vitrifies at a low heat there is danger that the combustion of the sawdust will generate heat sufficient to vitrify easily burning clays, and the product will not possess the desired spongy or porous character. We firmly believe that thorough methods of fireproof construction will extend in a short time to the better class of residences. In large warehouses, where it is of the greatest importance, the tendency is still to reduce expense by the use of certain methods of slow-burning construction. These are almost as expensive, if carefully carried out, as thorough fireproof construction; and they seldom serve to save the building when a fire once gets started. It can be said in their favor that they are less a menace to surrounding property, but they are seldom successful in saving themselves or their contents from destruction.

TRADE NOTES.

WE were glad to note at the convention that the subject of enamelled bricks received a good share of attention, and much general interest was shown in the discussions that followed upon the subject; also the disposition of our manufacturers to enter the field with an article equal in all respects to that of foreign make. The Tiffany Pressed Brick Company of Chicago are turning out an enamel brick that is receiving very favorable comment, being white and clear, with a highly finished surface and possessing great durability. They guarantee the brick equal in every way to any manufactured, not excepting the imported article.

IT is encouraging to note the increased popularity which fireproof construction is earning for itself, its use being extended to nearly all grades of buildings.

In response to the demand from the architects and owners for fireproofing adapted to residential purposes, the manufacturers are putting forth some new ideas that are meeting with deserved favor. We have had our attention called to the new one-inch hollow tile for partitions, etc., that the Pioneer Fireproof Construction Company are now putting on the market. These tiles are designed especially for residential work and flats where economy in space and cost is desired. The company report a rapidly growing demand for them.

WE note that the architects are giving more attention generally to selection of colors in mortar, and securing some very pleasing effects by proper choice. We feel that a great deal can be done in this direction, and are glad to know that it is interesting the profession more than formerly.

Some very fine specimens in mortar color are being put upon the market by the Ricketson Mineral Paint Company of Milwaukee, Wis. They claim absolute fastness of color in all their goods; also that their material can be handled forty-eight hours after mixture, not hardening in that time. The popularity of their brand would seem to warrant the claim. Besides the straight colors, they make a feature of special shades manufactured to order.

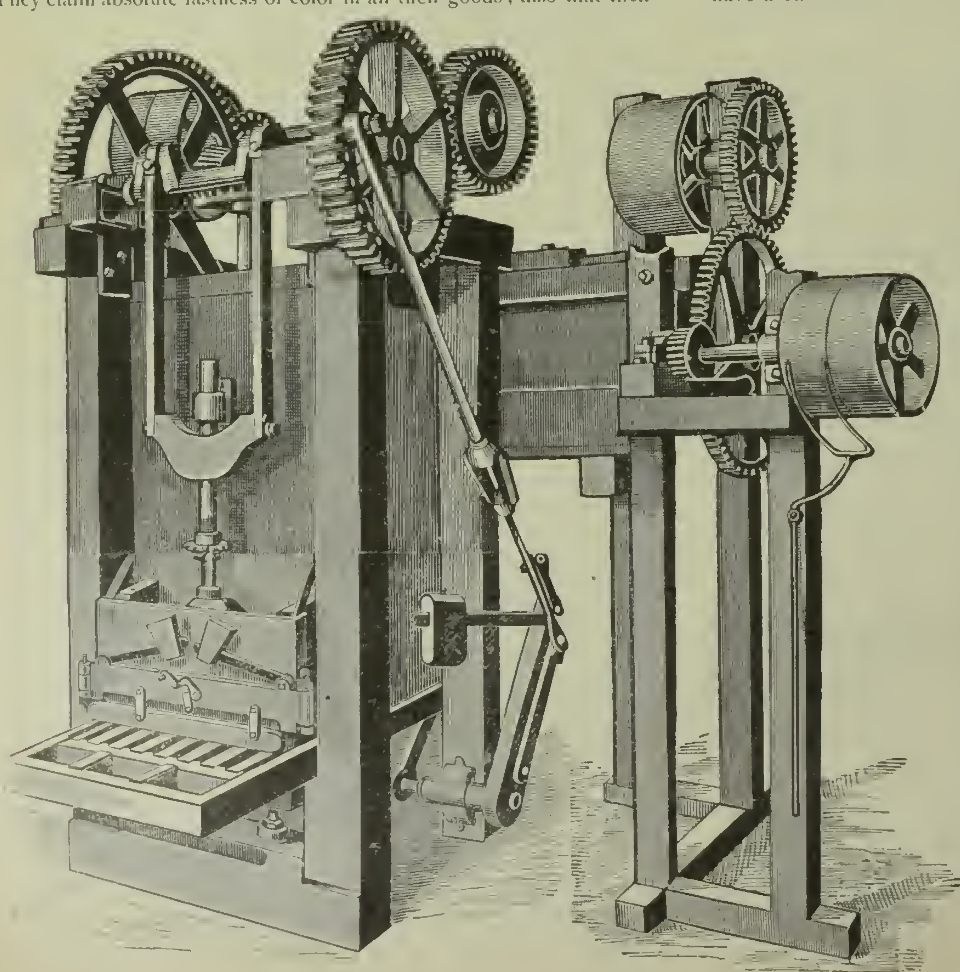
A handsome shade of their buff mortar color appears in the structure of the Eureka Club House, the half-tone print of which will be found on page 29.

ON page v appears the advertisement of the Simpson Brick Press Company. This concern are the manufacturers of the celebrated Simpson presses, and notwithstanding the financial depression report business as being good. They have recently constructed several large plants in the East, and are figuring on many more.

Those intending to embark in the dry press process of making brick would do well to correspond with this firm, as their machinery is well known to be of the highest quality. As further evidence of the superiority of their line, they were given nine points of advancement in dry press brick machinery by the official judge on that class of machinery at the World's Fair.

WE have recently had the pleasure of visiting the Chemical Sand Brick Works, owned by Mr. W. H. Lathrop, of Racine, Wis. It is a model plant of its kind, having all the latest improvements in machinery for the production of chemical sand brick, and this past year has turned out some half million handsome specimens of the same. Mr. Lathrop claims for these bricks all the virtues of a desirable building brick, laying particular stress on the quality of the increasing hardness of the bricks with lapse of time. He further states that he will guarantee them for any reasonable term of years. They are made in any desired design or color, and present a very handsome appearance wherever used.

Mr. Lathrop reports a growing demand for his production, and has some very flattering testimonials from architects and builders who have used his bricks.

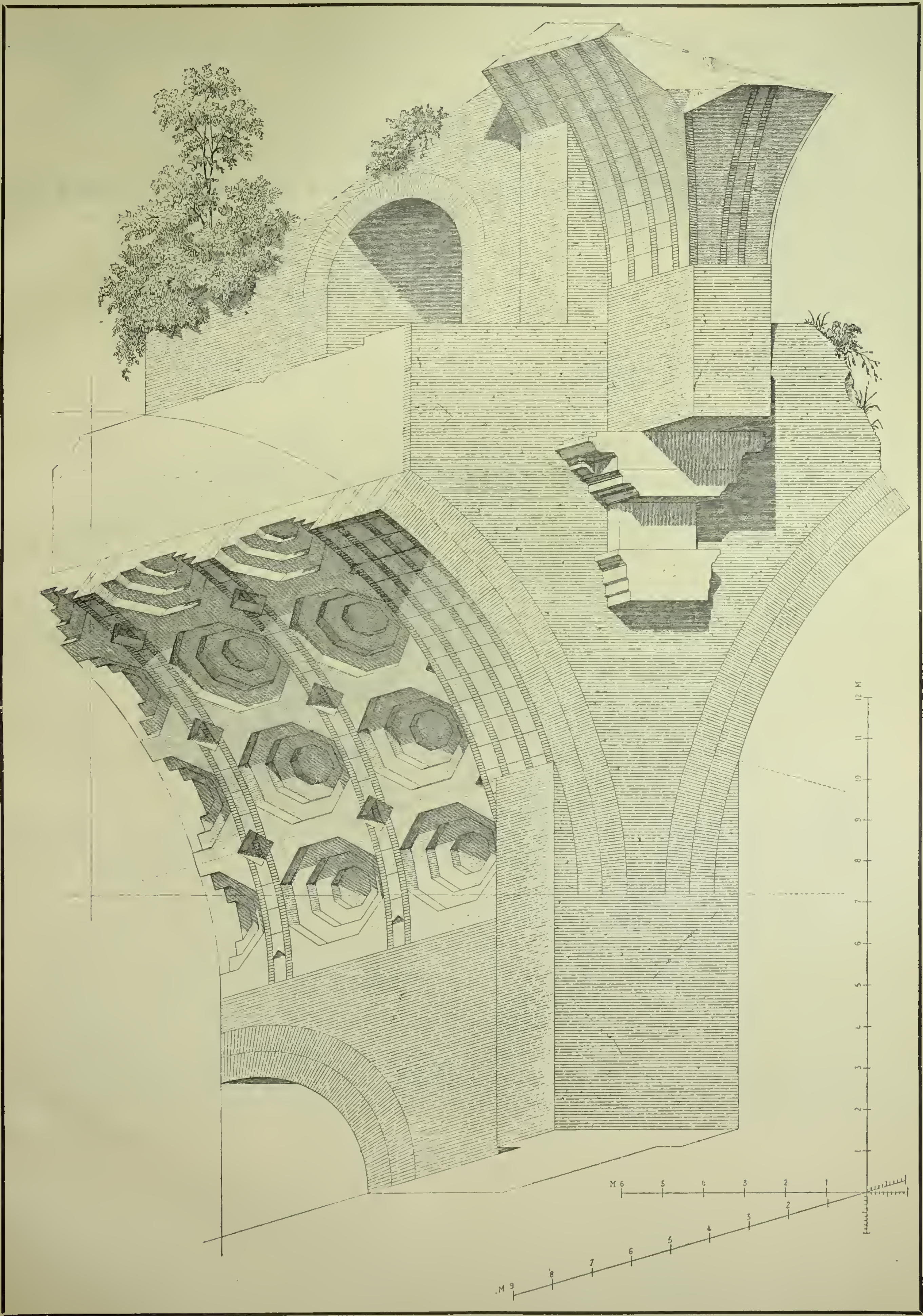


THE cut on this page is a representation of the new, and latest improved brick machine, patented by George Carnell, having a horizontal pug mill attached, and a patent throw-out motion, which pushes out the moulds. When a mould gets caught, or a stone gets fastened in the machine, this catch will open, and thus all danger from breakage is avoided. It is superior to any other machine in use for taking the clay direct from the bank, tempering it, and making good, straight, and solid stiff mud bricks.

In the construction of this machine the aim of the inventor has been to relieve the crown wheel and tempering shaft of as much strain as possible. The result is that the crank shaft acts independently of the tempering shaft, thus distributing the strain on two vital movements. The benefit of this arrangement is apparent; the only work required of the pug shaft is the tempering of the clay, the motive power of the crank shaft being directly from the counter shaft; thus the machine is capable of working the clay very stiff without endangering the crown wheel or shaft. The machine is powerful, durable, and simple in its construction and does not require much skill in handling. The working parts are well protected from dirt and sand and can be easily duplicated. The plunger is regulated with a screw, thus insuring the greatest speed and exactness. Each machine is thoroughly tested before leaving the shop and is sold entirely on its merits.

A SPECIMEN PLATE.

27 of these Full-Page Plates.



100 Illustrations and Diagrams in the Text.

The above is a specimen of the full-page plates illustrating our translation of Choisy's "L'Art de Bâtir chez les Romains." This valuable work and a reprint of treet's "Brick and Marble," illustrated by over 200 illustrations, which in future will be largely photographs, will be two of several strong features of THE BRICK UILDER for 1894.

READ OUR SPECIAL OFFER ON PAGE III.

THE BRICKBUILDER

VOL. III. BOSTON, APRIL, 1894. NO. 4.

A TERRA-COTTA RESIDENCE.

By permission of *The Clayworker*.

RESIDENCE OF W. D. GATES, HINSDALE, ILL.
MESSRS. JENNEY & MUNDIE, ARCHITECTS, CHICAGO.

WHEN "skeleton construction" is mentioned, Chicago appears to be naturally associated with the term. That system seems to have had its greatest development in this city, and, too, in an astonishingly short period of time. The first building to embody the idea was the Home Insurance Building, which was built in 1883. From the windows of its twelfth story can be counted to-day more than thirty office buildings, all ten or more stories high, at least ten of them having their façades entirely of terra-cotta (save in some cases the first two or three stories, which are stone), and all of them employing in a greater or less degree terra-cotta cornices, band courses, sills, lintels, etc., in the construction of their exterior walls.

So far as Chicago is concerned the extended use of terra-cotta as a building material is due to the almost necessity for its application in "skeleton construction." THE BRICKBUILDER will publish details later, illustrating the methods of construction of modern office buildings varying from the old system of heavy walls through various stages to the latest most highly organized steel structure covered from sidewalk to roof with a veneer of terra-cotta.

Terra-cotta is such an adaptable material for veneering steel construction, it is so easily moulded to fit an angle or an I beam, that even when pressed brick curtain walls and piers are used the natural recourse is to terra-cotta for sills, lintels, and mullions. This we say from a constructive standpoint, without considering terra-cotta as a medium for architectural possibilities not yet realized.

The purpose of this article is to illustrate the use of terra-cotta for minor buildings, taking a residence as an example. What more natural than for the president of a terra-cotta company to say, as did Mr. W. D. Gates of the American Terra-Cotta Company: "Why shouldn't I build my house of terra-cotta, instead of stone or brick?" No good negative answer could be found to that question, and a terra-cotta house in the charming suburb, Hinsdale, was the result. Illustrations are published herewith showing the exterior appearance of the house, together with some details of its construction.

If this house were for any other than a terra-cotta manufacturer, the cost would be naturally one of the first questions. Terra-cotta facing at present costs more than pressed brick, but as compared with Buff Bedford, the cheapest, best, and most commonly used cut stone in Chicago, the same design, executed in terra-cotta, costs ten to twenty-five per cent less than in the Buff Bedford limestone.

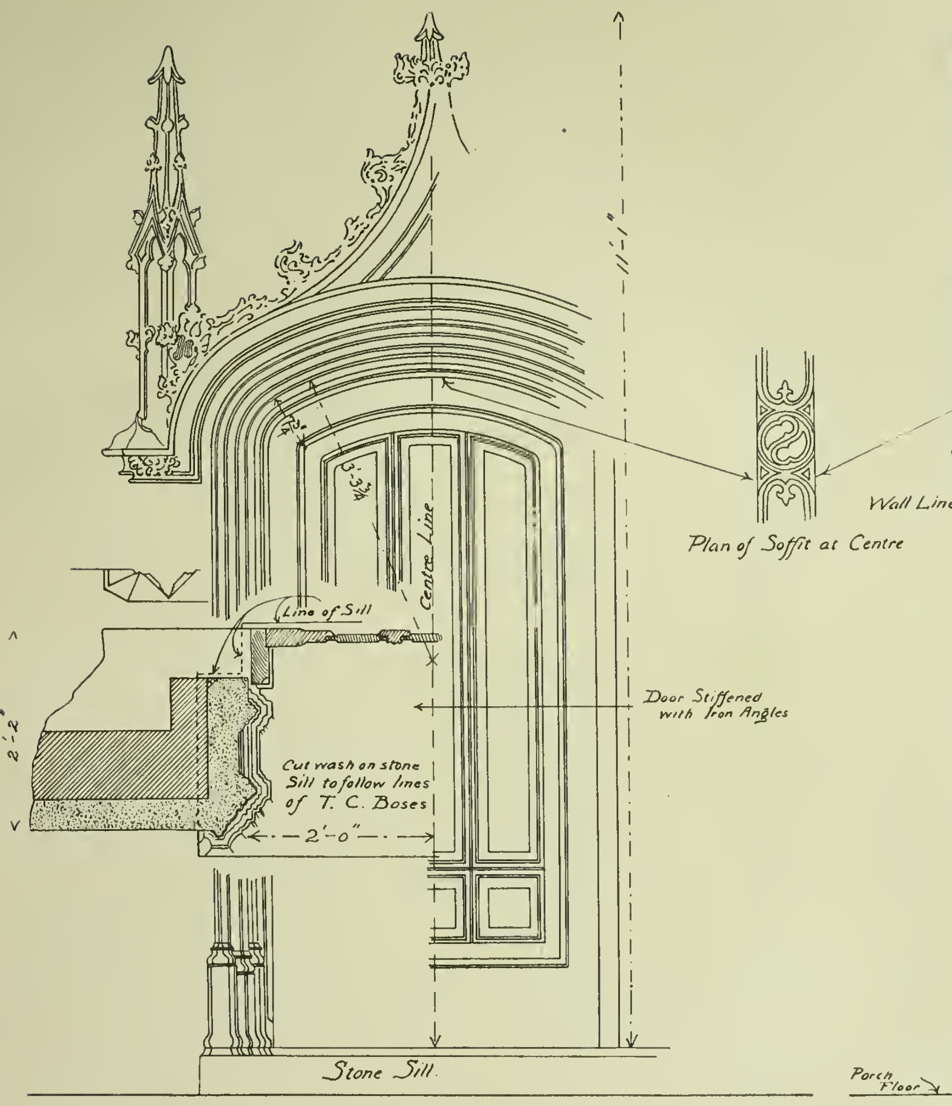
The foundation walls of this house are rubble limestone, coated outside with composition. The interior floors and partitions are ordinary wood joist and stud construction. The roof is of stained wood shingles, though by preference it would have been Spanish tile. The ridges, hip rolls, chimneys, and the entire exterior down to the ground level, are terra-cotta, excepting the steps, which are stone. Even the basement coal window sill, designed to be stone, was actually made in terra-cotta.

As regards the construction of this terra-cotta house, nothing could be more simple. The terra-cotta was made in the form of four-inch ashlar, and built up just ahead of an eight-inch brick backing to which it was firmly bonded by means simply of occasional brick projecting into the cellular backs of the ashlar. Each projecting brick was bedded in a corner of a cell, so that one side and one edge of each brick has a mortar bearing. With the exception of these bond brick, the hollow terra-cotta remained without filling, thus gaining all the advantage of a hollow wall. The plain blocks were made in sizes averaging seven inches and ten and a half inches in height, of alternate courses respectively, by about eighteen inches in length. A rule is to make the vertical dimension a multiple of two and a half inches, so that it will suit the ordinary brick backing. It is considered best to keep the greatest blocks within the dimensions of a two-foot cube, although the veranda column shafts were nicely made in single pieces (the shells being one and a half inches thick), and often still larger pieces are made, without too perceptible shrinkage and warping.

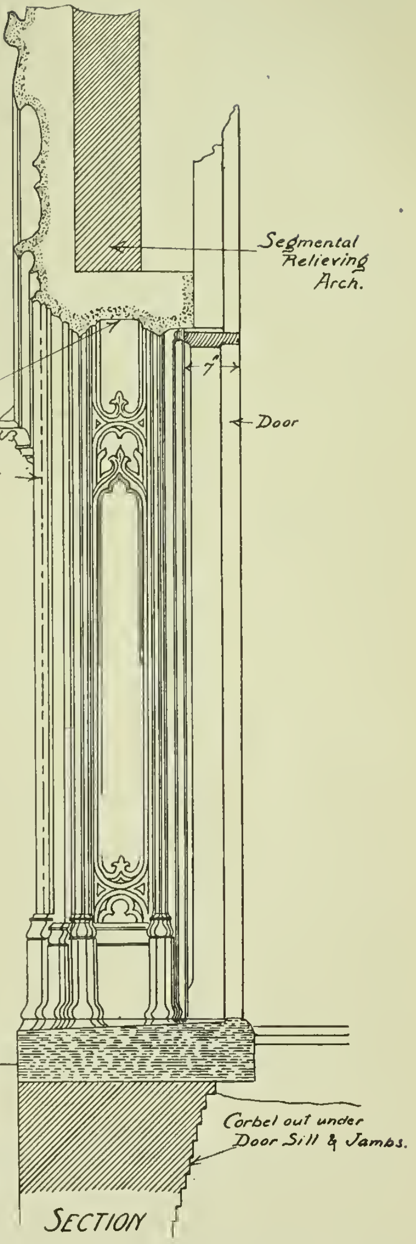
By permission of *The Clayworker*.

VIEW OF PORCH, RESIDENCE OF W. D. GATES, HILLSDALE, ILL. (See detail on Plate 25.)

MESSRS. JENNEY & MUNDIE, ARCHITECTS, CHICAGO.



PLAN & ELEVATION OF MAIN ENTRANCE DOOR



SECTION

For special cases of construction, where rolled beams or cast lintels were desirable, nothing could be adapted so easily as terra-cotta. For example, see the head of a second-story window, a section of which is shown in Fig. 1 (Plate 27). Where an arched head was allowable, the terra-cotta as well as the brick backing, each easily carried itself, — see third-story window in Fig. 1. The arches of the front veranda, where there is little superimposed weight, carry themselves; care being taken, of course, to counteract thrusts by means of suitable ties. Wood scantling were thrust down into the shafts of the corner columns (iron angles would have been better), which, acting as vertical beams, required no horizontal tie below the crown of the arches; the wood plate under the rafters being the only tie. The vertical tie rods, shown in Fig. 5 (Plate 27), were omitted. The veranda rafters were well bolted to the main walls. The veranda columns, arches, and balustrade is a nice piece of work. The balustrade required special care, as it is open work and finished both inside and outside. In the case of the rear porch or loggia (Fig. 6, Plate 27), where a heavy load had to be carried over the arch, steel beams could be used sunk into the voussoirs in a way quite impracticable with any other material than terra-cotta.

In deciding on the color of terra-cotta for his house, Mr. Gates tried a bold experiment with spotted or mottled surface. Spots of black, brown, and white were scattered thickly over a warm buff ground, giving a raindrop effect. All of the terra-cotta was treated in this way before going into the kiln. The general effect is surprisingly successful. Mr. Gates considers that this mottled effect and a combed or otherwise roughened surface are two important considerations for plain ashlar work. With a plain tint on a smooth surface, the play of light reveals the slightest warping from a perfect plane and unpleasantly shows every inaccuracy of the joints. These objections, which might obtain in work on a fine residence to be viewed close to the eye, were entirely obviated by the above expedients.

Terra-cotta can be made in colors of a wide range (one contractor has a sample list of two hundred shades), from almost pure white through the yellows, grays, browns, to dark red; it is strong and yet light in weight; it can be bolted and anchored with ease; it can receive a semi-glaze which will keep out moisture without injuring its appearance; in short, terra-cotta is so "ductile," as some one has said, and it is so easily moulded to suit the designers' ideas in any style, that there is surely a pleasant future for it in residence work. The architect can visit the artistic modeller in the factory, criticise and change any of the ornament, and even have the individuality of his own thumb-nail appear in the surface of the finished building. It is to be hoped that the artistic standard of terra-cotta work may be put upon a high plane; that improved processes and constant cheapening will come rather in fire-clay floor arches, and partitions, so that fireproof dwellings may become more common; that the sleeping family may be as safe at home as the insurance policy in the incombustible office building; and that then "burned earth" may be a thing of use, a thing of beauty, and a joy for a lifetime.

CHICAGO, April 11, 1894. D. EVERETT WAID.

THE ART OF BUILDING AMONG THE ROMANS.*

Translated from the French of Aguste Choisy by
ARTHUR J. DILLON.

INTRODUCTION.

THE edifices of antiquity have been often described from an architectural point of view, but the details of their construction are still but vaguely known. When during the first years of the fifteenth century architects reinstated in honor the ruins of these long-forgotten monuments, they thought first of all to create a new art by imitating classic models. In accordance with this idea they chiefly observed the forms, the proportions, and the ornaments which they wished to revive by new applications; and the impulse given by them to archæological research is felt up to the present time: their pupils, following the way opened to them, have turned over the soil of Italy and of Greece to continue the work of restoration thus begun. During three entire centuries discoveries have multiplied with extreme rapidity, but the spirit of investigation was not sensibly changed; it stopped at the surface of the monuments, without studying the skeleton, and the progress consisted principally in a better appreciation and a better knowledge of the exterior beauties of antique architecture.

To-day the results of so much labor are almost completely classified; the scattered fragments have resumed their places, and without great effort we can picture to ourselves the monuments of Rome and Athens in all the splendor of their primitive decoration. To complete the undertaking of our forerunners, it remains to make known the structure of the edifices of which they so learnedly interpreted the forms. Without doubt their writings throw some light on the means of construction; but the indications they offer in this regard are ordinarily very summary. They are given nearly always incidentally as isolated facts, as simple remarks connected by no theory. These general glimpses suffice to arouse our curiosity, but are far from satisfying it; they rather make us understand the utility of a special study in which the practical rules which were observed in antiquity would be collected and explained with more exactitude and development.

Such a review of abandoned methods would offer more than that undefined interest which is attached to the beginnings of all human industry. The construction, such as it is shown by the scattered details in descriptions of ruins, seems as ingenious as it is strong; it sums up a long and laborious experience consecrated by monuments which have undergone the test of centuries; it permits us to appreciate the extent and the nature of the resources made use of by the ancients, the development the applied sciences had attained in their day; in a word, the circumstances of antique construction form part of the social history of the peoples who have preceded us, and in more than one respect the questions they raise merit from us serious attention.

In the treatise which follows, I will touch on some of these questions, insisting especially on those which have relation to Roman art. With the Greeks the analysis of construction would be so involved with that of the architecture that it would be difficult to separate them so as to examine them apart; but the difficulty ceases when one examines the monuments raised under the domination of Rome. Their authors troubled themselves little enough about refinements of form; the arrangement of plans, the choice of methods of executions, was better suited to the entirely practical turn of their minds. As if they felt themselves incapable of embracing, as did the Greeks, architecture in its entirety, and following out together the various operations it comprises, they established a well-defined difference between structure, in which they were masters, and decoration, for which they affected a disdainful indifference. They left to others the task of ornamenting their edifices, charging themselves with the arrangement and building of them, two problems which they made their own, treating them in a manner truly Roman. The way they imprinted, in the extent of their vast works, the traces of their character, needs, and customs has often been remarked; what they did in the art of building is less known; but here also one must expect to meet the stamp of their organizing genius, and the use of processes without precedent in accordance with the exceptional nature of their resources.

In fact, the vestiges of construction which date back to good epochs of Roman art show arrangements which it would be hard to find even indicated in monuments of another period; it suffices to observe one of those vaults which denote by their presence the points to which Roman empire extended, to be struck with the series of details which establish between ancient methods and our own such profound differences. These are on every hand: arches built in the thickness of the masonry; chains of supports of unusual forms; strengthenings of divers sorts, formerly hidden in the middle of stone work or veiled by plaster, which the decay of the edifices reveals to us by portions often disfigured or incomplete. What functions did these curious ruins fill? Of what use were these big, roughly constructed arches swallowed up in the masses of the vaults, these skeletons of brickwork which often checker the surfaces? By what rules and with what object were these members of this plastered framework combined in the body of the masonry, always light, put up with little trouble, hastily, and without precision? Nothing in our own construction corresponds to these auxiliary works; and nevertheless, judging their importance by the universality of their employment, they seem to have played a capital part in the economy of Roman building. Without doubt they were not there for ornament; they were too irregular and put up with a too evident haste for one to have thought of leaving them apparent; they constituted a kind of interior framework for the building where practical ideas were manifested the most freely and the most sincerely because there were no exigencies of architecture to complicate or hinder their expression. Thus the rules of the art of building are written, so to speak, in these singular works; and if one had to choose certain details to characterize the Roman's methods of construction, no partial study of their edifices would be better suited to this object than that of the ribs with which they braced their vaults.

These ideas struck me forcibly the day I found myself for the first time in the presence of the ruins of ancient Rome, and they have served as a point of departure for my researches among ancient monuments. It seems to me that the history of these monuments, regarded from the point of view of an engineer, could easily be written and set forth without confusion, if to establish a system in the work one profited by the close connection which in general joins the details of Roman construction to the principles which govern the building of vaults. Especially placing myself at this point of view, and, moreover, guided and sustained by the counsels and good wishes of a master who united to the science of an engineer the talents of an architect, I endeavored in a series of voyages which the *administration des ponts et chaussées* kindly encouraged, or prescribed, to gather together the principal documents likely to throw light on the technical questions which relate to the monuments of Roman art. It is the results of this research which I publish to-day. Without undertaking to reconstruct in all its parts a lost system of construction, I shall try at least to describe various details at present too imperfectly comprehended, to give an account of processes of which the significance has seemed clear to me, and to simply call attention to those whose meaning I have not fully grasped.

To tell the truth, I have thought less of writing a history of construction among the ancients than of furnishing the documents for such a work; and I had before all to be on my guard, in a case where observation is so often so delicate a matter, against documents of doubtful origin and capable of misleading a critic. Therefore I have imposed on myself the express condition of citing no examples without having personally established their exactitude or without clearly indicating the sources from which I have drawn them. Sometimes it has been necessary to complete my observations by hypotheses, but in no

* *See advertising page ix.*

case have I done this without making the point where observation ceases and hypothesis begins very clear.

As to theoretic explanations, I should have liked to have surrounded them with the same guarantees, confining myself to advancing only those confirmed by ancient writings; but this verification has not always been possible and the writer on whom I counted most to guide me has too often failed me. Vitruvius speaks of vaults only incidentally, in a vague manner, and with a brevity which is but little in accord with the importance of the subject. It is, in fact, because at his time vaulted construction had by no means reached the development it afterwards attained; no vault of very great span and built on the system of rubble masonry, which later was so widespread, can with certainty be attributed to an epoch anterior to that of Vitruvius; the author of the only ancient treatise on construction remaining to us assisted only toward the end of his life at those colossal enterprises which recall to us the names of Augustus and Agrippa, and which marked the beginning of a new era in Roman architecture; he himself had no part in the magnificent impulse which produced the Baths of Agrippa and the Pantheon of Rome, and his book, the work of his old age, offers us less a picture of the innovations of a contemporary epoch than a souvenir of the procedure in use during the last days of the Republic, — à sort of return toward the methods he had applied in the course of his long career.

Vitruvius excepted, the ancient writers do not treat construction with enough detail for one to have reason to expect from them anything really useful. Pliny, given above all to speculative observations, develops less the methods followed in the use of materials than the natural history of the materials themselves. Frontinus regards construction more as a director of works than as an architect; and though he may often mention vaulted works built under his direction, he nowhere enters into the details of the process. There still remain, perhaps, writings on Roman agriculture or on military arts, in which are found short descriptions relative to building; but the constructions mentioned have too special an object, and the writings, which treat of them briefly, can only throw a doubtful light on the general principles of practical architecture. Moreover, the rare allusions which they make to ordinary methods are very obscure, and many would remain, I think, unintelligible, if the ruins were not there to serve as commentaries.

The almost absolute silence of writers forced me to explain theoretically the facts I have observed; but the explanatory hypotheses have fortunately shown characteristics of great truth, and the perfect clearness which the ancients have shown in all their applications of the art of building fills out, to a certain extent, the blanks in the treatises they have left us. Strictly economical calculations were to me manifestly evident as the principal cause of the various characteristics of ancient construction, and in spite of the very natural distrust with which I was inspired by such an hypothesis applied to the monuments of the great Roman power, it constantly forced itself on me at the end of my studies as the inevitable conclusion to which I must come in spite of myself.

Thenceforth I perceived that one accustoms himself too easily to look upon the Romans as a people who, disposing of immense riches, had never to consider material means, and who could disdain without a scruple the expedients which are sometimes suggested to us by the insufficiency of our resources. The passion for large things assuredly was not a stranger to their enterprises, but the genius of the Romans knew how to reconcile the vastness of projects with a facility of execution. The more closely I examined their monuments, the more it seemed to me impossible not to recognize the employment of a thousand artifices, having for their object, if not the reduction of skilled labor, at least a simplification of it. While architects have aimed in their conceptions of the ensemble at a majesty of effect and an endurance worthy of the power and eternity of the Roman people, an evident eye to rigorous saving guided them in the execution of every part; they always aspired to achieve by the use of processes, as easy as they were simple, the double merit of perfect solidity and incomparable grandeur.

This observation led me to look at Roman construction as having a practical aspect I did not at first suspect; as the Romans sought economy in their edifices perhaps we might gain something in reviving some of their processes. Every day we borrow from the ancients forms of decoration; apparently they have something to teach us in the art of building as well, and the history of their edifices more completely known may interest the future of the art of construction as well as that of architecture. This conjecture seems incontestable, but it is not absolute, and to appreciate the importance and degree of fidelity which in these days would be allowable in the imitation of ancient processes one should take account of the differences made by the interval of fifteen centuries between the Roman resources and our own. I shall not speak here of the slaves the Romans so frequently employed in building; they had, especially in the provinces, a resource still greater and more ordinary, which was to use on the public buildings that part of the population of the empire subject to public labor. They thus recruited in corvées as many laborers as they wished to employ. But these improvised workmen, torn from their habitual occupations and dragged by force to the works, were generally found very ill prepared for their new rôle. The Romans did not hesitate to put them to any fatigue whatever, but they were obliged to apportion the difficulties of their tasks according to their inexperience; it was necessary to demand from them purely physical efforts only, and to reduce as far as possible the part left to their intelligence and dexterity. Thanks to the progress of civilization, such resources and the methods which facilitated their employment are now forbidden us.

Moreover, the methods employed by the Romans have not all this exceptional character; they do not all present such close correlation with a social system which ceased long ago to weigh upon the world, and besides these methods of execution, the study of which henceforward belongs exclusively to history, we find among the Romans quite a number of artifices of less special character which may be employed in our own time as they were at the time of the Cæsars. Such are the expedients which the ancients invented, as we shall see, to reduce the importance of the auxiliary works; centrings, for example, or scaffoldings, and, in general, those expensive accessories which hamper the progress of the work and increase its price. The adoption of any complex processes or roundabout ways was repugnant to the Roman mind. Physical labor cost them little, and nowhere in the durable parts of their buildings have they been saving of it, but nowhere have they expended it for temporary work without regret. The rule which they followed was, on the contrary, to utilize for permanent work, and in the simplest way, all the resources drawn on for the construction of their edifices; this very elementary rule will account for the greater part of the artifices peculiar to Roman art which we are to show.

So, independent of the methods whose employment we cannot renew without placing ourselves in formal opposition to the economic system of our times, we meet in the old traditions of the art of building with processes whose merit does not result exclusively from their appropriateness to the people who used them, but whose generality permits them to be applied to new uses. Still the general principles followed by the Romans are very few in number; the reapplication of the resultant processes will always be subjected to certain restrictions, and to use them for our purposes it will often be necessary to modify them more or less profoundly. But even if imitation should be forbidden us, these processes are well worth studying. One who applied himself exclusively to their form would have but an imperfect knowledge of the monuments of antiquity, and a description of these monuments, from the point of view of construction, will aid at least in filling up some of the gaps in the history of a justly celebrated architecture. (*To be continued.*)

THE principal object of our greatly reduced club rates, which are given on page ii, is to enable draughtsmen and students, by sending their subscriptions through some one of their number, to get the paper at a very low price. We therefore request architects to call the attention of their draughtsmen to our club rates.

BRICK AND MARBLE IN THE MIDDLE AGES.

(*Continued.*)

CHAPTER IV.

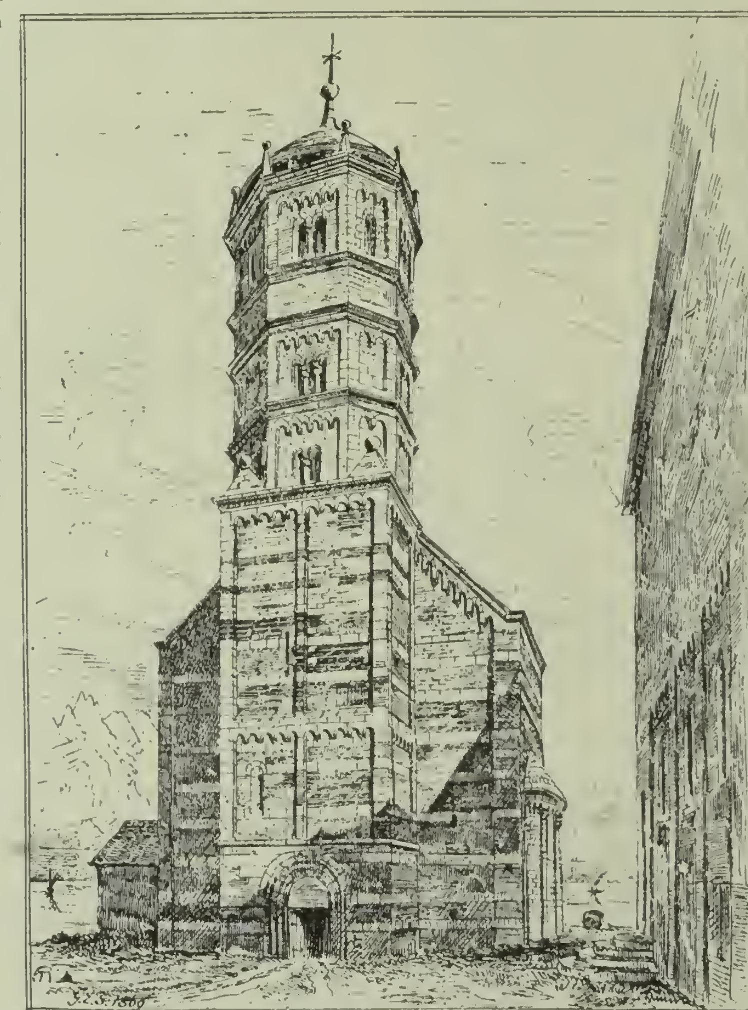
"But now 'tis pass'd,
That turbulent chaos; and the promised land
Lies at my feet in all its loveliness!
To him who starts up from a terrible dream,
And lo, the sun is shining and the lark
Singing aloud for joy, to him is not
Such sudden ravishment as now I feel,
At the first glimpses of fair Italy."
—*Rogers.*

CHIAVENNA — LAKE OF RIVA — COLICO — GRAVIDONA — LAKE OF COMO — VARENNA — STELVIO PASS — LECCO — BERGAMO — BROLETTO — CHURCHES — CASTLE OF MALPAGA.

THE situation of Chiavenna is eminently beautiful: in a deep valley surrounded on all sides by mountains whose slopes are covered with soft and luxuriant foliage of oak and chestnut, and where every available open space is devoted to trellised vineyards, it contrasts strongly with the pine-covered hills so lately passed on the northern slopes of the Alps; placed, too, at the confluence of two streams, — the Meira and the Lira, — it rejoices in the constant, rushing sound of many waters.

It was only necessary to move out of the shade of our hotel into the melancholy piazza in which it stands, to discover that an Italian sun lighted up the deep-blue sky; and a walk to the principal church, dedicated in honor of St. Lawrence, a stroll through the narrow streets, and a rather toilsome ascent through a vineyard formed upon a rock which towers up behind a kind of ruined castle, and from which a capital view is obtained of the singular and beautiful *cul-de-sac* in which the town is planted, sufficiently convinced us of its power.

The church of St. Lawrence is entered from a large, oblong cloister, in one angle of the space, enclosed by which rises a tall campanile, its simple form, and its arcaded belfry full of musical bells, contrasting well with the outline of the hills, which overhang and hem it in. On the east side of the cloister are the church, an octagonal baptistery, and a bone-house, all ranged side by side, and opening into it, and the latter curious as an example of the extent to which the people of Chiavenna amuse themselves by arranging skulls and arm bones into all kinds of religious and heraldic devices, and with labels to mark the names of their former owners. The *tout ensemble* is picturesque in its effect, and the cool, pleasant shade of the cloister, with the view of the church and its tall campanile, and irregularly grouped buildings looking brilliantly white in the clear sunshine, was very pleasing.*



BAPTISTERY, GRAVIDONA.

Italian beggars, persevering, and, at any rate in appearance, very devout, did their best to annoy us here and everywhere when we ventured to stop to examine or admire anything; and Italian beggars are certainly both in pertinacity and in filth about the most unpleasant of their class.

My voiturier gave me a lesson worth learning, and not perhaps unworthy of note for other unsuspicious travellers. We had a written contract to Chiavenna, and thence to Colico he had agreed verbally to take us for a certain sum; before we started I found, however, that he intended to charge us three times as much as we had agreed upon, and as very luckily we found a diligence on the point of starting, we secured places in the cabriolet at its back, from which we had the best possible position for seeing the views, and so left him in the lurch, with divers admonitions to behave himself more honestly for the future.

At ten we left, and had a very enjoyable ride to Colico. The valley, however, bore sad traces of the havoc made by the inundations of the Meira, and of the storm of the previous night. We soon reached the shores of the little Lake of Riva, along whose banks our road took us sometimes in tunnels, sometimes on causeways built out into the water, until at last we reached the valley up which runs the Stelvio road, and then, after passing along the whole length of a straight road lined on each side with a wearisome and endless row of poplars, we were at Colico. Here we prudently availed ourselves of the opportunity of an hour's delay in the departure of the boat for an early dinner, and, then embarking, waited patiently the pleasure of our captain.

The scenery of Lake Como has been so often extravagantly praised that I was quite prepared to be disappointed; but for the whole distance from Colico to Lecco it is certainly on the whole more striking than any lake scenery I have seen. The mountains at its head are extremely irregular and picturesque, and throughout its whole length there is great change and variety. In this respect it contrasts favorably with most other lakes, and I certainly think that not even in the Lake of Lucerne is there any one view so grand as that which one has looking up from within a short distance of the head of Como over the Lake of Riva to the mountains closing in the Stelvio, and rising nobly above the sources of the Meira and the Lira.

Somewhat, too, may be said of the innumerable villages and white villas with which the banks of the lake are studded; they give a sunny, inhabited, and cheerful feeling to the whole scene, and, reflected in the deep-blue lake, in those long-drawn lines of flaky white, which are seen in no other water to such perfection, add certainly some beauty to the general view.

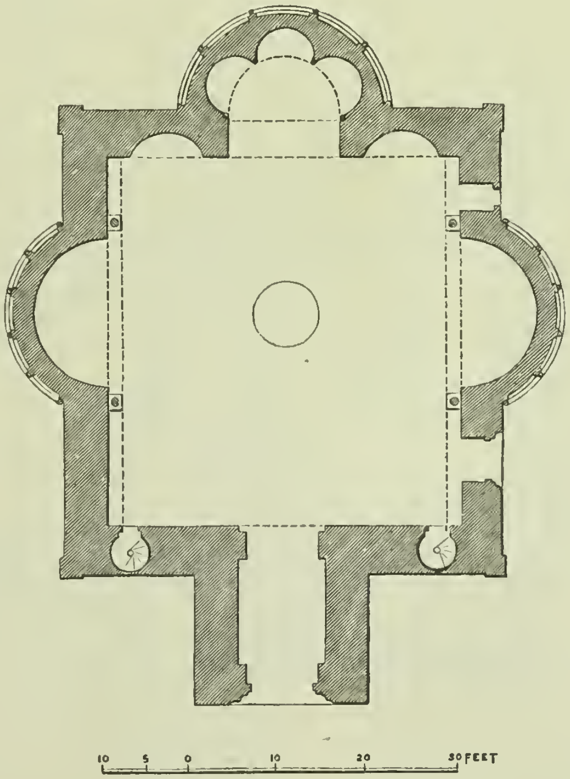
One of these villages, Gravidona, within half an hour's sail of Colico, ought not to be left unvisited by any one who cares about architecture.

Close to its little harbor stand two churches, side by side, one

* Probably most travellers who pass by Chiavenna are now on their way to or from the Engadin, by the beautiful Maloja Pass. They will do well before they reach the top of the Pass to notice on their left the ruined remains of a Gothic chapel of the fifteenth century, which may, I suppose, aspire to the honor of being at a greater height above the sea than any other Gothic church in Europe. Its architectural merit is not great, but still it has a certain value, as showing how well a simple little Gothic church looks among the wildest mountain scenery.

an oblong basilica, the other a baptistery of, as it seems to me, such great interest that I give illustrations both of its plan and of its exterior. It will be seen that the dimensions are small, the total internal width being less than forty feet, whilst the design of the east end is most ingeniously contrived so as to give no less than five eastern apsidal recesses. There are two stair turrets in the wall, on each side of the western tower, which lead up to a sort of triforium passage, which is formed behind an arcade in the side wall of the church, and one of them leads also to the first floor of the tower. The triforium consists of an arcade of seven arches in each side of the wall. The three small apses at the east have each their own semi-dome, and the chancel, as well as all the other apsidal recesses, are similarly roofed. All the walls retain more or less traces of old paintings, the Coronation of the Blessed Virgin occupying the principal apse, and the Last Judgment the west wall. The whole church is built in white marble and black limestone, used in courses, or stripes, with extremely good effect.

The roof of this baptistery is of wood. The exterior is best explained by reference to my drawing of the west front. It stands on a charming site, with a background of lake and mountain, such as one seldom enjoys. There is a contrast here, which strikes one very much, between the ingenious skill of the planning of such a building as this and the rudeness of the execution of the details. I know nothing as to the history of Gravidona; but it looks as though the plan came from the hands of men who knew something of the church of San Vitale at Ravenna, whilst its execution was left to the rustic skill of the masons of the country.



PLAN — BAPTISTERY, GRAVIDONA.

The baptistery is dedicated to St. John the Baptist. Close to it, as I have said, stands the church of San Vincenzo, which, though Romanesque in its foundation, has been much modernized, and is now mainly interesting on account of the exquisite examples of late fifteenth century silversmiths' work which still enrich its sacristy. Conspicuous among these is a silver processional cross. This cross is nearly two feet across the arms by three feet in height from the top of the staff. There is a crucifix on one side and a sitting figure of Our Lord on the other, figures of SS. George, Vincent, Sebastian, Christopher, and Victor, and Our Lord on the base or knop, and half-figures of the Evangelists on the arms of the cross. The ornaments consist of crockets bent and twisted, of blue enamels, filigree work, nielli, and turquoises set in the centre of dark-blue enamels. It is, in short, a piece of metal work which might well make a modern silversmith run down swiftly into the lake and drown himself in despair at the apparent impossibility in these days of rivalling such a piece of artistic and cunning workmanship, in spite of all our boasted progress!

Not much less splendid is a chalice of about the same age. It is ten and three-quarter inches high, has a plain bowl, but knop, stem, and foot all most richly wrought with figures, niches, and canopies, and the flat surfaces filled with fine blue and white Limoges enamels. The paten belonging to this chalice is very large, nearly ten inches across, and quite plain.

Half the passengers on the steamboat were, of course, Austrian soldiers and officers, the other half English or Americans, either resident at or going to Como. We, however, stopped on the way, and, leaving the steamboat in the middle of the lake, after a row of about twenty minutes found ourselves at Varenna, a village exquisitely placed just where the three arms of the lake — the Como, the Lecco, and the Colico branches — separate, affording, whether seen from here, from Bellagio, or from Cadenabbia, the most lovely lake views it has ever been my good fortune to see.

Here we had what seemed likely to be an endless discussion upon the relative merits of a four-oared boat and a carriage as a means of conveyance to Lecco. We inclined to the latter; but, leaving the matter in the hands of an active waiter, we busied ourselves with eating delicious fruit, admiring the tall cypresses growing everywhere about the shores of the lake, and watching the exquisite beauty of the reflections of Bellagio and the opposite mountains on the smooth bosom of the water.

We were soon off again, and well satisfied to find ourselves trotting rapidly along the well-kept Stelvio road, instead of dragging heavily and slowly along, as one always does, with a Swiss voiturier; soon, however, we were to find that our driver was an exception to the Italian rule, and that he who wishes to travel fast must not expect to do so with vetturini.

The churches which we passed were in no way remarkable; they all had campanili, with the bells hung in the Italian fashion in the belfry windows, with their wheels projecting far beyond the line of the wall; but they all seemed alike, uninteresting in their architecture, so that we were in no way sorry to pass them rapidly on our way to Lecco. This eastern arm of the lake, though of course much less travelled than the rest of its course, is very beautiful, and its uninhabited and less cultivated looking shores, with bold cliffs here and there rising precipitously from the water, were seen to great advantage, with the calm, unrippled surface of the lake below, and the sky just tinged with the bright light of the sun before it set above.

Lecco contains nothing to interest a traveller; we had an hour to spend there before we could get fresh horses to take us on to Bergamo, and wandered about the quaint-looking streets, which were full of people — some idly enjoying themselves, others selling luscious-looking fruit. We went into a large church not yet quite completed; it was Renaissance in style, almost of course, and on the old plan, with aisles, but very ugly notwithstanding. In the nave was a coffin, covered with a pall of black and gold; six large candles stood by it, three on either side, and two larger than the others on each side of a crucifix, at the west end. The whole church revelled in compo, inside and out, and there was external access to a wretched bone-house in a crypt.

Leaving Lecco, we had a long drive in the dark to Bergamo; the night was very dark, but the air was absolutely teeming with life, and sounds of life; myriads of *cicale* seemed to surround us, each giving vent to its pleasure in its own particular note and voice, with the greatest possible determination; and had I not heard them, I could scarcely have believed it possible that such sounds could be made by insects, however numerous they might be. We changed horses at a village on the road, and went on rapidly. The old town of Ponte San Pietro was passed, having been taken at first to be Bergamo, and remembered by the sound of a troop of men singing well together as they passed us in the dark in one of its narrow streets, awakening with their voices all the echoes of the place, which, till then, had seemed to us to be supernaturally silent. It was eleven o'clock before we reached Bergamo, and, tired with our long day's work, we were soon in bed.

A prodigious noise in the streets before five o'clock the next morning gave us the first warning that the great fair of Bergamo was in full swing; sleep was impossible, and so we were soon out, enjoying the busy throng which crowded the streets of the Borgo, in a before-breakfast walk; the crowd of women selling fruit, the bright colors of their dresses, the rich tints of stuff hung out for sale, the display of hairpins and other ornaments in the innumerable silversmiths' shops, and the noisy, laughing, talking people who animated the whole scene, made the narrow arcaded streets of the busy place most amusing.

After breakfast we started at once for the Città, as the old city of Bergamo is called. It stands on a lofty hill overlooking the Borgo San Leonardo, within whose precincts we had slept, quite distinct from it and enclosed within its own walls. The ascent was both steep and hot, but the view at the entrance gateway of the Città over the flat Lombard country was very striking, and well repaid the labor of the ascent. This vast plain of bluish-green color, intersected in all directions by rows of mulberry-trees and poplars, diversified only by the tall white lines of the campanili which mark every village in this part of Lombardy, and stretching away in the same endless level as far as the eye could reach, was grand, if only on account of its simplicity, and had for us all the charm of novelty.

Through narrow and rather dirty streets, which do little credit to the cleanly habits of the Bergamask nobility, to whom it seems that the Città is sacred, and whose palaces are, many of them, large and important buildings, we reached at last the Piazza Vecchia, around which is gathered almost all that in my eyes gives interest to Bergamo.

Across the upper end of the Piazza stretches the Broletto, or town hall, supported on open arches, through which pleasant glimpses are obtained of the cathedral and church of Sta. Maria Maggiore, which last is the great architectural feature of the city.

But we must examine the Broletto before we go farther. And first of all, its very position teaches a lesson. Forming on one side the boundary of a spacious piazza, on the other it faces, within a few feet only, the church of Sta. Maria Maggiore, and abuts at one end upon the west front of the Duomo. It is to this singularly close — even huddled — grouping that much of the exquisite beauty of the whole is owing. No doubt Sta. Maria and the original cathedral were built first, and then the architect of the Broletto, not fearing — as one would fear now — to damage what has been done before, boldly throws his work across in front of them, but upon lofty open arches, through which glimpses just obtained of the beauties in store beyond make the gazer even more delighted with the churches when he reaches them than he would have been had they been all seen from the first. It is, in fact, a notable example of the difference between ancient grouping and modern, and one instance only, out of hundreds that might be adduced from our own country and from the Continent, of the principle upon which old architects worked: and yet, people, ignorant of real principles in art, talk as though somewhat would be gained if we could pull down St. Margaret's, in order to let Westminster Abbey be seen; whereas, in truth, the certain result would be, in the first place, a great loss of scale in the Abbey seen without another building to compare it with and measure it by; and in the next, the loss of that kind of intricacy and mystery, which is one of the chief evidences of the Gothic spirit. Let us learn from such examples as this at Bergamo that buildings do not always require a large open space in front of them, so that they may be all seen and taken in at one view, in order to give them real dignity.

The whole design of the Broletto is so very simple as to be almost chargeable with rudeness of character. The ground on which it stands is divided by columns and piers, the spaces between them being all arched and groined. Towards the Piazza three of these arches, springing from rather wide piers, support the main building, and another supports an additional building to the west of it. Above the three main arches are three windows of which that in the centre, though very much altered, still retains a partially old balcony in front, and was evidently the Ringhiera, from which the people standing in the Piazza were wont to be addressed by their magistrates. The windows on either side are very similar in their design and detail; their tracery is of fair middle-pointed character; and the main points in which they strike one as being different from English work are the marble shafts with square capitals in place of monials, a certain degree of squareness and flatness in the mouldings, and the very pronounced effect of the sills, which have a course of foliage and moulding, and below this of trefoiled arcaded ornament, which in one shape or another is to meet the traveller everywhere in Northern Italy; either,

BROLETTO, BERGAMO.

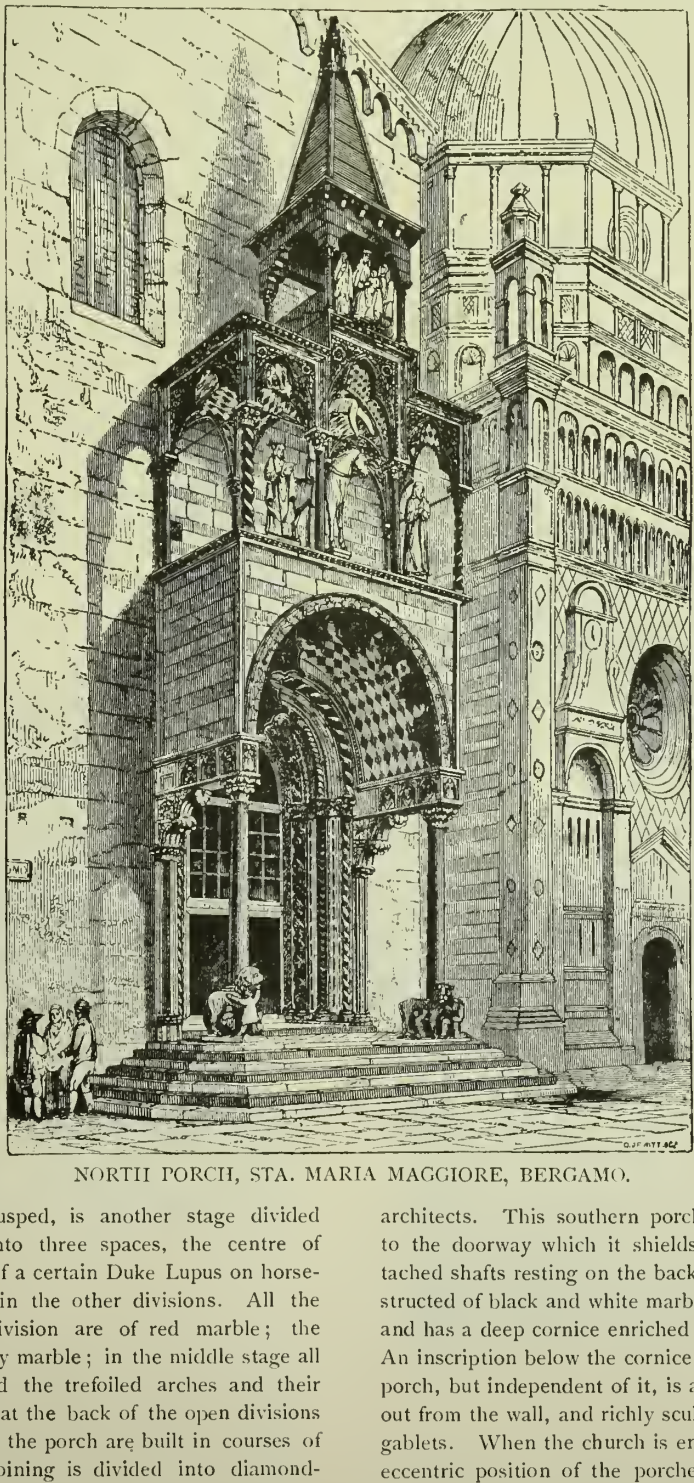
as here, hanging on under the sills of windows, or else running up the sides of gables, forming string-courses and cornices, but always unsatisfactory, because unmeaning and unconstructional. The origin of this sort of detail is to be found in the numerous brick buildings not far distant, where the facility of repeating the patterns of moulded bricks led (as it did in other countries also) to this rather unsatisfactory kind of enrichment. The detail of the arcades supporting the upper part of the building is throughout bold and simple, and I should say of the thirteenth century; the bases are quite Northern in their section, the caps rather less deep in their cutting, but still in their general design, and in the grouping of tufts of drooping foliage regularly one above the other, reminding one much of Early French work, though they are certainly not nearly so good as that generally is. There is a flatness about the carving, too, which gives the impression of a struggle, in the hand of the carver, between the Classic and Gothic principles, in which the latter never quite asserted the mastery. The lesson to be learnt from such a building as this Broletto appears to me to be the excessive value of simplicity and regularity of parts carefully and constructionally treated; for there are no breaks or buttresses in the design, and all its elements are most simple, yet nevertheless the result is beautiful.

To the west of the Broletto is a good open staircase (much like that in the Piazza dei Signori at Verona), forming a portion of one side of the Piazza, and leading to the upper part of the buildings, and, I think, to the great clock-tower, which, gaunt and severe in its outline, undecorated and apparently uncared for, rears its great height of rough stone wall boldly against the sky, and groups picturesquely with the irregular buildings around it. I have omitted to notice that the whole of the Broletto, with the exception of the window shafts, is executed in stone, and without any introduction of colored material, so that it in no way competes with the exquisite piece of colored construction which we have next to examine, immediately behind it.

A few steps will take us under the open-arched and cool space beneath the Broletto, to the face of the north porch and baptistery of Sta. Maria Maggiore. This is a very fine early Romanesque* church, but with many additions and alterations on the outside, and so much modernized inside as to be quite uninteresting to any one who thinks good forms and good details necessary to good effect. The plan is cruciform, with apses to the choir, on the east and west sides of the south transept, on the east of the north transept, and at the west end of an additional north aisle; in all no less than five apsidal ends. The nave is of three bays with aisles, and to each transept have been added, in the fourteenth century, porches, thoroughly Italian in their whole idea, and novel to a degree in their effect upon an English eye.

A domed chapel, erected as a sepulchral chapel by Bartolomeo Colleoni in the Renaissance style, on the north side of the nave, is most elaborately constructed of colored marbles. The effect is too bizarre to be good; there is an entire absence of any true style in its design; and there is nothing which makes it necessary to criticise it with much minuteness.

The best and most striking feature in the whole church is the north porch, a most elaborate structure of red, gray, and white marble, to which a drawing without color can hardly do justice. It is supported upon detached marble shafts, whose bases rest upon the backs of rather grand-looking lions, curiously grouped with children and cubs. Above the arches which rest upon these shafts, and which, though circular, are elaborately cusped, is another stage divided by columns and trefoiled arches into three spaces, the centre of which is occupied by a noble figure of a certain Duke Lupus on horseback, with a saint on either side in the other divisions. All the shafts except those in the upper division are of red marble; the highest stage of all is entirely of gray marble; in the middle stage all the moulded parts are of red, and the trefoiled arches and their spandrels of gray marble; the space at the back of the open divisions and the wall over the main arches of the porch are built in courses of red and white marble. All the groining is divided into diamond-shaped panels, composed alternately of black, red, and white marble, all carved in the same kind of pattern. In the great arch of the porch the outer moulding is of red marble, and all the cusping of gray. The construction of the whole is obviously very weak, and depends altogether for its stability upon iron ties in every direction.


NORTH PORCH, STA. MARIA MAGGIORE, BERGAMO.

The approach to the porch, by seven steps formed alternately of black and white marble, increases the impressiveness of the grand doorway, in front of which it is built, the whole of which is of white marble, whose carved surfaces and richly moulded and traceried work have obtained a soft yellow color by their exposure to the changing atmosphere, and are relieved by one — the central — shaft being executed in the purest red marble. There are three shafts in each jamb, carved, twisted, or moulded very beautifully. These shafts are set in square recesses, ornamented, not with mouldings but with elaborate flat carvings, in one place of saints, in another of animals, and with foliage very flat in its character, and mainly founded on the acanthus.

To an English eye these columns in the doorways are some of the most charming features of Italian architecture; but they must be always looked at as simply ornamental, and not as constructional features; and perhaps in all doorways the shafts, being really incapable of supporting any considerable weight, would be better if, by their twisting and moulding, it were clearly shown that their architect meant them to be simply ornamental. In the Bergamo doorway the spaces between the shafts are so strong in their effect, though carved all over their surface, that any lightness in the columns themselves is amply atoned for. Such a work as this northern porch at Bergamo is indeed a great treat to an English architect, teeming as it does with fresh and new ideas, and in a small compass showing so many of the radical points of difference between Northern and Southern Gothic, and at the same time offering so beautiful a study of constructional coloring, that it is impossible to tire of gazing at it.

The porch to the south transept is of a simpler but somewhat similar design. Both are placed against the western half of the gable against which they are built, with a pleasant ignorance of those new-fangled views of regularity of plan which are the curse of modern architects. This southern porch is round-arched, and fitted exactly to the doorway which it shields. Its outer arch is carried on detached shafts resting on the backs of monsters, and it is mainly constructed of black and white marble. It is of only one stage in height, and has a deep cornice enriched with a series of niches with figures. An inscription below the cornice gives the date as 1360.* Above the porch, but independent of it, is a lofty monumental pinnacle corbelled out from the wall, and richly sculptured with crocketed pinnacles and gablets. When the church is entered, the reason for the apparently eccentric position of the porches is seen. They were so placed to

* The church was built in A. D. 1134 by Maestro Fedro.

* "✠ MCCCLX·MAGISTER·JOHANES·FILIUS·C·DNI·VGI·DE CAMPILIO·FECIT·HOC·OPUS." This Giovanni da Campione was one of a family of architects of much celebrity. See their genealogical tree in "Italian Sculptors," p. 106.

give more space for the altars to the east of the transepts, and their successful effect is good evidence that no artist need ever distress himself about a want of regularity, if it is the result of a little common sense attention to convenience in the arrangement of his plan.

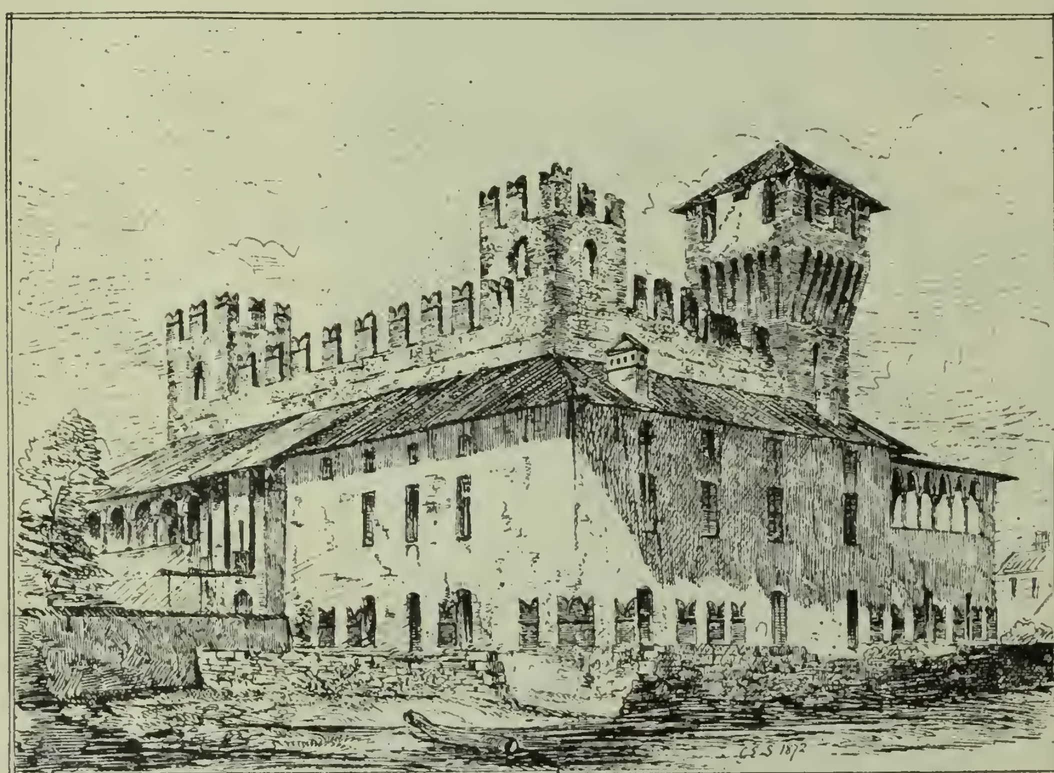
The southern side of the church gives a very fair idea of what the general character of the original building of 1134 was. The windows were very plain, the walls lofty, the roof flat, and ornamented with corbel-tables up the gables and under the eaves, and pilasters were used at intervals instead of buttresses. There is a central octagonal lantern which may be old, but which is entirely modernized. The most interesting remains are the various apses already mentioned. They are of two divisions in height, the lower adorned with very lofty, boldly moulded arcades, above which is an elaborate cornice, and above this again a low arcade on detached shafts, behind which the walls are considerably recessed to form galleries, which produce a very deep shadow. The capitals are elaborately carved, and the upper cornice is again very rich. Altogether, little as remains unaltered of the old fabric, it is enough to give an idea of a very noble and interesting phase of art. Near a doorway into the north chancel aisle the external walls have traces, faint and rapidly decaying, of some very exquisite frescoes, or, more probably, *tempera* paintings.

The steeple is in a most unusual position, — east, namely, of the south transept, — not less, I believe, than some three hundred feet in height, of good and very simple pointed character, without any approach to buttressing, and remarkable as having an elaborately arcaded string-course a few feet below the belfry windows, which have geometrical traceries enclosed within semicircular arches, affording, like the south transept porch, a curious illustration of the indifference of Italian architects to the use of the pointed arch where strength was not of consequence.

Italian campanili have quite a character of their own, so distinct from and utterly unlike the steeples of Northern Europe, that this, the first Gothic example I had seen, interested me exceedingly. Perhaps its detail was almost too little peculiar, if I may venture to say so; for certainly it has left no such impression of individuality on my mind as has the beautiful campanile to whose grace so much of the charm of Verona is due.

The cathedral at Bergamo, which is close to the Broletto and Sta. Maria, may be dismissed in a word. It has been rebuilt within the last two hundred years, and appeared to be in no way deserving of notice. In a courtyard on its north side is a small detached polygonal baptistery, founded in 1275, which must have been very interesting. It is all built of marble, and richly adorned with shafts; but so far as I could see every portion of it has been renewed within a few years. Beside Sta. Maria Maggiore and the Broletto, we found little to see. Two churches — one in the Città, and another, desecrated, in the Borgo — have very good, simple pointed doorways, with square-headed openings and carved tympana; but beyond these we saw scarcely any trace of pointed work. We had a luxuriously hot day in Bergamo, and as we sat and sketched the Broletto, a crowd, thoroughly Italian in its composition and proceedings, gathered round us and gave us a first lesson in the penance which all sketchers must be content to undergo in Italy. Before long I found that my only plan was to start an umbrella as a defence, both against the sun and the crowd, and this, though not entirely successful, still effected a great improvement.

The walk down the hill to the Borgo was more pleasant than the climb up, and we were soon at our inn again, and then, after a most delicious luncheon of exquisite fruit and coolest lemonade, concluded by a very necessary dispute with our landlord about the amount of his bill, ending, as such disputes generally do in Italy, with a considerable reduction in the charge and the strongest expressions of regard and good wishes for our welfare on our way, we mounted our carriage, and were soon on the road towards Brescia.



CASTLE OF MALPAGA.

Not far from this road and within about eight miles of Bergamo lies one of the most interesting of the many castles of which one so frequently sees remains in the north of Italy. This is the castle of Malpaga, which was inhabited by the famous Condottiere Bartolomeo Colleoni, of whom we have already heard at Bergamo, and of whom we shall see something again at Venice. It belongs now to a nobleman who lives in the Città of Bergamo, and leaves this old and stately pile to the keeping of his hinds, who tend his silkworms, gather his grapes, make his wines, look after his corn and cattle, and

CAMPANILE, BERGAMO.

do as much as in them lies to gather the fruits which Mother Earth yields in these parts with such ungrudging profusion, but trouble themselves little about the preservation of the old castle or its belongings, seeing that they seem to give scant pleasure to their lord.

The castle as originally built was a square building enclosing a courtyard built of brick externally, and adorned with a forked battlement which is common everywhere in old buildings between this and Vicenza, and with four square corner towers, of which one larger than the others has a very bold and fine overhanging machicolated parapet. In the centre of the south front the drawbridge still remains in use, and was lowered for our exit from the castle. Outside the square castle was a space, and then a low wall again furnished with the forked battlement. This must have been a very picturesque arrangement; but unfortunately its real character is now only intelligible to the skilled eye. For the great Colleoni, finding himself in possession of a castle which gave him insufficient space for his magnificence, built up walls on the top of the old battlemented outer wall, and created his state rooms in the space between this new wall and the old external wall of the castle. These rooms of his have much damaged the effect of the outside of the castle; but internally they are still interesting, owing to the sumptuous character of the painted decorations with which he had them adorned. These were executed at about the time of the visit of Christian II. of Denmark to Colleoni, and are interesting if not great works of art. The old courtyard, though small, is very fine in its effect. The upper walls are carried on pointed arches and are covered with fresco or distemper paintings, said to have been executed by Giovanni Cariani of Bergamo, or by Girolamo Romanino of Brescia, extremely striking and attractive in their general style of color and drawing. The most picturesque incidents are illustrations of Colleoni's career, — the Doge of Venice giving Colleoni his baton in the presence of the Pope, and a fine battle subject.

A squalid area for rubbish, children, pigs, cats, and what not, is left all round the moat, and beyond this are all the farm buildings and laborers' residences, which go to make up the *tout ensemble* of a great Lombard farmyard. The surroundings are not clean nor very picturesque, but the castle itself has so great an interest that no one who visits Bergamo should pass it by unseen.*

(*To be continued.*)

TERRA-COTTA CAPITAL.
CARRÈRE & HASTINGS, ARCHITECTS.

THE accompanying detail from the Central Congregational Church at Providence was photographed before erection at the works of Stephens, Armstrong & Conkling, now the Philadelphia branch of the New York Architectural Terra-cotta Company. The terra-cotta all over this church is most charmingly executed. The brick was supplied by T. Milton Shafto & Co., of Philadelphia. Mr. F. J. Sawtelle, at Providence, superintended the work for Messrs. Carrère & Hastings.

* The round church of San Tommaso in Limine, described by Mr. Gally Knight as similar in plan to San Vitale, at Ravenna, is only eight miles to the north of Bergamo, and ought, equally with Malpaga Castle, to be seen. I regret that I have never yet visited it.

Recent Brickwork in American Cities

PROVIDENCE.

UNTIL within three or four years the public and business buildings of Providence have been either of stone or of the traditiona brick with stone trimmings. Nearly all the private houses were of wood. Fifteen years or so ago Messrs. Stone & Carpenter did introduce terra-cotta on a large scale in Slater Hall, at Brown University, in the Hotel Dorrance, and in some private houses; but the quality of the work did not quite suit them, so the attempt was never followed up. And although these gentlemen have always seized any opportunity to make ornamental use of brick, yet, with the exception of some single panels, it was not until they built the Burrill Building, at the corner of Westminster and Mathewson Streets, that they again took up the new material.

BURRILL BUILDING.

The Burrill Building, however, is not altogether of clay material. The first three of the five stories on Westminster Street are of light stone supported by the usual plate glass and iron; those above, and the whole Mathewson Street elevation, are of brick with terra-cotta trimmings. A glance at the photograph will explain the treatment. The top story has round-arched openings, the fourth, on Westminster

Street, has windows with square heads formed by terra-cotta lintels which are supported in the centre by cleanly modelled columns of the same material, standing free, while the jambs are ornamented with a pattern in brickwork. The same arrangement, without the jamb ornament, is used on Mathewson Street. The color of the brickwork is light buff, with wide joints, while the terra-cotta is a little darker. While the distinction between brick and stone on the front is perhaps a trifle marked, the building as a whole is the best on the street. It is simple, dignified, and finely detailed.

TRAYNE BUILDING.

Mr. Ely's Trayne Building, nearly opposite the Burrill, is a studied design in gray brick and lighter terra-cotta, with very fine detail, and the whole makes one wish that he had not used copper bays to fill his three main openings, which rise through two stories and are round headed. The first story of iron and glass, with a side entrance of stone, leading to the offices in the upper stories, is very well handled.

Perhaps the best use of copper bays in this neighborhood has been made in the Conant Building, in Pawtucket, which is a city almost continuous with Providence, by Messrs. Gould, Angell & Swift. This design is executed in old-gold brick, with brownstone trimmings and galvanized iron cornice. The bays, on the side, are of small projection and are enriched with delicate Renaissance arabesques.

As an example of Renaissance detail, the Telephone Building of Messrs. Stone, Carpenter & Willson, of which the elevation has already been published in The Brickbuilder, is worth careful study. Above a first story of iron and stone, better handled than such stories usually are, rise two stories of brick and terra-cotta, divided vertically by fluted pilasters, and crowned with a terra-cotta cornice and balustrade. Over each of the store fronts which flank the main entrance to the Telephone Company's offices projects in the second story a bay window, which in this case is of terra-cotta, with engaged columns at the corners, and highly ornate frieze and cornice. Even here it seems that the building would hardly lose in dignity if the bays were not used. The proportions of the buildings are right, and the detail is exquisite; do we really need the bays, finely handled as they are?

The outer walls of the Telephone Building carry the steel beams without the aid of columns, but the interior is all of skeleton construction; terra-cotta arches on steel beams are carried by steel columns, which, in their turn, are protected by terra-cotta. The roof is built in the same way and covered with concrete and asphalt.

The telephone wires in this city are carried underground in a sub-way accessible through manholes. When the cables reach the new building they pass under the sidewalk into a tunnel-like space partitioned off for them in the cellar, where they are carried on racks, projecting horizontally from each side wall until they reach the cable tower which communicates with the rest of the building only on the top floor at the distributing room. They are carried up the opposite sides of this tower, which is provided with ladders and with platforms every seven feet in height, on alternate sides, for convenient access to the cables. From the distributing room the wires are carried under the raised floor of the operating room to the switchboard.

The same architects have in hand the new Central Police Station for the city. This building is also in the Italian Renaissance, and, though not so ornate as the Telephone Building, has just as fine proportions and a very fine arrangement of masses. It is a good example of the truth, which our architects have been slow in learning, that however much good ornament may help a well-proportioned and well-massed building, such a building will lose none of its power or charm if it be left quite plain.

Though all of the terra-cotta work just spoken of has been done with Renaissance detail, as is indeed largely the case in other cities since the Classic style is once more in the ascendant, the material lends itself with equal ease to Gothic forms.

Another building now going forward for the city is the Museum of Art and Natural History at Roger Williams Park.* Here the architects, Messrs. Martin & Hall, have used yellow brick and terra-cotta together in a very pleasing way. The inspiration of the design, which is very refined and skilful, has been drawn from the French châteaux of the early Renaissance.

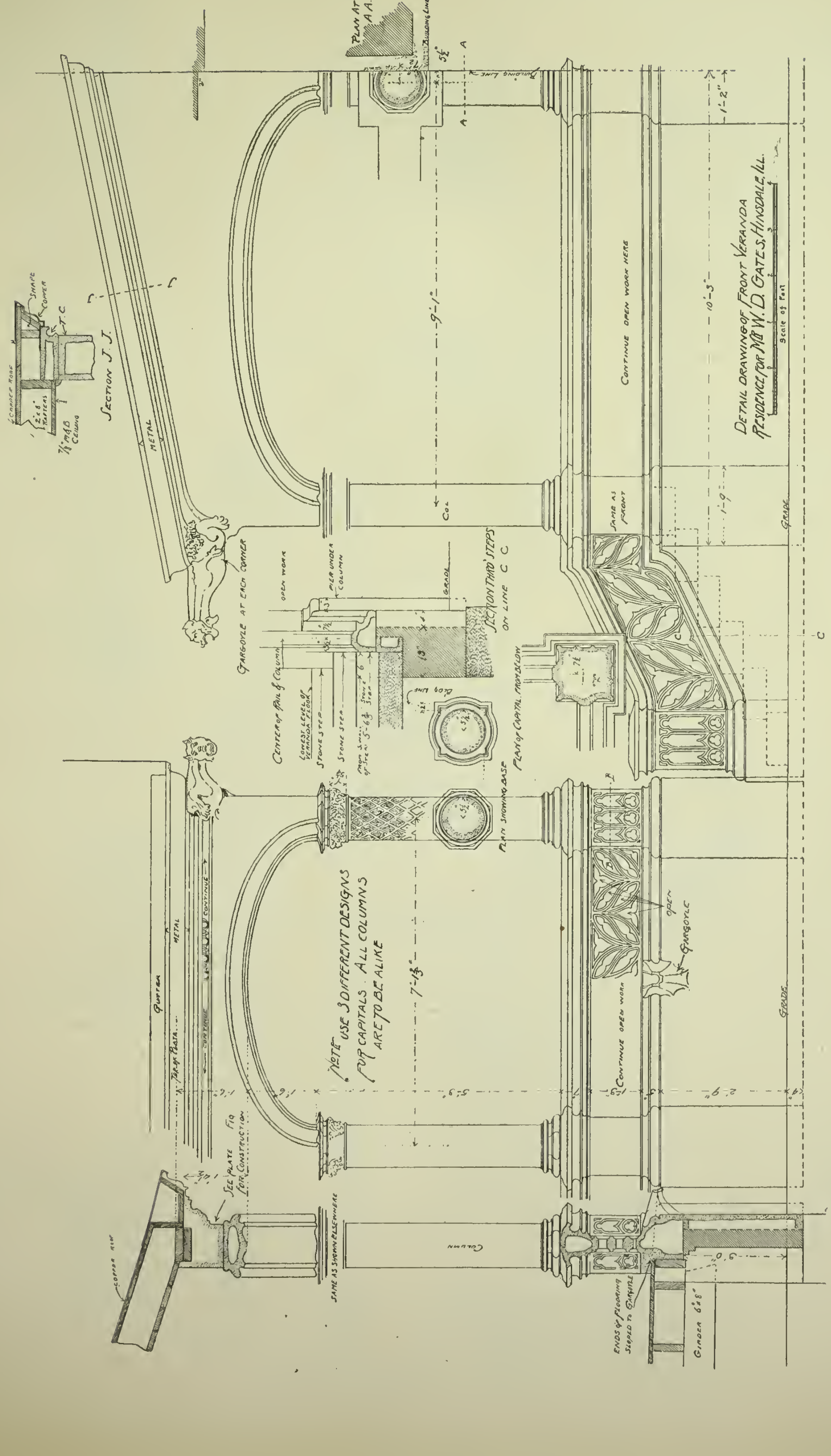
There is something very attractive in the outbreak again and again of the irrepressible Gothic spirit among the classic forms which were just coming into use in those old buildings. The style has all the picturesque quality which we enjoy in Gothic, while it is nearer our own time and taste in its forms; at the same time it is in its best work scholarly and refined without being so learned and precise as the Italian is apt to be, and withal it is perfectly adaptable to any needs which it may have to meet. All these points the architects have seized, and, while they have kept their work simple and dignified and have avoided all temptation to be picturesque and use angle turrets and other startling effects, they have allowed their fancy considerable play in the details.

Thus far the city work is in competent hands. But a stop is soon to be put, it seems, to this sort of nonsense. There is a resolution now before a committee† of the Common Council (it has been passed by the Aldermen, and I understand the Mayor favors it), which will turn over the official architecture of the city to the tender mercies of the city engineer's office! The scheme seems to be not to create the office and department of city architect, but to add to the force of the engineer's department a few architectural draughtsmen and an architectural superintendent.

Of course all interested in art foresaw the result. The Chapter of the Institute here took up the affair and tried to make a fight for reasonable methods of doing business. The tide is too strong and they have had to drop the matter. The Council think they are saving money, and they are blind to any other view. The engineer's department costs fifty-three thousand dollars a year. For four recent years, — years, too, in which there was more than the average amount of building, — the city paid about seven thousand a year for architects'

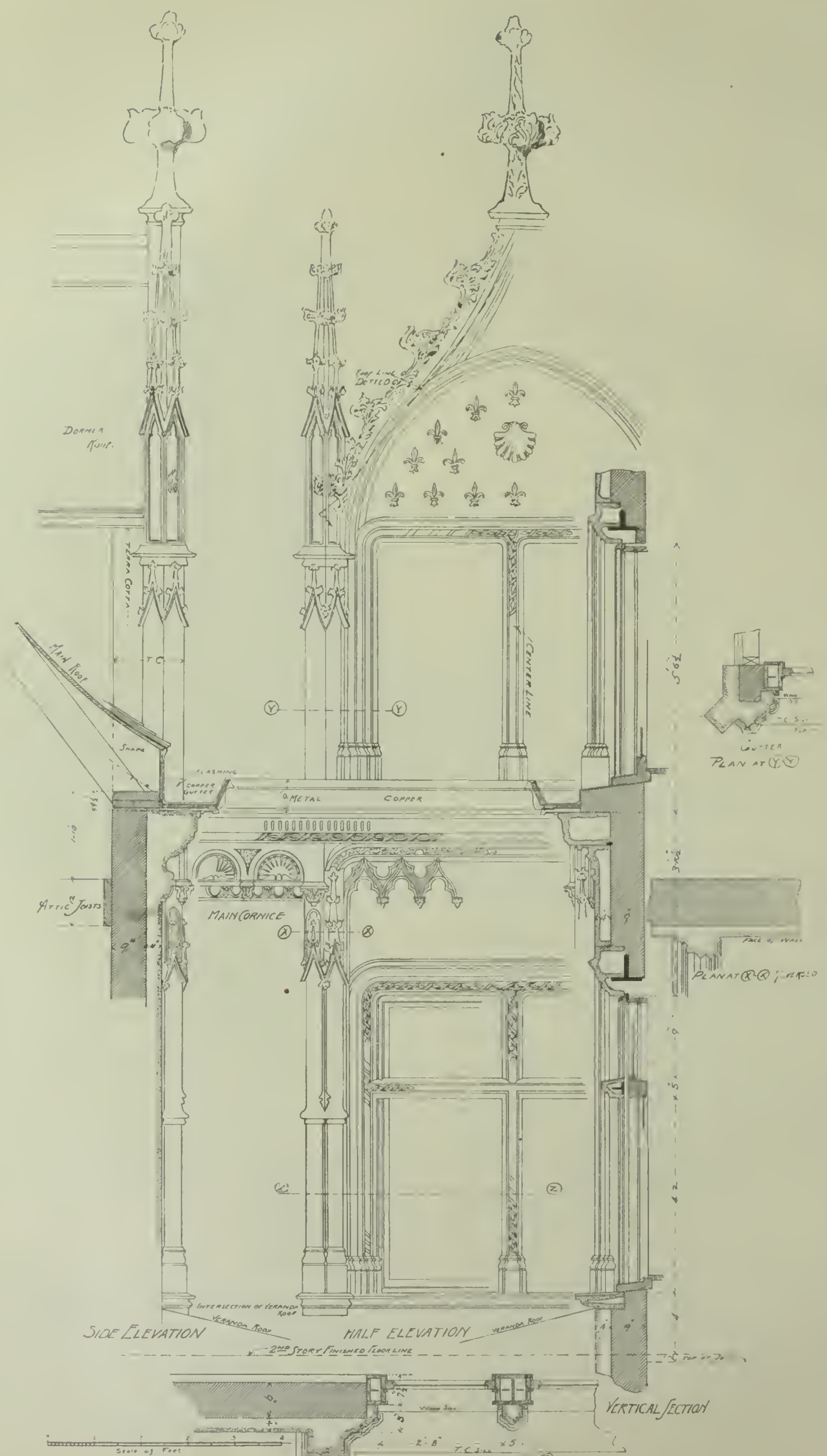
* A scale detail of part of this building was published in the last number of The Brickbuilder.

† The resolution has been tabled by Council, I am informed, and there the matter now stands.



DETAIL, RESIDENCE OF W. D. GATES, ESQ., HINSDALE, ILL.

MESSRS. JENNEY & MUNDIE, ARCHITECTS, CHICAGO.



DETAIL, RESIDENCE OF W. D. GATES, ESQ., HINSDALE, ILL.

MESSRS. JENNEY & MUNDIE, ARCHITECTS, CHICAGO.

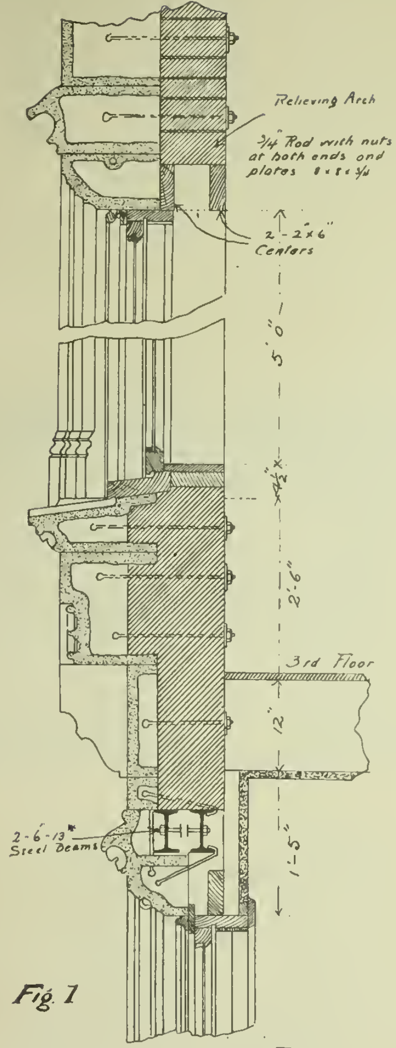
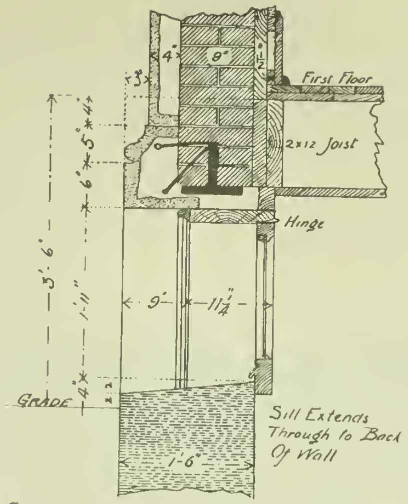


Fig. 1

SECTION AT DORMER IN TOWER
SHOWING CORBELLING



SECTION OF COAL CHUTE WINDOWS

Fig. 3.

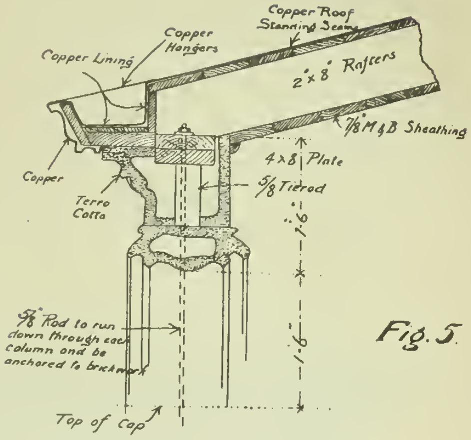


Fig. 5.

SECTION THROUGH VERANDA CORNICE

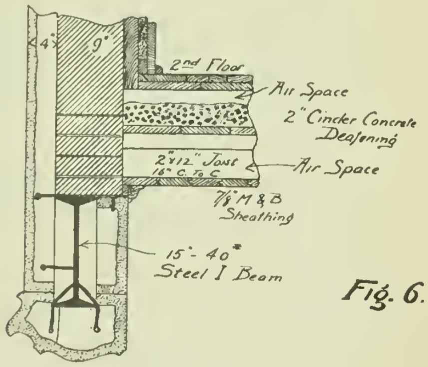
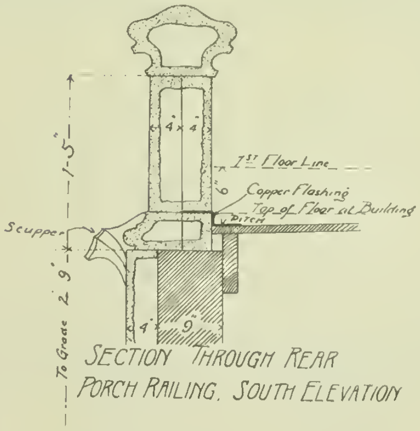


Fig. 6.

SECTION THROUGH ARCH
AT REAR OF HOUSE



SECTION THROUGH REAR
PORCH RAILING, SOUTH ELEVATION

Fig. 4.

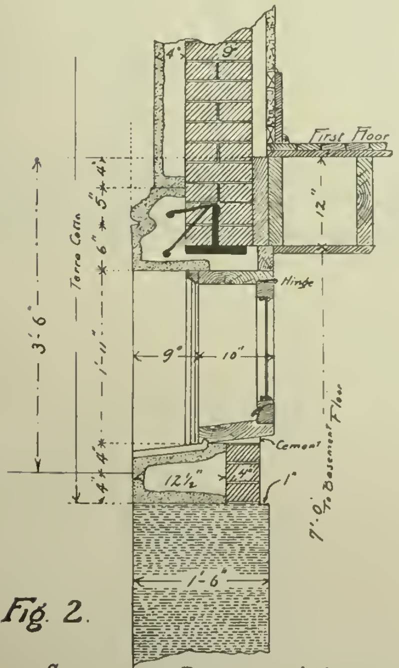


Fig. 2.

SECTION OF BASEMENT WINDOWS

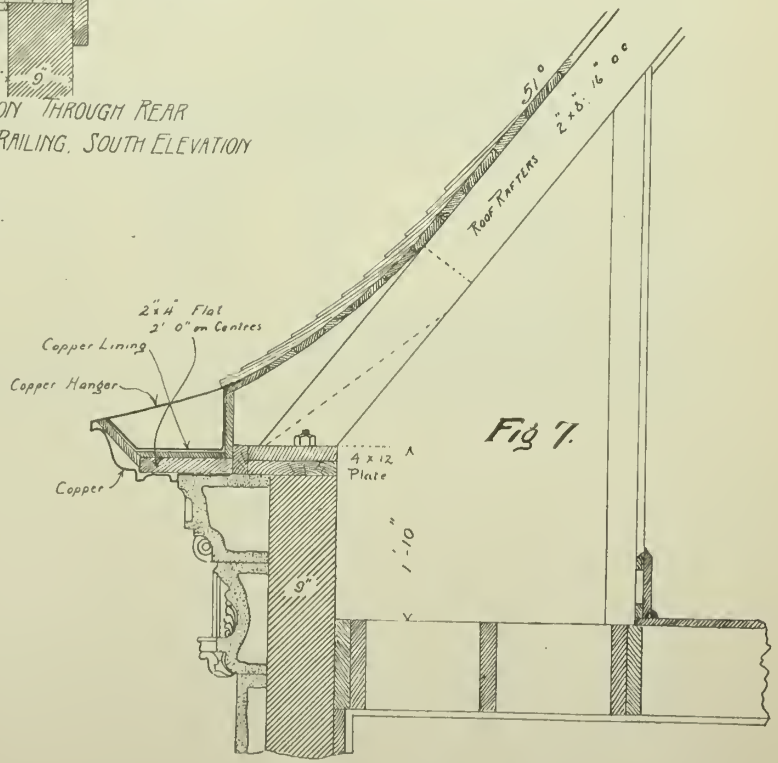


Fig 7.

SECTION OF MAIN CORNICE

DETAILS, RESIDENCE OF W. D. GATES, ESQ., HINSDALE, ILL.

MESSRS. JENNEY & MUNDIE, ARCHITECTS, CHICAGO.

SIDE ELEVATION, STORE AND OFFICE BUILDI

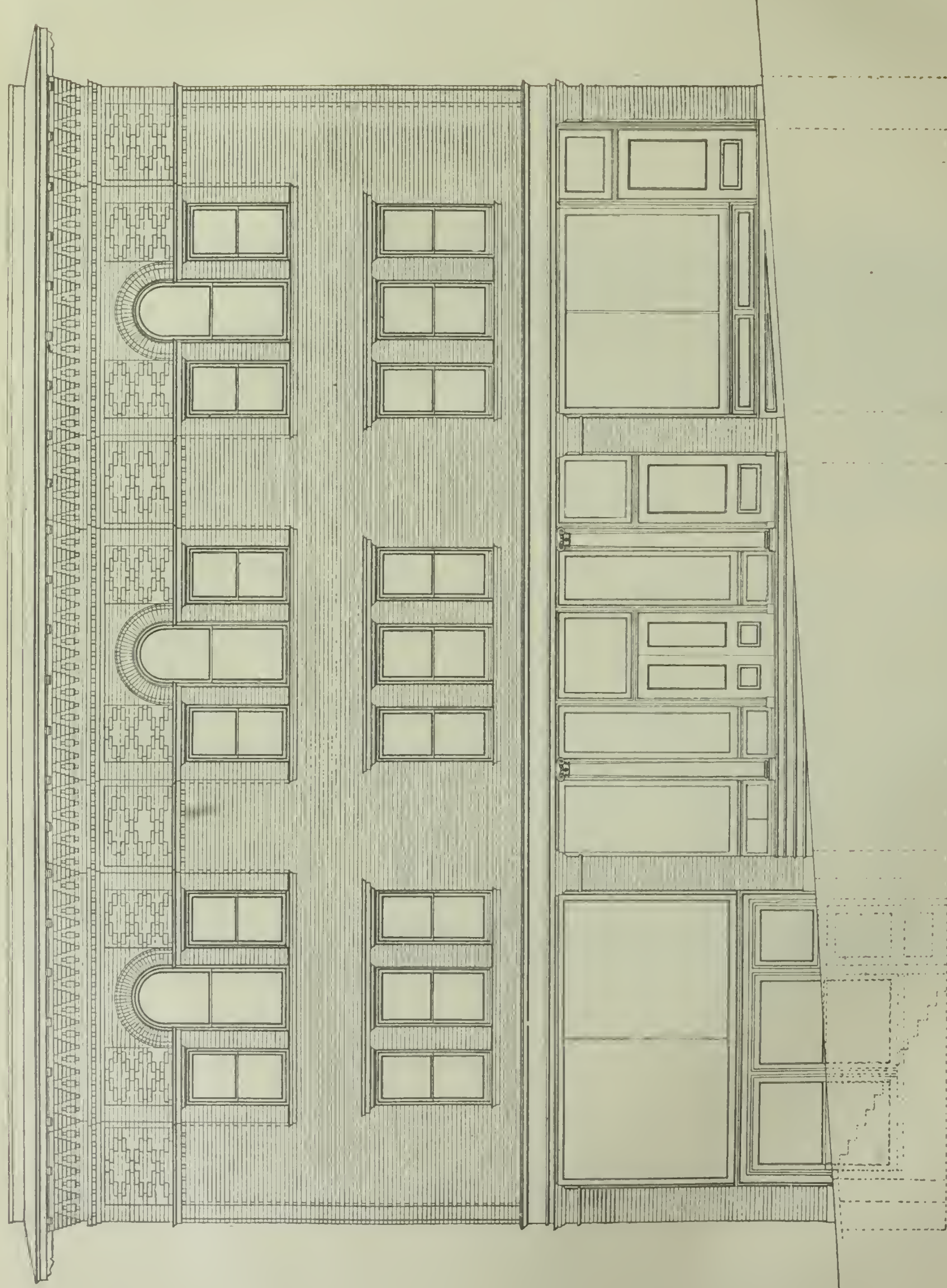
(ONE-EIGHTH-

MESSRS. WALKER & KIMBALL, ARC

FOR D. C. PATTERSON, ESQ., OMAHA, NEB.

SCALE.)

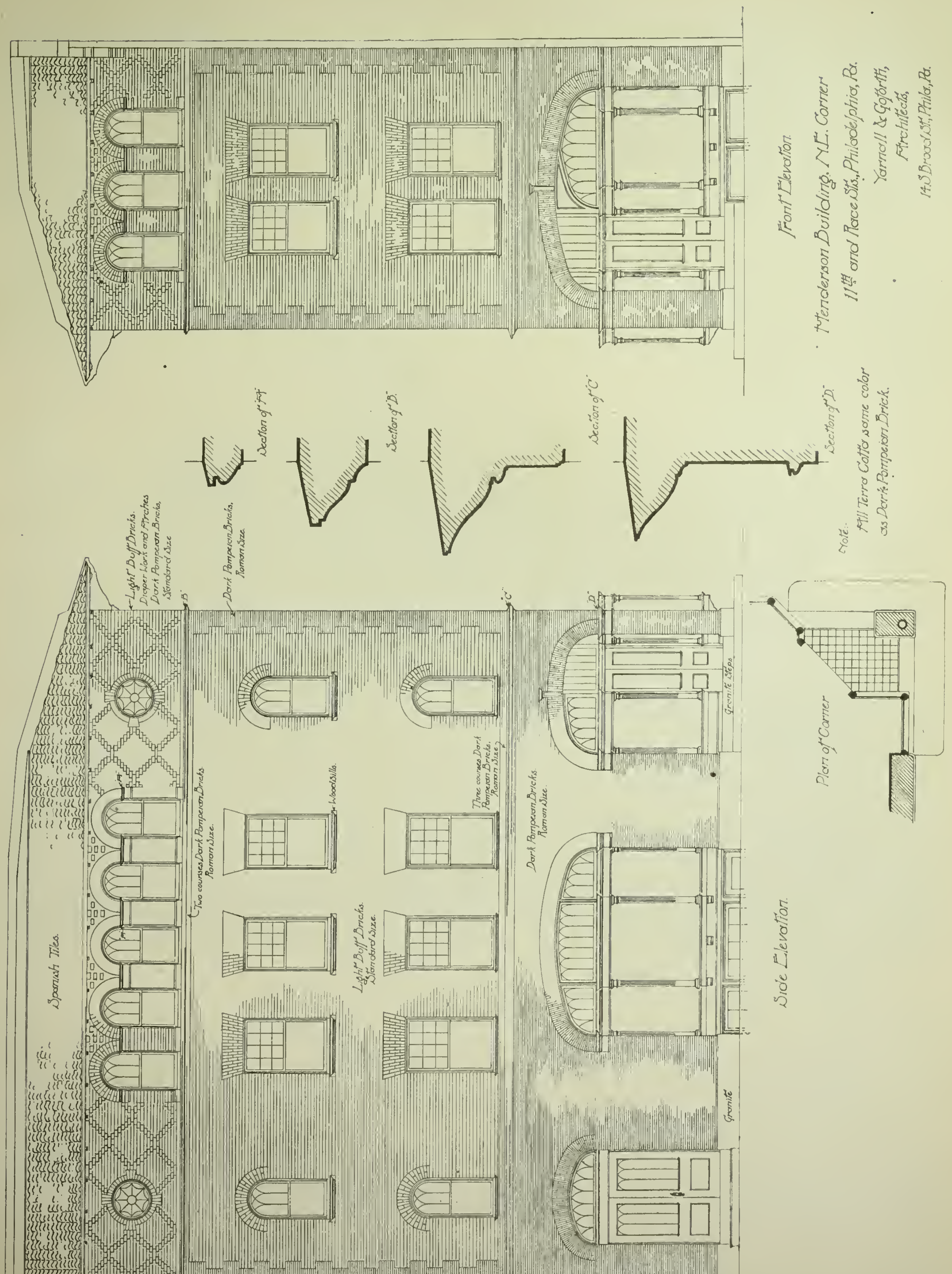
ECTS, BOSTON AND OMAHA.

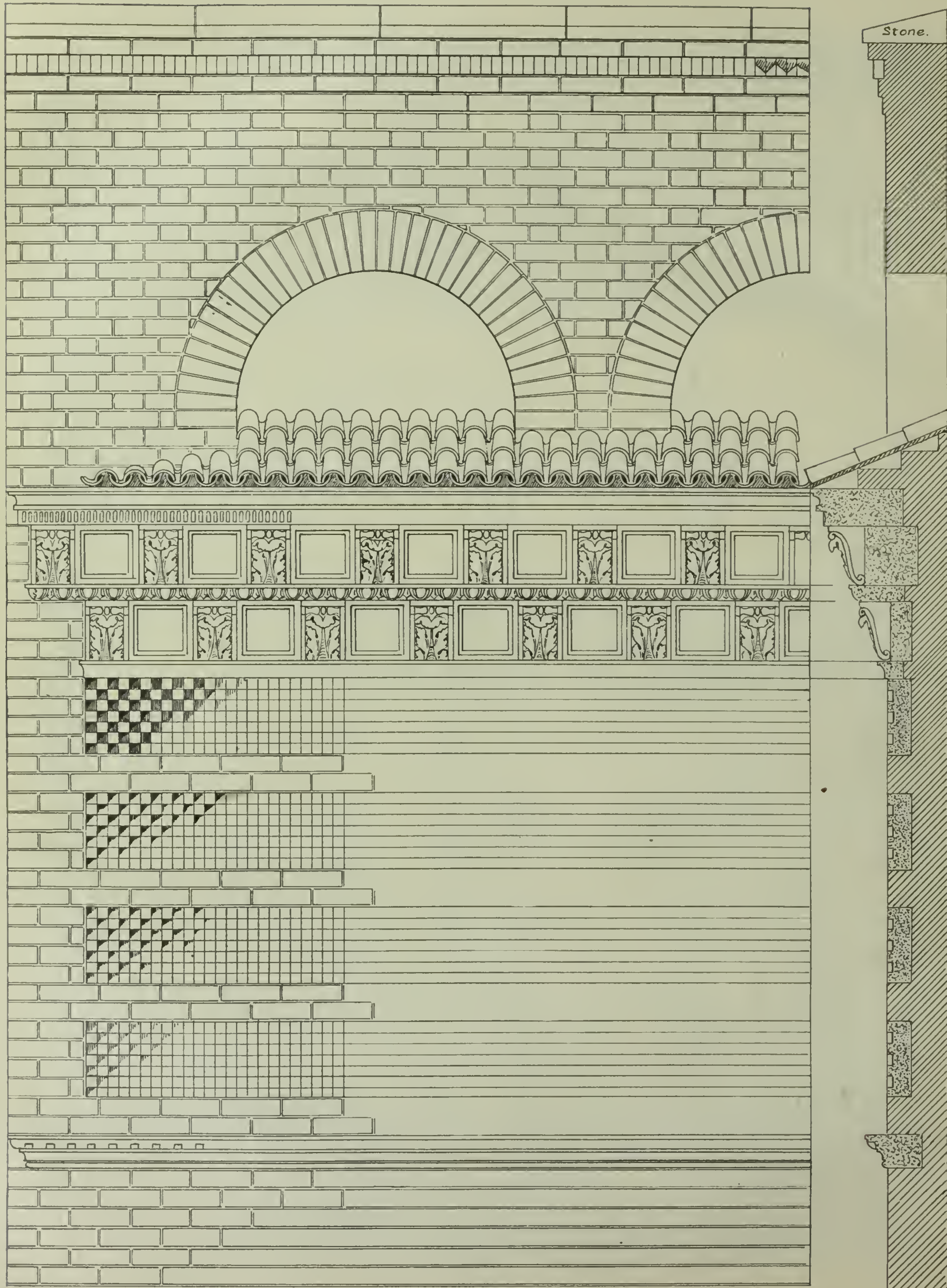


FRONT ELEVATION, STORE AND OFFICE BUILDING FOR D. C. PATTERSON, ESQ., OMAHA, NEB.

(ONE-EIGHTH-INCH SCALE.)

MESSRS. WALKER & KIMBALL, ARCHITECTS, BOSTON AND OMAHA.


Front Elevation.
Henderson Building, N.E. Corner
11th and Race Sts., Philadelphia, Pa.
Yarnall & Goforth,
Architects,
14 S. Broad St., Phila, Pa.
Section of "A"
Section of "B"
Section of "C"
Section of "D"
Note:
All Terra Cotta same color
as Dark Pompeian Brick.
Light Buff Bricks.
Diaper Work and Arches
Dark Pompeian Bricks.
Standard Size
Dark Pompeian Bricks.
Roman Size.
Spanish Tiles.
Two courses Dark Pompeian Bricks
Roman Size.
Wood Sills.
Three courses Dark
Pompeian Bricks.
Roman Size.
Light Buff Bricks.
Standard Size.
Dark Pompeian Bricks
Roman Size.
Granite Steps.
Granite
Plan of Corner
Side Elevation.



THREE-QUARTER-INCH SCALE DETAIL, CORNICE OF BERKELEY LYCEUM, NEW YORK.

ALFRED E. BARLOW, ARCHITECT, NEW YORK.

commissions. That this sum, which is only a trifle over the engineer's yearly salary, is extremely low when considered as the cost of a city architect's department, and that for this sum it is possible to obtain first-class work, while if architectural draughtsmen are added to the engineer's department, it must augment the cost and at the same time lower the character of the work, — all this seems not to enter their thoughts. We can save money — why can't the engineer take care of the work? Before such questions the extravagant architects retire abashed, for with such men those questions cannot be answered. It is the old story of the materialist against the idealist, of science against poetry, and, unfortunately, the judges are prejudiced and must be educated by experience.

the most aristocratic street in the town, yet the course of empire, moving eastward this time, had long since carried the greater part of its congregation into the newer and more fashionable part of the "East Side." The new church, therefore, stands on quite high ground in one of the pleasantest spots in the city, and in one where the best architectural effort of the last few years has had a chance to show itself, for around the church are houses by Messrs. Stone, Carpenter & Willson, Rotch & Tilden, Gould, Angell & Swift, and W. E. Chamberlain. Mr. Sawtelle, the architect who had charge for Carrère & Hastings of the erection of the church, has built the parsonage beside the chapel, and Martin & Hall are now filling the last vacancy in this Stimson Avenue colony.

CENTRAL CONGREGATIONAL CHURCH, PROVIDENCE, R. I. Messrs. Carrère & Hastings, Architects, New York.

St. John's Church, on North Main Street, to turn to a pleasanter subject, has within a year or so finished a parish house designed by Messrs. Peabody & Stearns. The material is yellow brick of different dark tones, and the treatment is very simple and quiet, and depending for its effect not upon ornament but upon mass, proportion, and the color harmony of the different bricks employed.

The old St. John's itself is of stone, but there are several brick churches in Providence. Some of them are exceedingly evil in design, one of them attains to no mean rank, and that one only, of which more in another article, can be compared with the new building which Messrs. Carrère & Hastings have recently built for the Central Congregational Church. The growth of the city has left several churches, still occupied, on streets which are now more or less crowded thoroughfares. Though this was not the case with the Central, whose old church, built about fifty years ago, was then upon

But these houses, save here and there the first story of one, are not of brick, and we must return to the church. The mass of it, as seen from a distance, and it is on high enough ground to be seen in some directions from far away, is very good, though possibly the dome is a little flat. All the near views of the church are good. The best of course is one of those which bring the tambour over the crossing into the centre of the picture. The view from the east end, really the north end, up over the chapel and the apse, is full as fine as from the front. The mass from these points is most excellent, though the tambour is a trifle bare and perhaps the cornice of the dome is a little too shelf-like for the splendid detail of some of the other parts of the church.

The view we have just taken emphasizes the cruciform plan of the church, with its chapel behind the semicircular apse. The west front, here really the south front, has the traditional two towers, the three doors, and the central windows, though these here are blank, all beautifully handled, with some of the feeling of the old Spanish work of the Southern Americans, but with the clean-cut, classic detail of Italy. A short nave, with a barrel vault,— a real barrel vault of tiles,— forming the roof as well as the ceiling, a nave which has its regular side aisles, leads us to the crossing over which, sustained by the four heavy brick arches which form the square and by the pendentives drawing the square into an octagon, and then into a circle, rises the tile dome. Transepts extend with their side aisles east and west, and an unlighted, early-Christian-looking apse with its *concha* or hemispherical roof, forms the sanctuary on the north, here the ecclesiastical east.

The interior detail of the church is very fine and interesting. The organ loft is somewhat unsatisfactory in execution, though the design is excellent. The angel figures with musical instruments, instead of being modelled in full round, or in relief against a background, are in low relief, with the background cut through, and the effect troubles one.

Aside from the organ loft, the pews, the pulpit, and the sanctuary furnishings, which are of wood and very finely detailed, the interior detail is of terra-cotta and of plaster. The tiling of the dome and of the vaulting shows inside, except in the apse. The brickwork is

CENTRAL CONGREGATIONAL CHURCH. FRONT ENTRANCE.

plastered. It is of course intended to decorate the whole church in color after the manner of the beginning made in the apse dome, and if Mr. Schladermundt has the chance to finish the work as he has begun, the church will be an example of what color decoration ought to be as a support to architecture.

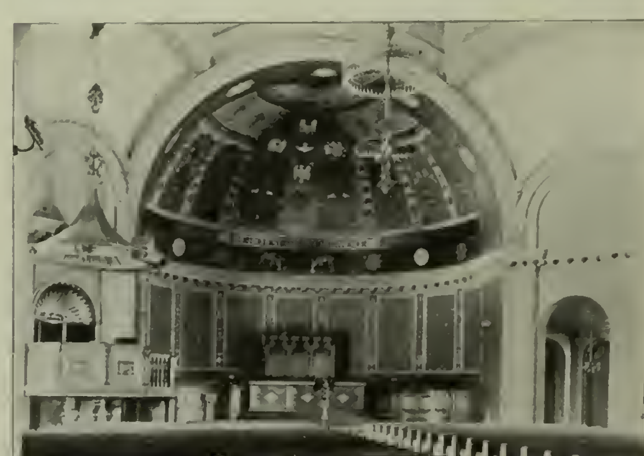
The color scheme of the outside of the church, too, has been well handled. Buff bricks, which here have a pinkish tinge, and there have turned a beautiful green under the weather; light terra-cotta, beautifully modelled; tile roofs of a dull, purplish red, with terra-cotta lantern again over the dome, and gilt crosses on the towers, on which the terra-cotta at the roof angles contrasts well with the tiling, form a very pleasing combination.

The crosses on the towers and the cruciform plan of the church show the progress toward ritualism which the "Lord Brethren," as Blackstone called them, are making in the wake of the "Lord Bishops." In fact, considerable has been the comment on the action of a sober Congregational society in building its "meeting-house" in a style which reminds the laity, at least, of cassocks and berettas.

CENTRAL CONGREGATIONAL CHURCH. ORGAN LOFT.

To the architect, of course, the question simply reads, Does the building meet the requirements of the problem and does it meet them beautifully? Whether Renaissance or Gothic is the more to be preferred for churches, is a mere matter of personal taste. This church seems to meet its problem beautifully. There is, then, no need to talk, after all, of denominational fitness or unfitness as absolutely fixed, for this or that style. Let the architect go straight through the problem with his best ability according to the best taste he has, using such forms as seem to him pleasing, and, if he is an architect, he need not be afraid of the verdict.

NORMAN M. ISHAM.



CENTRAL CONGREGATIONAL CHURCH. PULPIT.

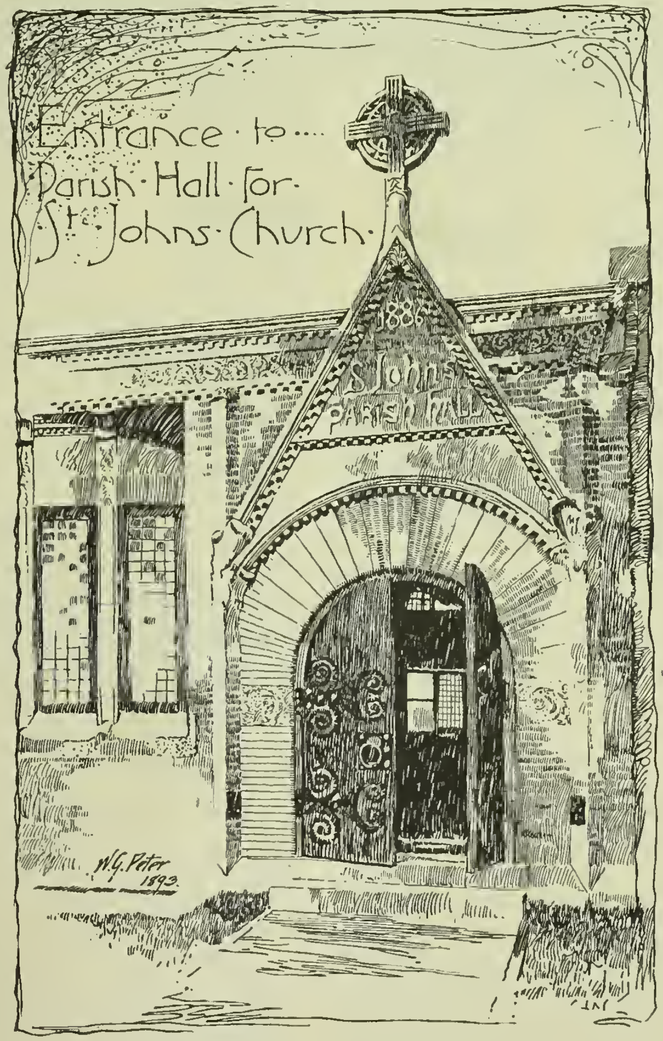
WASHINGTON.

SUCH a variety of styles, if I may call them such, are to be found in Washington that the cultured visitor is really bewildered as he walks up and down its streets. On every hand one finds hideous examples of what the average citizen points to with pride and calls "modern architecture."

Here and there the eye is relieved by the sight of a quiet front, so modest and retiring that it seems to shrink from the loud clothes and gaudy finery of its ostentatious neighbors. It is scarcely noticed by the novice, and if at all, the remark is heard: "Anybody can design a thing like that."

These quiet fronts are, for the most part, relics of the taste of the past, and show great skill and refinement in the relative proportions of openings to wall surfaces. Built of hand-made pressed brick of delightful color, crowned with good cornices, usually of moulded brick painted white, of a pattern not now in stock, with doorways generally of Colonial treatment, they stand as landmarks of the artistic appreciation of two generations ago. One who has not seen them cannot imagine the charming effect produced by these cornices of brick. The projection is not great,— about four and a half inches. The soffit is ornamented with mutules, and the returns at the corners with the conventional honeysuckle, as is so often seen in the Greek Doric.

Apparently the architects of Washington have but recently thoroughly appreciated the artistic possibilities of terra-cotta in combination with brick, and many still are learning. Preferring stone for the solution of their problems of decoration and construction, the examples of really good treatment of brick fronts are the exception, not the rule. Here, as in other Eastern cities, public taste is improving sufficiently to be able to distinguish the superiority of the present woık over that done ten years ago, and to wish for more. This is a good sign, and we may well feel glad that it is so.



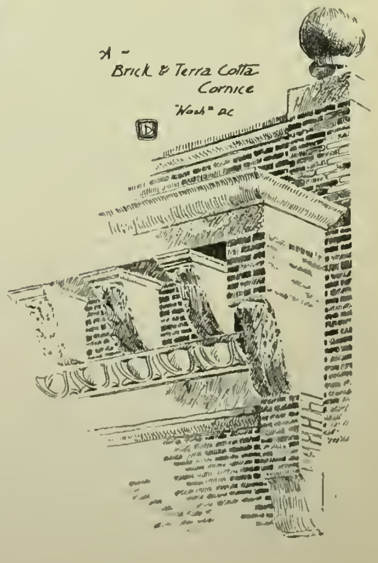
(SEE ARTICLE ON THIS PAGE.)

Of private residences done in brick, those of John Hay, Esq., and General Anderson, designed by H. H. Richardson, are probably familiar. They are very quiet, moulded brick being confined to the base courses and cornices. The wall surfaces are given life and color by pattern-work, and often hexagonal shaped brick are used, which, from their peculiar shape and color, make the design more pronounced. Many houses by Hornblower & Marshall have well-studied brick friezes, surmounted usually by copper cornices, lending character to otherwise plain but well-proportioned fronts. The house of Representative Dalzell, on New Hampshire Avenue, has the wall surfaces of the façade slightly enriched by pattern-work of darker headers. The entrance is unique in its way. It is a semicircular opening within a square frame, framed by a running conventional design carved in lighter brick, making the whole quite Moorish in feeling.

A very nice bit of brick and terra-cotta work is that of the Parish Hall of St. John's Church, on Sixteenth Street. It is to be regretted that it is so small, as a larger building worked out in a similar manner could not fail to be an ornament to the city. The Army and Navy Clubhouse shows what refinement can be gotten by the use of perfectly plain, rough red brick with red mortar joints. Perhaps the most striking example of a structure wholly of brick and terra-cotta is the United States Pension Office. This building has been the cause of as much comment, both of praise and condemnation, as any building ever erected in the District of Columbia. Its popular name is the "Beer Brewery." One well-known gentleman of high standing has been known to remark of it, "The only fault with it is, it is fireproof." All this adverse criticism arises from its having a hideous, barn-like structure towering above the main roof, entirely out of keeping with the building proper, and forming the roof of the large court. Moulded on the lines of the Palazzo Farnesi at Rome, the principal façade is considerably longer. By thus altering the proportions, a good deal of the character of the original is lost. But, standing at a point where the ugly cupola cannot be seen, the building is very imposing and quite pleasing. The details are entirely of terra-cotta, and well executed.

In the new power-house of the Washington and Georgetown Railroad Company, by Burnham & Root, the design fully expresses the character of the building. It is of dark-red brick with black mortar joints, and has just enough stone to relieve the monotony. Terra-cotta might have been substituted for the stone without artistic loss. Many residences recently erected are of various shades of buff and mottled brick. One in particular, on the corner of Massachusetts Avenue and Twenty-first Street, is worthy of notice, as in it the attempt has been made to grade the color from chimney top to ground level from dark to light, with considerable success.

It is to be regretted that, with so many colors from which to choose, more harmony among buildings in the same block cannot be gotten. Perhaps an improvement might be made if there were more concerted action on the part of the architects. While slight differences of color do not cause any one to deter from the harmony of the whole as viewed from a distance, when we see jumbled together red, white, yellow, brown, with perhaps here and there a green one, the effect is anything but pleasing. The very fact that they have such variety



STORE AND OFFICE BUILDING FOR D. C. PATTERSON, Esq., OMAHA, NEB.
Messrs. Walker & Kimball, Architects, Boston and Omaha.

of color to choose from is their undoing. It is a case of embarrassment of riches, which the able man may know well how to handle with the taste insuring the best results, but which the average unartistic builder-architect considers his opportunity to concoct something original.

Many buildings have details in brick and terra-cotta so good as to save the whole from utter failure as works of art. Chimneys, doorways, cornices, gables, can be picked out all over the city as being better than the buildings they adorn. The cornice of the new addition to the Washington Gas Light Company's offices, a sketch of which is here shown, is a good sample. E. W. Donn, Jr.

PLATES.

Plates 25, 26, and 27 are illustrative of the first article published in this number.

Plates 28, 29, and 30 give the two elevations of the building shown by the prospective sketch on this page. The plain walls are laid with sand-struck common hand-made brick (light burned). The trims are of red front brick (Omaha Hydraulic-Press) somewhat darker than the others. Joints white for body, red for trims, and tuck-pointed.

Plate 31. Henderson Building, Philadelphia, Yamall & Goforth, architects. The brick were furnished by the Eastern Hydraulic-Press Brick Company and the terra-cotta by Stephens, Armstrong & Conkling before their consolidation with the New York Architectural Terra-Cotta Company. The plate is one-eighth-inch scale.

Plate 32. Cornice of the Berkeley Lyceum, New York. Alfred E. Barlow, architect. Terra-cotta work by the New York Architectural Terra-Cotta Company. This is a good example of a brick and terra-cotta cornice with practically no projection, gaining in height what it loses in projection.

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

PUBLISHED BY

The Brickbuilder Publishing Company,

CUSHING BUILDING, 85 WATER STREET, BOSTON.

P. O. BOX, 3282.

Subscription price, mailed flat to subscribers in the United States and Canada	$2.50 per year
Single numbers	25 cent
To countries in the Postal Union	$3.00 per year

Entered at the Boston, Mass., Post Office as Second Class Mail Matter, March 12, 1892.

THE BRICKBUILDER is for sale by all Newsdealers in the United States and Canada. Trade Supplied by the American News Co. and its branches.

PUBLISHERS' STATEMENT.

No person, firm, or corporation, interested directly or indirectly in the production or sale of building materials of any sort, has any connections, editorial or proprietary, with this publication.

A PROMINENT manufacturer of terra-cotta criticises the editorial in our last number, on brick and terra-cotta coloring, as apt to give architects a wrong view of the subject. He himself takes exactly the opposite view from that of our editorial, and supports it with these arguments.

A brick manufacturer will sort a kiln of bricks of one color, into ten or twelve different shades, and of each shade he will have enough stock to supply an ordinary job. Now, while the application of color by a "slip" is simple enough, burning it to exactly a certain shade is not so easy. If, for instance, an architect wishes uniformity in brick and terra-cotta, and selects one of the several shades of a certain colored brick, the terra-cotta manufacturer may have considerable difficulty in exactly matching it, although he would strike so near it as to match a shade two or three degrees above or below the one selected. The architect, then, it is suggested, should give the terra-cotta manufacturer the first place, allowing him to make a color to match a certain *color*, not a certain *shade* of brick, though keeping his terra-cotta of a uniform tone. The terra-cotta will certainly match one of the several *shades* into which that color of brick is sorted, and that shade can be taken for the work.

OUR article in the last number was written from the recent experiences of several architects who had tried to have a brick made to match terra-cotta, and possibly the inspection of a very well-equipped terra-cotta plant was so fresh in our minds that we over-estimated the ability of terra-cotta manufacturers to produce exact matches. However, having stated the criticism as nearly as we remember it, let us suggest that this criticism might not apply to the cases we had in mind. Brick manufacturers are not found in every market, carrying stocks of a large number of different colors. Suppose the brick the architect wanted was not to be had in his locality, in stock. It could be made, and come pretty close to the required shade. The question is, Can the average well-equipped brickyard make a special run of brick and closely match a certain shade, easier than one of the scientifically operated terra-cotta factories commanding every facility for securing special color-work? We still hold to our position, with a concession in the case of the several large cities where every variety and shade of brick is found in stock, and there is no need of having a color made to order. As, however, we base our opinions upon the experiences of a comparatively few architects, we invite correspondence for publication, from both manufacturer and architect. If there is any question as to which is the better and fairer method, THE BRICKBUILDER columns are the place for its discussion.

MR. GLENN BROWN of Washington, in his article "Government Buildings compared with Private Buildings," in the *American Architect* of April 7, gives some interesting tables showing cost and time of construction, and completion of first, second, and third class structures, from which the following averages of cost are instructive. Eight first-class structures, that is, structures that are fireproof throughout, cost an average per cubic foot of 37¼ cents. Six buildings of the second class, erected of less costly materials, but with iron beams and terra-cotta or brick arches for the floors, averaged 24½ cents per cubic foot. Only two buildings of private nature are included in the third class, which is plain brickwork, and wooden joists and flooring. These cost 10 and 12½ cents per cubic foot. Much of the cost of the buildings of the first class comes from the highly ornamental character, or the use of expensive cut stone work, and, judging from these buildings, it is safe to estimate that a good brick fireproof office or mercantile building can be built for not over 25 cents per cubic foot.

THE government, however, from these tables, appears to be paying 30 cents per cubic foot for a 12½-cent building. It is getting nothing but wooden floors, while buildings privately built are made fireproof for five cents less per cubic foot. In first-class buildings it pays 60 cents against plain, ordinary people's 37 cents. It now looks as though Mr. Burnham's blunt letter to Mr. Carlisle had caused that gentleman, who is supposed to guard the money interests of the country, to continue not only paying twice what ordinary people pay, but getting atrociously bad returns for his liberal investment.

MR. CARLISLE made a mistake in considering Mr. Burnham and his associates on the committee of the A. I. A. some of those "ar*ch*itect fellows" who could be indefinitely put off. As a matter of fact, any one of that committee is probably a man of broader calibre than the honorable secretary of the treasury, and Mr. Burnham's professional career certainly proves him fully as strong a man as Mr. Carlisle. But the latter is in his castle and surrounded by political henchmen of all grades, whose general methods no member of the committee of architects could come down to. Mr. Burnham's letter has been criticised quite as freely as it has been commended. But what other course was open to him? It was quite evident nothing would be gained by submitting quietly, while, by putting the thing in plain, unvarnished fact, he did the one thing that no milder course would have accomplished: he drew the attention of the public by making an issue the newspapers would take up.

PROF. A. D. F. HAMLIN, of the Department of Architecture, Columbia College, New York, makes the interesting announcement that he will conduct a summer travelling school of architecture, limited to fifteen members, taking them to Italy early in June and returning early in October. The programme is made out especially with reference to a study of the Italian Renaissance style, and, starting from Naples, the trip will include Pompeii, Herculaneum, Capri, Rome, Spoleto, Foligno, Perugia, Arezzo, Florence, Siena, Pisa, Lucca, Pistoja, Bologna, Ferrara Padua, Venice, Vicenza, Verona, Mantua, Milan, Pavia, and Genoa. Thus, it will be seen, most of the places in Italy of any architectural interest will be visited, and such a trip with a man of Prof. Hamlin's scholarly attainments cannot fail to result beneficially to the students who go. It is with great pleasure that we call the attention of our readers to this project. Full particulars may be had by addressing Prof. Hamlin at Columbia College.

"THE BRICKBUILDER" COMPETITION FOR A CITY HOUSE.

PROGRAMME.

IT is supposed that a client has a forty-foot lot in New York City, upon which he wishes to build a fine residence, which, if he desires to sell at some future time, he may convert into two separate houses, so that they will not only sell the easier, but so sold, bring a higher price than the one large house would bring. To this end the house must be planned so that it may be convenient to use as a single house, but so that very little and inexpensive alteration would change it to two twenty-foot houses divided by a party wall. The exterior is to be of brick and terra-cotta, or wholly of terra-cotta. The cost is not limited. In planning, ten feet at the rear of the lot, which is one hundred feet deep, must be left unoccupied.

The problem is principally one of both planning and design, for to be successful it must have the appearance of a single house, and yet when divided appear equally good in design as two separate houses.

The house will consist of four stories besides a basement and cellar. An elevation at one-quarter-inch scale, and a plan of each floor at one-eighth-inch scale, are the drawings required. A description of the alterations necessary to convert the house must be prepared and reasons given for the plans and the elevation adopted. The drawings are preferred flat, but when it is inconvenient to so send them they may be sent in pasteboard rolls. They are to be made on white paper, imperial size, the elevation on one sheet, the plans on another, and sent, carriage paid, to the office of THE BRICKBUILDER, Room 52, 85 Water Street, Boston, Mass., on or before June 1, 1894.

PRIZES.

There will be three cash prizes; the first $100, the second $50, and the third $25. Three other prizes in books will be given; the first any architectural book listed at $15, the second listed at $10, and the third listed at $5.00. If there be more than six designs considered by the jury as meritorious, the authors of those not receiving prizes will be presented with a year's subscription to THE BRICKBUILDER.

The award will be made by a jury of three competent architects.

Each drawing must be marked with a motto or cypher, and a sealed envelope similarly marked, containing the full name and address of the designer, must accompany the drawings. These envelopes will not be opened until after the award is made.

The six prize drawings shall become the property of THE BRICKBUILDER, and any or all of the designs submitted will be published without further recompense to their authors.

FOR a club of fifteen subscribers the yearly price of THE BRICKBUILDER is only $1.50.

FIREPROOFING.

THE ROOF IN FIREPROOF CONSTRUCTION.

IT is certainly gratifying to see how much interest is now felt by architects, engineers, builders, and owners in fireproof construction. The desire for something durable, that will resist the great destroying elements of time and fire, is growing, and it is now generally conceded that the most durable and reliable materials for all kinds of buildings is burned clay, and therefore in all buildings where protection of life and property is desired it is being used more than ever in this country.

Insurance statistics tell us that the loss by fire is regularly and steadily increasing at the rate of $10,000,000 a year. In the year 1893 the loss was over $160,000,000, which is over $512,000 for every working day. This does not include the loss by men thrown out of business or employment, nor the additional rates on insurance in consequence of the risk. Neither does it include the taxes necessary to keep up the fire departments in every city and town in the country to guard against the loss.

Nearly all the writers on fireproof construction refer to protecting the inside of buildings. The ceilings, floors, and between the joists are filled in with hollow clay blocks; hollow brick walls take the place of lath and plaster for partitions; iron supports and columns are encased with burned clay to keep the heat from twisting, cracking, and even melting them. In every conceivable way, clay bricks and blocks are used to prevent the fire from spreading and extending. All this is done for the inside of buildings, and it is well enough. It costs money, but it does the work. While this is done for the inside of the building, a roof is put on that offers no resistance to fire, but in many cases attracts it. The roof is the most exposed part of the building, and, next to the foundation, the most important. 29.6 per cent of the fires in 1893, and in fact an average for many years, was caused by exposure. That means that $48,000,000 of property was destroyed by fire in the year 1893 that did not originate on the premises. To guard against loss from exposure the best protection is to fireproof the outside of buildings — to put on a roof that will resist the heat. The same material that will protect the inside will protect the outside. It is fast coming to that. All will concede that the fire-clay roofing tile is the coming roof in this country, as it now is in many European countries. There are many reasons for this, but your space will only allow me to present a few of the advantages tile has over any other material for covering houses.

First. Tile is fireproof, frostproof, and waterproof. To test the fire qualities, put a well-burned tile, and a piece of the best roofing slate, on your grate. See how quick the slate will crack and fly to pieces, while the heat of no grate can crack or melt the tile. Iron of any kind left in a kiln where tile is burned will be found melted when the kiln is opened. To test its frost qualities, put a tile under the drippings of your roof, and let it freeze and thaw the whole winter. You will see the frost will have no effect on it whatever.

Second. Tile is ornamental and durable. If there is a tile roof in your city, compare it with the roofs on surrounding houses, and see how much it adds to the beauty and character of the house. The roof is the most prominent part of a handsome building, and a tile roof always attracts attention to it. There is nothing shoddy about a tile roof; it is there to stay, and it will be just as good, and look just as well, one hundred years from now as it does to-day. Tile has a history of thousands of years; no other roofing material has.

Third. Tile is a non-conductor. Place a thermometer in an attic covered with tile, and another in an attic covered with slate, and see the difference. The rooms under a tile roof are cooler in summer and warmer in winter. It neither attracts nor retains the heat or frost. You never heard of a tile roof being struck by lightning.

Fourth. Weight. The old forms of tile are heavy and cumbersome. They were made by hand, in plaster moulds, and nearly always had to be plastered together with clay or cement. The new tile is made by machinery, under heavy pressure, and is compact and light. It weighs six and one half pounds to the square foot, while slate and gravel weigh ten pounds. This difference in weight is a very important point in constructing the walls and rafters of a building.

The new machine-made tile requires no paint; it is a beautiful terra-cotta red, the most appropriate color for the roof of a handsome house. It requires no cement that cracks and breaks, and by its construction it laps and locks together so no wind can move it, and at the same time accommodates itself to the vibrations and settling of the building. In case a tile is broken a new one can be inserted without removing adjoining tiles, and its lock holds it in place.

Price is an important factor in building. The old tile, made by hand, and the Spanish tile, laid in cement, are both expensive. The new tile, made by machinery, competes very closely in cost with slate. An ordinary dwelling of ten or twelve rooms seldom requires more than forty squares to cover it. If you can get a tile roof on a house of this size for an additional cost of less than $100, it certainly should not be considered.

It is safe to say that in no branch of industry (except possibly electricity) has there been as much improvement in the last few years as in clay-working machinery, and it is to this improvement we are indebted for the interest now taken in fireproof construction. Ten years ago the ornamental brick, the hollow blocks, and other forms now used for fireproofing were unknown, or if known were impracticable on account of the skilled hand labor required to form them. Now the machinery made for clay men do the work better, and cheaper, and bring the best formed materials within reach of the builder. The architects and machine men have worked together in this improvement, the one suggesting and planning, the other putting the suggestions and plans into practical working machinery. The result is a greater variety of more compact materials, at a much cheaper cost. While this is true of brick, and fireproofing hollow ware, it is also true of roofing tile. The machine of to-day takes the place of the plaster mould, the steam dryer of the uncertain sun and wind, the closed kiln of the open top arrangement; and the result in tile is you have a compact, smooth surface, uniform in size and color, straight and true, so they fit well together and do away with plaster and cement. lighter in weight, and so reduced in cost that they are brought in close competition with the next best roofing material known. Machinery has done all this, and has enabled our best architects to predict, with absolute certainty, that tile is the coming roofing material for this country.

Another advantage machinery has given to the tile business is that they can be made so fast, and with so little loss, that a certain supply can be had without delay. Architects know the great difficulty and delay in the past in getting tile for their buildings. There were so few tile factories in the country, and they were always filled with orders months ahead. The Clay Shingle Company of Indianapolis now have four large factories in different parts of the country making their form of tile, and are negotiating with others, so they are able to supply any amount of tile on short notice. Before this century closes every State in the Union will have its tile factory, and all first-class buildings will have fireproof construction on their roof as well as on the inside.

JOHN R. ELDER.

Indianapolis, Ind.

THE most dangerous part of a theatre, in point of fire risk, is the stage. Here clay materials, so far, have found practically no application, nor will they ever, in all probability. To say that canvas and wood can be treated with a simple paint or liquid finish so that they will not burn, seems to most people paradoxical; yet there are at least two, and possibly more, concerns manufacturing such preparations. At the works of the Martin Process Fireproof Paint Company, in New York, we were shown by Mr. George A. Nelson several tests of canvas, mosquito netting, wood, and straw, which had been treated with their paint and other protective preparations. By subjecting the materials to continued flame, they were slowly charred, but not once did any flames start. The principal theatres in New York have scenery protected by the Martin preparations, but in Boston we question whether a single manager has taken this precaution. We understand that the New York Fireproof Paint Company, on Maiden Lane, also manufactures successful preparations. Why could not such woodwork as is absolutely necessary in fireproof buildings be so treated? The preparation may be applied as a filler, to doors, floors, window frames, etc., before they are finally finished.

WE are informed that Minneapolis is to have a plant for the manufacture of hollow brick, etc., for fireproofing. The McMullan Brick Company has been incorporated there with a capital of fifteen thousand dollars. Joseph Congdon, a prominent contractor and builder, is the president, and James McMullan secretary and treasurer. The company will develop the plant of the Minneapolis Hydraulic Pressed Brick Company.

THE SCARBORO, NEW YORK.

FIREPROOFING MATERIALS: THE LORILLARD BRICK WORKS COMPANY, 92 LIBERTY ST., NEW YORK. ORNAMENTAL TERRA-COTTA: NEW YORK ARCHITECTURAL TERRA-COTTA COMPANY.

THE Central Congregational Church at Providence, illustrated on pages 61 and 62 of this issue, is interesting in showing an application of the Guastavino method of fireproof construction to dome and vault construction.

CASS GILBERT, Endicott Building, St. Paul, will advertise this month for bids on the Armoury Building, at Shattock School, Faribault, to be a fireproof building, with five-inch segment arches, partitions, and furring of hollow tile. Red pressed brick for outside walls. Estimated cost, seventy-five thousand dollars.

THERE will be erected in Philadelphia, on the corner of 15th and Market Streets, by Mr. Alfred Harrison, a twelve-story hotel, which is to be strictly fireproof throughout. The building will be entirely of terra-cotta, there being no bricks used at all, except possibly for the fire-escape tower. It will be a steel-frame building, every particle of the steel covered and protected by terra-cotta. The body of the walls will be of hollow cubes of terra-cotta extending through the entire thickness of the walls, modelled on the exterior to the required design, and scored on the inside to receive the plaster, which will be applied directly to the terra-cotta, and be of a quality that will resist the action of fire and water. There will be no wood floors nor stairways; in fact, everything which can be made of fireproof material will be so.

The building, as before mentioned, will be twelve stories in height, and be in the French Rennaissance style, very highly ornamented, and will contain all the modern improvements. Experiments are now being made by the architects, Messrs. Cope & Stewardson, and their engineer, Mr. Furber, in order to determine what kind of partitions will be most thoroughly fire and sound proof, with particular reference to the latter requirement. The drawings are now being made and the work of erection will begin about June 1.

LIMES AND CEMENTS,

MORTARS AND MORTAR COLORS.

AMERICAN PORTLAND CEMENT.

THE manufacture of high-grade Portland cement in the United States is really a new industry. For many years so-called Portland cement has been made in small quantities in Pennsylvania, but up to within three years a cement has not been made in this country that could compare in quality to the highest brands of German and French Portland cements. While we possess raw material in Pennsylvania and New Jersey much superior to the raw material found in Europe, it has been only recently that several American manufacturers, by carefully studying the subject, have discovered correct methods of making cement and of using their raw material to the best advantage. With the exception of such works, built within the last three years, manufacturers are greatly handicapped by the impossibility of applying correct principles, using, as they do, crude methods of calcination and a primitive mode of grinding. To keep up with improvements, and better the quality of their product, so many radical changes would be necessary that the cost would be even greater than in building new works. The English manufacturers, too, labor under this disadvantage. The Germans, on the other hand, engaging in the manufacture of cement much later, and profiting by the knowledge and experience of the English, constructed their works in accordance with correct principles. It may be, also, that the Germans, of a more scientific and technical turn of mind than the English, discovered details in the manufacture of Portland cement unknown to the latter. At all events, it stands as a fact, that English Portland cements in general are not to be classified with German Portland cements; there is a radical difference between the two. The English cements are coarsely ground, quick-setting, low in lime, and consequently not so strong; whereas the German cements are as a rule finely ground, slow-setting, and high in lime. These differences mean a great deal, both as to economy and strength in works of construction, as will be explained hereafter. On account of the superiority of German cements, doing so much more, better, and safer work, their price, as well as the demand for them, has increased, whereas the opposite is the case with English cements.

In the United States, there is an immense field for the manufacture of high-grade Portland cement, if the German methods are followed in every detail. The material found in the United States, especially in certain parts of Pennsylvania and New Jersey, is certainly superior to any yet discovered in Europe. At Whitaker, N. J., three miles east of Phillipsburg, on the Lehigh Valley Railroad, and sixty-four miles from New York, the cement rock deposit is very extensive. This rock is a slate marl, the analysis of which is as follows: —

Silica	14.44 per cent.
Alumina Sesquioxide of Iron	5.91 " "
Carbonate of Lime	75.17 " "
Carbonate of Magnesia	.77 " "

This deposit of rock was bored in several places to a depth of two hundred feet, with no change in the character of the rock, or in the analysis, and from a number of borings in various parts of the deposit the analysis of the rock averaged the same within a half of one per cent. Nature could not be more kind in her gifts to man, than in this Whitaker deposit. It is impossible to find a material more adapted to the manufacture of the highest grade of Portland cement. The constituents of the rock are just in the proper amount and quantity to manufacture such a cement. This facilitates the process of manufacture, and guarantees the uniformity of the finished product, for it is not necessary, as it is elsewhere, to add lime to the raw material to get the proper proportions of component parts in the cement. The cement rock deposit of Pennsylvania runs low in lime, and to keep the finished product up to the proper amount of lime it is necessary to add limestone to the cement rock. It is a well-established fact that the limestones of Pennsylvania possess more or less magnesia; this, in quantities of over three per cent in the finished product, is exceedingly detrimental to the stability of Portland cement, causing disintegration. It is what a manufacturer abhors. In quantities of less than three per cent it does not affect in any way the quality of the cement. Even in the best limestone quarries it is difficult to separate stone running low in magnesia from that running high, and manufacturers who use limestone in connection with their rock cannot make as uniform cement as those who do not have to add the limestone. At Whitaker it never has been and never will be necessary to add limestone to the cement rock.

Possessing the proper material is a very great advantage, and, in fact, it is the basis of success; but it is not everything that is required to make the best cement. There are various processes of manufacturing Portland cement. The old method, or the "lime kiln" process, is very imperfect; yet considerable cement in Europe, and almost all in England, is made in this way, the kiln being an improvement on the lime kiln, but on the same principle. The Germans, however, have adopted the Portland draw kiln based on the Hoffman principle, which has produced most excellent results, and which is adapted to their raw material. Most of our domestic Portland cements are made with what is really a lime kiln, — improved, it is true, by increasing the height of the stack, making it more solid, giving it a better lining, etc., but the same in principle.

In manufacturing cement by this process the manufacturer first quarries his rock, adds chalk or lime in proportions, and grinds it as fine as possible. It is then placed in a pug mill and thoroughly mixed. This mixture is then made into a very stiff paste and moulded into bricks, which are dried artificially and then placed in the kiln, first a layer of coke and then a layer of bricks, and so on until the kiln is full. The contents are ignited and left to burn for a period of ten or more days, at the end of which time the contents are drawn out, coming from the kiln in a mixture. In brick manufacturing on the same principle it is well known that the light-burned brick are towards the side of the kiln, where the heat was less intense, and consequently brick throughout a kiln of this kind vary in color, hardness, density, etc., according to the position they occupied in the kiln. It is the same in the manufacture of cement; the properly burned clinkers are in the centre of the kiln, where the heat is the highest, and the under-burned stuff lies towards the walls of the kiln. When the contents are drawn it is necessary for men to pick out the properly burned clinkers, which are ground for the finished product of the highest quality. The under-burned stuff is usually ground, barreled, and sold for a second or third grade cement, and sometimes worked over again and reburnt. The effect of this process on the quality of the cement is very evident. First, it is impossible to separate all the under-burnt stuff from the good clinkers; more or less of it *will* get in. These properly burned clinkers are in themselves all very large, sometimes as large as a barrel, and, being so large, considerable under-burnt stuff is distributed throughout them. The effect of this under-burnt stuff on the finished product is very detrimental. It contains the same amount of lime as the properly burned clinkers do, and as the object of calcination is to combine all the lime and silica and alumina, the more under-burnt stuff there is in the finished product, the more free lime there is in the cement, and consequently the weaker and more unsafe it is. While under this process one barrel of cement may be very good, another may be very bad; there is no uniformity.

Another disadvantage connected with this process is the inability to reach the high heat required to combine three parts of lime to one of silica. The best Portland cements show about sixty-two to sixty-three per cent of lime and twenty-one per cent of silica in the finished product, and the more perfectly the above amounts of lime and silica are combined, the greater the strength of the cement and the safer it is. This combination requires from three thousand to three thousand five hundred degrees of heat, and in a lime-kiln process it cannot be attained. Therefore those who use this process very generally decrease the amount of lime, and as the lime is decreased in the raw material the heat must be lessened, the principle being, the higher the lime, the higher the heat. Most American Portland cements are made by this process, and architects and engineers have looked upon them as unreliable and not uniform, they have so often tried them and found this to be the case. While the manufacturer using such a process may be honest in his efforts, he cannot succeed in attaining good results, for his methods are radically opposed to such results.

When works were constructed at Whittaker, N. J., the manufacturers were well aware of this fact, and, realizing that the age is progressive and that inferior cements must eventually go, and those of the highest quality remain and be established, they determined to go even farther than the Germans and manufacture a cement which could not be surpassed in quality by any cement in the world. The Germans admit that the dry process, or making it from the raw material ground to a finely powdered state, is the correct principle; but they have not as yet discovered a process by which this principle could be applied under the conditions they have. The rotary cylinder process used at Whitaker is especially adapted to the raw material found there, whereas in Europe it would not prove a success on a basis of economy. There the raw material is too bulky and refractory. Petroleum, which is the fuel under the rotary cylinder process, is too expensive for them. Where they have experimented with this process they have made the best cement, but it cost them too much. At Whitaker it is the cheapest, best, and most reliable process that can be used. The works were built several years ago and this process put in; since then a number of improvements have been discovered and adopted, making the process more successful than ever. The following is a description of it: —

The rotary cylinder is made of wrought iron, lined with best fire brick. It is forty feet long and about five feet in diameter. It revolves on its axis, on an incline, so that the raw material enters at a point higher than where the clinkers drop out at the end of the cylinder. The rock is taken from the quarries and always carefully analyzed, although this is not actually necessary, the rock being so uniform at all times. Yet this is an extra precaution used in the case of every batch of rock. It is then ground to impalpable powder, and passed from the grinding machine to the stock box at the head of the rotary cylinder. By a conveyor it passes into the cylinder from the stock box continuously. The cylinder revolves slowly on its axis. Petroleum, mixed with air, and ignited, is forced into the other end of the cylinder. This blast is continuous and heats the cylinder to three thousand five hundred degrees. The heat is easily regulated by increasing or diminishing the supply of oil. As the powder enters the cylinder and comes in contact with the heat all the carbonic acid gas is driven off through a stack connected with the top of the cylinder, and the powder gradually passes down, moved by the revolution of the cylinder. As it proceeds it is subjected to severer heat, and, turning over and over, is all submitted to the same high uniform heat. Calcination and vitrification gradually take place, and the clinkers, forming, drop out at the end of the cylinder into a receiving chamber, where they are allowed to cool slowly, and when perfectly cool are ground to the finished product.

Under the old-style process as used in this country it takes fully ten days or more to make a barrel of Portland cement; under the rotary cylinder process it does not take over twelve hours. The advantages of the rotary cylinder process over every other process in existence are as follows: —

First. Every particle of the raw material is submitted to the same uniform heat, and consequently the clinkers coming from the cylinder are all alike in color, density, hardness, and state of vitrifaction, which results in making the finished product alike and uniform in every particular. If one barrel of cement is poor, all must be poor; if one barrel is good, all must be good, as all the clinkers are alike as they come from the cylinder.

Second. The heat is always under the full control of the manufacturer: he can lessen or increase it at his will. There is no other process in the world where this can be done so perfectly as in the rotary cylinder. Also, it is possible to attain a much greater heat than is necessary on account of being able to reach so high a heat that the lime can always be kept high in the cement, thus insuring a stronger finished product. It is for this reason that the rock at Whitaker is especially adapted to the rotary cylinder process, being high in lime and more thoroughly under a high heat.

Third. The clinkers are small in size, never larger than a bean, and consequently are uniform throughout and more easily handled and ground.

Fourth. If anything should occur to mar the quality of the cement, it can be discovered instantly and checked; whereas under the lime-kiln process it takes ten days to discover the results of a single burning.

I have tried to show why a cement manufactured under the rotary cylinder process, when proper material is used, as at Whitaker, for instance, is superior to any manufactured under any other process. I take it for granted, however, that, leaving out of the question where a Portland cement is manufactured, all engineers and architects are open to correction, and prefer to use a cement on their operations in which they have confidence and which they believe will do the best work. It must be admitted that there is a prejudice, and a very just one, against the use of American Portland cements for high engineering work for the reasons heretofore stated. It is, however, the aim of the Whitaker Cement Company to overcome this prejudice by conscientious effort, and they have certainly been very successful in whatever locality their cement has been used. Inquiry may be made why I discriminate so strongly against cements, though ordinarily good, in favor of some others. It is for this reason: There are some cements, correctly manufactured, which possess characteristics which I claim are the distinguishing features of a proper Portland cement, and which characteristics are essential to insure economy as well as stability in work. It is a fact conceded by every one that all Portland cements running from sixty-two to sixty-three per cent of lime and twenty-one per cent of silica, if hard burned, are stronger than others of lower amount of lime and lighter burnt. However, a cement running from sixty-two to sixty-three per cent of lime, and hard burnt, may have the strength, but under certain conditions not be able to manifest this strength. A cement of great strength, which is coarsely ground, will not show as great adhesive strength under scientific test as if it were finely ground. The finer a Portland cement is ground the greater are its adhesive qualities. The Portland cement of great strength, very finely ground, possesses one characteristic which distinguishes it from others not so strong or so fine. It will get its maximum strength in a much shorter time. This is nothing but ordinary common sense. The best portion of any cement is the hardest burnt portion, which is the most difficult to grind, and the impalpable portion of such cement has an intense affinity for the sand and stone in mortar and concrete. It is known that with hard-burnt cements the residue on a No. 100 sieve has no setting qualities, and if this residue were ground much finer it would set, and exhibit more strength in setting, the finer it was ground. And if all the cement were ground to impalpable powder, it would take but a very short time for it to get its maximum strength, neat. It is a decided advantage when the hardening of the mortar is not too slow, because the structure is then placed, in a short time, beyond all dangers. In the works at Whitaker, this principle in manufacture is taken into consideration, and seventy per cent is guaranteed to pass through a 200 sieve, or forty thousand holes to the square inch. This seventy per cent is practically impalpable powder. An additional guarantee that not over ten per cent residue shall remain on a No. 100 sieve is made by the Whitaker Cement Company.

It is a most difficult thing to grind hard-burned cement finely. In England ordinary burr stones are used, and as a consequence the cement is very coarsely ground. In Germany the grinding is done by more improved machinery, and is finer; but at Whitaker the clinkers are ground in steel grinding machines which require great power and endurance. As a result, the Whitaker cement is exceedingly fine, and will attain its maximum strength, neat, in a comparatively short time.

If architects and engineers would reject all cements not meeting, under the hands of a competent tester, the following tests, all American manufacturers would be forced to put out a cement insuring better and more stable work, on an economical basis. The specifications I would recommend are these: —

1. The cement, neat, must stand a minimum tensile strain of four hundred pounds to one square inch section (briquettes one day in air and six days in water).

2. The cement, three parts of sand (standard crushed, quartz being used for testing) and one of cement, must stand a minimum tensile strain of one hundred and twenty-five pounds to one square inch section (briquettes one day in air and six days in water).

3. The cement must stand the boiling test, or test for safety. The test must be made as follows: Make a thick cake of neat cement, allow it to set hard in air, twenty-four hours, then immerse it in boiling water, and keep this water up to 212° Fahr. for twenty-four hours. At the end of twenty-four hours, if the cake shows no sign of disintegrating or cracking, it has passed the boiling test.

4. The cement must pass the following test for fineness: There shall be only two per cent on a No. 50 sieve, ten per cent on a No. 100 sieve, and thirty per cent on a No. 200 sieve.

5. An experienced, capable man shall do the testing.

A cement standing, in every particular, the above specifications, is much more economical than one which does not, and I would recommend, in concreting for heavy buildings, using such a cement, the following proportions: One part cement; four parts sand (coarse, sharp, and free from all loam); seven parts broken stone (clean from all dirt). For mortars, I would use one part of cement to three parts of clean, sharp, and coarse sand, with the addition of a very little cold and thoroughly slacked lime. One part cement, four of sand, and a very little lime — just enough to give plasticity to the mortar — would give most excellent results.

Of course, in the use of large proportions of sand and broken stone in concreting, and the use of large quantities of sand in mortar, it is necessary to be most careful in the mixing. In making the concrete, it is well to use as little water as possible, and to carefully ram the concrete until it sheds water. The concrete, when set, will then harden very rapidly, using the quality of cement recommended. It is false economy to buy cheap cements and use more in the concrete or mortar. Better and more stable work would be attained, and cost less, by using larger proportions of broken stone and sand, with a high-grade cement meeting the foregoing specifications. It is highly important, to insure success, that the best quality of broken stone and sand be obtained, and that the work be done properly.

I trust this article may be read with interest by architects, engineers, and builders, and that it may induce them to recommend or use the best of Portland cements for their work, which I know they will find will give them more satisfactory and economical results.

WM. J. DONALDSON.

(*See Editor's note on following page.*)

WE think it is only fair to Mr. Donaldson, and to the cement he has done so much to bring up to its high quality, to state a fact which he has modestly omitted from his article, but which is of interest to all who have read it. Then, too, perhaps we can say it with better grace than Mr. Donaldson. The cement manufactured by the process he describes is the Alpha Portland cement, made by the Whitaker Cement Company. Mr. Donaldson, whose office is in the Betz Building, Philadelphia, is the general agent for this cement, and here in New England it is handled by James A. Davis & Co., corner State Street and Merchants' Row, Boston.

(*For further cement notes see page xii.*)

THE MANUFACTURER.

A Department devoted to the Market Side of Clay Production.

INTRODUCTION.

THE manufacturing side of the clay-working business is already well taken care of by several periodicals. The market side, previous to the publication of THE BRICKBUILDER, has been neglected. It is the purpose of this paper, from cover to cover, to advocate the use of clay-building materials, and, by presenting their merits in every conceivable way, induce owners, architects, and builders to use them wherever possible to the exclusion of other materials. THE BRICKBUILDER will, in short, use every legitimate means to increase the consumption of brick, tile, and terra-cotta. Its success in this direction means more business for the manufacturer, necessitating more and better machinery, and greater dyer and kiln capacities. It means the establishing of new yards where there are none at present. We therefore expect the hearty support and co-operation of every clay-worker and every manufacturer of brickyard equipment who wishes to see a larger and more general use of clay products. The columns of this department are open to the discussion of all questions relating to the market side. Every manufacturer who has a suggestion for *selling more brick* should put it into these columns. We especially request clay-workers to subscribe to, read, and write for our paper. Its success as an advocate of architecture in clay materials directly benefits every one interested in clay-working.

TWO LETTERS.

TO THE EDITOR OF THE BRICKBUILDER: —

Sir, — The writer first wishes to congratulate you on the neat appearance, mechanical excellence, and general make-up of your publication, which will surely be appreciated by brickbuilders as well as brickmakers. If your publication causes better brickwork, the brickmaker is benefited; the more attractive we can make brick walls, the more demand there will be for them. There are two essential features necessary for a handsome brick structure: first, there must be bricks perfect in shape, uniform in color, with well-finished surfaces; second, they must be skilfully laid in the wall. To accomplish this result, there must be harmony between the brickmaker and the brickbuilders. Brickmakers have publications representing their interests, brickbuilders have their interests represented through your periodical; through these mediums the manufacturer and the builder can compare notes, which must prove mutually beneficial. The great question with both is how to increase the demand for brick for all purposes. In your article in March number you give the brickmaker sound advice, saying, "He should use every legitimate means to secure the use of brick wherever it can be substituted for other material." The builder should do likewise; he should post himself on the advantages of brick over other articles as a building material, especially over wood. A brick building is more durable; it is cooler in summer and warmer in winter, with walls properly ventilated by spaces for circulation of air between the outer and inner courses of brick; it is as dry as wood; it is in less danger from fire, hence insurance rates are less; it saves painting. These are some of the points to make in the argument for brick walls. Again, people ought to be convinced of the fact that they can have a brick wall trimmed with stone, terra-cotta, and fancy patterns of moulded brick, that cannot be surpassed for artistic beauty by any other material. Articles on the lines of that referred to in March number will result in great good to our business. We do not adyertise the merits of our wares as others do in other lines.

The demand in the Southern States for well-made bricks is increasing. Most buyers want all hard bricks. This necessitates the purchase of better machinery and the construction of improved kilns for burning all hard, sound bricks. No broken or damaged bricks are sent to buildings in this section. They must be all whole. For face bricks there is a growing demand for dry-press bricks. This is being met by manufacturers putting in the best dry-press machinery. There is also considerable inquiry for roadway pavers, or annealed bricks. This demand will no doubt soon be met by enterprising brickmakers. There are now signs of increased activity in building material, which, of course, has been dull for twelve months past. Most of the large plants ship their product to market by rail.

R. B. MORRISON.

Rome, Ga.

TO THE EDITOR OF THE BRICKBUILDER: —

Sir, — You have been kind to me in sending your very excellent journal, which in its line has no equal, that I am aware of. Brick building, in all its forms, principles, practice, and economic interest, is the most important industry that concerns the growth, welfare, social and pecuniary interest of our cities.

Utility, strength, health, and protection against fire are the greatest considerations. These are the factors with which you are to deal, I think, with the most special care. It is true that architectural elegance and beauty must not be overlooked, but no amount of elaborated adornment in the exterior construction of buildings will in any reasonable degree compensate for ill-proportioned buildings or walls, or inferior materials or workmanship. I have no space here to discuss this subject, and it may look like presumption for me to say that about all true principles of building up cities are either ignored or violated. If I cannot show this fact in a few short articles, I will take a "back seat," and acknowledge that I don't know what I am talking about. I trust that THE BRICKBUILDER will take up this important subject and find more able help than I could give in its discussion.

I am very truly yours,

J. W. CRARY, SR.

Bluff Springs, Fla.

The two foregoing letters are gratifying evidences that our remarks on the market side, in last month's issue, struck home in two instances at least. Every word of Mr. Morrison's communication is solid common sense, yet there are thousands of clay-workers to whom his way of looking at the subject has never occurred. His statement that "if THE BRICKBUILDER causes better brickwork the brickmaker is benefited," only half covers the ground. We are working not only to cause *better* brickwork, but more of it. We want to see towns and villages as well as cities built of brick. We want to see brick dwellings, brick churches, brick schools, brick stables, as well as brick stores, instead of stone or frame structures. Further, we want to see brick walls replace wooden and iron fences, brick in our pavements replace cedar block, asphalt, or stone, brick sidewalks, and, in short, a brick everywhere it can satisfactorily meet the requirements of its position. We ask any brickmaker to look about him and see what might have been done in brick, but was not. Mr. Morrison says brickmakers have publications representing their interests. We want to correct this by a statement that no publication more than half represents their interests, and there is only one,— THE BRICKBUILDER, representing by far the more important portion of their interests; for we hold that the market side of any industry is the all-important side. Give an industry a market, and the processes of manufacture will be met; but without that market no process is of the slightest value. This is so self-evident, and is so clearly proven every day of history, by the shutting down of works when the demand for their goods ceases, that it seems needless to dwell upon it for a moment. But it shows that the market is the key to the whole situation. Upon it depends the operation of existing plants, and the equipment of new ones, and, consequently, every sale of brickyard machinery or equipment. To try and increase this market is the mission of THE BRICKBUILDER — to cover the portion of the brick manufacturer's business upon which depends directly every other portion covered by the journals devoted to manufacturing processes.

The increase in the market for clay goods depends largely upon the *users*, not the *makers*, of these goods. The owner who erects a building, the architect who designs it, the contractor who builds it, are the parties upon whom the selection of material depends. THE BRICKBUILDER works to increase the demand for brick by placing arguments in its favor directly before the building classes, and also by placing at the disposal of the manufacturer a weapon to use in counteracting the influence of the several papers used by wood-workers. By showing what the leading American architects are constantly doing in successfully using clay materials, through the publication of photographs, sketches, and working drawings, and by publishing examples of the best historical work in Europe, together with strong articles advocating brick and terra-cotta work, we are each month distributing, in rapidly increasing numbers, a series of convincing arguments, proving that the materials *you*, the manufacturers, produce are the best for building purposes, not only for construction pure and simple, but for artistic effect. Is such work as this not worth your co-operation? Is it not *resulting* directly to your advantage?

ORNAMENTAL BRICK WALKS.

WHEN two or three shades of brick are obtainable that are of the same hardness so that they will wear uniformly, a very handsome walk can be laid following the same class of designs so successful in tile floors. When all these colors are not of the same hardness, by selecting the hardest for the centre of the walk, which is to be kept plain, and laying the three colors to produce a border design, the wear on the sides will not be sufficient to seriously affect the walk. This especially applies to a walk from the house to the street. There is an infinite number of ways in which such a walk may be laid with the use of only two shades of brick. Such a walk, with a well-designed front wall, would be exceeding effective, in connection with a fine brick residence.

CLAY-WORKING LITERATURE.

THE importance of the clay-worker as a factor in building operations is slowly but surely being recognized. Heretofore his connections with the art of building have been in the main incidental, but within the past twenty years the few simple and somewhat crude examples of his lack of skill have been crowded to the rear, and their place supplied by a larger variety of more beautiful and useful evidences of his progress. Even the common building brick of twenty years ago has been replaced by a better-appearing and much more durable and serviceable article, and the quality of all building material manufactured from clay is constantly being improved. The science of preparing and mixing clays, unknown a comparatively few years ago, while yet in its infancy, has borne its full part in the evolution of clay-working, and no branch of the clay-working industry is receiving more careful consideration than is being given to this branch of the business. The civilization of the last half of the nineteenth century has demanded that more attention should be paid to the æsthetic, and that buildings should be erected which, without detracting from their strength, durability, or usefulness, should be more pleasing to the eye. To this demand the architects of this and previous generations have royally responded. Their efforts to satisfy the taste of the cultured of this age have taxed the resources and ingenuity of the progressive clay-worker, and to them the world owes its tribute for a class of buildings more beautiful and pleasing than those of any other country or previous era. The artistic combination of colors and shapes, which can now be produced with brick and terra-cotta in this country, is the evidence of the growth of the clay-worker's art, and will for ages be the monument of those who have aided in its development. But the student who endeavors to obtain, from the literature of the clay-worker, information to guide and direct his research, and to assist him in obtaining a technical knowledge of the art, finds his efforts completely balked. Acknowledged by all to be the oldest of the arts, the methods and processes of mixing, forming, and burning clay have for centuries been transmitted from father to son, from one artisan to another, with scarcely a written word to assist the ambitions of the earnest seeker for a better way, or to record the mistakes of his predecessor. No college or educational institute in the world has ever yet given any prominence to this art, which is still in its swaddling clothes, but which has for so long been an important factor in the world's history. Very many branches of study, a knowledge of which is absolutely necessary to the modern clay-worker, are, it is true, taught in all our colleges and universities; but the text-book which shall teach the proper application of the knowledge thus obtained, to the conversion of Mother Earth into articles of use and beauty, has not yet been published. The first works which have been written or compiled are in the main unreliable, largely because they are out of date. The development of the art has been too rapid for its historian to keep pace with it. Another, and perhaps the prime, reason for the lack of printed data on so important a subject is that within a few years the manipulation and burning of clay were considered as an avocation requiring brawn and muscle rather than an art or profession needing brains and intelligence. To-day the clay-workers, as a class, compare favorably with other manufacturers. Among them can be found many men of superior intelligence and attainments, whose practical training, added thereto, has enabled them to reap the reward they so richly deserve. The necessity for knowledge is rapidly asserting itself, and the clay-worker of the future will have a thorough practical training in chemistry, geology, and physics. He will, in addition, be a practical machinist of no mean order. Speed the day when from the public and private libraries of this country can be obtained information necessary to the success of the clay-worker. Hasten the time when an ambitious young man or woman can graduate from our high schools or colleges, with an education that will entitle them to membership in the ranks of clay-workers deserving of the name.

D. V. PURINGTON.

VOLVME VI JAN. 1897 No. 1

THE BRICKBVILDER

OFFICE 85 WATER STREET BOSTON

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

PUBLISHED BY

ROGERS & MANSON,

CUSHING BUILDING, 85 WATER STREET, BOSTON.

P. O. BOX 3282.

Subscription price, mailed flat to subscribers in the United States and Canada . . . . . $2.50 per year

Single numbers . . . . 25 cents

To countries in the Postal Union . . . . . $3.50 per year

Entered at the Boston, Mass., Post Office as Second Class Mail Matter, March 12, 1892.

THE BRICKBUILDER is for sale by all Newsdealers in the United States and Canada. Trade Supplied by the American News Co. and its branches.

PUBLISHERS' STATEMENT.

No person, firm, or corporation, interested directly or indirectly in the production or sale of building materials of any sort, has any connection, editorial or proprietary, with this publication.

THE BRICKBUILDER is published the 20th of each month.

AT the possible risk of wearying some of our readers, we feel constrained to recur to a subject of which we have frequently spoken in these pages, viz.: the consideration of bond in brickwork and the necessity of a uniform size for bricks. It is a melancholy and somewhat humiliating fact that under existing conditions the quality of brickwork is — all things considered — probably worse in America than in any other civilized country, while the quality of bricks is often better than elsewhere. All know our usual methods of building brick walls. The interior partition and bearing walls are invariably built with no less than four, oftener six or seven, courses, all stretchers followed by one course of headers, the resulting bond being necessarily very imperfect. As the mortar is frequently of poor quality, the wall so built has very little transverse strength. In case of fire, the falling beams frequently bring considerable lateral pressure to bear upon the walls, and our brick walls are frequently overthrown in fires, when walls, properly built and bonded, would stand and check the fire. There can be no doubt that the greater destruction caused by fires in this country, even in our masonry buildings, is largely to be ascribed to this cause. No one factor is more important in fighting fires, as every fire captain would testify, than to have walls which can be depended upon to stand, and which will serve as ramparts against the fire. On this account lateral strength is usually more important than longitudinal strength in a wall. The bond in which transverse and longitudinal strength are equal is one cause of headers to two of stretchers; but even such a bond as this is almost never found in the interior walls of buildings in this country.

With regard to the exterior walls the case is even worse. Until quite recently, the ideal of an exterior brick wall was one of brick, carefully culled to give the greatest uniformity of color and laid all stretchers, the front skin of face brick tied to the backing only by cutting off occasional bricks at the back and tailing bricks in behind the cut brick into the backing, or by using hoop iron bond. In either case the tie is so slight that the facing adds practically nothing to the strength of the wall. Such a wall is as bad artistically as it is constructionally. The even and hardly visible jointing and the uniformity of color produce a surface absolutely devoid of character or interest, and without the charm of color, which comes naturally and inevitably where bricks are used without culling, and are laid with joints sufficiently wide to tell in the color scheme.

Of late, since our architects have been learning the beauty of color variety in brick, and the value of the jointing as an element in the color and texture of the wall, these walls of monotonous sameness have become less common. Not only have bricks of russet, buff, and other colors been introduced, but even the red bricks are very often laid without culling, as they ought always to be. The greater effectiveness and interest given to the appearance of a brick wall surface by the true English and Flemish bonds has also come to be appreciated, and these are more and more used in place of the insipid stretcher work which was invariable twenty years ago. Owing, however, to the fact that common bricks in this country are rarely made, as they ought to be, so that two headers with the intermediate joint will be just equal to a stretcher, it is difficult and expensive to make use of these bonds. The width of the brick in relation to its length is usually too short, and the result is that the strongest of these two bonds, the true English bond, can rarely be made use of, without cutting the brick to avoid the vertical joints coming over each other to the detriment of strength as well as appearance. For this reason the Flemish bond is more often employed; but even in this bond the headers can be brought over each other only with considerable pains.

An added difficulty arises from the fact that bricks from different kilns are of very different sizes; so that where a better grade of brick is desired for the facing, as is usually the case, it is difficult to find a brick for the backing that will bond with it and sometimes only by using a better quality of brick than is really required. These difficulties result too frequently in the vicious practise of building a face wall with a sham Flemish bond, the bricks being cut in half to form sham headers, true headers being used only every three or four courses where the courses of the facing and of the backing happen to come to the same level, or sometimes headers are inserted when the two are not quite on a level, and the outer skin, being so largely independent of the backing, settles a little differently and the few headers are cracked in two by uneven settling. All this encourages the bricklayer in slipshod, careless, and unworkmanlike methods. He has little or no opportunity to show what he is really capable of, or to become really interested in the finer points of his craft, such as the laying of the more complicated bonds or brick pattern work. Indeed, he hardly even masters the laying of good English and Flemish bond, so that these are more expensive to lay than they ought to be from sheer unfamiliarity of the workman as well from the unnecessary difficulties resulting from the uneven sizes and bad shapes of the brick. All this group of difficulties harks back to the one fruitful source of the trouble: the fact that brick manufacturers have not been able to agree upon, and rigidly adhere to, a proper standard size of brick which should apply to face-brick and common brick alike. No doubt some manufacturers purposely make their brick undersized, in order to sell a larger number, but such men are a small minority, we are glad to believe.

It is within the power of the manufacturers to combine and enforce a proper standard size. The difficulty of making allowance for differences of shrinkage in different clays is not insurmountable. Such a policy rigidly carried out would greatly encourage the use of brick and would bring about its employment in many cases where stone is now employed on the one hand, and where wood is employed at the other end of the scale. We are sure the architects would encourage such a movement by specifying standard size brick if they could readily be obtained. We wish the manufacturers could see that their own best interest lies this way, that they could greatly increase the use of brick by such a policy. The makers of pressed brick would find it to their interest to bring pressure to bear on the makers of common brick to adopt the standard size. We are sure that in this way the use of pressed brick would be increased. The better work that would result from the proper bonding between face and backing would make brick walls more durable than they now are. We are sure a rich harvest is in store for those who inaugurate the reform, and who bring it to the attention of architects.

PERSONAL AND CLUB NEWS.

Mr. H. W. Buemming, architect, has opened an office in the Pabst Building, Milwaukee.

Mr. Gould has retired from the firm of Gould, Angell & Swift, architects, Providence, R. I. Messrs. Angell & Swift will continue the business at the same office.

Recent events at the Chicago Architectural Club: December 28, annual Christmas-tree celebration; January 4, paper by R. E. Richardson, explaining the electrical terms and conditions as met with by architects; January 11, reception: Messrs. W. H. Eggebrecht, H. D. Jenkins, and E. S. Seney acting as hosts.

At the annual meeting of the St. Louis Architectural Club, held January 2, the following officers were elected: President, W. B. Ittner; first vice, Ernest Helfensteller; second vice, J. C. Stephens; secretary, G. F. A. Breuggeman; treasurer, C. H. Dietering. These with Oscar Enders and J. L. Gray will constitute the executive board.

The first regular meeting of the Pittsburg Architectural Club was held in their new quarters, Carnegie Library Building, Wednesday evening, December 16. The following officers were elected: President, Frank A. Large; vice-president, Jno. T. Comes; secretary, Chas. I. Ingham; treasurer, Miss Elise A. Mercur. Executive committee: Chas. W. Tufts, Robert G. Dickson, Miss McMasters, H. Childs Hodgins. The constitution and by-laws submitted at a former meeting were adopted as drafted.

The Twelfth Annual Exhibition of the Architectural League of New York will open February 20, in the building of the American Fine Arts Society, 215 West 57th Street, and continue to March 13 inclusive. Hours 10 A. M. to 6 P. M., 8 P. M. to 10 P. M. Sundays, 1 P. M. to 6 P. M. and 8 P. M. to 10 P. M.

Exhibit entry blanks returnable Monday, February 1.

Last day for reception of exhibits, Wednesday, February 10, 6 P. M.

The New Jersey Society of Architects held its regular monthly meeting at the parlors of L. Achtel Stetter, Newark, N. J., on January 7. Assemblyman McArthur, of Jersey City, addressed the meeting regarding his proposed new State building law applying to cities of the first and second classes. After discussion the matter was referred back to the committee having it in charge.

We have received the catalogue of the Architectural Exhibition held by the T Square Club at the Pennsylvania Academy of the Fine Arts, Philadelphia, in connection with the sixty-sixth annual exhibition of painting and sculpture. It is a publication creditable alike to the profession which makes it possible, and to the club which has brought together so much good material. The value of publications of this sort is very readily appreciated. Indeed, it is possible that as much general, tangible good is accomplished by the publication of the catalogue as by the holding of the exhibition, which it in part illustrates; for while the exhibition passes, and is apt to share the fate of most all architectural exhibitions in that the general public is not in evidence, the catalogue is a thing to be treasured and preserved in the architects' offices, and cannot fail to be an educational factor. This book adds to the laurels of the T Square Club, an organization which now easily ranks as one of the most active professional bodies in the country. This catalogue has one innovation in the shape of a very excellent color reproduction of the drawing of the doorway of Santa Paula, Seville, by A. C. Munoz. This is, as far as we know, the first instance of color being used in connection with an architectural catalogue, and it is very successful.

ILLUSTRATED ADVERTISEMENTS.

THE adjoining illustration shows the doorway to a residence in Brooklyn, N. Y., the whole of which is executed in terra-cotta and brick. Montrose W. Morris is the architect, and the work was made by the New York Architectural Terra-Cotta Company. In the advertisement of the company for this month, on page xxviii,

is shown the alternate of Mr. Aldrich's design which was premiated in the competition held by the company.

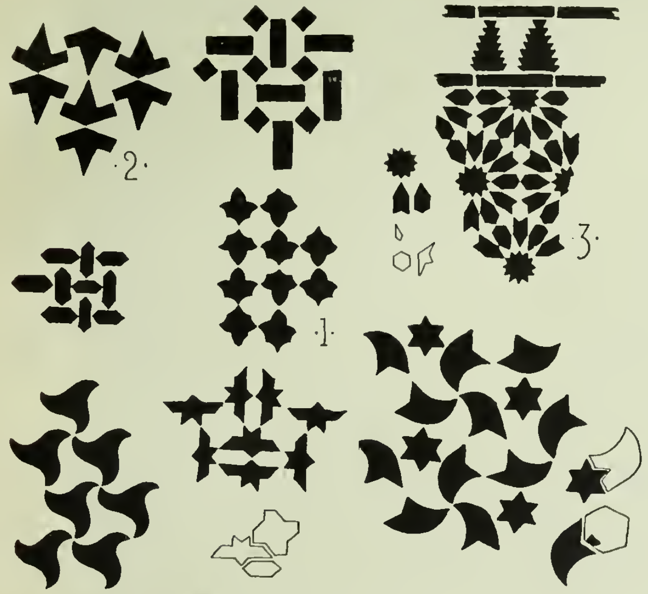
In the advertisement of R. Guastavino, page xiv, the fire-proof tile dome over the rotunda of the library for the University of Virginia is shown. The library is one of the group of new university buildings by McKim, Mead & White, and the illustration shows to good advantage Mr. Guastavino's system of fire-proof tiling.

A splendid illustration of Macmonnies' Bacchante, which was presented by Mr. Charles F. McKim to the Boston Public Library, is shown in the advertisement of Mr. F. B. Gilbreth on page xxxiv.

Spanish Brick and Tile Work. IV.

BY C. H. BLACKALL.

SINCE the publication of the last paper upon this subject, the writer has been able to verify his expressed surmise in regard to the character of the work in the doorway of Santa Paula, at Seville. The faience was modeled by one of the most promising pupils of the Della Robbias, who established himself in Spain after



MOORISH TILE PATTERNS.

a long course of study in Italy. While this does not add to the artistic merit of the work, the fact is of interest.

There remains only one manifestation of Spanish ceramic art to be included within the scope of this paper, namely, the enameled tiling. It is hard to speak dispassionately of Spanish tiles. From a practical standpoint they leave a great deal to be desired, as the workmanship is almost invariably crude and the enamel is applied to a very inferior grade of terra-cotta; but in an artistic sense it is doubtful if the world has ever seen ceramic work which was, on the whole, so eminently successful; and with the exception of what has been accomplished by the Persians and by a few of the Northern races in India, there are no other encaustic or enameled tiles known to us at present which can approach the Spanish work for brilliancy of design combined with a strictly decorative treatment of mass and a harmony of colors. All periods of módern art have been inspired very directly by these wonderful creations. The very term "Majolica" comes from the name of an island lying off the coast of Spain, in which the fabrication of vitreous enamels at an early period of modern history began to assume a high importance, and from whence the secret of the manufacture was spread over Europe. All of the Semitic races have been inclined to tile work, and even as far back as the days of the Assyrian monarchies encaustic tiling was a recognized and very successful medium of adornment, while the enamels and potteries of Damascus, of lower Egypt, of Bagdad, and of Ispahan, have been prized by artists and collectors for many generations. It is then not strange that the Moors, who inherited the artistic tendencies of their Asiatic forbears, should, when removed to the security of the Spanish Moslem empire, with ample means at command and a degree of security from external political complications such as the Arab races never enjoyed elsewhere, be able to carry their decorative tendencies to the highest perfection. Moorish art was a matter almost purely of detail, and, owing to the peculiar, seclusive manner of life which this strange race preserved for so many centuries, there are very few manifestations of external architecture or decorative art. There are a few instances, such as the exquisite structure in the enclosure of the Alhambra, known as the Wine Gate, in which a species of external ceramic treatment was tried by the Moors; but, as a rule, the exteriors of the buildings erected by them were somber and uninteresting, and the lavish imaginative qualities of their arts and sciences were reserved for the privacy of the interior.

The Moorish tiles were formed from a stiff but not very hard clay, which was squeezed into molds so that the individual pieces were slightly beveled on the edges towards the back, permitting of very fine joints, if such were desired, though more commonly the tiles were so bedded in a matrix of mortar as to leave broad and somewhat irregular joints, the bevel of the tile allowing the mortar to key thoroughly around each piece. The colors were applied in the shape of enamels, rarely any glazes or transparent colors being used. In the early Moorish work, tiling, whether for dados or floors, was treated purely as a mosaic, a pattern being evolved by the combination of a few forms repeated in a geometrical arrangement. Thus, in Fig. 1, the pattern is made by only two tiles of different colors. Figs. 2 and 3 are likewise made with a single shape in different colors, and even so complicated a pattern as the one shown by Fig. 3 requires only three forms of colored and three of white tiles to build up the entire design. In the later Moorish period the strictly mosaic treatment was abandoned, and we find tiles on which the patterns were stenciled over a white ground so as to reduce the manual labor of setting in place, while after the Christian conquest the tiles were frequently in slight relief, the pattern stamped in the moist clay and the impressions filled with the liquid enamel to produce the different effects of pattern and color. Attempts have frequently been made in recent years to copy the effects of the Moorish tiling, but while the raised and stenciled tiles can easily be adapted to our present conditions, it would require at least a generation of education to so train our mechanics as to be able to set the intricate mosaics which the early Moors used so constantly for their walls and floors; and aside from any question of expense, which would be a considerable factor, it would hardly be practicable to undertake to reproduce the Moorish tiles in our work.

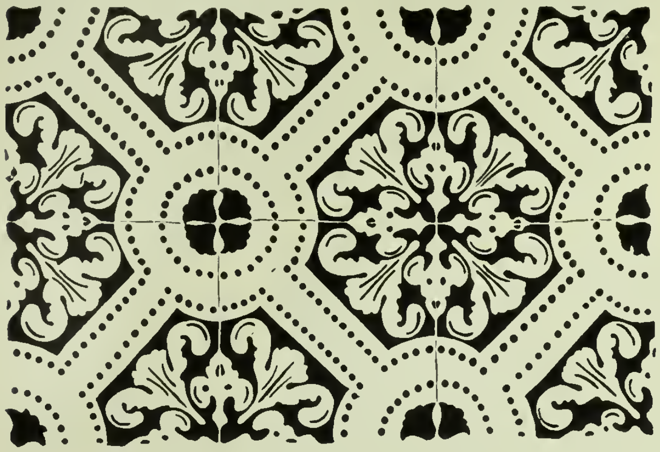
The colors of the Moorish tiles are mostly green, blue, black,


PATTERN OF EXTERIOR WALL TILES FROM LISBON.

white, and yellow, the green, white, and black combination largely predominating. There seems to be very little variety in tones used, as the colors are practically the same in nearly all the Moorish work

INTERIOR OF TOWER OF THE CAPTIVE, THE ALHAMBRA.

now remaining, the variety of treatment and diversity of effect having been produced entirely by changes in the pattern or in disposition of colors. There are two groups of buildings which are preeminent among the existing examples of Moorish construction wherein tiles were used for decorative treatment. The Alcazar at Seville is one of the royal residences which was erected by Moorish workmen for the



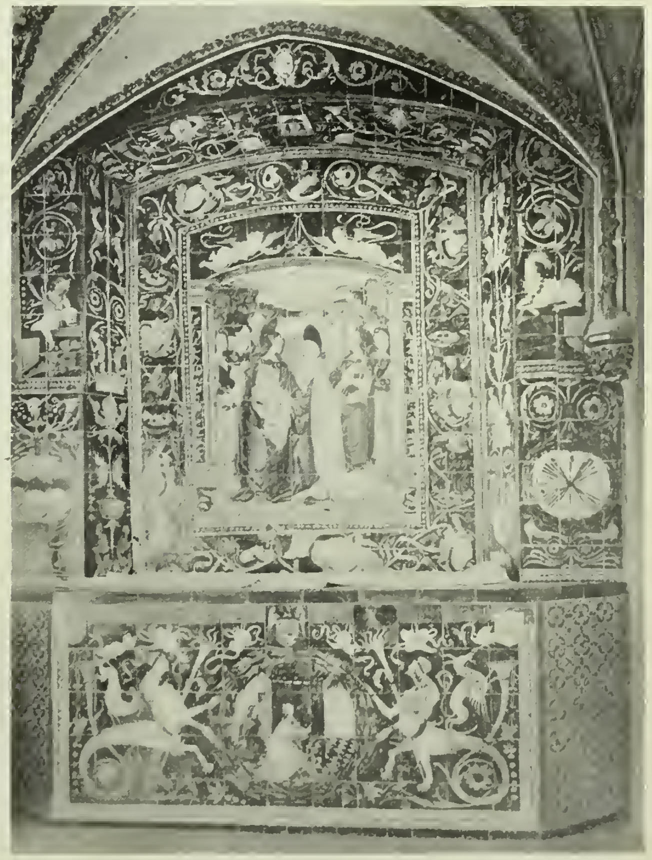
PATTERN OF EXTERIOR WALL TILES FROM LISBON.

early Christian conquerors; and although it is not, strictly speaking, a Moorish product by ownership, it is such by the character of the work, debarring a few of the more modern changes. This building has been very carefully restored, is kept in exquisite repair, and serves as perhaps, on the whole, the best example in which the Moorish styles can be studied, though the treatment in a decorative sense is not as pure as in some of the other instances. The interior consists of a vast succession of apartments grouped around interior courts, the whole ornamented with lavish Moorish details, and with a wealth of tiling in the shape of wainscotting and paving, all of which is, in an artist's sense, none the less entertaining because of the rococo additions of later date or the charming tropical gardens which close the vistas of the broad halls.

The Alhambra of Granada is the structure which is most intimately associated with Moorish work. It is, properly speaking, a collection of buildings erected upon the spur of a hill jutting out into the valley above the city, and includes a number of structures of different periods, which until quite recently were sadly dilapidated and almost totally neglected. Of late years, however, the Spanish government has restored a very considerable portion of the Moorish work in a most intelligent manner, and as far as concerns the details of design, the interior gives a very fair idea of what the Moors attempted to produce. Any one who has seen this work in place is sure to retain a very vivid impression of how it looks and what it is, but any attempt to describe it without the aid of color is almost hopeless; for while the Moors placed a great deal of insistence upon the design, and their keen geometric taste enabled them to evolve most surprising results with very simple motives, yet color was so essentially a part of the whole that mere black and white reproductions absolutely fail to convey exact impressions. Furthermore, it is to be doubted whether the Alhambra as it exists to-day in its most carefully restored portions can be a correct representation of Moorish art. The rooms are grouped around courts, and there is plenty of sunshine and a certain amount of green foliage at the end of each vista, so that surprises await one at every turn; and the succession of halls and corridors, with their enameled surfaces, is very fascinating; but the absence of life, the lack of fittings, make even this fairy-like palace seem very dreary. We all know how hopeless a new house seems before it is carpeted or furnished, and the same applies to this Moorish work; it needs surroundings, it needs life, and all the thousand and one little things which add personal interest, in order to be anywhere near appreciated. The view which is reproduced of the interior of the Tower of the Captive is from a very brilliant watercolor by G. Simoni, in "*Die Baukunst Spaniens*," and with the accessories so cleverly introduced, it gives, better than any photograph, an idea of what the Alhambra might be, in an inhabitable state.

Encaustic tile ceased to be used as a mosaic with the incoming of the Renaissance. The Spanish architects, however, produced some marvelously interesting work in this direction, and not only used tiles by themselves, but frequently carried ceramic painting to a very considerable extent. The illustration of the altar-piece and wall decoration is from one of the chapels of the cathedral at Seville. The whole of the decoration is in tile, and is one of the most ambitious examples of this particular phase of art which is in existence.

The extent of possible discussion of such a subject as this is almost without bounds, and I can accordingly only hint at the variety of treatment, the complexity of design, and the contrasts of color which result from the use of enameled tiles by the Moors and their successors in Spain. There is one manifestation, however, which I wish to notice. Lisbon is essentially Spanish in its art antecedents, and the ceramic manifestations of the Moors survive in Portugal to a greater extent than anywhere else on the peninsular. The street fronts of the houses are faced almost universally with enameled tiles. The idea is an excellent one; and properly developed, nothing more brilliant and interesting could be imagined than a long street, to say nothing of a whole city, clothed in all the beautiful hues which are to-day so easily produced by the ceramic artists. Plain white tiles are seldom used, though sometimes a single tone is employed. Blue is the color most employed, a blue pattern on a



ALTAR-PIECE, SEVILLE CATHEDRAL.

white ground, the tone being a cross between Delft and a French blue. The Portuguese have by no means perfected this mode of finish, or decoration, whichever it may be termed, although they have used it now for several centuries, and it is certainly a very interesting manifestation of possibilities.

Architectural Terra-Cotta.

BY THOMAS CUSACK.

(*Continued.*)

FROM the poetic to the severely practical may seem a long distance; in the present instance, however, it is but a step, such as the one we have now taken from the end of the last to the beginning of the present chapter. Thus far we have traced in sketchy outline the origin and application of burned clay from the building of Babel to the Christian era; thence through the Middle Ages, the Renaissance period, and onward to its modern revival in England, and subsequent introduction in America. We now take up the things of yesterday, to-day, and to-morrow, in this year of grace 1897, and we would fain hope, in a way that may prove helpful to those in whose hands lie its destiny in the coming century.

FIG. 7. HOFFMAN LIBRARY, ST. STEPHEN'S COLLEGE.

A time there was, and that not very long ago, when an architect having a desire to use terra-cotta was obliged to adopt some style admitting of comparatively small blocks. These he was advised to use in a more or less isolated manner, with brick filling as the connecting link. When not wholly detached, sundry expedients were frequently resorted to as a makeshift remedy for miscalculation in shrinkage, or, perhaps, a deviation from the figured dimensions in setting-out piers, openings, and breaks, etc., at the building. It was conceded, even by the manufacturers themselves, that in some instances the tail wagged the dog; and we fear that the practise, reprehensible though it be, has not yet been wholly abolished. This was merely yielding to difficulties, instead of adopting adequate means to overcome and finally end them. Available examples furnished by past ages were freely drawn upon, but failing to find a beau ideal from among them, the architect was expected to invent one suitable for immediate use. This he sometimes undertook to do, with remarkable promptitude but varying success. The mountain, he was informed, would not come to Mahomet, which for the nonce left the prophet but one alternative — pack his draughting paraphernalia, so to speak, and betake himself to the mountain. As a consequence, both design and construction were made subservient to the fancied as well as the real exigencies of the material. To some extent this is necessary, — for every material has its limitations,— but when it comes to fixing a standard of excellence by judicious compromise, we believe in leveling up rather than leveling down.

In the case of burned clay, however, everybody seemed inclined to capitulate, and allow this most excellent servant to become master of the situation. That undesirable state of things was not destined to last through an age of scientific research and mechanical invention. A race of men who have annihilated time and space by harnessing the unseen forces of nature, whether on land or sea, could not submit to the caprice of so simple an element. The action of fire upon a piece of selected and suitably prepared clay can be regulated and controlled with as much certainty as it can upon any other mineral. We state this advisedly, as a literal fact, and within certain limits, which we will hereafter endeavor to define; no competent architect need feel himself hedged in by irksome restraints, such as those to which he was at one time obliged to submit.

It is no longer a question of arbitrary style, having now resolved itself largely into one of treatment. Even in that there remains a world of latitude, in the hands of men who have profited by the observation of recently executed work, and feel an inclination to keep abreast with the times. Of course, if an architect has taken for his ideal the Temple of Karnack, or has set his heart upon a replica of the Parthenon, or has decided upon a reproduction of the Erechtheum, with, perhaps, monolithic columns and a trabeation admitting of joints only over centers of capitals, then there is but one, or at most two, things for him to do. He must go in search of a quarry capable of supplying the stones, and of a bank account from which to pay for them. But if, on the other hand, he can concentrate his ideas within the limits of classical Roman, Romanesque, Byzantine, Saracenic, Gothic from the thirteenth to the twentieth century, or any phase of Italian, French, or Spanish Renaissance, there is some hope for him. In any of these he can use terra-cotta throughout much as he would stone: or he can use it in combination with brick from basement to dome, minaret, spire, or campanile. All will depend upon his conception of these styles, and his way of handling any or all of them. One thing he must do: study the very wonderful capabilities of the material, without losing sight of its limitations. Great progress has been made by our best architects in these matters of late years. A large proportion of recent work bears the evidence of advanced thought and conscientious effort, usually in the right direction. Yet, judging from what we sometimes see done or attempted, there is still much to learn as to what may or may not be expected in the use of this material under given conditions. We hope, in succeeding pages, to contribute something towards a better understanding of the facts and principles underlying this aspect of the subject.

We are not writing for the behoof of men who, having failed in everything, take refuge behind a shingle of large size, on which has been painted the word ARCHITECT; by which magic name they seek to distinguish themselves from the great army of unemployed. They are past praying for. Our remarks are addressed primarily to men who have earned or are now earning their right to that title, and who have worn or intend to wear it honorably. We therefore take for granted their wide acquaintance with the merits of material in general. This much is essential to success under any circumstances. But when the material to be used is largely terra-cotta, a more exact knowledge of its physical characteristics is indispensable. To know as much as may be about the whys and wherefores of its manufacture will likewise greatly help them in using it to architectural as well as to commercial advantage. To that

end, we will turn from the general to the particular application of these observations, and instance a number of difficult yet every-day problems confined to work that has been or can be executed successfully. Attention will also be directed to some of the things which (as yet) cannot be made satisfactorily in terra-cotta, and that being so, is to our mind a sufficient reason why they should not be attempted. Like most things, this branch of our subject has a negative as well as a positive side, and to be of any real value the treatment must be unreservedly frank as well as intensely practical.

" I, from no building, gay or solemn,
Can miss the shapely Grecian column."

We will therefore begin with the column, which, in its diverse manifestations, affords as good an illustration as any we can think of as to what can and what can *not* be accomplished in terra-cotta. One of the most troublesome things to make is a full column that will withstand critical inspection on all sides. The difficulties begin to increase when the diameter exceeds 1 ft.; beyond that, the point is soon reached when they become insurmountable. If it be a three-quarter column, with an engagement on every alternate block for building into wall, most of these difficulties disappear, and the diameter may be increased to as much as 2 ft. and still remain practicable. In the former case we are speaking of plain shafts, but when severely fluted, the trouble is obviously increased. This is because of the extreme accuracy with which the arrises of the fillets have to fit, and the trueness of line required to make them presentable to the eye on close inspection. Macaulay's inspired schoolboy may not have known of the nicety demanded in working these drums in stone or marble, but every stone and marble cutter does. And when they have done their utmost, a good deal of faking still remains to be done after the column has been set in its position. This paring is not permissible in terra-cotta; for once the fired surface has been broken, a patch takes the place of an irregularity, and the remedy is, if anything, worse than the disease.

FIG. 4. ENTRANCE TO CASTLE SQUARE THEATER, BOSTON.

In the case of a 12 in. column with a height of, say, eight diameters, it would be jointed into five pieces, each weighing about 95 lbs. When the necessarily soft clay is pressed into a plaster mold, a proportion of the moisture is absorbed, and when ready for turning out to dry, it has acquired a considerable degree of stiffness. A safe-edge of ¾ in. has been allowed on each end, standing back about ¼ in. from the bottom of the flutes, to be trimmed off after burning. On this it is set to dry, first on one end, and then on the other, as shown on Fig. 1. Five eighths of the shrinkage takes place in the drying, and three eighths in the burning. In both cases the piece rests on a thin layer of coarse sand, each grain acting as a roller, which enables the circumference to travel more easily towards its center during the progress of contraction. But notwithstanding these and many other precautions, the weight of the piece, if it does not cause it to spread, is liable to impede the uniform shrinkage of the end on which it rests. Of course the greater the weight, the greater must be the impediment. If the column is jointed in three instead of in five (as architects will sometimes insist upon doing), the bottom third being parallel and the other two entasized, this burring on the ends is sure to happen. In that case the weight has been increased to 150 lbs. in a shaft of 12 ins. diameter, involving a corresponding uncertainty in fitting at the joints, as well as in the alignment of the pieces themselves.

But let us double the size of our column, viz., 2 ft. in which case it would be made (if made at all) in seven pieces of 2 ft. 8 ins. each. These would weigh 675 lbs., and, for the reasons just stated, may be considered altogether impracticable. If, however, " fools rush in," etc., as they sometimes will, and order a 2 ft. column complete drums without vertical joints, they may expect to pay for their enlightenment in regrets as endless as they will be useless. Some inexperienced manufacturer may take the order, and under pressure endeavor to go through with it, but in the end the architect will find that to order is one thing, but to execute is quite another matter.

In a three-quarter column, the conditions being reversed, the block can be turned out as at Fig. 2. The sanded board on which it lies being tilted to alternate ends at an angle of 30 degs., the shrinkage will be uniform, the block will be sound, and if reasonable care is exercised in its remaining vicissitudes, the ends will fit each other when set. A shaft of this kind can be made up to 2 ft. diameter, jointed in five pieces averaging 3 ft. 3 ins. long and weighing 700 lbs. But to make quite certain of the result, we would advise jointing it in seven pieces of 2 ft. 4 ins., thus reducing the weight to 490 lbs., and thereby securing a much greater uniformity in drying and burning. Four columns of this size and character are used on the Maryland Life Building, Baltimore, of which Mr. J. E. Sperry was the architect. In justice to him, however, we will say that he is not responsible for the jointing. Each shaft is jointed into twelve pieces, which are about five too many; and we cite this as an example to avoid, rather than one worthy of being followed. We are, of course, assuming a case in which it has been deemed imperative to make a column of this size in single blocks, without vertical joints, but do not wish to be understood as favoring that method.

Somewhat similar columns have since been made for the same architect, and are used on the Brewers' Exchange, Baltimore. They, however, are jointed vertically into alternating segments, one course being in two, and the next in three pieces, with the interior built of solid brickwork bonded into and forming part of the wall. The result is highly encouraging, and has given much satisfaction to the architect. The same plan was adopted in constructing four attached columns used on the Castle Square Theater, Boston (Fig. 4). Messrs. Winslow & Wetherell were the architects in this case, and they, too, think the effect very successful.

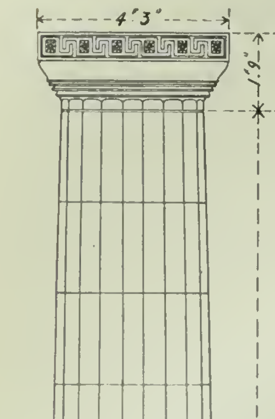


FIG. 5.

In Fig. 5 we illustrate the construction of a Doric column: the first of its kind that we have seen attempted in terra-cotta. Two of them are used on the fourteenth story of the Central Syndicate Building, Broadway and Pearl Street, New York City. It has been remarked that the Greeks did not use columns of this kind on the fourteenth story. Had they lived in New York, however, they would ere this have been confronted with a condition, not a theory, and in that case, there is no telling what they *might* have done. The dotted lines on plan show how the courses break bond and tie each other without the necessity of extraneous anchors. In addition to the iron stanchion in center, the core is filled in with brick and cement, as in the instances just mentioned. The result compares favorably with similar columns in granite used on the first story of the same building. Taken altogether, we think this successful example will settle any doubts that may have existed as to the feasibility of constructing a Doric column in terra-cotta.

A full column, when it exceeds, say 1 ft. 4 in. in diameter, should be jointed up in segments of four or six pieces, according to size, the vertical joints being in the center of the flute. The height of the segment should not be more than one and a half times its width, and may be from 4 to 8 ins. in thickness, the back being left perfectly flat, so that it may be dried on a level board, as at Fig. 3. Columns of 2 ft. 10 ins. diameter have been made in three segments on plan to satisfy the scruples of architect and owner, who had at first insisted on having them in complete drums. When this method is adopted and the piece turned out of mold, the vertical joints, being radial, form an angle with the board on which it rests. This overhang will cause the sides to sag unless temporary supports (to be cut off before burning) are placed at intervals in the angle, as seen in Fig. 3, which is a quadrant. In the case just referred to the segments were 2 ft. 6 ins. wide, 2 ft. 8 ins. in height, by about 8 ins. thick in the center, and the columns so constructed may now be seen on the Chapin Building, Buffalo. We have seen a letter from the architect, Mr. F. E. Kent, in which he speaks in the most eulogistic terms of these columns after they had been set.

In Fig. 6 we illustrate a column of about the same general proportions. It, however, is made in six segments, and with base and capital has a total of 118 pieces. It will be noticed that the flutes on the lower part are not filled with the usual convex billet, but are slightly recessed, the surface being struck from the same center as the column, for which see enlarged flute at D. The termination at top is also somewhat uncommon, but not without warrant, though this treatment has been criticized in the hearing of the writer as unauthorized. In reply he ventured to quote as a precedent the Chapelle San Bernardino, at Verona, in which are columns practically identical in both these respects. The joints are intentionally emphasized in the drawing, and the three accompanying plans will show the construction. The core being of brick, laid in cement and all the interstices grouted, we get a shaft capable of sustaining an immense weight. But should still greater stiffness be required, a cast-iron core or a polygon of riveted steel sections may be introduced, giving an almost unlimited strength. Twenty-six of these columns were used by Mr. C. C. Haight on the Hoffman Library, St. Stephen's College, a view of which we give (Fig. 7) from a recent photograph. *(To be continued.)*

IN the course of a recent visit to New York City, I had occasion to view the Park Avenue front of the Murray Hill Hotel, itself an erection of yesterday; yet judged by the dilapidated condition of the red sandstone, it might have been built by Diedrich Knickerbocker. This is about the center of the brownstone high stoop district, at one time the Mecca of successful tradesmen, and still the homes of the elect, when "at home." The balustrades, basement walling, water tables, window trimmings, and even the flat ashlar veneers appear to throw off a coat of scale, from one to three eighths of an inch in thickness, every year or two. I was informed that this occurs with great regularity, until the advent of the boarding-house keeper, after which decay becomes more rapid, and demolition the inevitable adieu. I traversed several of the crosstown streets, and the difference between them from 18th to 59th was merely one of degree, but all bearing a close approximation to their age, which is premature, being from five to fifty years. It is no uncommon thing to see one of these fronts pulled down and replaced with Philadelphia, or latterly, with Pompeian brick and terra-cotta. A brownstone church on 7th Avenue near 14th Street, which was built in 1856, has just been demolished and rebuilt in cream-white brick and terra-cotta to match.

A similar state of transformation is going on in the down-town sections. Stone and marble fronts that were the pride of a past generation are giving place to granite lower stories with superstructures of terra-cotta and brick, behind which is a sinuous anatomy of riveted steel. Thus does evolution in all things emphasize the survival of the fittest — *Correspondent.*

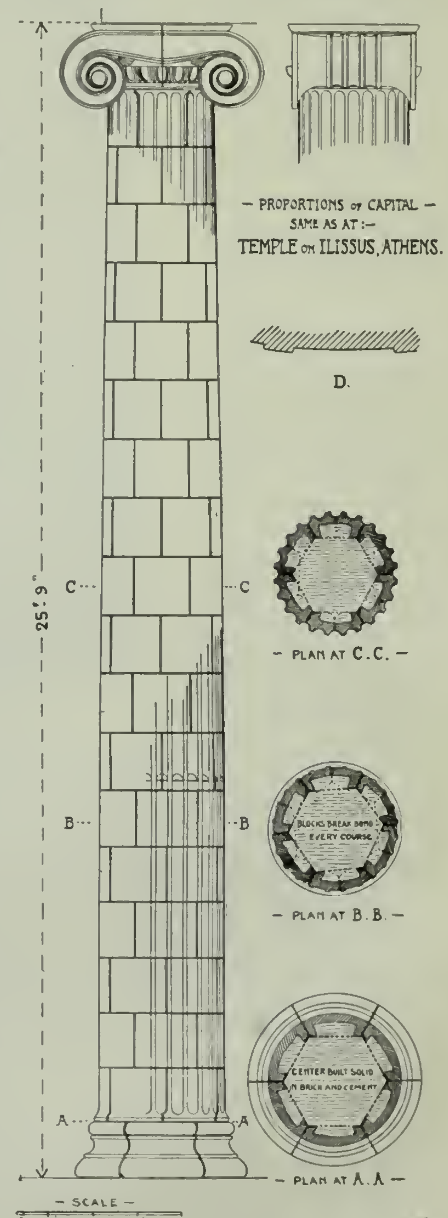


FIG. 6.

Fire-proofing Department.

SOME VALUABLE OPINIONS ON FIRE-PROOF CONSTRUCTION.

THE fire-proofing of our large commercial buildings is of such vital importance that, although as a science it is of quite modern development, its methods have of late years been the subject of many tests and special investigations made for the purpose of determining to what extent such precautions as are customarily taken serve their intended purpose. There have been several fires in buildings which are known commercially and scientifically as fire-proof structures, and though the actual damage resulting from such fires has, in most instances, been relatively quite slight, they have suggested very pertinent inquiry as to whether our materials are applied in the best and most scientific manner, and whether our fire-proofing systems are really fire-proof. Terra-cotta in one form or another has been very generally adopted for the protection of steel work and the construction of floors, and its properties and the details of its employment have received considerable study. With a view to determining the current opinion in regard to the use and the possibilities of terra-cotta, THE BRICKBUILDER has interviewed several of the leading architects in New York and Boston to ascertain whether in their judgment terra-cotta meets the requirements of the conditions of properly fire-proofing a building, and whether such a material, as a whole, can be depended upon.

Among those interviewed was Mr. George B. Post, of New York, who said that he considered sawdust or porous terra-cotta a most excellent material for resisting the combined action of fire and water, conditions which always arise in any burning building. In portions of the new twenty-five-story St. Paul Building on lower Broadway, and in the World Building, the Havemeyer, and in fact all of the large buildings which Mr. Post has erected, he has used the porous terra-cotta for fire-proof construction. Where the floor has to sustain a heavy direct load the end construction is the lightest and the strongest, but where lateral stiffness in the floors is desired, he believes the side construction to be the best adapted for the purpose. The ordinary builders, if left to themselves without the closest supervision, do not sufficiently fire-proof the floor openings in a building, and they are apt to ignore the fire-proofing of the girders. He believes, however, that the necessity for protecting the flanges of the beams is often exaggerated, and he cited the experience of the fire which a few years since burned out the upper stories of the building which he had erected for the Western Union Telegraph Company on Broadway. This fire originated in the low story which contained the batteries, and the heat was so intense that the granite window trimmings were destroyed and a couple of unprotected columns in the story were actually melted at their tops. The floor construction was of brick arches turned between the beams, and the lower flanges of the beams were protected by only five eighths of an inch of plaster. In the story above where the fire started there was one large room spanned by trusses. A gallery was hung from the floor beams, and after the fire it hung in festoons. So far as Mr. Post could ascertain, the floor beams and trusses, though protected so slightly in the lower flanges, suffered no appreciable damage. He infers from this that if the beams are thoroughly bedded in and covered by terra-cotta and mortar following any of the present forms which are in the market, it is not possible for a fire to dangerously affect the steel work. In his judgment, any of the recent and thoroughly well-constructed buildings which have been put up in New York can be called practically fire-proof, though in case of a great exterior conflagration he believes that in many buildings the skeleton construction would be sufficiently affected by unequal expansion to render the removal of the building necessary.

He believes that, on the whole, the forms of terra-cotta blockings and fire-proof shapes are satisfactory. He would not advise, however, any form which permitted of large or continuous voids in the thickness of the floor, unless such voids were blocked off at intervals by solid partitions. Other things being equal, he prefers a solid light filling between the beams.

It has been Mr. Post's practise to set the exterior columns of the steel skeleton well inside the wall of the building, separating them from the exterior construction by a waterproofing of some form and surrounding them thoroughly with cement grout and porous terra-cotta at least 4 ins. outside of the outer flanges of the steel. This is the construction which he used in the St. Paul Building, the outside walls being supported by the floor beams, which project beyond the columns and form cantilevers. He does not feel, in the light of his experience, that there is actual necessity for any terra-cotta under the flanges of the beam, though he usually specifies a thickness of 1¼ in. In the case of girders he specifies 2 ins. in thickness of terra-cotta around the flanges, which he believes is ample. For fire-proofing columns he uses nothing but terra-cotta. He does not believe that a dangerous heat would go through any of the present market constructions of terra-cotta fire-proofing if used in an intelligent and proper manner.

Mr. Francis H. Kimball, of Kimball & Thompson, New York, stated that, in his judgment, porous terra-cotta can thoroughly fire-proof all the construction of a building and is the best medium for the purpose on the market. He has used this material in the Manhattan Life Building, the Standard Oil Building, and a number of other large structures in New York. The flat arch construction, however, as ordinarily employed, is not absolutely satisfactory. It forms a good ceiling and answers the purpose of fire-proofing admirably, but the filling over the terra-cotta archings, composed of a low grade of concrete, is apt to settle and cause cracks in the finished tile floor construction. In his practise he has never used the end construction. He considers that the floor arches themselves are not called upon to really carry any load except their own weight, as in nearly every case continuous wooden sleepers are placed from beam to beam, which actually carry all of the superficial load. He uses skew-back blocks which lap under the beams 1 in., which he considers ample protection for the beam, and prefers such construction to the use of slippers. When asked as to whether the present systems of fire-proofing with terra-cotta blocks have been tested in actual use by fire and water so that we can be absolutely sure of their ultimate resistance, he said that there had been really no fires of any extent in the most recently constructed fire-proof buildings; consequently it is impossible to say that any of these structures have been submitted to extreme tests, but judging by such opportunities for observation as have arisen, it is possible to make a building absolutely fire-proof by the use of hollow terra-cotta. He instanced a test by fire of a building owned by the Potter estate, corner of 8th Street and Broadway, in which a steel column in the basement on the corner, which was covered with terra-cotta blocks and a thin layer of finished plaster, was exposed to a very intense heat from a fire in the surrounding stock of dry goods, and was subsequently, before being cooled to any degree, exposed to the action of water as well. Beyond the plaster being peeled off no damage occurred to the construction and the steel was not affected at all.

In the Manhattan Building, Mr. Kimball employed hard terra-cotta for the floor construction, but he would not be inclined to use the hard blocks again, as he preferred the porous. For fire-proofing columns his practise is to use terra-cotta with a thickness of at least 4 ins.

When asked as to the advisability of using stone outside the steel columns, he stated that he did not believe it could be relied upon to resist the flames. A statement often heard is that New York is building up so rapidly with large fire-proof buildings that it is not likely a conflagration could get started with sufficient impulse to extend very far. But right in front of the Manhattan Building, on the opposite side of Broadway, there is a large area covered with buildings with the ordinary wooden floor construction, which might, under certain circumstances, get afire and produce a conflagration of sufficient intensity, if it should encounter a stone-faced building in its path, to entirely strip off the exterior stone facing in a few minutes, and leave the steel columns exposed to the action of the heat, with the inevitable result of the columns yielding and the whole building collapsing. He considered that for fire-proofing purposes 4 ins. of brick or terra-cotta would be better protection than a foot of stone, and that in a fire-proof floor the terra-cotta blocks ought to be bedded solidly around the beams. He suggested that instead of the concrete or cinders filling over the terra-cotta blocks, which is very customarily employed, it would be better either to have blocks made lapping under the beam, and the whole depth of the beam, or to fill in over the arch blocks with light terra-cotta. He had occasion some time since to make investigations in regard to the weight of the various fire-proof constructions, and he found that the ordinary cinders concrete would actually weigh about 90 lbs. per cubic foot, whereas terra-cotta blocks which would be amply sufficient for filling purposes need not weigh over 45 lbs. per cubic foot, a saving of 50 per cent., which in a building many stories high means a vast saving in the structural steel as well as in the foundation work. Mr. Kimball has used construction of this description and believes that it gives a floor which will not shrink nor allow the marble or tile work to crack. In the construction of the roof over Altman's store, he built up over the terra-cotta archings with porous terra-cotta blocks to obtain the necessary pitch to throw the water off. It is a very simple matter to make long filling blocks quite light, with end pieces so constructed as to lap over the top flange of the girder, setting these light blocks over the constructive arch blocks. This would give a light, absolutely fire-proof, non-shrinkable floor construction, which would be very stiff against lateral stress.

For fire-proofing about the webs and flanges of the girders Mr. Kimball advises 4 ins. of terra-cotta, and he has found it necessary to have special shapes made for this purpose. This was done in the Manhattan Building. In regard to exterior walls he has given considerable study to devising some system of construction which would be light, strong, and practically impervious to water. It is well known that a brick wall will soak water even in an ordinary storm, and a driving rain will beat through even 4 ft. of brickwork. He studied out a system employing constructive terra-cotta blocks, which he considers very adaptable for party walls above the roofs of adjoining buildings or any exterior wall where the surface can readily be got at. The visible exterior surface consists of 1 in. of Portland cement, the wall itself being built of hollow porous terra-cotta blocks laid in any thickness from 8 to 24 ins. The cement keeps out the moisture, and the blocks are light, strong, and warm, besides being absolutely fire-proof. He had a section of this construction set up for experiment and specified it for the Manhattan Building, but circumstances led to its being abandoned, though he considers it an excellent scheme. He would use such construction for party walls, gable ends, etc., and taken in connection with the steel frame it is possible to have it laid up so as to be thoroughly bonded and possess very nearly the rigidity of brick, while the weight is only about one third.

In conclusion, Mr. Kimball calls attention to the possible danger which might arise from a great conflagration even in so well built a city as New York, and stated that the system of fire-proofing by use of terra-cotta is perfectly satisfactory in theory, and can be developed in such a manner as to give the best results; but as often employed the details are very carelessly attended to, and the construction is usually not watched with sufficient care in ordinary building operations.

Mr. Bruce Price, of New York, called attention to the fact that there are many different forms of blocks for floor construction, some of them being very imperfect mechanically, and others as near perfect as could be expected of a material which has to be handled by all sorts of mechanics. He considers the end construction following the Maurer system one of the best which the market now affords, being fully 20 per cent. lighter than some of the other shapes and at least 25 per cent. stronger. As an instance of the strength of this type of floor, in the American Surety Building, erected from his plans, after the floor blocks were set in place blocks of granite weighing as high as 5 and 8 tons were dumped on the archings and worked over before being set, without the slightest damage to the construction. The weak part of the construction is the amount of protection to the flanges of the beams, which at the best is none too good, though this is a question of mechanical excellence rather than of suitability of material. He considers that in setting terra-cotta blocks only the best of Portland cement should be used. He believes terra-cotta to be an excellent material for partitions on account of its strength as well as its sound-proof qualities, while for resisting the spread of a fire the hollow blocks would undoubtedly last longer than anything else. In regard to fire-proofing on columns, when his clients and the conditions will permit, he employs terra-cotta, as he has found it perfectly satisfactory, and it answers every purpose of fire protection and solidity. Mr. Price prefers the hard-burned to the porous terra-cotta as he feels he can get the best results on ceilings and the resulting work is considerably stronger.

Mr. C. T. Wills, who was the builder of the American Surety Building as well as many other large structures in New York, said in reply to a question, that in his judgment it was a disadvantage to use porous terra-cotta for floor blocks on account of its tendency to absorb water. He considered the hard-burned terra-cotta amply sufficient protection against fire, as the heat would not go through either hard or porous to any extent. It is possible by using terra-cotta to build a structure which shall be absolutely fire-proof, and he felt that nothing else would give equal satisfaction, while as a matter of practical building construction, terra-cotta is by all odds the best material in the market.

Mr. E. A. Rogers, who was superintendent for Mr. Price on the Amercan Surety Building, stated that hollow terra-cotta blocks formed a construction for partition work which could be depended upon not to crack, warp out of plumb, or fail in being sufficiently stiff against lateral pressure. The blocks afford an excellent opportunity for passage of wires, pipes, etc., and will not heat through in case of a local fire in a single room. With the hard terra-cotta floor blocks which were used in the Surety Building there was no trouble whatever from moisture. For furring against outside walls nothing is more satisfactory than hollow terra-cotta blocks, and for fire-proofing against columns the best practise is to use from 2 to 4 ins. of terra-cotta. He had found the hard terra-cotta blocks hard to cut and easily broken, and would under some circumstances prefer the porous terra-cotta, though he did not consider them so strong as the hard. For protecting the lower flange of the beams, he considered that a slipper 1 in. thick was less apt to give trouble than the forms in which the springing block was molded to fit under the flange of the beam.

A Boston architect who has been identified with some of the largest buildings throughout the country, but who prefers not to have his name appear, was quite emphatic in the expression of his opinion in regard to the absolute merits of terra-cotta as a fire-proofing medium, which, in his judgment, amply meets all requirements and can be fully depended upon to resist the action of both fire and water. This architect, in his practise, makes it a custom to use for floor arches terra-cotta blocks which are the full depth of the beams. If a 10 in. beam is used a 10 in. block is specified, and if a 15 in. beam is required a block is made of corresponding depth lapping 1 in. under the flange of the beam, thus leaving 1 in. above the blocks below the tops of the beams, which space is filled in solid with cement concrete. If a wooden flooring is to be used, a 2 in. underfloor is then dogged directly to the iron beams, above which is laid the finished floor. In this way the steel work is thoroughly protected on the sides and the bottom flange, and he believes that no fire would ever work through 3 ins. of solid wood to get at the upper flange of the beam.

Other interviews will be reported in the February number.— Ed.

Mortar and Concrete.

AMERICAN CEMENT.

BY URIAH CUMMINGS.

CHAPTER VII.

CEMENT TESTING.

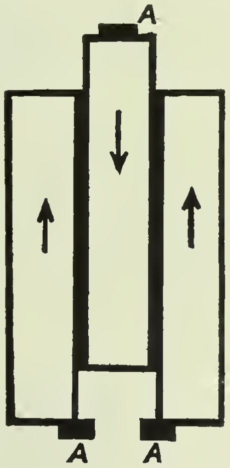
(*Continuation of tests made by Prof. Cecil B. Smith.*)

SERIES IV.

SHEARING TESTS.

THIS series of experiments was carried out with a view of obtaining more information on the shearing strength of mortar. The method adopted was as follows:—

Three bricks placed as shown in sketch were cemented together, and tested at the end of one month. It was found that by placing pieces of soft wood at *A*, *A*, *A*, an action as nearly as possible a shear was obtained, and gave very satisfactory results, the pressure being practically concentrated along the two mortar joints. No side pressure was applied, because the desire was to obtain minimum results where friction was not assisting.



The combined effect of adhesion and friction can easily be computed if the adhesion and superimposed load are known.

The results are divided into lime-mortar, natural cement mortar, and Portland cement mortar, also into ¼ in. and ½ in. joints, also into flat common unkeyed bricks and pressed Laprairie brick keyed on one side. (1) The lime mortar was mixed 1 lime to 3 of standard quartz sand, by weight; (2) natural cement mortar was mixed, 1 of No. 2 natural cement to 1½ standard sand; (3) Portland cement mortar was mixed, 1 of No. 5 Portland cement to 3 standard sand. (See exhibits of bricks with mortar attached.) The test pieces were chiefly allowed to stand in the laboratory at a temperature of 55 to 65 degs. Fahr., but one set of natural cement mortar and two of Portland cement mortar were duplicated by immersing in water for 29 days, after setting in air 24 hours before submersion.

These results point out many interesting facts: (*a*) the first fact noticeable is that the results are independent of the *thickness* of joint; this is true of lime and cement mortars. (*b*) The next one is not evidenced to any extent in the table, but was quite apparent in the testing, viz., that the adhesion of the mortar to the brick was greatest when the mortar was put on very soft, and least when the mortar was dry. This will largely uphold the use of soft mortars by masons, albeit their reason is a purely selfish one, the mortar being easy to handle. The tensile tests of cements made *very* soft are lower than when the mixture has the minimum amount of water for standard consistency. But for adhesive tests the case is evidently the reverse. It may be here mentioned that in these tests all bricks were thoroughly soaked with water before the joints were laid. (*c*) Coming now to the tests on lime mortar, the shears were through the mortar, except in the fourth experiment, and therefore they are quite independent of the key of the pressed brick on the surface of adhesion. This would point out the fact that keyed brick are superfluous in lime mortar joints, and the shearing strength per square inch averages about 10½ lbs. per square inch. The tensile strength of the same mixture at the same age was 30 lbs. per square inch, and the compressive strength 102 lbs. per square inch. (*d*) The natural cement mortar showed distinctly that its adhesive strength was not as great as its shearing strength, which is the reverse of the lime mortar tests. It also showed that the keyed brick aided in some unknown way, for the results on them are three times as great as with the common flat brick. Of course this may have been, and probably was, partly due to the different surface of adhesion. In five tests out of twenty-one made on the natural cement mortar, the mortar sheared through, and the average of these five was 97 lbs. per square inch, which gives the shearing strength proper, while the average adhesive strength of the thirteen tests in air which came loose from the bricks was 26 lbs. per square inch in common brick, 48 lbs. per square inch on Laprairie pressed brick, and 38 lbs. per square inch on Laprairie pressed brick for three tests submerged in water for the whole period.

This would show that the adhesive strength is nearly twice as great on pressed brick as common brick, and that submersion in water had a rather harmful effect than otherwise on the adhesive strength, and was certainly of no benefit.

The tensile strength of the same mortar at the same age was 132 lbs. per square inch; the compressive strength was not obtained, but would have been about 1,000 lbs. per square inch. The hints to be taken from these tests are that pressed brick keyed on both sides will give much higher results than flat common bricks, and would probably place the shearing strength of such joints at 100 lbs. per square inch, and make it largely independent of the consistency of the mortar. Also that the shearing strength is very much higher in proportion to the tensile strength than was the lime mortar shearing strength to its tensile strength, but about the same proportion to its compressive strength, *i. e.*, 10 to 1.

It becoming evident that the thickness of joint had no appreciable effect, the Portland cement mortar tests were made all ¼ in. thick.

TABLE VI.

TABLE OF SHEARING TESTS, OR MORTAR ADHESION TO BRICK SURFACES (in shear.)

Series IV.

Kind of Mortar.		Joint.	Brick.	No. of tests.	How indurated.	Shear in lbs. per square inch.			REMARKS.
						Average.	Least.	Greatest.	
Lime 1.	Sand 3.	¼"	A	5	in air.	9.7	8.4	11.9	All sheared through the mortar.
Lime 1.	Sand 3.	½"	A	4	in air.	12.1	6.1	19.8	All sheared through the mortar.
Lime 1.	Sand 3.	¼"	B	5	in air.	12.0	9.1	15.5	All sheared through the mortar.
Lime 1.	Sand 3.	½"	B	5	in air.	3.0	5.5	11.0	All came away from brick (mortar dry).
No. 2. Natural Cement	1 Sand 1½.	¼"	A	5	in air.	22.3	8.0	32.1	All came away from brick.
Natural Cement	1 Sand 1½.	½"	A	5	in air.	29.0	24.0	33.0	All came away from brick.
Natural Cement	1 Sand 1½.	¼"	B	5	in air.	75.0	25.0	118.0	Two came away from brick, three sheared.
Natural Cement	1 Sand 1½.	½"	B	3	in air.	85.0	43.0	118.0	One came away from brick, two sheared.
Natural Cement	1 Sand 1½.	½"	B	3	in water.	38.0	34.0	42.0	All came away from brick.
No. 5. Portland Cement	1 Sand 3.	¼"	A	3	in air.	10.6	10.2	11.6	All came away from brick. The brick which was on top in the original laying, always sheared first and at a less load than that of lower one, which, of course, set under twice as much load or pressure.
Portland Cement	1 Sand 3.	¼"	A	3	in water.	13.0	10.2	16.4	All came away from brick.
Portland Cement	1 Sand 3.	¼"	B	3	in air.	16.5	9.2	24.2	All came away from brick.
Portland Cement	1 Sand 3.	¼"	B	3	in water.	27.1	20.2	36.9	All came away from brick.

A. Common, flat, unkeyed, salmon brick.
B. Laprairie pressed brick, key on one side.

The results are surprisingly low. The adhesion on the common brick is about the same for air drying or submersion in water, and is slightly less than one half that of natural cement mortar tests of 1½ to 1. This is a significant fact, for while a neat tensile test of No. 2 natural cement 4 weeks old is 268 lbs., the No. 5 Portland is 459 lbs. for the same age, and a 3 to 1 No. 5 Portland is 82 lbs. for same age. (See table of general laboratory results.) Thus while any test of this cement would show that a 3 to 1 mixture of the latter would be nearly equal to a 1½ to 1 test on the former, yet in their adhesive properties to common brick the heavily dosed sand mixture was only half as strong as the natural cement mortar with a smaller dose of sand. We might easily have expected this; but the main point is: is it taken account of, in considering the comparative values of these mixtures, that the adhesive strength of a Portland cement mortar heavily dosed with sand is low as compared with a weaker but richer mixture of natural cement mortar? The shearing of Portland mortar shows that the adhesion to pressed brick is greater than to common brick, but not in such proportion as in natural cements, being 1½ or 2 to 1 in place of 3 to 1 in the latter. But here again comes out the advantage given to Portland cements by testing them under water; the submerged specimens are stronger than open air ones, while in natural cements the reverse is the case.

Table VI. summarizes the results obtained.

SERIES IV. (*A*)

THE STRENGTH OF MORTAR IN COMPRESSION IN BRICK MASONRY.

All engineers realize that the strength of mortar is much less tested in cubes than in thin layers, but just what proportion they bear to one another is not very well known. The following experiments have been made with a view of obtaining this information. (See table VII.).

At the same time that these tests were made, mortar was also made into test pieces, and tested at the same age. We are thus enabled to form an idea of the relative strengths of mortar in thin joints and in cubes, and also to form an intelligent opinion of the comparative strengths of lime mortar, natural cement mortar, and Portland cement mortar. The mortars of the fourth, fifth, and sixth tests are identical with the mortars of the *shearing* tests, and show the same clear superiority of the natural cement 1½ to 1 over the Portland cement 3 to 1 when used in this manner. Table VIII., summarizes the results obtained.

Roughly speaking, the lime mortar at 1 week 5 to 1 is 6 times as strong; the lime mortar at 1 week 3 to 1 is 14 times as strong; the natural cement mortar at 1 week 1½ to 1 is 4 times as strong; the Portland cement mortar at 1 week 3 to 1 is twice as strong, as the same mortar tested in cubes, at the same age.

Referring to the amount of compression in Table VII., it will be seen that the amount of compression per foot is much less according as this ratio is less; *i. e.*, the less yielding the mortar, the nearer does the strength in cubes approach to the strength in joints. This is to be expected, because the more yielding substances will be at a much greater disadvantage when unsupported at the sides than if enclosed in a thin masonry joint.

In the second, third, fourth, and sixth tests at 17,500 lbs., the load was released, and the permanent set observed was as given in the fifth column of the preceding table.

It seems probable from this, therefore, that the lime mortars must have yielded to an injurious extent before there were any external signs. But whether this was the case or not, it is impossible

TABLE VII.

MORTAR JOINTS IN COMMON BUILDING BRICK PIERS.

Composition of Mortar.	Age of Test.	Thickness of Joints.	Dimensions of Brick Pier.	Per cent. water in mortar.	Loads in lbs. per square inch. 1st signs of failure in mortar.	1st signs of failure in brick.	Bricks failing rapidly.	Maximum load.	Compression per foot under a total load of 5,000	20,000	35,000
No. 1. 1 Lime. 5 Building sand.	1 week.	3/16"	7.80" by 7.85". 16.57" high. 6 bricks. 61.2 sq. in. area.	37 (?)	245	327	980	1,143	.015"	.08"	.13"
No. 2. 1 Lime. 5 Building sand.	3 weeks.	3/16"	8.0" by 8.0". 11.16" high. 4 bricks. 64.0 sq. ins.	37	469	563	1,406	1,553	.007"	.043"	.075"
No. 3. 1 Lime. 5 Building sand.	3 weeks.	3/16"	7.9" by 7.9". 24.50" high. 9 bricks. 62.4 sq. ins.	37	400	689	897	1,282	.005"	.053"	.094"
No. 4. 1 Lime. 3 Laboratory sand.	1 week.	1/4"	7.75" by 7.85". 11.42" high. 4 bricks. 60.84 sq. ins.	34	287	575	....	1,117	.032"	.133"	.158"
No. 5. 1 of No. 2 Natural cement. 1½ Lab'tory sand.	1 week.	1/8"	7.80" by 7.90". 11.15" high. 4 bricks. 62.01 sq. ins.	22½	968	1,190	1,403	1,984	.009"	.027"	.054"
No. 6. 1 of No. 5 Portland cement. 3 Laboratory sand.	1 week.	1/4"	800" by 7.95". 11.30" high. 4 bricks. 63.60 sq. ins. area.	20	755	959	1,305	1,564	.007"	.007"	.019"
No. 7. 1 No. 5 Portland. 1½ Lab'tory sand. Common building bricks.	1 week.	1/4"	8.00" by 8.00". 11.5" high. 4 bricks. 64.0 sq. ins. area.	20	1,125	1,563	....	1,734	.000"	.0045"	.011"
No. 8. 1 No. 11 Portland. 1 Lab'tory sand. Laprairie pressed brick.	12 days.	1/4"	8.3" by 8.3". 11.8" high. 4 bricks. 68.9 sq. ins. area.	....	1,679	1,800	1,930	1,960	.001"	.006"	.011"
No. 9. 1 Lime. 3 Lab'tory sand. Laprairie pressed brick.	4 weeks.	1/4"	8.2" by 8.2". 11.5" high. 4 bricks. 67.2 sq. ins. area.	35	260	853	....	1,263	.048"	.115"	.156"
No. 10. 1 No. 2 Natural. 1½ Lab'tory sand. Laprairie pressed brick.	4 weeks.	1/4"	8.4" by 8.4". 11.0" high. 4 bricks. 70.6 sq. ins. area.	22½	1,345	1,629	1,746	1,983	.000"	.0027"	.005"
No. 11. 1 No. 5 Portland. 3 Lab'tory sand. Laprairie pressed brick.	4 weeks.	1/4"	8.4" by 8.4". 11.1" high. 4 bricks. 70.6 sq. ins. area.	20	1,204	1,600	1,629	1,785	.002"	.011"	.016"

NOTE:—These results were obtained after the publication of the paper, and are the additional pier tests promised in the text.

to say, because the compression was quite uniform up to and in many cases much past the points of evident failure.

TABLE VIII.

	Strength of Mortar per square inch.			Loads released at 17,500 lbs., set observed per lineal foot.	
	In joints.	In cubes.	In tens'n.		
(1)	245	40	17	....	1 week old, mortar, 1 lime, 5 sand.
(2)	469	57	20	.01"	3 weeks old, mortar, 1 lime, 5 sand.
(3)	400	57	20	.03"	3 weeks old, mortar, 1 lime, 5 sand.
(4)	287	21	....	.08"	1 week old, mortar, 1 lime, 3 sand.
(5)	968	250	....	....	1 week old, mortar, 1 Natural Cement, 1½ sand.
(6)	755	341	43	.00	1 week old, mortar, 1 Portland Cement, 3 sand.

It seems fair to suppose that 1 week and 3 weeks are about the minimum and average times which would elapse before the maximum load might be put on a brick wall, and when it is remembered that

these joints were less than ¼ in. thick, the amount of compression in a high brick wall under a load of 80 or 90 lbs. per square inch is seen to be very great, and under a load of 300 to 400 lbs. per square inch, a brick wall 50 ft. high in lime mortar would not only fail, but compress from 2 to 6 ins. in doing so — the compression practically all taking place in the mortar, as in the unyielding Portland cement mortar the compression is seen to be very small.

The second part of this paper will contain tests made on piers built with pressed brick, in which the mortar has had longer time to harden, and interesting results are looked for.

The brick in this case was, as mentioned in Table VII., common building brick. The photograph given illustrates the method of testing and the interesting manner of failure of fifth test, in which the lines of least resistance are clearly defined.

(*To be continued.*)

AN architectural contemporary announces that a fair porportion of iron in a mortar makes no difference in regard to the durability of the latter. Within certain limits that is perfectly true; but the investigator might have added that durability is not everything. Bricks are frequently blamed for being "streaky," and it would be found in most cases that this appearance is due to the iron in the mortar. The sand used commonly contains minute grains of iron in a condition to be readily oxidized, unless closely imprisoned within the mortar. On weathering, these may not impair the durability of the cementing material as a whole, but they induce disfigurement on the surface of the brick.— *Exchange.*

LIME, HYDRAULIC CEMENT, MORTAR, AND CONCRETE. I.

BY CLIFFORD RICHARDSON.

THE FOUNDATION OF CEMENTS. The foundation of all cements, except those of a bituminous nature, which are used for binding together materials in masonry and concrete, is lime, the oxide of the metal calcium, which, although never found in the free state, is, in its various combinations, so widely diffused in nature.

OCCURRENCE. It occurs as carbonate in marble, in limestone, in chalk, in marl, and in shells, as sulphate in gypsum, as silicate in many minerals and rocks, and as phosphate in a few.

FORMS OF IMPORTANCE. Carbonate of lime in its purer forms and, when mixed with clay, in argillaceous or hydraulic limestones and some concretions, is of the greatest importance to the engineer and builder. From those forms in which there is but a small admixture of other substances lime is made. From those which contain clay or from a mixture of the pure carbonate with clay, hydraulic lime and cement are made.

CAUSTIC OR QUICKLIME.

The product of the expulsion of carbonic acid from the purer forms of carbonate of lime at a red heat is caustic or quicklime. It is the more or less pure oxide of the metal calcium, of which it contains about 95 per cent. when of the best quality.

The process of making lime in this way is called lime burning. It is conducted in kilns of various forms in which a suitable temperature can be maintained.

LIME KILNS. The kilns in use in lime burning are of both the intermittent and continuous types, and these again may each be divided into two classes, one in which the fuel is mixed with the limestone, the other where the combustion is carried on in a separate chamber or furnace, apart from the stone.

Whatever the method of burning, the product is much the same, the advantage of one form over another being purely one of economy of fuel and completeness and regularity of burning. In the United States almost all the lime burning is done in kilns of the continuous type, with the fuel, either coal or wood, mixed with the stone. Wood is supposed to produce a better lime, as the ash is smaller in amount and not so silicious. Where fuel oil, or gas is available, one of these sources of heat is the most satisfactory for lime burning.

LIME BURNING. Lime burning consists of raising limestone to that temperature at which it will lose its carbonic acid. It is usually carried on at a bright-red heat or about 1,700 degs. Fahr., although carbonate of lime begins to decompose at a lower temperature. Too high a temperature is undesirable, as this may produce a chemical combination between the lime and the impurities which all limestones contain to a greater or less degree. If these impurities are silicious, silicates of lime are formed which fuse and prevent the lime from slaking properly. The formation of such silicates may also take place with the ash of coal. This is known as clinker and is carefully thrown out in drawing the lime from the kiln. Smaller particles, however, cannot be separated and injure the quality of the lime.

It is necessary that a current of air should pass through the kiln, when lime is burned, to carry off the carbonic acid, as carbonate of lime, when heated in a vessel from which the gas cannot escape, is not decomposed and no lime is formed. A current of steam is even more desirable than air, but this is never used in practise, as it is hardly economical. The limestone is, however, often sprinkled with water which has, to a small degree, the same effect.

SOURCES OF LIME.

Limestone and marble are the usual sources of lime, but it can also be made from chalk, some marls, and oyster shells. Chalk is not found in this country, marl is used only for Portland cement, and oyster-shell lime principally for fertilizers and purifying gas. Stone lime is preferable for building purposes to any of the other forms.

CHANGES IN LIMESTONE IN BURNING.

The changes which a limestone undergoes in burning are loss of weight by the removal of carbonic acid, water, and organic matter if present; change of volume, of density, of color, and of hardness.

Massive limestones, or marbles such as are used in making lime, have a specific gravity and density of from 2.65 to 2.75. Lime in the form of the stone from which it is made, that is, in lumps, is porous owing to the loss of carbonic acid and water. It has, therefore, a density of only 1.5 to 1.85, although the specific gravity of the lime is usually about 2.8 to 3.1, and that of the pure oxide 3.16.

The color of many limestones is due to organic matter which burns away and leaves the caustic lime white. If it does not burn away it is due to mineral impurities which are undesirable.

The hardness of lime is of course inferior to that of the stone from which it is made owing to the porous condition in which it is left, and there is a slight increase in volume due to the expansion of the gas in the stone.

From pure carbonate of lime exactly 56 per cent. of oxide or caustic lime should be obtained, but owing to the loss of water and organic matter, as well as carbonic acid and to waste, this figure is never reached except when there are admixtures of clay or silica. Then the loss of carbonic acid is not as great as from pure carbonate of lime. When the limestone contains much carbonate of magnesia the product of burnt lime may be considerably reduced, as this carbonate contains more carbonic acid than carbonate of lime. Such a limestone is known as dolomite and is of inferior value for making lime.

COMPOSITION OF LIMESTONE.

The ordinary marbles and limestones available for burning are never entirely pure. They contain a greater or less admixture of carbonates of magnesia and iron, of clay, and other silicates, of silica, of alkalies, of organic matter, and of sulphates, phosphates, and pyrites.

The following analyses are typical of the variations found in their composition.

ANALYSES OF LIMESTONE.	Carbonate of Lime.	Carbonate of Magnesia.	Iron and Aluminum.	Silica and Silicates
No. 1 White Marble, Maryland,	97.2	1.0	.6	1.0
No. 2 Blue Limestone, Maryland,	96.0	.5	1.9	1.8
No. 3 Silicious Marble, Maryland,	81.8	.8	.9	17.2
No. 4 Dolomite Tompkins Cove, N. Y.	53.8	41.2	.7	2.6
No. 5 Hydraulic Limestone, Maryland	57.9	3.0	4.9	20.4

EFFECT OF IMPURITIES. We find limestones which are nearly pure, having 97.2 per cent. of carbonate of lime, in the form of white marble, and 96.0 per cent. in a blue limestone. In contrast are stones which contain silica or clay as well as silica, as shown by the presence of iron and aluminum, and those which are mixed with carbonate of magnesia. All the forms have their peculiar properties. The purest should be, of course, selected for lime burning. The impurities in a limestone have an important influence on the character of the caustic lime made from it. A quicklime prepared from a limestone comparatively free from impnrities and consequently nearly pure calcium oxide is called a rich or fat lime. With the increase of admixture of other substances the lime becomes poor, that is to say, it does not slake easily, and when this exceeds 10 per cent. the burnt stone begins to slake with more difficulty or fails to do so at all, and can be no longer regarded as a mere lime, but is hydraulic or magnesian lime depending upon whether the admixture is clay or carbonate of magnesia. Already with from 5 to 8 per cent. of clay in the limestone, the lime has hydraulic properties, and these increase until it is very highly hydraulic with 25 per cent.

When the admixture is magnesian and the rock is composed of carbonate of lime and magnesia, without clay, the resulting lime does not attain hydraulic properties, but merely becomes poor and fails to slake readily. With even 10 per cent. of magnesia, lime becomes poor, and with a larger amount still more unsatisfactory. Lime from dolomite, or magnesian limestone, which is very common in the United States, contains about 21 per cent. of magnesia, and is of inferior value for building purposes. Too much of this lime is used in the country, and it should be avoided as far as possible under all circumstances.

Lime containing a large amount of magnesia, if free from im-

Requirements for American Portland for coast Fortifications, U. S. Government.	Fineness through No. 50 sieve.	Fineness through No. 100 sieve.	Fineness through No. 200 sieve.	Tensile strength 1 in. Briquettes, neat, 24 hours in air.	Tensile strength 1 in. Briquettes, neat, 24 hours in air, and 6 days in water.	Tensile strength 1 in. Briquettes, neat, 24 hours in air, and 27 days in water.	Tensile strength 1 in. Briquettes. 1 cement, 2 sand. 24 hours in air, 6 days in water.	Tensile strength 1 in. Briquettes, 1 cement, 2 sand, 24 hours in air, 27 days in water.	Tensile strength 1 in. Briquettes, 1 cement, 3 sand, 24 hours in air, 6 days in water.	Tensile strength 1 in. Briquettes, 1 cement, 3 sand, 24 hours in air, 27 days in water.	Hot water tests.
At mouth of Cape Fear River, N. C.	99%	90%	70%		500 lbs.	600 lbs.	175 lbs.	250 lbs.			Briquettes 24 hours in air, 24 hours in water 212° F.
At Sandy Hook, N. J.				250 lbs.	450 lbs.				125 lbs.	200 lbs.	
Tybee Island, Ga.	100%	90%							125 lbs.	200 lbs.	Pats 24 hours in air, 3 hours in water 212° F.
Sullivan Island, S. C.		85%		200 lbs.	375 lbs.	500 lbs.			125 lbs.	175 lbs.	
Sheridan's Point, Va.	95%			175 lbs.	375 lbs.						After 24 hours, immersion in water 212° F.
Galveston, Texas.	95%			75 lbs.	300 lbs.	400 lbs.					
Gull Island, N. Y.	95%			75 lbs.		400 lbs.					
Key West, Fla.	96%	90%	70%	125 lbs.	400 lbs.	500 lbs.	150 lbs.	200 lbs.			Briquettes 24 hours in air, and 24 hours in water 212° F.
Dutch Island, R. I.	95%	77%		250 lbs.	400 lbs.	600 lbs.			125 lbs.	200 lbs.	
San Diego, Cal.				200 lbs.	450 lbs.	700 lbs.					
Portland, Me.	95%			150 lbs.	380 lbs.						
Portsmouth, N. H.	95%			175 lbs.	400 lbs.						

purities, may be used, however, for furnace linings as it resists heat well and is very basic, not fusing as readily as pure lime in presence of silica.

COMPOSITION OF CAUSTIC LIME.

The composition of commercial quicklime is varied, depending on the kind of rock from which it is made. The following are analyses of some typical limes, found in our markets : —

ANALYSES OF CAUSTIC LIME.

No.	Source.	Lime.	Magnesia.	Iron oxide and alumina.	Silica and silicates.	Loss on ignition.
1	New York from limestone .	95.6	.6	.8	1.2	1.0
2	Baltimore Co. from marble . .	95.3	.8	.9	2.2	.7
3	Washington, D. C. from dolomite .	73.3	21.4	4.0	.9	1.3
4	Connecticut from limestone .	85.1	5.7		2.8	6.3
5	Connecticut from dolomite .	55.3	36.4	3.2	1.4	3.7
6	West Virginia from limestone .	89.9	2.2	5.8		2.2
7	West Virginia from limestone .	74.2	2.4	1.5	3.9	17.9

It appears that limes which are 95 to 96 per cent. pure are the best that are attainable commercially and that they are frequently less pure. When fresh from the kiln lime would, of course, show no loss on ignition, but on storage it absorbs water with great avidity from the air until, as in that numbered seven, it has reached 17 per cent., when it is nearly half air slaked. Fresh lime, or that which has been carefully protected from the air, is of much greater value for building purposes, although too often this is unattainable.

UNIFORMITY IN CEMENT SPECIFICATIONS.

UNDER a clause in the bill making appropriations for the construction of gun implacements and fortifications, which passed Congress June 6, 1896, the cement used is required to be of domestic manufacture. The specifications of the various officers of the corps of engineers in charge of this work, as far as they relate to Portland cement, have been brought to our attention and are given in abstract in the table on opposite page.

As there has been considerable discussion recently in the journals of the engineering and allied professions in regard to uniformity in specifications for Portland cement, the very considerable variations in the above requirements is noticeable, especially as the work is all of one kind and to be done entirely by one organized body of men, who are supposed to represent the very highest standard in their profession. They are, nevertheless, not agreed as to what the requirements of a first-class American Portland cement should be or at least how its quality should be determined.

One requires a neat test of 75 lbs. in one day in air, another one of 250 lbs. under the same circumstances. The variations in the requirements for a neat test at the age of seven days are relatively less, lying between 300 and 500 lbs., but even these are large. At twenty-eight days the demand is for a very varying increase of strength over that at seven days, from 100 to 250 lbs. Two of the engineers require a test with two parts of sand, four a test with three parts, and six no sand test. As this is, perhaps, the most reliable test of Portland cement, it is remarkable that it should be omitted by half of those in charge of such improvements. Four officers require the boiling test, in three cases substituting it for a sand test.

It seems unfortunate, even if the large body of engineers of this country cannot agree upon specifications for hydraulic cement, that the Corps of Engineers of the United States Army cannot set a better example than appears in their recent specifications. It should be added, however, that the manufacturers of American Portland cement should, with the use of ordinary care, be able to meet the most severe of these requirements, and that some of them are too lenient.

The Masons' Department.

THE ARCHITECT AND CONTRACTOR — IN GENERAL.

BY THOMAS A. FOX.

(*Continued.*)

WHILE it is a comparatively simple matter to lay down the general principles which should govern the relations and dealings between the owner, architect, and contractor, the most valuable rules and suggestions, after all, come only with experience. In the case of extras, for example, the results of laxity of method and delay of settlement are so trying that one severe experience is usually sufficient to prevent a reoccurrence of such difficulties. It is hardly necessary to call attention to the fact that, as the settlement for extra work or work omitted is necessarily made at the close of a building operation, it is greatly to the advantage of the architect and contractor to be in a position to close the transaction without friction or disagreement with the owner, whose most lasting impressions of a given piece of work are generally those associated with the final dealings. When differences arise during the progress of construction, the architect or contractor, if they are right, usually have the opportunity to prove their case from subsequent developments; or if there is an honest disagreement, the architect or contractor, as the case may be, can show that, although his judgment may have been at fault, his intentions were of the best, and under such conditions the offense is usually forgiven or forgotten; but let there be a serious breach at the close of a building operation, and it is almost impossible to convince an owner that he is being fairly treated, and it is quite improbable that he would, under these conditions, give the architect or builder an unqualified indorsement to enable either of them to get future work.

Early in this consideration of the relations between architect and contractor, attention was called to the fact that the ability to carry out a large building project successfully depended more on the individuals than on any hard and fast rules which can be formulated, and that a thorough knowledge of the rights of the contractor as well as those of owner should be understood and recognized by the architect. Much of the trouble between the architect and his client arises from the fact that the latter usually assumes, unless he is told to the contrary, that it is the duty of the architect to always take sides with the owner in any controversy as against the contractor. This idea, which is more common than one would suppose, and is even held by some of the narrow-minded members of the profession itself, doubtless arises from the fact that as the architect is paid by the client, he considers that he has retained a professional adviser, under practically the same conditions as he would retain a lawyer to defend a case in court. This, however, is not the position in which a conscientious member of the profession should allow himself to be placed, and before undertaking a commission from a client who has not had experience, this relationship is a matter which should be fully explained and understood. Probably, if the truth was told, the architect who claims that he holds the autocratic position of counsel for the owner would be forced to admit that such an attitude was necessary for his own protection, for the same reason that a certain architect was fond of asserting that no client employed by him ever had to pay for an extra, the simple fact being that this architect never approved such an item on a bill, although the plans and specifications coming from his office were at least no better than those from many others who made no pretense to such infallibility. This architect, judging from the highest standard of professional practise was no more just than one who went to the other extreme, and accepted commissions from the contractor, which of course in the end are paid by the owner. It has already been stated here that the responsibility for the abuses which lead to the most serious controversies in connection with building operations are about equally divided between the different parties concerned; but naturally the architect, while trying to assume an impartial position in the matter, but at the same time anxious to raise the standard of professional practise, may give a stronger emphasis to the shortcomings of his associates than to others equally responsible. But it must be admitted that the greatest responsibility in the effort to reform the abuses, to which attention has been called in these papers, must, from the nature of things, rest upon the architect, and if he can acquire a reputation for possessing a thorough knowledge of the various requirements of his profession, and at the same time that of dealing honorably and justly with his client on the one hand and the contractor on the other, he will soon find himself in a position where he need employ only those in whom he has strict confidence, and will seldom, if ever, be forced by his client into accepting any one to perform work who will not of his own volition carry out the proposed work according to the terms of the agreement. A prominent lawyer once defined a contract as an agreement between two honest men. The bitter competition which has been found of late years among all professions and trades has naturally tended to lower the standard of business integrity; but in spite of this, and probably to the end of time, no matter what may be the position of the employer, in a vast majority of cases he prefers to hire to perform his work only those whom he is sure will live up to the terms of an agreement; and although success may come more rapidly in some instances to those who are willing to take undue advantage of their fellow men, it will not, in the long run, be as satisfactory, as substantial, or as great, as to those whose word is as good as their bond.

(*To be continued.*)

INQUIRY AND REPLY.

SHOULD lime be used in mortar to prevent freezing?
H. S. M., Kansas City.

No. On the contrary, lime delays setting, and is of no advantage.

Is the subject of a better grade of mortar, or a more liberal use of cement in masonry construction, being given due attention by architects and builders? or is the strength of bonding of secondary importance?
R. H. Meyers, St. Louis.

The arguments which are of force in this case are the same as those for the use of high-grade materials of all descriptions which are to be used in any structural work. The entire structure cannot be stronger than its weakest part, so that poor cement and mortar make any superiority of quality of other materials of no value.

FROM OTHER COLUMNS.

OLD brick are being used instead of sand to make lime mortar, in the rebuilding of the new Union Station in Columbus, O. The refuse brick from the old walls are ground in a crusher. It is said that a quality of mortar for color work superior to that obtained with sand is produced.— *Eng. News.*

COST OF HAND AND MACHINE-MIXED CONCRETE. Machine-mixed concrete can be done at from one fourth to one third of the cost of hand mixing; at the same time the machine mixing is more thorough and economical. With a given amount of aggregate, from 10 to 20 per cent. less cement can be used without impairing the strength of the finished work.

The absolutely uniform results obtained by the best grade of machine mixers lessens the danger of cracks due to uneven setting, as the expansion and contraction of the mass will vary directly as the proportion of the cement varies throughout the mass.

Therefore there is not only a direct saving in the quantity of cement used, but also in the quality of the work as well as in the finish and lasting properties.

A new cement will contract and expand more than an old and stored cement.— *Cement.*

Recent Brick and Terra-Cotta Work in American Cities, and Manufacturers' Department.

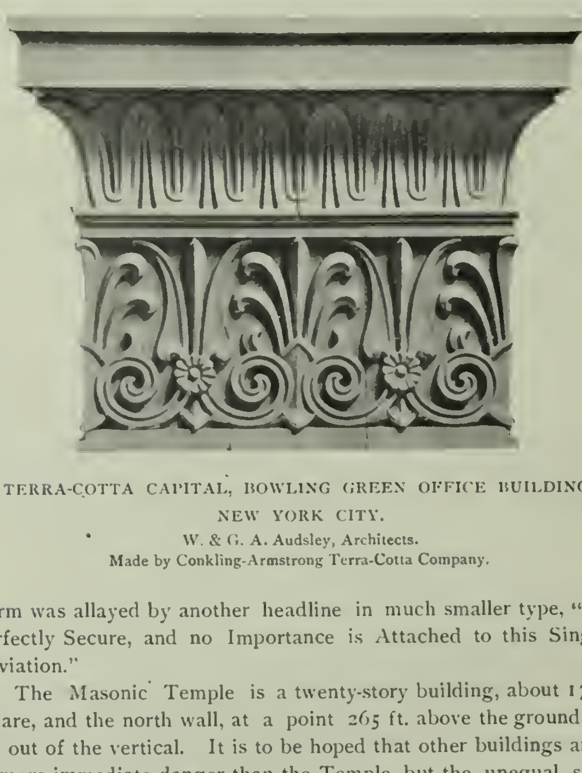
CHICAGO. — No one expects extensive building operations this year, and yet architects and builders look for a fairly good business, notwithstanding the serious disturbances caused by election events, and more recently, the failure of some large banking institutions.

The list of projects announced looks well, although there is little of special importance.

Of the building that is to be done, architects are evidently desirous of having it done on a right basis.

Hopes often expressed in these columns in the past are being realized to the extent, at least, of a preliminary organization of architects, which has been lately effected. An Architects' Business Association has been formed, which aims to protect building interests against dishonest contractors, and the profession itself against unworthy members. It is earnestly to be hoped that an effective effort will be made to obtain legislation, giving the profession a legal status.

A local daily recently created quite a sensation by announcing in bold headlines, "It's a Leaning Tower," "Masonic Temple out of Plumb," etc. Having employed a surveyor to do some investigating,



TERRA-COTTA CAPITAL, BOWLING GREEN OFFICE BUILDING, NEW YORK CITY.
W. & G. A. Audsley, Architects.
Made by Conkling-Armstrong Terra-Cotta Company.

alarm was allayed by another headline in much smaller type, "It is Perfectly Secure, and no Importance is Attached to this Singular Deviation."

The Masonic Temple is a twenty-story building, about 170 ft. square, and the north wall, at a point 265 ft. above the ground, is 9 ins. out of the vertical. It is to be hoped that other buildings are in no more immediate danger than the Temple, but the unequal settlement of this important structure will serve as a text for discussion on "rigid joints," "the danger of cast-iron connections," etc.

In the list of buildings projected, Warren H. Milner, county architect, is planning various additions to the public hospitals, jail, and infirmary.

Perkins & Krause have two factory buildings, one 75 by 100 ft., seven stories, and the other, 50 by 100 ft., five stories high.

Cowles & Ohrenstein have in hand a store building 76 by 86 ft., four stories, and a warehouse.

An apartment building, designed by Mr. Fritz Foltz, is mentioned in which each suite has its bedrooms in the story above its parlor, kitchen, etc.

Some three hundred million common bricks were manufactured in and about Chicago during 1896. This is only one third of the capacity of our kilns, and but two thirds the production of the previous year. This fact in itself is significant as showing the condition of the building business during the year.

ST. LOUIS. — The new year has brought little of special interest in the building line. In fact, there is more or less disappointment among the architects and builders, as it was felt that by this time there would be considerable more work under way.

Capital seems very nervous, and as soon as one excuse has become worn another is found. There have been very few business failures in our city within the last year, and no banks, but the failures throughout the country have been a disturbing element in money circles and have caused the delay of some important building schemes, but as the year advances a steady improvement is noticeable.

There has been no time within the last several years when building could be done so cheaply as now. This presents an opportunity which is being taken advantage of by many, in building good residences in the more aristocratic neighborhoods, such as Westmoreland, Portland, and Bell Places, while the business depression has tended to diminish the number of cheap flats and building of houses for speculation.

Among the handsome residences just being completed is the Dozier residence in Westmoreland Place, by Architect F. L. Wees. The building is three story and basement, of brick and terra-cotta, in the French Renaissance, and will cost $75,000.

Architect W. A. Swasey is building another near by of white brick and terra-cotta, while further up the street he has just finished a large stone residence for Mr. B. Nugent, at a cost of $65,000.

In Bell Place, Architects Barnett, Haynes & Barnett have just finished two residences costing about $40,000 each, one in stone and the other in buff brick with white terra-cotta trimmings; while F. C. Bonsack is taking figures on a stone residence for Mr. G. W. Brown, to be built in Portland Place.

Architect Taylor has just completed a five-story building on Broadway, on the site of the old Aloe Building, which was the scene of a fatal fire about a year ago, in which several firemen perished. The front is of red terra-cotta with large plate windows on each story, making an ideal business building and a decided improvement over the old rookery that was destroyed.

The building of the St. Louis Dairy Company, occupying nearly half a block between 20th and 21st Streets, by Architect Swasey, is a very interesting piece of red brick and half-timbered work. The basement is occupied by the stables, wagons, etc., while the upper floors are used for the offices and laboratory.

There are a number of old landmarks in which the advancement of modern progress has made it necessary to make alterations. Among these the old Davis Building, for nearly a quarter of a century the home of the large wholesale house of Samuel C. Davis, is being transformed into a department store, by Shepley, Rutan & Coolidge, at a cost of $50,000.

A movement is on foot to provide some permanent place for large gatherings, conventions, etc., and Architect Ramsey has prepared plans for a large amphitheater to occupy the north end of the Exposition Building, with a seating capacity of about 8,000, and in case of conventions, by using the arena, as many as 14,000.

AN ENTRANCE IN TERRA-COTTA, UNION TRUST BUILDING, ST. LOUIS, MO.
Louis H. Sullivan, Architect.
The face and common bricks used in this building were furnished by the Hydraulic Press Brick Company, of St. Louis.

PITTSBURG.—The outlook in the architectural and building line for the coming season is very good. There is a movement well under way to erect a new Chamber of Commerce building at a cost of about $1,000,000. The Ninth U. P. Presbyterian Society of Allegheny are to erect a new church, to be of brick and stone, and cost about $20,000. Architect J. E. Allison is preparing plans for a new church of brick for the Methodist society of Vandergrift. Architect J. M. Alston has the new Insane Asylum for Allegheny City, which will be of brick. Architect Charles Bickel has the new German Turn Verein Building on South Side. Architect T. E. Cornelius is planning a small hotel for Coraopolis. Architect W. S. Sims has a fireproof laundry building on Fifth Avenue, Oakland; also a residence in the East End, each of which will cost about $20,000.

Mr. A. C. Boyd, of Boyd & Long, architects, died last month. Architects Shaw & Metcalf have dissolved partnership, Mr. Shaw continuing the business, and Mr. Metcalf returning to England.

Architects George Orth & Brother were successful in the completion for the new building for the Western Bank of Pennsylvania.

YERKES OBSERVATORY, GENEVA, ILL.
Henry Ives Cobb, Architect.
The buff brick used in this work was furnished by the Columbus Brick and Terra-Cotta Company, Columbus, Ohio. The architectural terra-cotta by the American Terra-Cotta & Ceramic Company, Chicago.

PORTION OF YERKES OBSERVATORY, SHOWING DETAIL.

MINNEAPOLIS.—A number of interesting things have developed, and we feel confident for next season, but matters are quiet now.

Among other interesting reports is that of a new Chamber of Commerce, to cost $300,000, which is to be voted upon by the Chamber. They have secured an option on the corner adjoining the present building. This is an important and much-needed improvement, a number of the larger corporations being unable to find quarters in the present inferior building.

A very interesting and unusual experiment has been made by the New England Furniture and Carpet Company during the past year, which culminated New Year's night. They wished to observe the tenth anniversary of their beginnings in Minneapolis in a fitting manner, and conceived the idea of building a neat, roomy modern house in one of our best suburbs, and giving it away, free of cost, to the lucky holder of the ticket selected in an open and fair manner from those issued during the year to their patrons, every $25 purchase entitling holder to a ticket. The house was designed by one of our leading architects, and is a gem in every way. As usual, the winner was one of the smaller purchasers, holding but the one ticket, which was quite sufficient, of course. The lucky person was a lady who had purchased $27 worth of goods; a decidedly good investment, all things considered. The head of this company is a former Bostonian, Mr. W. L. Harris.

There has been considerable trouble and expense connected with the new electric plant and elevators at the Court House. An expert has carefully examined it and made an exhaustive report of his findings, but the elevator company does not take kindly to it naturally, and there is to be a joint investigation. Meanwhile, the service is unsatisfactory and the stairways are found safe and useful.

W. B. Dunnell has prepared plans for the new State Insane Hospital, to be built at Aroka, at total cost of some $900,000, one third of which will be required for a beginning.

The local G. A. R. posts have prepared a petition to our Park Commission requesting permission to erect a $35,000 building in Loring Park, to serve as headquarters and a museum for relics, etc.

The Regents of State University have asked the legislature for $100,000 to erect needed buildings during the coming two years: A chemical building this year, and for 1898 a fire-proof botanical building, a horticultural building, veterinary building and light and heating plant at State Farm.

NEW YEAR'S CALENDARS AND CATALOGUES.

To one who contemplates entering the clay-manufacturing business the new catalogue issued by the American Clay-Working Machinery Company, Bucyrus, O., will be found of invaluable assistance. There is a wealth of facts to be found from cover to cover, which seem to furnish all information upon the subject which could be desired. About every machine required in the manipulation of clay is illustrated and described; not only this, but the finished product itself as well as its application is shown in a most interesting series of illustrations. Such a work as this can be considered nothing less than an up-to-date journal of the industry it represents. Copies of this catalogue will be sent free on application to the company.

TERRA-COTTA DETAIL EMPLOYED IN GOODRICH HOUSE, TOLEDO, OHIO.
Coburn, Barnum, Benes & Hubbel, Architects.
Made by the Northwestern Terra-Cotta Company.

TERRA-COTTA CAPITAL, BOWLING GREEN BUILDING, NEW YORK CITY.
Made by the Conkling-Armstrong Terra-Cotta Company. An illustration of this building will be found in the company's advertisement, page v.

SAMUEL H. FRENCH & CO., Philadelphia, paint manufacturers and dealers in builders' supplies, have issued a most useful pad calendar, each leaf having a space for memoranda for every day in the week. A calendar of this sort once used becomes almost indispensable in office equipment.

MR. F. B. GILBRETH of 85 Water Street, Boston, has again issued his attractive calendar showing the time of tides. This, we presume, will not particularly interest our inland subscribers unless they are troubled with wet cellars.

THE "American Seal Paint" Calendar, issued by Wm. Connors, Troy, N. Y., in addition to the regular calendar features tells how "Uncle Sam" got his name, and shows his *modus operandi* of adding stars to the field of blue. The color scheme introduced is very attractive.

MR. F. W. SILKMAN, dealer in minerals, clays, colors, and chemicals, 231 Pearl Street, New York, has sent us a very handsome calendar, the top part of which has an engraving encircled by an embossed border, which adds much to the attractiveness of the whole. Each calendar has a different subject for illustration, which is taken from some well-known painting.

A NEAT little iron frame which has been treated by the Bower-Barff Oxidized or Rustless Iron Process holds the calendar issued by the L. Schreiber & Sons' Company, Cincinnati, to whom we are grateful for having remembered us.

R. GUASTAVINO has sent us a calendar which is interesting particularly because of the half-tone illustrations it contains, which show in a manner that almost explains his system, several of the prominent buildings wherein his fire-proofing tiles are employed.

NUMBER four of the series of "Minor Italian Palaces," which is being issued by the Cutler Manufacturing Company, Rochester, N. Y., contains seven plates from sketches made by Mr. Claude F. Bragdon, which, though grouped under the head of "Minor Italian Palaces," are nevertheless very interesting.

THE progress in material prosperity which this country has experienced during the past decade, no less than the increased possibilities of artistic manufacture, are well exemplified by the recently published Sketch Book of the Philadelphia and Boston Face Brick Company. This brochure contains over a hundred designs for fireplace mantels illustrated in greater part by photographic reproductions of actual work. The Sketch Book contains only fireplace designs. They are well chosen, clearly and artistically presented, and offer a choice both in form and color suitable for a great variety of purposes. We may not habitually ascribe daintiness to such a material as pressed brick, but the brick forms are combined so cleverly that, especially in some of the smaller mantels, very dainty effects are produced; and though we might more naturally associate a brick mantel with a hall, a dining room, or a den, there are a number of photographs of charming mantels for parlors or boudoirs which leave little to be desired.

EXECUTED IN TERRA-COTTA FOR TREMONT TEMPLE, BOSTON.
Made by the Perth Amboy Terra-Cotta Company.

ALL THIS IS NEWS.

THE KITTANNING BRICK AND FIRE CLAY COMPANY, Pittsburg, Pa., whose yearly output of front brick in all shades will exceed seven million, have contracted with Meeker, Carter, Booraem & Co., 14 East 23d St., N. Y., to handle their Eastern business.

WALDO BROTHERS, the well-known building material dealers of Boston, have leased on a long term the Tudor Wharf property at Charlestown. This splendid piece of water-front property will be fully equipped for the better handling of the concern's extensive business.

THE PENNSYLVANIA ENAMELED BRICK COMPANY has recently supplied forty thousand enameled bricks for the Third Avenue Bridge, at Harlem, N. Y., Isaac A. Hopper, builder; also twelve thousand of same for the Police Station and City Court Building at Yonkers, N. Y., Edward A. Forsyth, architect.

THE PERTH AMBOY TERRA-COTTA COMPANY have just closed, through their agents, Waldo Brothers, the contract for the Proctor Building, Bedford Street, Boston, Winslow & Wetherell, architects. This is the most elaborate use of terra-cotta of any building scheme in Boston, the entire front being of terra-cotta from the sidewalk up.

G. R. TWITCHELL & Co., Boston, are supplying 100,000 red face brick for the new West End Schoolhouse, Boston, John Lyman Faxon, architect; Mead, Mason & Co., builders. Also 50,000 red face brick for the new schoolhouse, Dorchester district, Boston, E. W. Clarke, architect; W. S. Sampson & Son, Builders.

THE architectural terra-cotta for the new building for Mt. Holyoke College at South Hadley, Mass., will be supplied by the Perth Amboy Terra-Cotta Company through their New England agents, Waldo Brothers. The plans are by Gardner, Pyne & Gardner, H. P. Cummings & Co., contractors.

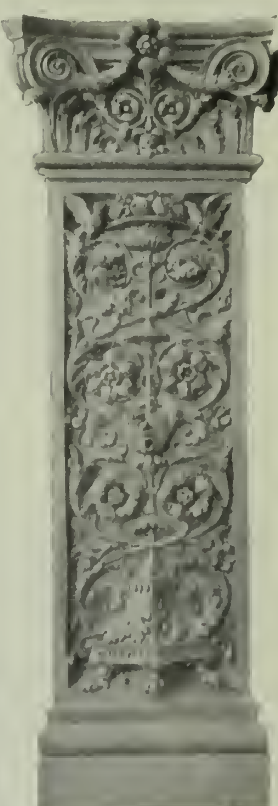
IN the reorganization of the Pennsylvania Enameled Brick Company, Seymour Van Santvoord becomes president; Henry Burden, 2d, vice-president: Wm. F. Burden, secretary and treasurer; Arthur E. Barnes, general manager; and F. P. Huston, New York representative. In addition to the manufacture of enameled brick, the company is now making a fine grade of white front brick.

THE PERTH-AMBOY TERRA-COTTA COMPANY will furnish the architectural terra-cotta on the following contracts: St. James Office Building, Broadway and 26th Street, New York City, Bruce Price, architect, the details of which will be very elaborate; Bell Telephone Building, 11th and Filbert Streets, Philadelphia, Chas. McCaul, architect; Western Electric Building, southeast corner Bethune and West Streets, New York City, Cyrus L. W. Eidlitz, architect.

THE TIFFANY ENAMELED BRICK COMPANY will supply the enameled brick for the "Fair" Building, northwest corner State and Adams Streets, Chicago, Jenney & Mundie, architects; George A. Fuller Company, contractors; Sherry Hotel, southwest corner Fifth Avenue and 44th Street, New York City, McKim, Mead & White, architects; Richard Deeves & Son, contractors. This order calls for about 270,000 White English size enameled brick.

THE COMMERCIAL WOOD AND CEMENT COMPANY, through their New York office, 156 Fifth Avenue, have closed contract with J. L. Ginn, Philadelphia, for 21,000 barrels of Commercial Rosendale cement for gun emplacement at the United States Fort Caswell, at the mouth of the Cape Fear River, N. C.

They have also closed contract with the Hartford Paving Company, Hartford, Conn., for 10,000 barrels of Commercial Rosendale for the United States gun emplacement at Portsmouth, N. H.



EXECUTED IN TERRA-COTTA FOR TREMONT TEMPLE, BOSTON.
Made by the Perth Amboy Terra-Cotta Company.

THE WHITE BRICK & TERRA-COTTA COMPANY, of 92-94 Liberty Street, New York, have just completed the terra-cotta for a candy factory, 84 to 90 Vandam Street, De Lemos & Cordes, architects; the Store Building, 78 Fifth Avenue, A. Wagner, architect; and Flushing Bank Building, at Flushing, L. I., S. E. Gage and W. J. Wallace, architects; and have closed contracts for residence at Bergen Point, N. J., A. F. Leicht, architect: chapel at Geneseo, New York, Heins & LaFarge, architects: and terrace for Tiffany residence at Westbury, L. I., W. J. Wallace, architect.

MR. J. FRANCIS BOORAEM, well known through his connection with the American Enameled Brick Company, has been admitted to the firm of Meeker & Carter, the new firm name becoming Meeker, Carter, Booraem & Co. The firm of Meeker & Carter is well known as being one of the largest operators in building materials in New York City, among the many manufacturers for which they are agents being the Staten Island Terra-Cotta Lumber Company, Woodbridge, N. J.; the Standard Fire-proofing Company, Perth Amboy, N. J.; Selden Brick Company, Erie, Pa.; Kittanning Brick & Fire Clay Company, Pittsburg, Pa.; Pennsylvania Brick Company, Oaks, Pa.; Williamsport, Brick Company, Williamsport, Pa.; Alumina Shale Brick Company, Bradford, Pa.; Garthe Roofing Tiles, Baltimore, Md.; American Enameled Brick & Tile Company, South River, N. J.; Farnley Glazed Bricks, Farnley, Leeds, England.

WE are very glad to print the following letter, which will explain itself. Such testimony from a well-known architect will do much toward placing the American manufacture of enameled brick in a right light before our architects and builders.

ILLINOIS CENTRAL RAILROAD COMPANY.

Office of the Chief Engineer.
Chicago, Dec. 14, 1896.

Tiffany Enameled Brick Company, Chicago, Ill.: —

Gentlemen: Having thrown open to the public the underground suburban station at Van Buren Street, which is said in all respects to be a phenomenal success, I feel I must extend my thanks to some of the material men and contractors that so ably assisted me in its construction.

Your enameled brick (English size), which I used in this work, I have found are all you could possibly recommend them to be; and you deserve much credit from all, especially the architectural profession.

Not only are your brick very evenly enameled, and scarcely any difference in shade, but they are exceedingly hard, and I found could be perfectly ground for high-grade arch work, where I had to use some of them.

Taking pleasure in knowing that this lay-out at Van Buren Street Station, of your material, will be a great card for your firm, I remain,

Yours respectfully,
Francis T. Bacon,
Supervising Architect, Illinois Central Railroad Company.

DURABILITY AND SAFETY.

SECTION OF MASON SAFETY TREAD.

Few building improvements in recent years have more quickly won deserved recognition from architects and builders than the Mason Safety Tread, which was introduced in Boston only about a year ago, and is now almost as well known as the Old South Church or the sacred codfish. The Mason Tread is a unique device, extremely simple and exceedingly effective. It is easily applied and adapted to a great variety of places, especially in our Northern climate, where stairs, entrances, and sidewalk lights are made slippery during so large a portion of the year by rain or snow.

The Mason Tread consists of a base of chilled steel with elevated ridges forming dove-tail grooves into which strips of lead are firmly pressed, the softer metal giving a sure foothold and the steel ensuring great durability.

The tread material is used in hundreds of places on our streets in the repair of worn Hyatt light borders, and the company is prepared to manufacture for new buildings sidewalk lights protected with their material. For internal use, Shepard, Norwell & Co. were among the first of our great retail merchants to appreciate the worth of the Mason Tread, and their grand staircase shows it to great advantage. Houghton & Dutton will have the stairways of their mammoth new building fully equipped with the treads, and in many other stores. In the Adams House and other principal hotels they are used upon stairways, entrances, and thresholds. They are used upon stairways in the City Hall, Quincy and Faneuil Hall Markets, Boston, upon the stone steps of all the police stations, and the company is at work upon a contract to place them upon the stairs in subway stations, where they will receive the severest test of all.

At the company's office, 40 Water Street, Boston, a sample stairway may be seen, showing the application of the treads to wood, iron, and marble. Mr. W. S. Lamson, of cash-carrier fame, is president of the American Mason Safety Tread Company, and Mr. Henry C. King, of Lawrence, treasurer. The factory is at Lawrence.

WANTED.

A first-class salesman in front brick and terra-cotta to sell goods in Massachusetts, Rhode Island, and Connecticut. Must have an acquaintance with the trade and a knowledge of figuring terra-cotta. Address C. S. S., Care of The Brickbuilder.

INDEX TO ADVERTISEMENTS.

VOLVME VI FEB. 1897 No. 2

THE BRICKBVILDER

OFFICE 85 WATER STREET BOSTON

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

PUBLISHED BY

ROGERS & MANSON,

CUSHING BUILDING, 85 WATER STREET, BOSTON.

P. O. BOX 3282.

Subscription price, mailed flat to subscribers in the United States and Canada	$2.50 per year
Single numbers	25 cents
To countries in the Postal Union	$3 50 per year

Entered at the Boston, Mass., Post Office as Second Class Mail Matter, March 12, 1892.

THE BRICKBUILDER is for sale by all Newsdealers in the United States and Canada. Trade Supplied by the American News Co. and its branches

PUBLISHERS' STATEMENT.

No person, firm, or corporation, interested directly or indirectly in the production or sale of building materials of any sort, has any connection, editorial or proprietary, with this publication.

THE BRICKBUILDER is published the 20th of each month.

IN our editorial column last month we took occasion to urge again the necessity of making common brick as well as pressed brick of the standard size, in order to do away with the unnecessary difficulties which the present unevenness of shape and improper proportions of most of the common brick put in the way of a general use of good bond in brickwork, and we pointed out that the reform we advocated would be certain to lead to a largely increased use of brick. There is a large field from which brickwork is now practically excluded, and in which it ought to be commonly employed, namely, our suburban architecture, and the practises we have been condemning are certainly among the causes which contribute to prevent the conquest of this important field by brick.

At the last monthly meeting of the Boston Society of Architects, Mr. Clipston Sturgis read a most interesting and suggestive paper in which he compared our suburban architecture, which is almost exclusively of wood, with recent suburban architecture in England, in which brick is generally employed. In the course of his paper he referred to the imperfect bonding of our brickwork, which must be improved if the use of brick is to become general, especially if 8 in. walls or hollow walls are used, which would be insecure unless thoroughly bonded. He emphasized especially the grave menace to the safety of all our great cities which exists in the easily inflammable wooden suburbs, by which they are on all sides surrounded. In these often large districts, more or less closely crowded with wooden buildings of the most inflammable character, a conflagration might start which the more solid masonry buildings in the heart of the city would be totally unable to resist. It is true that buildings in which the exterior walls only are of brick, and which have wooden floors and interior partitions, may easily be totally destroyed by fire, but it is a comparatively easy matter to prevent a fire in such a building from spreading to others in the neighborhood. It is true also that a conflagration of even limited extent will sweep away such buildings in its path almost as easily as if they were entirely of wood; but if *all* the buildings in a neighborhood had external walls of brick or other non-combustible material, no such conflagration would be likely to get under way. This is one reason why conflagrations are of so much less frequent occurrence in Europe than they are with us. It was shown that the expense of brick buildings need not be very much greater than those of wood. Moreover, if the use of brick was thus largely increased, brick would become still cheaper. The greatly increased demand would make it possible to sell bricks at a profit at prices much less than those which now prevail. Interior furring against brick walls can be done away with by using hollow-brick fire-proof furring blocks, which are now made of such a size that they can be bonded in with the brick. A very good wall is one built 8 ins. thick of brick, with a 1 in. air space and a 4 in. interior wall of fire-proof hollow bricks, bonded into the exterior wall. Such a wall has practically all the strength of a 12 in. wall, and is as dry as if furred on the inside with wood, especially if the air space is ventilated at the bottom into the celler, and at the top into the roof space, as can easily be done. Unfortunately, at present the building laws of Boston and some other cities make the use of hollow walls unnecessarily expensive by refusing to count the inner lining as part of the effective thickness of the wall, when yet, if properly bonded, such a lining adds materially to the strength of the wall. The additional cost of the brick is fully offset by the greater permanence of the structure, by the saving in painting and repairs, and by saving in the insurance. It is a great mistake to suppose, as is sometimes done, that it is to the advantage of underwriters to have buildings that will burn up. All the efforts of insurance people have tended the other way. In a district in which structures having exterior walls and roofs of non-combustible material are the rule, and not the exception, underwriters can and will give more favorable rates on such buildings than where they are surrounded by highly inflammable structures. External ornaments of wood must, of course, be avoided if the advantage of the brick wall in point of safety against fire is to be preserved. Such wooden ornaments are nearly always ugly and are always unnecessary, especially now that manufacturers of molded bricks place such a variety of designs at the disposal of the builder.

But beyond the important questions of durability and safety lies the question of beauty. The best design in wood cannot equal the effectiveness of a good brick design. The wood always has an unsatisfying appearance of flimsiness and want of permanence. But our average wooden suburban house is uglier than it need be, and most of our suburbs are hopelessly depressing in their commonplace and often complacent vulgarity. There is certainly no substantial foundation for the feeling that there is anything unsuitable in the use of brick in the country, the feeling which regards it as something belonging to the city. That feeling, when it exists, arises solely from our having been so long accustomed, in our new country, to houses of wood, which have naturally persisted longer in the country than in the cities. There is a satisfaction in the look of permanence of a good country house of brick, and the warm, soft colors of a well-built brick wall nowhere are so beautiful as in a house embowered in trees. We do not need to go to Europe to discover this. The country districts of Maryland, and Virginia, and portions of Pennsylvania still have fine old county seats of brick whose grouped chimneys and substantial-looking walls are most pleasant objects in the landscape.

The time, we believe, is not far distant when more substantial methods of building in our suburbs will be insisted upon, and brickmakers may find this important field preoccupied by other methods if they do not bestir themselves. We believe these are matters to which architects have not given as much attention as they should, and they might exert a great and salutary influence for the improvement of our suburban architecture.

PERSONAL AND CLUB NEWS.

BENES & KUTSCHE, architects, Chicago, have removed from 63d Street to more spacious offices on the sixteenth floor of the Manhattan Building.

HARVEY L. PAGE AND STANFORD HALL, architects, have formed a copartnership under the firm name of Harvey L. Page & Co., with offices at Chicago and Washington, D. C.

MR. GODDARD has retired from the firm of Mills & Goddard, architects, Columbus, O., and connected himself with Peters, Burns & Pretzinger, of Dayton, O., as superintendent. Mr. Wilbur T. Mills will continue the business of the old firm.

THE new iron steamship being built by F. W. Wheeler & Co., Detroit, Mich., for the Bessemer Steamship Company, of New York, has been named by the owners the *W. L. B. Jenney*, as a mark of appreciation of the well-known Chicago architect's connection with the invention and introduction of lofty steel-skeleton construction of buildings.

THE exhibition of the Chicago Architectural Club has been postponed from March 2 to March 23. On the evening of February 15, Mr. George R. Dean, architect, read a paper on "The Evolutionary Position of American Architecture."

There were thirty-seven competitors this year for the Robert Clark Medal, the subject being "A Public Bath."

In awarding the silver medal the judges, Messrs. Louis J. Millet, Charles A. Coolidge, and J. K. Cady, were confronted with two designs of such nearly equal merit that they chose to make a new precedent and award two medals, one of which was their own contribution. The prizes were awarded as follows: Gold Medal, David G. Meyers, Boston, Mass.; Silver Medals, John F. Jackson, Buffalo, N. Y., and Oscar M. Hokanson, Philadelphia, Penn.; Bronze Medal, Arthur Shrigley, Lansdowne, Penn.; Honorable Mention, John F. Sheblessy and Thomas Livingston, Chicago, Ill.

THE regular monthly meeting of the St. Louis Architectural Club was held on the evening of February 6. President Ittner announced the committees and outlined the work for the year. Mr. Farish gave an interesting talk on "Cabinet Finish." A talk on "Hobos of the St. Louis Architectural Club in Rome," with lantern slides, was given by Mr. Fred Cox.

AT the regular monthly meeting of the Washington Chapter of the American Institute of Architects, held Jan. 8, 1897, the following officers were elected to serve during 1897: —

President, Joseph C. Hornblower; Vice-President, James G. Hill; Secretary, Edward W. Donn, Jr.; Treasurer, William J. Marsh; Committee of Admissions, Glenn Brown, W. M. Poindexter, J. R. Marshall. Mr. Eames, of Eames & Young, of St. Louis, was the guest of the evening. At the meeting held Friday, February 5, Mr. William Martin Aiken described the exhibition of the drawings of the American School of Rome, held in Philadelphia.

THE regular meeting of the New Jersey Society of Architects was held February 4, at the Board of Trade Rooms, Newark, N. J.

In an informal discussion regarding professional etiquette several instances of unprofessional practise were cited, and the practise of making promises to prospective clients which could not possibly be fulfilled were condemned. Several instances were cited in which the uniform contract between architects and owners, which was adopted some time ago by the society, were productive of much good in preventing misunderstanding with clients.

BOOK REVIEW.

"HOW to Build a Home"[1] is the title of a small book by F. C. Moore, who, from his experience and long observation as president of a large fire insurance company, is so abundantly able to give good advice on such a subject that his suggestions are well worth study. The book is sensibly written, with an appreciation of practical requirements and a refreshing absence of mere theory, containing the sort of advice one would expect from a friend who had built a house and knew what not to do and how to avoid it. Most people who build a house for the first time, if they employ an architect at all, are quite likely to be a bit afraid of him and his alleged extravagances, and not knowing really what they want, are loth to admit the vagueness of their expectations. It is to such that Mr. Moore's book will prove a boon, as it will enable them to understand the architect's plans, and avoid at least some of the faults which are sometimes overlooked by the most competent experts.

[1] "How to Build a Home. Being suggestions as to safety from fire, safety to health, comfort, convenience, durability, and economy." By Francis C. Moore, President of the Continental Fire Insurance Company, New York. Cloth, $1.00; paper, 50 cents.

ILLUSTRATED ADVERTISEMENTS.

THE accompanying illustration shows the entrance to the Hamilton Club Building, Paterson, N. J., in which terra-cotta has been used with encouraging success from the level of the first story sill course. Mr. Charles Edwards is the architect, and the work was furnished by the New York Architectural Terra-Cotta Company.

In the advertisement of R. Guastavino, page xiv, is shown a

Guastavino System ceiling in one of the wards of the New Buffalo General Hospital, George Cary, architect.

In the advertisement of Charles T. Harris, Lessee, page xxvi, two views of the station for the Toledo & Ohio Central Railway Company, at Columbus, Ohio, are shown, Yost & Packard, architects.

F. B. Gilbreth, in his advertisement for this month, page xxxiv, illustrates the doorway of Casa de las Conchas, Salamanca.

Italian Towers, IV.

BY C. HOWARD WALKER.

STA. MARIA DELLA CROCE, CREMA.

THE previous articles have shown examples of the most characteristic towers of Italy, from the earliest fortification tower type to the elaborated colonnaded type, represented by towers such as those of Chiaravalle and S. Gottardo, at Milan. There remains, scattered over Italy, two other varieties, each much more easily classified under an architectural style than those already mentioned, and yet both much more lacking in what can be truly called style. They are the Gothic and the Renaissance towers. Omitting Giotto's tower, at Florence, which is individual and like no other tower in existence, the Gothic towers of Italy, that is, the towers that attempt Gothic elaboration, are not especially attractive. The style never thrived on Italian soil. There was too conspicuous an environment of classic precedent, and climatic conditions did not tend to produce or to find acceptable the high peaked roofs and large openings of what is essentially an architecture of the Northland, suited to rains, and snows, and gray skies. With the close commercial ties that Italy had with Germany, and also from the fact that German mercenaries and free-lances constantly formed an important factor in the martial forces of Italian cities, it was most natural that the art of both Germany and France should have some reflex influence upon Italian architecture; but although there are distinctly Gothic churches in Italy, such as the Cathedral of Orvieto, and of Siena, the style had undergone a very manifest change, and instead of being sturdy, vigorous, expressing constructive conditions, and rich with masses of light and shades, its forms had become flattened, its constructive expression disappeared, and the Gothic style of Italy was a delicate veneer of lace-like forms, veiling the broad, simple walls of a Roman construction. It is manifest, then, that only the phantom of a Gothic art appears in Italy, always excepting the Gothic art of Venice, which is in truth an Oriental art, and that it is in the details that the Gothic style is plainly manifested. This detail is delicate and interesting. In most cases the masses of the buildings and towers are comparatively uninteresting.

The spire of the North becomes merely a steep, pointed roof in the South, and the four corner pinnacles are set on in such a fashion that it seems possible to remove them without affecting the integrity of the building, as they have little relation either in scale or in construction with the masses below. Of the Renaissance towers, little better can be said. In Venice Palladio and Sansovino erected plain, square, brick campanile, and terminated them with classic bell decks, surmounted by steep pyramidal or conical roofs. The design is simple and severe; the contrast of white marble between the red brick tower and the dark roof is excellent, and these towers are distinctive, distinguished, and the best of their class, in fact they are classic monuments elevated upon medieval shafts.

STA MARIA IN STRADA, MONZA.

But when the pilaster treatment of the Renaissance style begins to make its appearance upon the successive stories of bell towers, the confusion of horizontal and perpendicular lines produces a very unsatisfactory result, and as the style begins to decay, inasmuch as novelty is sought for at the expense of good taste and proportions, the Renaissance towers become scarcely worthy of notice, occasionally amusing and interesting, and capable of being commended by that last of compliments, *i. e.*, that they would make good etchings, but scarcely be considered good architecture.

S. GIORGIO MAGGIORE, VENICE.

For it is very nearly axiomatic that any pronounced architectural form is at its best when treated with lines in the direction of its mass, and this is exactly what the Renaissance style with its superposed orders did not do when applied to towers. As a natural result, the worst of these towers are those which are elaborated the most, and the best are those like San Giorgio, in Venice, where architectural forms are confined to the termination of the towers, and to the natural efflorescence of the shaft. These papers have by no means exhausted the list of Italian towers. They are merely intended to draw attention to typical forms, and it will be seen that the simpler their forms, the more nearly constructional, the more effective the towers become.

They are an absolutely distinct class by themselves, in no way partaking of the rich development of buttress, gable, pinnacle, and spire characteristic of Northern work, and should not be compared with that work; but in their own way — rising in simple, clear-cut grace above the long horizontal roofs of Italian cities — they possess

CATHEDRAL, SIENA.

a charm of sincerity and of quiet dignity that we should be loth to lose.

CREMA. S. Maria della Croce, built between 1490 and 1515, by Giovanni Battista Battaglia, of Lodi, shows a mixture of Gothic tradition and influence of Bramante in the church of S. Maria della Grazie, in Milan. The tower suffers from two distinctly superposed orders, the lower cornice being as important as the upper, but the octagonal termination is well proportioned.

LORETO. The church was built early in the fourteenth century,

CHURCH OF SANTA CASA, LORETO.

and has been again and again enlarged. The dome is by Sangallo and Bramante; the façade and probably the tower by Calcagni, 1587; the upper part, with its bulbous termination, is by Vanvitelli. The tower is somewhat octagonal in plan, the upper portion badly proportioned to the lower. It has unnecessary pediments as ornamental features, and a most peculiarly uncouth spire, excellent in its color proportion, but awkward in form.

MONZA. S. Maria in Strada. Gothic church, dating from middle of the fourteenth century, with a very delicate Gothic dwarf tower, with very miniature corner pinnacles, delicate terra-cotta and brickwork, and beautiful window on the bell deck.

SIENA. Cathedral. The campanile, a simple, delicate, square tower of seven stages, was rebuilt in the fourteenth century by Agostino and Angelo da Siena. It is striated in white and black marble, and is a variation of the brick Lombard type with Gothic pinnacles. The spire is octagonal, of stone. It is a very beautiful tower.

STA. MARIA DELLA SALUTE, VENICE.

TURIN. La Superga, built in 1717–1730, by Juvara. Upon each wing is a rococo tower with bulbous spire, but in this case the pinnacles are so arranged that they serve to carry the line of form from the lower mass up into the spire successfully. This tower is

LA SUPERGA, TURIN.

excellently proportioned above the roof, but seems to need greater and higher substructure. It is, however, one of the best rococo towers in existence.

VENICE. S. Giorgio Maggiore, by Palladio, in 1565, with a very graceful, beautiful square brick tower with stone belfry, circular stone lantern above, and conical spire.

S. Maria della Salute, by Longhena, 1632, has two delicate campanile, of which the arched pediments and domed terminations harmonize with the great dome of the church, but are not successful in themselves.

BRICK VAULTS BUILT WITHOUT CENTERS.

Translated from the "*Anales de la Construccion y de la Industria.*"

BY A. C. MUNOZ.

IN the province of Extremadura, Spain, timber is so scarce that in construction it becomes necessary to dispense with its use whenever possible, even in temporary supports such as centers for arches or vaults; as a result of this, almost all the brick vaults in that province have been built without the assistance of a center.

Several methods are in use, which differ but slightly from each other, and according to the kind of vault to be built. It may be said that all the different methods are based either upon the use of quick-setting mortar, or on taking advantage of the friction between the bricks and the mortar, to temporarily hold them in place until the mortar sets or until the vault is closed.

The vaults which depend on the quick setting of the mortar may be divided in two groups; in those of the first group the bricks are placed with one face tangent to the intrados curve, as in the Guastavino construction; in those of the second group, the bricks are placed with one side tangent to the intrados curve.

In the first group there are three methods of construction which are generally used for segmental barrel vaults, though semicircular ones, as well as groined and cloistered vaults, may be similarly constructed.

GROUP I. FIRST METHOD OF DIAGONAL COURSES.

In Fig. 1 let ab and cd be the side walls from which the vault springs, and a-c one of the head or end walls. A small groove determining the curvature of the vault is cut in the wall a-c and in the side walls ab-cd horizontal grooves are cut to receive the springers. It is preferable to form these latter grooves while the side walls are being built.

This done, the bricks and half bricks 1, 2, 3, 4, . . . 1′, 2′, 3′, 4′, are inserted in the groove on the wall a-c, in the above order, beginning at the two corners simultaneously and using quick-setting mortar. This first ring finished, the springers g and f and the brick h are laid; then, beginning always at the springing line, the diagonal courses i, i′, i″, i‴, and k, k′, k″ are built, resting each brick partly on the one previously laid and partly on two bricks of the previous diagonal course, the workman holding each brick until the mortar has set enough to support it.

Skillful workmen build these vaults by the eye, but for careful work it is better to guide the construction by means of strings stretched between the head walls, and determining the curvature of the intrados.

Should there be no head wall, the first ring 1, 2, 3, 4, . . . 1′, 2′, 3′, 4′, would have to be built over a center, but the diagonal courses would be built as in the previous case.

When the vaults are of great length they are usually divided into several sections by transverse arches and the sections vaulted separately but simultaneously, beginning at both sides of the transverse arches.

SECOND METHOD OF LONGITUDINAL COURSES. (FIG. 2.)

In this method, a groove having been cut or built in the side walls, the springing courses 1, 2, 3, 4, 5, on either side composed of bricks and half bricks is first constructed, and the following longitudinal courses are constructed by inserting the bricks m-m between every two projecting bricks of the springing course, and then by inserting the bricks n-n between the bricks m, and thus successively, working from both sides upwards until the vault is closed at the crown.

THIRD METHOD OF TRANSVERSE COURSES. (FIG. 3.)

In this method, as in the first, grooves are cut in the end wall and in the side walls. The first course consists of bricks and half bricks built into the grooves of the end wall a-c, and as in the second method, the following courses are constructed by inserting the bricks between every pair of projecting bricks of the previous course, thus forming a series of transverse courses.

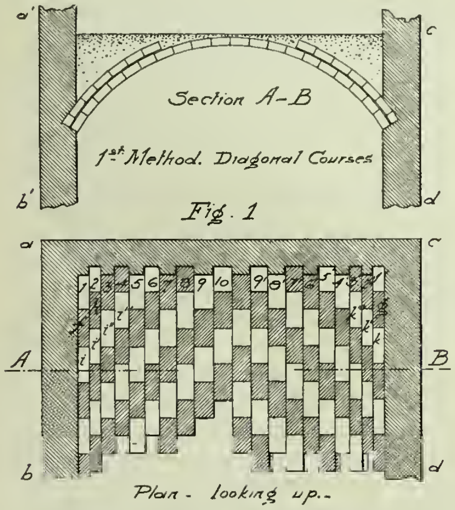


Fig. 1

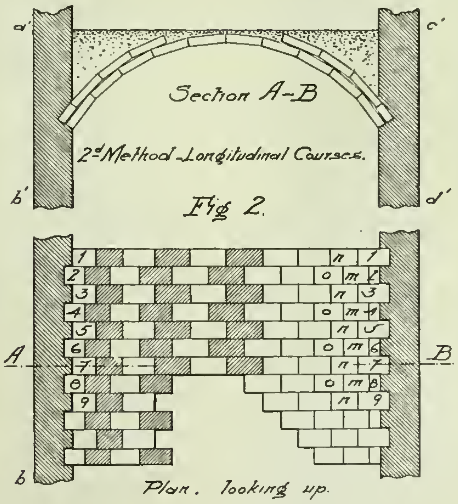


Fig. 2.

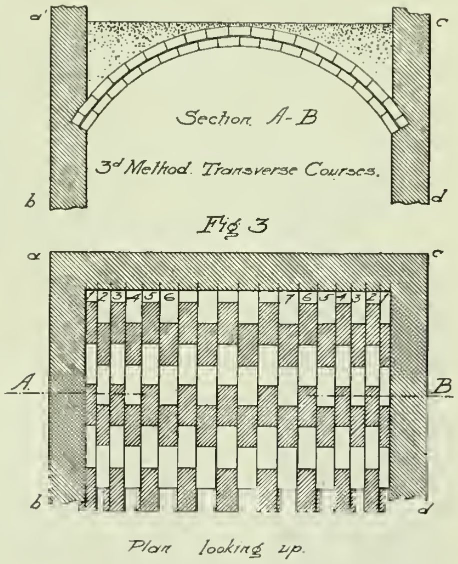


Fig. 3

These three varieties of vaults are useful when not intended to support a great weight, and are often used in building staircases. Their strength is increased by making them of two thicknesses of brick, in which case care should be taken that the joints of the upper arch do not correspond with those of the lower one. Also a good layer of mortar should be laid between the two arches.

The mortar used in the second arch need not be quick setting, as the lower one takes the place of a center.

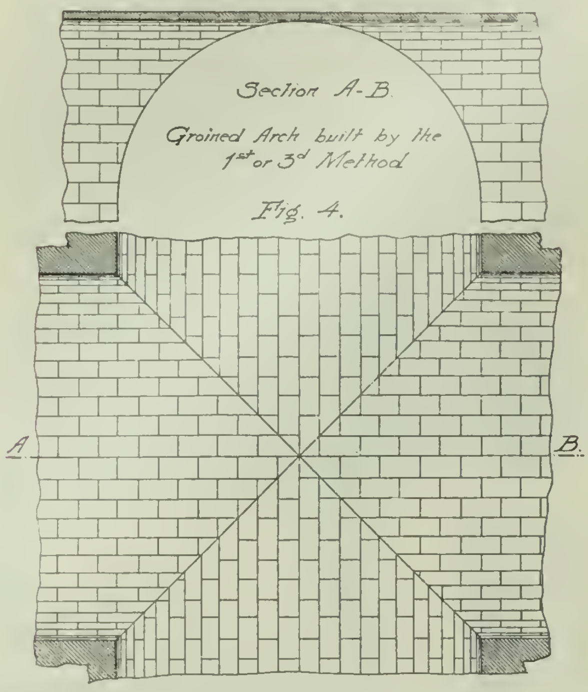
When, as is most generally the case, chalk is used to make a quick-setting mortar, care must be taken not to close the vault until the mortar of the portion built has thoroughly set, for the reason that chalk increases considerably in volume while setting; and should the vault be closed at once, a thrust would be created at the springing of the arch which would either crack the supporting walls or the arch itself, and even destroy the latter.

Cloistered and groined vaults are also built by the three methods described, the first and third methods being better adapted for groined vaults. At the groins or at any curves of intersection the bricks are cut to fit. In careful work it is better to determine accurately the curves of intersection and guide the construction by means of light wooden frames or strings.

Fig. 4 is a groined vault built by either the first or third method.

The method often used for ordinary brick vaults, in which the rows of brick are perpendicular to the groins, cannot be employed when working without centers, as the joints would be helycoidal planes, and it would be impossible to give them by the eye their proper inclination at the different parts of the vault.

In all these vaults their stability depends on the thorough



adherence of the mortar and the bricks, which soon form a solid mass and reduce the thrust to a small quantity.

GROUP II. BRICK ARCHES AND VAULTS WITH "VERTICAL LEAVES."*

The difference between an ordinary arch and one of vertical leaves is that in the first the faces of the bricks are in planes radiating from the axis of the arch or vault, while in the second the bricks are laid with their faces in parallel planes perpendicular to the axis, thus forming a series of vertical leaves of the thickness of one brick.

The left half of Fig. 5 shows an ordinary arch, and the right half shows one of vertical leaves.

These vaults are built by cutting out on the end walls a channel or groove about ½ in. deep, and determining the curvature of the vault, the width of the channel being equal to the thickness of the vault, which may be half, one, one and a half, or two bricks. The first leaf is built by covering with quick-setting mortar one face of each brick, and the edges, forming the joints, and sticking them in place in the channel, beginning at the springing lines. The first leaf finished, the second and successive ones are constructed similarly, sticking the bricks against the previously built leaf and breaking joints.

When there is no end or head wall, an arch of three or four leaves is similarly constructed at each end with the aid of a light frame, after which the vault is built against these arches, as explained.

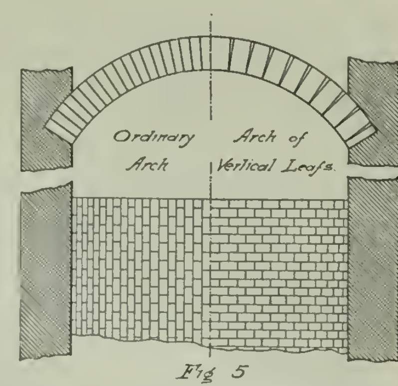
Vaults of this kind also depend, for their stability, on the thorough adherence of the mortar to the bricks, and on the quick setting of the mortar.

BARREL VAULTS WITH "INCLINED LEAVES." (FIG. 6).

These vaults are a modification of those just described, and in which the successive leaves are in parallel but inclined planes. In these, the use of quick-setting mortar is not required, as they depend on the friction between the bricks and the mortar for stability during construction.

* The word "leaf" is perhaps the best to use to express the idea of a series of thin arches made by the bricks, as in the construction to which the word applies; besides, it is the translation of the Spanish word "*hoja*" used in the original.

Vaults of this kind are generally composed of two distinct portions, the lower or springing portion, in Fig. 6, that between the lines ao-qo, forming the angle and the upper or crown portion that between the lines qo-q'o, forming the angle β.



The lower portion is constructed like an ordinary arch, but without using centers, the joints pq, at which this mode of construction stops, being determined by the angle of friction of the brick with the mortar, represented by α; for, while the inclination of the joints is smaller than this angle, there will exist frictional stability. Beyond this angle, however, frictional stability no longer exists, and to finish the vault centers would be required, unless the system of construction is changed.

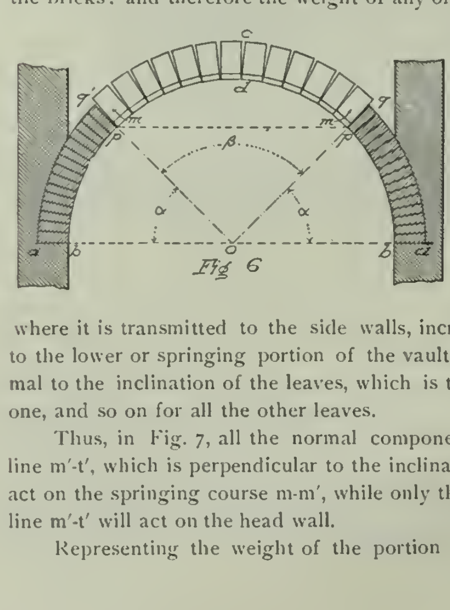
The required system for the upper portion of the vault consists in laying the bricks with their faces parallel to a plane having a given inclination (not greater than the angle of friction) and forming a series of inclined parallel leaves of the thickness of one brick.

One of these rings is shown in Fig. 7 in section and in side view by p' d' c', in Fig. 8, in plan by p d p, and in Fig. 6, in front view, by p q c-q' p d.

To construct the upper portion of the vault, an inclined channel, p q c-q' p d, Fig. 6, is cut out of the head wall. The bricks m-m are laid with their faces at an angle not greater than the angle of friction, one end of the brick being tangent to the curve of the intrados. Then the bricks 1-1', 2-2' (Fig. 7) are similarly laid until the first complete leaf 3-3' is formed.

The following leaves are similarly built, until the vault is closed at the opposite head wall, or, as is more often the case, the vault is closed at its center, the construction having proceeded from both head walls simultaneously. The closing leaves are constructed in different ways, as shown in Fig. 9, at A and B.

In this construction an outward thrust is produced against the head walls by the leaves which rest against them. This thrust is easily determined, considering how the forces act. The weight of the first or corner bricks m-m concentrated in its center of gravity resolves itself into two components, one parallel to the plane of the leaves, the other normal to it. The first is counteracted by the friction of the bricks with the mortar: the second or normal component presses against the head wall. Precisely the same occurs with all the bricks: and therefore the weight of any of the leaves forming the vault, resolved into its two components acting through the center of gravity of the leaf, will produce, first. a thrust parallel to the plane of the leaf and acting against the springing course m-m from where it is transmitted to the side walls, increasing the thrust due to the lower or springing portion of the vault; second, a thrust normal to the inclination of the leaves, which is transmitted to the next one, and so on for all the other leaves.



Thus, in Fig. 7, all the normal components to the left of the line m'-t', which is perpendicular to the inclination of the leaves, will act on the springing course m-m', while only those to the right of the line m'-t' will act on the head wall.

Representing the weight of the portion m' n' t' (Fig. 7) by W, and the angle of the inclination of the leaves by α, the thrust $T=W \cos. \alpha$ will act through the center of gravity of the portion m′ n′ t′. The stability of the head walls is determined by taking moments about a convenient point, as h in Fig. 9, by which is obtained the equation $Tl=W^1 \times \frac{x}{2}$ in which T is the thrust of the portion of the vault to the right of the line m′-t′ and acting through G, its center of gravity.

W′ is the weight of the head wall.

x is the width of the head wall.

l is the distance of the point h from the line of action of T.

If there is no head wall against which the first oblique leaves may be built, an arch is constructed by the ordinary method, using a

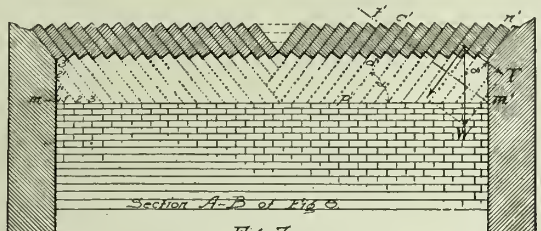


Fig 7

Plan of Fig 7 looking up.

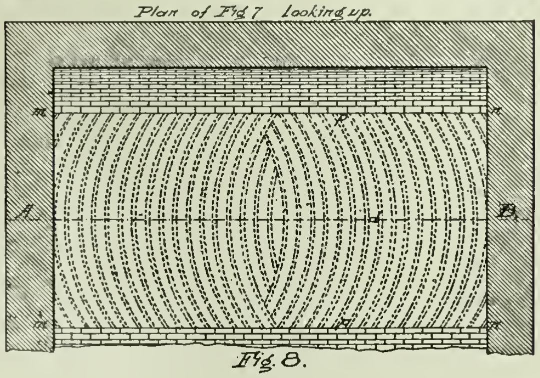
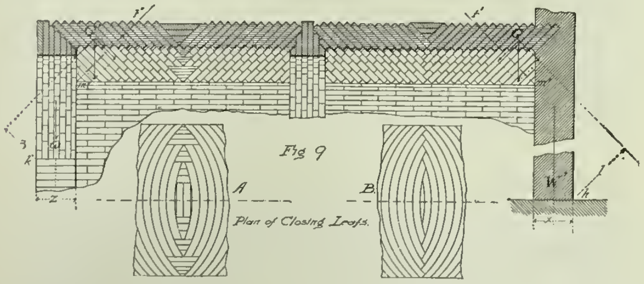


Fig. 8.

center, or by the method of "vertical leaves." The arch must be strong enough to resist the thrust, and its width is obtained from the equation $Ts=W_1 \frac{z}{2}$ (see Fig. 9), in which T is the thrust of the portion of the vault to the left of the line m″ t″; s is the distance of the



point k to the line of action of T; w′ the weight of the head arch, acting through its center of gravity; and z is the width of the head arch.

(*Will be concluded in March number.*)

THE WEIGHT OF THE PARK ROW BUILDING.

NATHANIEL ROBERTS, M. Am. Soc. C. E., who is planning the steel construction for the new thirty-story office building on Park Row, New York City, of which R. H. Robertson is the architect, estimates the total weights of the building as follows: —

Weight of building	56,200 tons.
Weight of steel	9,000 „
Total	65,200 „

The foundations will be laid at a depth commensurate with the height of the structure, the first stone course being 34 ft. 4 ins. below the sidewalk, while piles extend 20 ft. deeper still.

Architectural Terra-Cotta.

BY THOMAS CUSACK.

(*Continued.*)

THE two Tuscan columns (Fig. 8) used on a window forming the central feature of the Sixth Avenue elevation of the Siegel-Cooper Building, New York City, being 1 ft. 10 ins. diameter, it was thought advisable to build them up in sections, a proposal to which the architects readily assented. The shaft is jointed horizontally into seven sections, and vertically into three segments, making a total of twenty-one pieces, in the setting of which the joints were broken every course. The base and capital are each in one piece; and though much larger than those used in the shaft, present no difficulty in making, because the slight variation in shrinkage (just enough to cause an eyesore at a flush joint) becomes inappreciable when the joint occurs at a projecting fillet. The general effect proved very acceptable, and amply justifies the means taken to obtain it. There are several other columns of a similar character used on this building, mostly on the tower, but the maximum diameter being 1 ft. 5 ins., some were made in five and others in six complete drums. They were handled in the manner described for Fig. 1, and when set in position appear to satisfy every requirement.

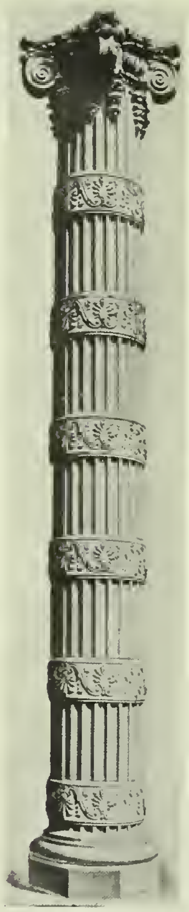


FIG. 11.

Thus far our remarks have applied exclusively to columns of the Doric, Ionic, Corinthian, and Tuscan orders. The examples cited may be considered merely as types of many hundreds that have been made with a fair degree of success, and of methods by which still greater success may be attained. They will, we hope, be sufficient to show that the difficulties by which the terra-cotta maker is beset, though onerous, are by no means insurmountable. The making of these columns requires mechanical skill of a high order, together with a special knowledge of clay, that comes best and surest to men who have had actual experience in handling, or opportunities of observing and studying its behavior under various conditions. Knowledge of this kind cannot be "read of in books, nor dreamt of in dreams." It must be acquired by very close and prolonged contact with the work, and some of it may be all the more effectual if absorbed, as Joey Ladle, the cellarman, was wont to receive his tipple, not by way of the throttle, but simply "taken in through the pores." Many and various are the expedients resorted to of a purely technical kind, in the several stages of manufacture, but all having the same object in view, viz: to counteract the ever-present tendency to warp, or sag, in the drying; and to promote uniform shrinkage in the blocks, as they pass through the final but inexorable ordeal of fire.

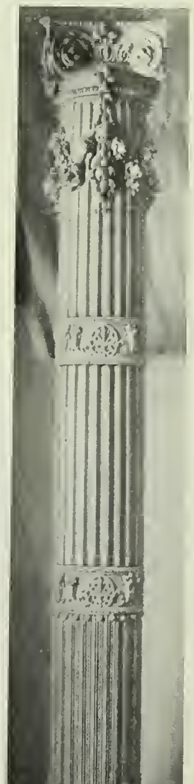


FIG. 14.

In columns of Saracenic, Byzantine, and late Romanesque character, few, if any, real obstacles will be encountered in their manufacture. The necessity for true alignment does not occur in them to the same extent; and the detail that may legitimately be introduced in the way of bands, spirals, zigzag flutings, lozenge, and diaper indentations of endless variety, serve to conceal such imperfections as may occur in the burning. The columns usually met with in Spanish Renaissance may likewise be included in this category. The Oriental richness of detail introduced, first by the Arabians, and then by the Moors, becoming assimilated with Italian outlines, produced a phase of Renaissance that is well within the limit of terra-cotta construction, and admirably fitted for plastic enrichment. The methods adopted in the case of previous examples will serve for them also, subject to such modifications as may fit in with particular circumstances.

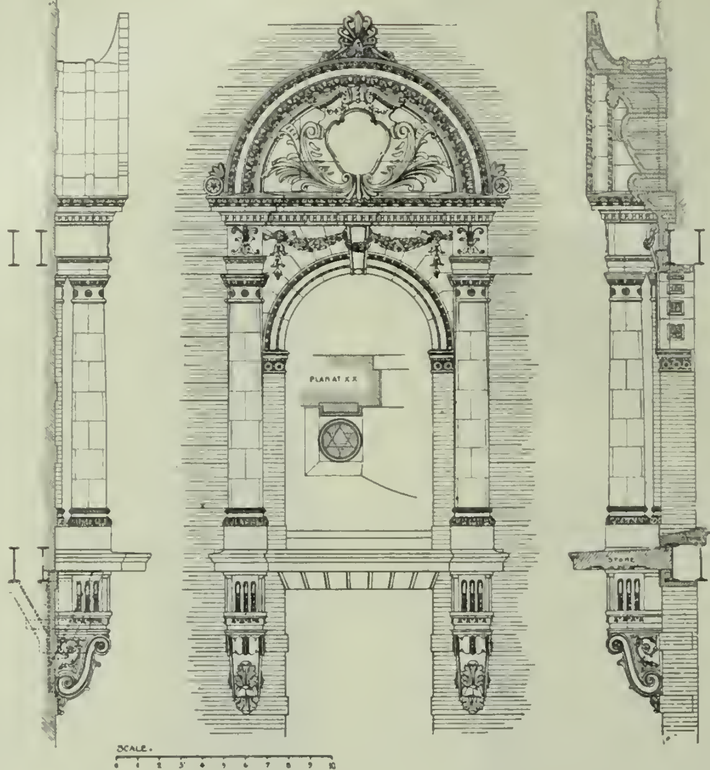


FIG. 8.

The parting of the ways between the French Renaissance of native growth and that previously introduced from Italy by Vignola and Serlio, found expression in the work of Delorme and other architects towards the close of the sixteenth century. The earlier portion of the Louvre, the Chateau d'Anet, and the Tuileries showed a divergence in many things, the most notable innovation among them, from the present point of view, being the rusticated pier and pilaster bands; and in admirable keeping with these followed columns (Figs. 9 and 10) into which were introduced bands of a more ornamental character, alternating with the fluted drums. These bands having but little projection, and adhering closely to the entasis of the column, did not in any way mar its outline. The idea of strength and vigor was thus obtained, without any sacrifice of grace, and when it was thought desirable to still further subdue the severity of the flutes, this was done by a husk, a ball-flower, or a diminishing drop ornament. These features could not have been introduced with any view to the use of terra-cotta, for the examples quoted were all executed in stone; but had such really been the intention, no device, however deliberate, could

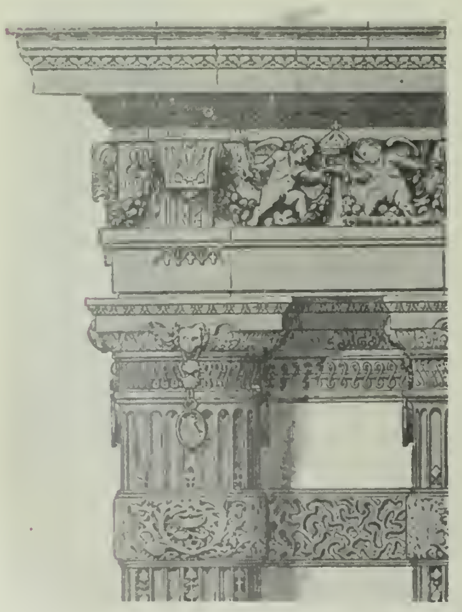


FIG. 9.

have more completely subserved the end in view. There is hardly anything within the wide range of its application to architectural purposes so ideal in point of fitness, and yet so well within the scope of economical execution. At any diameter up to two feet the drums and bands would be made in single blocks, being compact in form, and of convenient size for handling, with no troublesome projections to care for, nor salient angles to crack by premature or unequal drying. If much above that size they would be made in quadrants, the drums being jointed on the axis, while the bands would break joint on the intermediate angles, as in Fig. 11. A pair of these columns, designed by Messrs. Nolan, Nolan & Stern, of Rochester, were used by them on the Chamber of Commerce Building, recently erected in that city. In this case they are built around a steel core forming part of the structural support of a twelve-story building, of which we may have something to say when dealing with cornice construction. Columns of this character are, of course, susceptible to any suitable style, or degree of ornament, and may be varied in detail by modeling two alternating bands. These may again be multiplied by varying the central feature of the design on each of the four sides, and then by merely turning them on their axis in the setting, it would be possible to get eight different combinations when viewed from any one standpoint. Something of this kind is done in the columns of two very beautiful windows on the New Street front of the Manhattan Life Building, New York (Fig. 12). The chief thing to regret in that case is that they are situated on the sixth story, and are therefore doomed to blush unseen, wasting much of their sweetness on the preoccupied denizens of the Stock Exchange. The faces, however,

FIG. 10.

are clearly defined and artistically finished, and would stand critical inspection if used for interior work. This is a very modern building in construction and appointments, and in these respects represents modern ideas, but it will be seen that the architects did not allow the terra-cotta contractors to forget that: —

"In the elder days of art,
The builder wrought with wondrous care,
In the unseen and hidden part,
For the gods see everywhere."

The late Richard M. Hunt, just fresh from the Beaux Arts, gave to columns of this class a fitting introduction some forty years ago in one of his first works in New York City. They were made the chief distinguishing feature in the design of a residence on the north side of 38th Street, a little west of Fifth Avenue. At a later

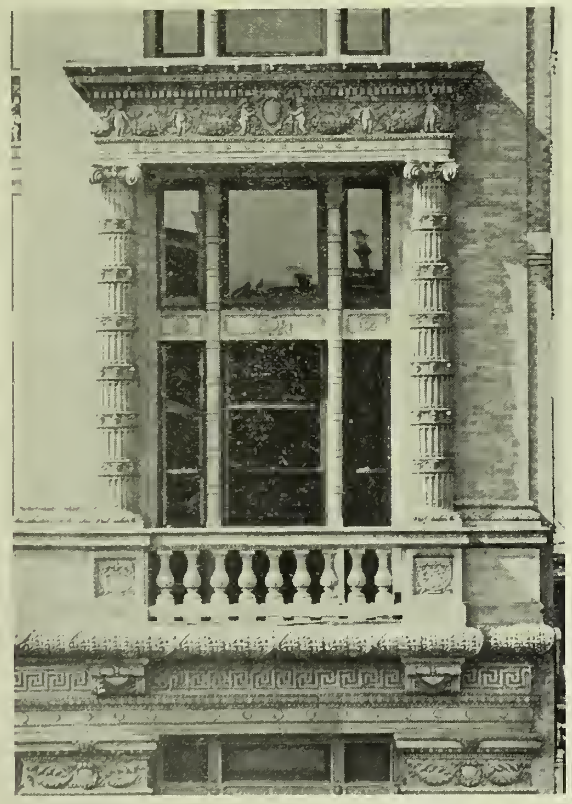


FIG. 12.

date some "archieteck" undertook to imitate this house; which he did in a particularly tame and colorless caricature, built on the abutting lot to the west. The lapse of time has not, in this case, been favorable to the survival of the fittest, for while the work of the architect has been torn down and rebuilt (perhaps in disgust), that of the copyist remains, a forlorn relic of fading gentility.

The original banded column used on the Louvre (Fig. 9), has since been modified on the one hand and emphasized on the other, in conformity with varying needs, and in keeping with widely different environments; but it has stoutly maintained its place as a distinct type in competition with, and often by preference over, other styles. If this has been so in the case of stone, where most of the laborious work and all of the carving must necessarily be done by hand, as distinguished from machine labor, there are obviously great advantages in the substitution of a material that can be molded into shape and finished by the modeler while in a plastic state. It is seldom that less than one pair of columns are required, but even with this number, the preliminary expense of models and molds, added to that of all other labor and material, will be less than half the cost of stone. With a greater number the relative difference in cost becomes more than proportionately large, because the set of molds necessary for one will, if need be, produce from thirty to forty columns.

In Fig. 13 we have one of eight very elaborate and yet appropriately enriched columns, used on the handsome new City Hall, Elmira, now approaching completion. Four of them support a pediment on the Church Street elevation, and the other four carry a similar pediment on Lake Street. The background of the shaft at its greatest diameter is 2 ft. 6 ins., diminishing to 2 ft. 2 ins. at the neck, from which the bands have a uniform projection of 1 in. The ornament is of necessity in very low relief, but so crisp in definition that its main outlines are legible at some distance. The drums are in quadrants, breaking joint with each other, and with the bands, which are also jointed in four pieces, leaving in each case an opening in the center, to be built solid in brick and cement. The making of these columns was capable of being simplified to such an extent that out of 16 molds of a convenient size was got 32 presses from each, or a total of 512 pieces, duly entasized, and requiring little, if any, fitting when taken from the kiln. The large capitals are each made in eight pieces, with joints that are practically invisible, and the Renaissance feeling infused into the Corinthian order is in complete harmony with all the ornament on the building. We do not hesitate to challenge comparison between these capitals and any of the contemporaneous examples in stone, which have been spoken of as exhibiting the highest attainable excellence in nineteenth century stone carving.

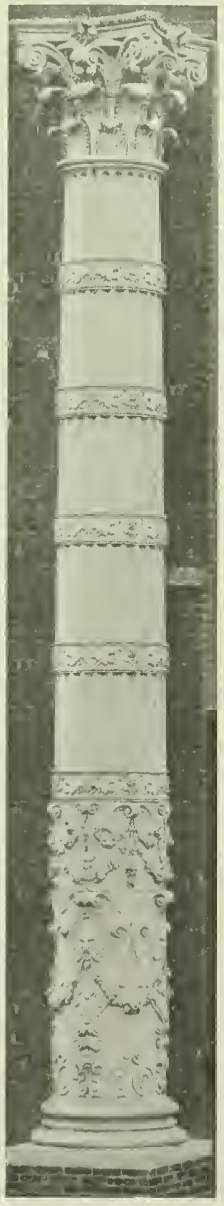


FIG. 13.

Two other columns (Fig. 13), smaller in size but of similar design, are used in the vestibule of the Church Street entrance, which is wholly in terra-cotta. This apartment, though not large, is exceedingly ornate. To each side of the columns stand paneled pedestals, carrying richly modeled pilasters and capitals, supporting an enriched architrave, festooned frieze, and cornice. Two niches have been thoughtfully provided in this vestibule by the City Fathers, in which, perhaps, to immortalize, at some later date, the more deserving of their number.

Columns of other sizes and designs might, of course, be added by way of illustration; but as they would be merely variations of those already given, their methods of construction would be determined by considerations such as have been stated. We have pointed out the chief difficulties that arise in the process of manufacture, and the extent to which, as well as the means whereby, these may be minimized, or wholly overcome. Where architects are willing to keep their demands within reasonable limits, and manufacturers ready to adopt such progressive methods as a riper experience may suggest, both can look forward to correspondingly successful results.

(To be continued.)

No good building was ever yet erected in which the architect designed the front, and left the flanks or internal courts to take care of themselves. So, also, no good building was ever seen in which the exterior only was thought of, and the internal decoration and design neglected. — *Street.*

Fire-proofing Department.

SOME VALUABLE OPINIONS ON FIRE-PROOF CONSTRUCTION.

CONTINUATION OF A SERIES OF INTERVIEWS WITH PROMINENT ARCHITECTS IN NEW YORK AND BOSTON, ON THE VALUE OF TERRA-COTTA AS A FIRE-PROOFING MATERIAL.

IN an interview upon the subject with Mr. John M Carrère, of Carrère & Hastings, New York, he stated that in his practise he has never had occasion to use anything except terra-cotta for fire-proofing purposes. He considers the material the best in the market, but the mechanical details of construction and the methods of setting in place leave considerable to be desired, and as usually employed around a building it is difficult to get a thoroughly workmanlike job. Burnt clay is perfectly reliable and can be depended upon for ample protection to the structure, but it is often not used to the best advantage; and where, as is usually the case, the handling and setting of it has to be entrusted to absolutely unskilled labor, it is not strange that the results should leave a good deal to be desired. Fire-proofing has become so much of a science that it could with great advantage be left to experts, whose advice and cooperation would be welcomed by architects and contractors; and, indeed, if the manufacturers of terra-cotta are to retain their hold on the confidence of the public, Mr. Carrère believes it would be highly desirable that they should insist upon either setting their material in the building, or at any rate that the individual manufacturers should follow the terra-cotta after it is delivered at the building, and should personally satisfy themselves that it is used in the right manner, notifying the architect whenever it is improperly applied or put up in a bungling manner. In this way a great deal of the mechanical objection to terra-cotta blocks could be obviated. Mr. Carrère says this is precisely what has been done by manufacturers of other lines of building materials, such as the patent wall plasters, for instance, the manufacturers of which found it absolutely necessary to control the mixing of the plaster, and to supervise the application to the walls of the finished product in order that the material should not be misrepresented or misapplied, and the leading manufacturers of these goods make a business of reporting constantly to the architects any improper use of their material. Often when the specification for terra-cotta fire-proofing is well written and comprehensive an architect cannot be sure that the best use is made of it. A more scientific treatment of terra-cotta is needed.

Mr. Carrère advocated a more thorough fire-proofing of the columns in a building. The casings for such work should be heavier than is usually employed for this purpose, and should be interlocking, so that in case of partial damage by fire or water the blocks will not become loose. He thought possibly two casings would be better still, so the outer one, if peeled off by accident, would not expose the column. He thought also that the spaces about a column and also all chases left in walls for pipes, or about beam ends, should be thoroughly filled with terra-cotta, so as to leave no opportunity for flues in the wall through which fire might be led. In fact, his feeling was that while the system of fire-proofing with terra-cotta blocks is excellent, it is often not carried far enough, and terra-cotta is used too sparingly about a building to make it what could be called absolutely fire-proof. This is a pretty serious condition, as it leads to over-confidence on the part of the tenants, and when trouble comes, as it is very likely to in the long run, the whole system is apt to be condemned, whereas it is really the fault of the way in which it is used. He also spoke of a very common practise in regard to repairs around large buildings, which, though constructed with the utmost care by the architect and builder, are placed in the hands of an agent who may have little interest in architecture and less knowledge of the actual construction. The fire-proofing may then be cut out most recklessly, and where blocks or sections of floors are removed for changes or repairs the fire-proofing is not put back in a first-class manner, a bit of mortar or some so-called fire-proofing paper often being made to answer a purpose which could only be properly accomplished by a thorough replacement of the terra-cotta blocks.

Mr. Carrère was asked if he considered a stone facing a sufficient protection for columns which are built into exterior walls. In his judgment, the custom of building a steel frame and facing it with a relatively thin casing of stone on the outside is not only not fire-proof, but is really criminal in that it does not afford sufficient protection to the steel. There are numerous examples of just such species of construction in New York in which in some cases granite, which has all the appearance of solid blocks, is so cut away to receive columns that only 2 or 3 ins. separates the exterior surface of the wall from the metal, which is consequently protected by no external fire-proofing whatever. In case of fire this stone would be pretty sure to fly to pieces and the columns would be left bare. If circumstances render the use of stone imperative it is better that the column be made entirely free, set in from the wall and fire-proofed throughout with terra-cotta blocks, in addition to the stone facing. Mr. Carrère saw no reason why walls as well as floors and partitions should not be built of terra-cotta, and he instanced one prominent building in New York in which the system of steel construction is carried to its logical conclusion. The steel skeleton is constructed in the usual manner and is then filled in between the exterior portions with steel bars set at close intervals, the exterior facing of the building being of finished terra-cotta, while the backing and all the fire proofing is of the ordinary terra-cotta blocks such as are used for partition work.

A vital issue that is often neglected is the arrangement of the rooms themselves in a building quite as much as the details of fire-proofing. We ought to build more on the compartment system, and the stairs, which are a vulnerable portion of the structure and are usually built of iron not enclosed nor fire-proofed at all, should be either cased throughout in terra cotta, or, better, regularly constructed of terra-cotta or tile without the use of steel at all.

Mr. Carrère called attention to a construction which is often found in buildings in which the steel work forming the soffits of window and door openings is left without any protection whatever. A building cannot be called fire-proof while any stone or iron is so used that it can be affected by heat or water, and terra-cotta in some form should be used to protect the openings of the doors quite as much as the floors. He suggests an improvement in the forms of floor blocks, which are customarily made to lap under the flanges of the beams with a thickness of about 1 in. of terra-cotta. The blocks so formed are probably ample for any required protection to the iron, but the pieces which lip under the beam are so often poorly set or broken in the setting that he thinks it would be better to have at least 2 ins. instead of 1 for the flange under the beam.

Mr. Winslow, of Winslow & Wetherell, Boston, when interviewed, stated that he considered terra-cotta itself thoroughly fire-proof and that fire-proofing results are only a question of thickness of material and the manner of application. For that matter, good terra-cotta is nothing but brick, and brick is generally conceded to be the best and most thorough protection against fire, though the weight of brick precludes its suitable employment for thick floors. We may be able to trust other constructions, but we know we can trust terra-cotta, and in the present state of the science there is nothing so satisfactory. He cited the instance of the Pope Building, Boston, which was recently destroyed by fire. Had it been constructed of stone or any other material than terra-cotta and brick, there would have been nothing left of it, and though, owing to the fact that the floor construction was entirely of wood, the building was virtually destroyed, the brick and terra-cotta amply demonstrated their capacity to resist the action of heat.

Mr. Winslow said that in the so-called fire-proof building as actually built the real protection is usually not carried sufficiently far. In any office building, for instance, there is enough wood about the floors and the finish, to say nothing of the contents, to make a very considerable fire if it once caught, and he would prefer to see a building in which all inflammable material of this sort was eliminated, so that, at the most, nothing but the contents could be consumed. In one of the large buildings recently constructed by his firm, a fire started in one of the rooms after it was all finished and ready for occupancy, the fire being caused by spontaneous combustion from painters' rags. The doors, windows, and portions of the floor were almost entirely consumed, but the fire simply burned itself out.

Winslow & Wetherell used hard terra-cotta in the construction of the large Tremont Building just completed. They have used elsewhere the porous terra-cotta, and are at present employing it in the Hotel Touraine, now in process of erection. They have found that the hard terra-cotta is quite brittle and is apt to break and crack in setting, and in practise they prefer the porous terra-cotta.

For partitions they have never felt inclined to use anything but terra cotta blocks, nor would they care to make any experiments with any other forms which have been offered to them. They consider that the terra-cotta blocks make a perfectly straight construction, and their experience leads them to believe that it will resist with perfect satisfaction the action of both fire and water. For furring on outside walls Mr. Winslow employs porous terra-cotta blocks. He has tried hollow brick, but on account of the brick being in itself not so strong as the ordinary hard-burned brick, he does not favor such employment and would prefer terra-cotta. Around columns, his practise has been always to fill in solidly with terra-cotta blocks, and where the column is hollow to fill the interior solid with cement concrete, applying a thickness of metal lathing and plastering outside of the whole. The fire-proofing of columns he considers a good deal of an open question, however, and feels that existing methods could be considerably improved upon in this direction. In regard to girders, he believes that if the webs are thoroughly encased and bedded with terra-cotta blocks, and the bottom flanges covered with metal lathing and plastering, no heat in a burning building, even though it might penetrate the plaster envelope, would be able to affect the steel, as the terra-cotta blocking beside it would take up the heat before it could act upon the metal.

As a matter of stability he considered terra-cotta floor blocks an excellent lateral brace. In the construction of the Hotel Touraine he began to have the floor blocks built in as the iron work was carried up, but has discontinued the setting of the blocks until all steel work is in place, as he believes the vibrations from the handling of derricks, etc., would tend to impair the set of the fire-proof work; but when the floor blocks are once in place nothing that will ever come in the building, in his judgment, will ever dislodge them or even unduly strain them. The most potent objection to the use of terra-cotta is the great weight which it necessitates per foot. For a low building this does not aggregate very much of a load upon the columns and foundations, but even admitting the question of weight, he would prefer to use terra-cotta blocks throughout on account of the added lateral strain. He cited the thirty-story building which is now under construction in New York, on Park Row, from plans of Mr. Robertson, representing, in some respects, the latest work in tall building construction, which, according to recent reports, is to be fire-proofed throughout with porous terra-cotta end construction floor blocks. Undoubtedly, all the various systems in the market were considered in connection with this building, but the fact that terra-cotta has been used instead of anything else is pretty good evidence that the material is satisfactory to those who have had most experience therewith. The setting in place of fire-proofing terra-cotta should not, however, be entrusted to careless or ignorant builders.

Mr. Winslow concluded that when you come right down to the broad work of fire-proofing a structure, he did not think anything was better than terra-cotta in its various forms. In England, the employment of terra-cotta has been constantly increasing of late years, which is ample evidence of how it is regarded in that part of the world.

Mortar and Concrete.

AMERICAN CEMENT.

BY URIAH CUMMINGS.

CHAPTER VII.

CEMENT TESTING.

(*Continuation of tests made by Prof. Cecil B. Smith.*)

SERIES V.

EVAPORATION AND CRUSHING TESTS AND EVAPORATION AND TENSILE TESTS.

(*a*) *Evaporation and crushing tests.*

This series had for its first intention, information on the comparative and actual amount of evaporation of moisture from different mortars made with different cements, but it soon developed into an endeavor to obtain some relation between crushing strength and evaporation. Any law on the matter, if there is any general law, will of course take years to demonstrate; but enough has been done to show that any investigations on this subject will be fruitful of results. The method of procedure was as follows: Mixtures were kept in damp air 30 days, then immersed 2 days in water of ordinary temperature, then taken out and weighed; they were then kept in the warm dry air of the laboratory at a temperature of about 65 degs. Fahr. exactly 2 days, when they were again weighed and immediately crushed. The experiments recorded in Table IX. were all made on 2 in. cubes, and 2 days was established, because it was found that at that time the evaporation was practically complete. Other experiments (not recorded) made on 3 in. cubes gave less evaporation per cent and also less strength. Attached to this are three diagrams; the first two show strength and evaporation in different mixtures and with five brands of cement. The third diagram is the product of the other two, and is quite worthy of inspection, because it would appear from it that it would be possible to estimate fairly and accurately, without actually crushing a specimen, what load it would bear.

TABLE IX.

EVAPORATION AND CRUSHING TESTS.

NO. 11 — PORTLAND.

SERIES V.

Mixture.	Evap. per cent. in 2 days.	Crushing strength per square inch.	Product.	Max. wt. of 2 inch Cube.	$\left(\sqrt[3]{\text{wt.}}\right)^2$	Column 4 divided by column 6.
				oz.		
Neat.	1.48	3925	5809	10.43	22.16	262.1
1 to 1	3.41	2211	7539	10.12	21.71	347.3
2 to 1	6.20	1031	6492	9.39	20.66	314.2
3 to 1	10.39	544	5652	9.14	20.30	278.4
4 to 1	11.49	431	4952	8.92	19.97	247.9

NO. 10 — PORTLAND.

Mixture.	Evap. per cent. in 2 days.	Crushing strength per square inch.	Product.	wt.	$\left(\sqrt[3]{\text{wt.}}\right)^2$	Column 4 divided by column 6.
Neat.	0.97	4367	4231	9.84	21.31	199 0
1 to 1	2.20	3062	6736	10.23	21.87	308.0
2 to 1	5.59	1079	6032	9.43	20.72	291.1
3 to 1	8.61	*940	8093	9.15	20.31	398.4
4 to 1	11.68	504	5886	8.86	19.87	296.2

* One day older than others.

No. 3 — Portland.

Mixture.	Evap. per cent. in 2 days.	Crushing strength per square inch.	Product.	wt.		
Neat.	4.65	1863	8662	10.00	21.62	400.7
1 to 1	4.10	1875	7687	10.12	21 71	354.1
2 to 1	5.67	1417	8034	9.60	20.97	383.1
3 to 1	8.11	687	5572	8.95	20.01	276.2
4 to 1	12.56	412	5176	8.88	19.90	260.0

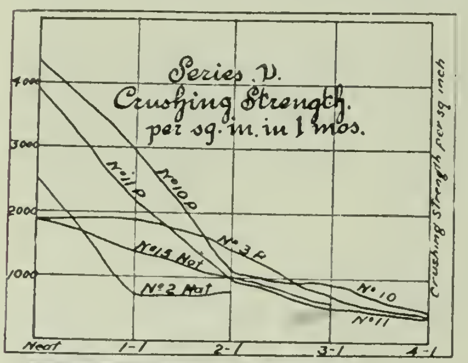
No. 15 — Natural.

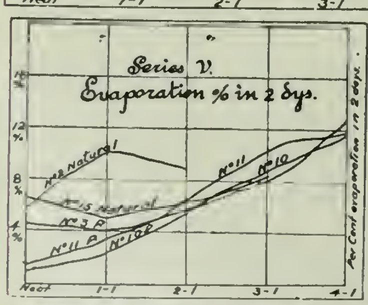
Mixture.	Evap. per cent. in 2 days.	Crushing strength per square inch.	Product.	wt.		
Neat.	6.76	1888	12762	9.40	20.67	617.4
1 to 1	5.08	1437	7300	9.65	21.02	347.3
2 to 1	6.12	988	6046	9.32	20.57	293.9
3 to 1	8.34	575	4796	9.05	20.16	237.9

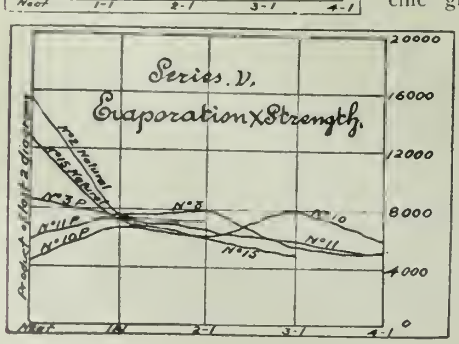
No. 2 — Natural.

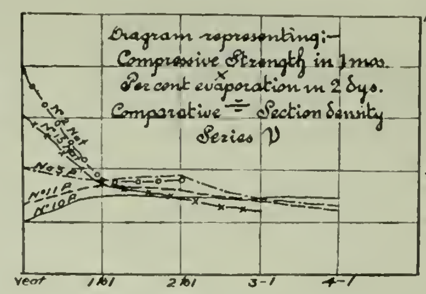
Mixture.	Evap. per cent. in 2 days.	Crushing strength per. square inch.	Product.	wt.		
Neat.	5.93	2575	15720	9.43	2072	758.
1 to 1	10.32	703	7254	9.06	2016	359.9
2 to 1	8.93	810	7233	9.28	2057	352.6

Reference to the table and diagrams will show that the evaporation increases and the strength diminishes with the increase of sand in the mixture. This is, of course, almost self-evident, but the striking difference in the amount of evaporation for different cements neat is unaccountable. This difference disappears as the admixture of sand increases, and we are led, therefore, to conclude that there is something inherent in the cement itself, which aids it more or less in holding particles of water in suspension. The natural cements show high evaporation neat, so also does the No. 3 Portland, which has a high specific gravity (see general tables), and the cubes of which weighed more than those of the No. 10, which evaporated least. We cannot account for it on the ground of Portland and natural, but one thing is evident, that that same quality which enables it to hold water in suspension also aids it in holding particles of sand together, but not particles of itself. The third diagram showing the convergence of lines on the 1 to 1 mixture is very striking. The *product of the crushing strength of a 1 to 1 mixture* and the *evaporation per cent.* under conditions named is practically CONSTANT. This is for one condition only, namely, 32 days, with access of water and 2 days' drying. This means in plain words that we may possibly be able to test with a balance instead of a crushing machine.



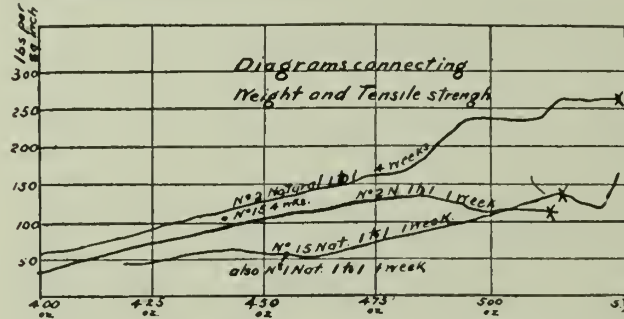


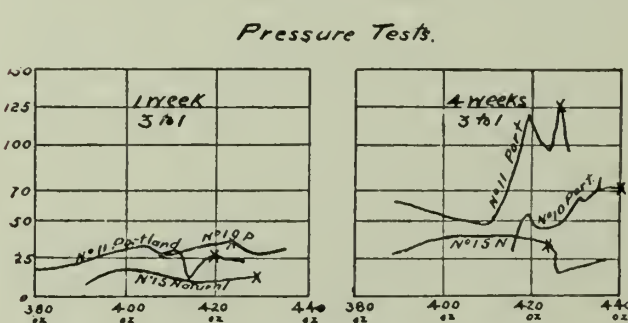


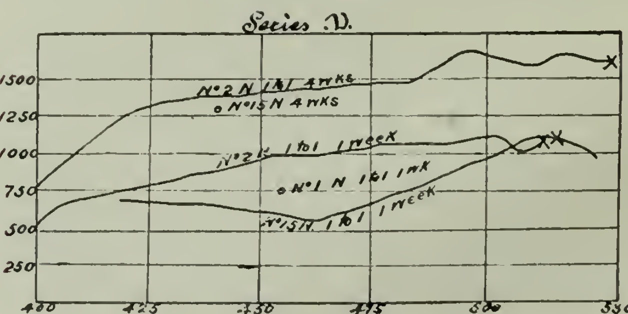


It is probable that the microscope would reveal a decided difference of structure in various cements. It is, of course, well known that the underburnt natural cements have softer, rounder, and more easily pulverized grains than that produced by the highly burnt clinker of the Portland. It is possible, therefore, that the evaporation qualities of a neat cement would indicate more closely than anything else the degree of burning practised, independent of the fineness. It will be noticed by Table II., that the residues on sieves afford no clue to the density of the mixture, and no guide to determine beforehand the evaporation. Neither does the weight of the

(*b*) *Evaporation and tension tests.*

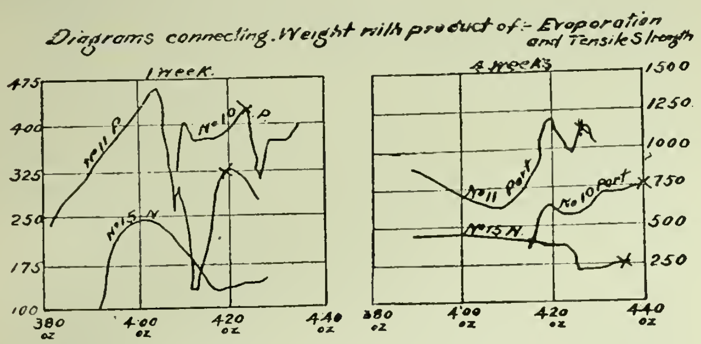






specimens vary at all regularly either with the crushing strength or evaporation.

It would seem that the coarse, angular laboratory sand had its interstices just about filled up with a 1 to 1 mixture, and the strength of the mixture depended directly on the amount of evaporation, in an inverse ratio. The Evaporation diagram No. 4 is the same as No.

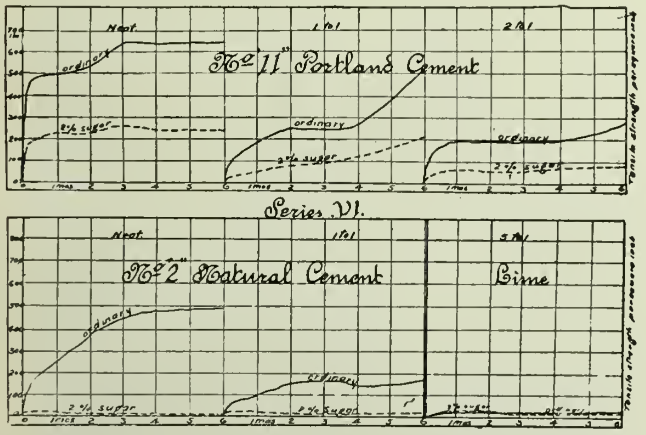


3, except that this product is referred to a uniform section density (*i. e.*) $(\sqrt[3]{weight})^2$; the diagram is practically the same, showing that the variation in weight of test pieces made practically no difference in the results, *i. e.*, the per cent. of evaporation determines the strength in 1 to 1 mixtures, but is no criterion in neat ones.

In Table III. and Table IV. the per cent. of evaporation in 2 days is again given, and diagrams are plotted showing the relation between the tensile strength and the weight of the dried briquettes in the pressure tests, and also other diagrams showing the product of tensile strength and evaporation plotted on a base of weights of briquettes.

The × marks in the diagrams show the positions of tests made with 20 lbs. pressure and 20 per cent. of water, and they are seen to stand at prominent and usually maximum points on the diagrams, proving that this is the best point to select of all the tests made.

It will be seen in these diagrams as in those of crushing tests,



that in 1 to 1 mixtures the variation of evaporation and strength combined is not very great, but not so close as in the former tests.

The 3 to 1 tests are very erratic, as might have been expected with different per cents. of water and different amounts of pressure. It is evident that each cement has distinctive qualities of its own, because with the same weight of briquette the strengths vary, and this brings up the important point that in sand tests the strength ought to be referred to some basis of weight of briquette, because a slight variation in weight seems, from Table IV., to affect the strength very much. It would not take much evidence to determine the average weight, and all tests could be reduced to this by multiplying by $(\sqrt[3]{weight})^2$ which would change the section density to a standard.

SERIES VI.

SUGAR TESTS.

Sucrate of lime is soluble in water, and it was chiefly a matter of interest to see the effect of sugar on cements in weakening them, because it has been asserted by several writers that the reverse is the case; one investigator several years ago showed by tests that from ½ to 1 per cent. of sugar would in 4 to 6 months give a gain in strength.

Sugar, in these tests, 2 per cent. of the amount of cement (by weight), was used, and the diagrams attached sufficiently indicate the results. In the Portland cement the strength ranges closely at 50 per cent. of the ordinary strength as far as 6 months, while with the natural cements, the sugar effect was overpowering. After 1 week's immersion the briquettes showed signs of cracking, and as time went on became completely checked, and expanded so much as to give practically no tests. This is further evidenced (see exhibit of briquettes) by the upper surface, which was protected by a coating of iron deposited from Montreal water, being intact, while the checking was greatest on the bottom where the water had free access.

The lime mixtures, kept in open air, showed encouraging results for 2 months, and seemed to prove that the use of sugar, in lime, as practised in India, was beneficial; but the 3, 4, and 6 months' tests disprove it. Altogether, it seems evident that this much or more sugar would be damaging in its effects on any kind of mortar in any situation, and it is extremely doubtful whether any sugar whatever would have other than a weakening effect.

In concluding this paper, the author cannot but help feeling that he is, as it were, dipping just on the surface of a vast subject, and that the more one finds out, the larger the unknown fields beyond appear.

In any efforts that have been made, the frequent manual aid and more frequent sound practical advice of Mr. J. G. Kerry have been of much service, and here is the place to acknowledge it.

The endeavor has been to find out anything of practical use to the engineering profession; and if any points raised here will fulfil this desire, the object of this paper will be, in the main, accomplished.

(To be continued.)

HEAT-RESISTING PROPERTIES OF PORTLAND CEMENT.

IN the "Digest of Physical Tests and Laboratory Appliances," Mr. J. S. Dobie gives particulars of the results of a recent investigation of the action of heat on Portland cement. Three different brands were examined, all of excellent quality, but two were of the slow-setting class, whilst the remaining one set very rapidly. Over two hundred briquettes were prepared, some consisting of neat cement, whilst in other cases one part of cement was mixed with one, two, or three parts of sand. The age of the briquettes ranged from two months to four years. In making the tests they were heated in a gas furnace to a temperature of from 650 degs. to 1,775 degs. Fahr. After removal from the furnace, every briquette was found to have lost weight, whilst in the case of the neat specimens, cracks were usually to be observed. These latter were less apparent in the case of the other briquettes containing sand. After cooling, the briquettes were tested for tensile strength with a load applied at the rate of 400 lbs. per minute. In all cases a marked decrease in the tensile strength was noted, which was apparently closely connected with the loss in weight of the sample. In those cases in which the reduction in weight showed that practically the whole of the water of crystallization had been driven off, the specimens had practically no breaking strength. The effect of different temperatures was, however, peculiar, since briquettes heated rapidly to 1,775 degs. Fahr. showed a loss of strength out of proportion to their loss in weight. When, however, the heating was slowly effected, these two losses were closely proportional. After cooling, the briquettes of neat cement could be crumbled to pieces in the fingers, whilst those containing sand disintegrated spontaneously on standing.—*British Clayworker.*

The Masons' Department.

THE ARCHITECT AND CONTRACTOR — IN GENERAL.

BY THOMAS A. FOX.

(*Continued.*)

MOST of the rules governing the honorable practise of the profession of architecture are the result of custom and usage. They are, therefore, much the same as should regulate all similar vocations, and are, consequently, so well known and understood as to need no particular attention or explanation. There is one condition of practise, however, affecting owner, architect, and contractor, which is almost always made mandatory, that is to say compulsatory, on the part of the architect, namely, that no architect shall accept "commissions." The constitution of the American Institute of Architects provides, and most of the other architectural organizations have a similar requirement, that "no fellow shall accept direct or indirect compensation for services rendered, other than the fees received from his client." Although there is no reason to suppose that this condition is often violated by those who belong to and practise under the regulations imposed by the various societies of architects, yet it must be admitted that an architect is often tempted by direct or indirect offers of commission, and it is fair to assume that such proposals would not be made unless they were sometimes accepted. In many instances violations of this rule have been known to exist, but it has been found impossible to prove the charge for the same reasons that it is always hard to prove bribery of other kinds, for such a transaction cannot be dignified by a term any less severe than this. Offers of commissions probably come of late more often from material men than from any other source, which is probably accounted for by the fact that competition has become so sharp that it is found hard to get even goods of merit on the market without resorting to some such measure, and also because commissions are now so generally offered and almost as often accepted with thanks in so many business transactions, that it is taken for granted that the architect will look with favor upon similar opportunities. The following circular, which has been lately framed by the Boston Society of Architects, to send to any one offering commissions, explains the case concisely and clearly, and it may be accepted also as defining the position of all architects who live up to the best principles of professional practise: —

"The enclosed communication has been received from you by a member of this society, offering a commission or special favors for the introduction and use of your specialties. Assuming, as is doubtless the case, that this is due to imperfect knowledge, on your part, of professional practise, allow me to point out that it is impossible for any reputable architect to receive commissions from material men for the following reason: The relation of the architect to his client is fiduciary, and the receiving of commissions which in the case of a business man might be perfectly legitimate is, in the case of the architect, in the nature of a bribe, as it leads him to favor certain materials for other reasons than his client's interests. On this account a by-law of this society provides that 'no practising member shall accept direct or indirect compensation for services rendered in the practise of his profession other than the fees received from his client.' In the hope that this information may lead to a change in your method of solicitation, which in the form referred to can only injure your interests with the class of architects whose approval you doubtless value, I am

"Respectfully yours, ——— ———

"Secretary Boston Society of Architects."

It can be seen from this circular letter that not only will the person offering a commission to an architect of standing fail to accomplish his purpose, but such action is liable to create a prejudice against both the individual and his material which will seriously affect the chances of their being favorably considered if at all. In this zeal to appear incorruptible many architects are inclined to treat offers of a commission much too harshly. In the case of a first offence on the part of a person who is presumably honest, it is only fair to assume that the offer was made under a misunderstanding of the conditions which should exist between the architect and those employed by him or under his direction. And in such instances, instead of making the person who offers a commission the object of his wrath, it would be much more profitable for the architect to first explain matters, and then find out what led the offender to think such a proposition was in order or would be entertained or accepted by an architect. An ingenuous way in which architects have been known to treat the matter of a commission, when they have learned that a sum for this purpose has been included in a bill for work or materials, has been to require the contractor to send a check for this amount to the owner, to whom, of course, the money rightfully belongs, for, as no one does work without profit, it is the owner who in the end pays all the bills, if they are paid at all. It is unnecessary to write at length on the subject of commissions; the facts in the case are clearly set forth in the two quotations given above, and the conclusions are self-evident. If a contractor or material man wishes the confidence and respect of the best members of the profession, he must depend entirely on the merit of his work or material. When he finds that offers of commissions or special favors are accepted, he may know that those who entertain such propositions, whatever may have been their professional standing in the past, are no longer to be considered as engaged in honorable practise. and he may rest assured that if any violation of the by-laws quoted above is brought to the attention of the officials of any society requiring its members to practise in conformity with such a rule, the offender will, if the evidence is satisfactory, be promptly brought to justice.

HOW TO PREPARE MORTAR.

MR. EDWARD WOLFF, an American authority on the subject of limes and mortars, makes some very interesting suggestions relative to the proper method of slacking lime and preserving it in good condition thereafter. He says: —

"The slaking operation should be done in a water-tight box made of boards, and so much water should be mixed in that the contents will never get dry, and a sheet of water will remain on top to prevent access of air. If the box will not hold the entire quantity of lime required, the contents may be emptied into a cavity made in the ground close to the pan, and this process may be repeated. This should be done at least two weeks before sand is added, or before the mortar is prepared for use. Slaked lime prepared and kept as stated has been found free of carbonic acid after many years, air and gas not having been able to find access.

RELATION OF COLOR TO QUALITY OF CEMENT.

MUNICIPAL ENGINEERING replies to the question, Has the color of cement anything to do with its quality? as follows: —

"As a rule, no. If a cement is very light colored, it is well to test it for strength, also for lime or possible adulteration with clay.

"If the cement is very dark, lampblack may have been added to deceive. Test for lampblack by dissolving in water, when, if present, an oily black film appears on the water. Lampblack of itself does no harm, more than to deceive ignorant buyers who think 'good dark color means good strong cement.' Color, smell, and feeling have very little to do with the value of a cement. Tests made with briquettes in tension are sure indicators of its value.

"It is surprising how many contractors and even cities trust entirely to the 'brand,' the manufacturers, or even the contractor, for a good cement. Cement tests are quickly and cheaply made, and should never be omitted in public or private important work."

Recent Brick and Terra-Cotta Work in American Cities, and Manufacturers' Department.

PHILADELPHIA.— Architecturally, at present, all eyes are turned to the exhibition of the T Square Club, held in connection with the sixty-sixth annual exhibition of painting and sculpture of the Pennsylvania Academy of the Fine Arts; this exhibition so totally exceeds anything of its kind ever held in Philadelphia that it has excited unusual comment, indeed we would have scarcely believed that the general public were sufficiently interested in architecture to give serious cognizance to an architectural exhibition. Such exhibitions are generally considered as dry, mechanical, and artistic blendings of ideas which the layman cannot comprehend without a great deal of effort, and they are consequently very little patronized; this has, however, been an entirely different affair, for — whether by the foresight of the committee or by accident, we know not — there have been shown in conspicuous positions many beautifully executed drawings in which the public at the present time are directly interested, and around these have been grouped many others, less interesting to the public by reason of their being from other cities, but withal, beautiful, interesting, and comprehensive. It is, without doubt, the finest collection which has ever been exhibited in this city, and the general study and attention which has been given it will undoubtedly advance the cause of artistic design very considerably. As this is the very matter which the members of the T Square

Club have for years been endeavoring to accomplish, it can be truthfully said in this instance that they have made decided progress this year, and gone a long step forward. It is to be hoped that they will carefully follow up the advantage thus gained, and by many more such events bring the architect, builder, and layman in closer touch than heretofore.

Of new work in prospect much might be said, as once again there are rumors of large undertakings; nothing, however, has taken definite shape except the work upon the new M which was begun a short time ago. The excavations are being pushed to the utmost, and it has been announced that the foundations and superstructure will follow immediately.

As if to decide quickly the question as to whether there shall

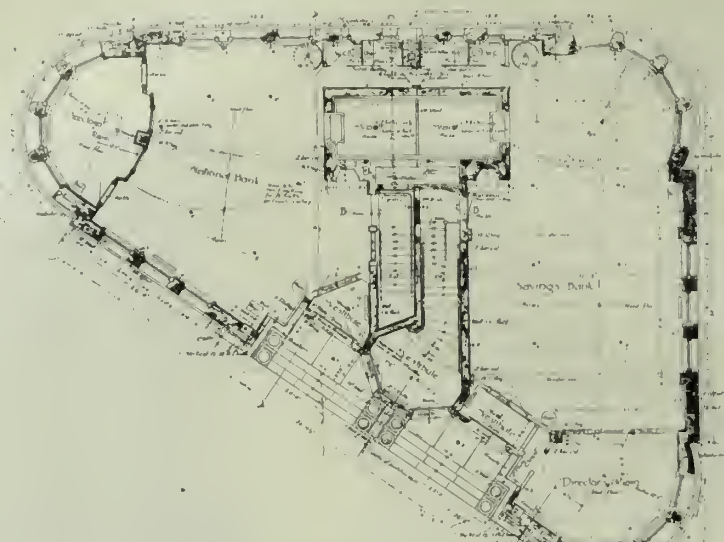
BUILDING FOR Y. M. C. A., 8TH AVENUE, NEW YORK.
Parish & Schraeder, Architects.
Built of gray brick and terra-cotta made by the Excelsior Terra-Cotta Company.

or not be a plaza in front of the city hall, came the disastrous fire of a few weeks ago, which practically destroyed every building in the block fronting the city hall on the northeast. This is one of the very blocks which the advocates of the plaza project have been endeavoring to have the councils condemn for that purpose, and the destruction of the buildings will now compel them to decide once for all whether it shall be done. It is obvious that there will never be another such an opportunity offered, and should councils fail to act now, the plaza project will undoubtedly be a thing of the past, and be shelved with the boulevard and other like propositions. There seems, however, to be a decidedly outspoken sentiment in favor of the project at the present time, and an ordinance has been drafted and published, for submittal to councils at their next session, which, if passed will at once clothe the proper authorities with power to take the preliminary steps in the condemnation proceedings, and it is not unlikely that the long-wished-for time has arrived when the city hall will be at least partially relieved from the danger of being entirely pent up upon all sides with sky-scraping buildings. If condemnation proceedings do not issue at once, active preparations will be made to immediately rebuild the destroyed portions.

Bids have been asked for the erection of a building on the corner of 7th and Sansom Streets, for the Philadelphia *Press;* the building will be 38 by 91 ft. in size, ten stories high, steel frame with brick walls, and stone and terra-cotta trimmings, fire-proof floors, etc. The drawings are by Theophilus P. Chandler, and the work of construction is to commence at once. It is said that as soon as this building is completed the Chestnut Street front of the lot will be cleared and rebuilt to conform with the work now being commenced.

Messrs. Cope & Stewardson have completed the preliminary drawings for the Pennsylvania Institution for Instruction of the Blind, which will be built this summer at Overbrook, one of the most beautiful of the newly laid out suburbs of this city; the building will be very large and commodious, will be built somewhat after the manner of the monastery, and will consist of a central administration building with reception and executive departments, and two wings, cloisters for girls and boys respectfully. The material for the building will be stone, plastered and pebble-dashed on the exterior, with trimmings and columns of terra-cotta, set in position by the stone-mason. Bids for the work will shortly be asked.

A very pretty alteration by Keen & Mead, architects, shown in the accompanying illustration, is situated on the corner of 15th and Jefferson Streets, is of Pompeian brick with red stone trimmings, the tympanum of the arches being of colored plaster, with small colored shields.



FIRST FLOOR PLAN, BANK BUILDING, NEWTON, MASS.
Elevations shown on plates 23 and 24.
William G. Preston, Architect.

ST. LOUIS. — At the present time there seems to be considerable energy back of the proposition to cut Locust Street through the Exposition Building from 13th to 14th Street. Should this be done, the scheme to give us a place in which to hold large meetings will necessarily be abandoned for the present, at least, as the proposed amphitheater was to be located in the north wing of the Exposition Building.

The property upon which the Exposition stands was given to the city years ago to be used perpetually as a public park, and was leased to the Exposition for fifty years, and the question as to whether a street can be cut through the property will doubtless have to be passed upon by the courts.

Churches have been among the many improvements that the growth of our city and the migration of the wealthy have made necessary. Last month three large churches were dedicated within eight days: The Lafayette Methodist Episcopal Church, the Lindell Avenue Methodist Episcopal Church, and the Jewish Synagogue for Shaare Emeth congregation.

The old Lafayette Church was a victim of the cyclone last May, and in the rebuilding the seating capacity has been more than doubled to meet the demands, and provisions have been made for addition in the future.

Messrs. Link & Rosenheim were the architects of the Lindell Avenue Church and the Synagogue, and in the latter they have designed a building to meet the modern requirements and advanced thought of the Jewish Church. Past traditions and customs have influenced them but little, and there is nothing to distinguish it from its near Protestant neighbors.

Besides the above mentioned there are a number of other large churches under contemplation, some of which will doubtless assume definite shape soon.

CHICAGO.— It is too early for spring building and there will probably not be much of a rush this year. Business is indeed dull. Some architects who have been important factors in Chicago work say that they have done nothing for a year or more.

The items of most importance just now seem to be warehouses, of which about half a dozen are in progress. Mr. Dankmar Adler has two to build, one 80 by 100 ft., nine stories high, and the other 50 by 100 ft., eleven stories. Pile foundations will be used, and the general construction will be, at least partially, fire-proof.

One announcement is that Greifenhagen & Kingsley are designing an apartment building exceeding $100,000 in cost.

Dwen & White are directing work on the McCoy Hotel, which is to be remodeled at considerable expense.

J. H. Wagner is the architect of a $60,000 shoe factory, which is just beginning construction.

AUBURNDALE PUBLIC SCHOOL BUILDING, TOLEDO OHIO — E O FALLIS ARCHT NASBY TOWER, TOLEDO OHIO —

PITTSBURG.— As the winter months are coming to a close business in the architectural and building lines is livening up considerably, and much work is talked of and planned for the coming season. The Central Board of Education has settled on two sites for the proposed sub-high schools one in the East End and the other on the South Side.

NINTH PRECINCT POLICE STATION, BROOKLYN, N. Y.
Frank Freeman, Architect.
Architectural terra-cotta made by the New Jersey Terra-Cotta Company.

An ordinance has been prepared for an appropriation for the erection of an isolation hospital in this city, to accommodate one hundred patients, and to cost between $150,000 and $200,000.

Architect F. J. Osterling will prepare plans for an insane asylum, an addition to the Allegheny City Home at Claremont, to cost $60,000.

It is rumored that the Pennsylvania Railroad Company is contemplating the erection of a new station at East End, to be of brick, and cost about $75,000.

Architects J. E. Carlisle & Co. were the successful competitors out of ten of the leading architects of this city for the new school building at Turtle Creek. It will have sixteen rooms, be fire-proof, and cost $40,000.

The First Presbyterian congregation of Wilkinsburg is contemplating the erection of a church building, to cost about $30,000.

Architect F. C. Sauer is preparing plans for a new parochial school building for the St. Joseph's Church at Allegheny.

It is reported that Mrs. Mary Kaufman will erect about thirty houses along Fifth Avenue, Walnut, and Howe Streets. They will cost from $7,000 to $12,000 each.

Architect T. D. Evans is preparing plans for a residence for Geo. Bennett, Esq., to be erected on Fifth Avenue, Bellefield, to cost $30,000.

Architect Thomas Boyd has prepared plans for a Pompeian brick residence at Beaver, Penn.

Architect Edward Stotz has prepared plans for a new town hall at Sistersville, W. Va. Mr. Stotz was the successful architect in the competition for the People's National Bank to be erected at McDonald, Penn.

Homestead is agitating the question of erecting a new town hall.

Bradford is contemplating the erection of a public building, to cost $60,000.

There will be considerable building at Turtle Creek the coming spring and summer.

Westmoreland County will invite architects to submit plans for a new court house.

MINNEAPOLIS. — We are in the midst of our midwinter dulness, with more or less of uncertainty staring us in the face as to what the spring will bring forth. We have reason to believe that it will be a material improvement over last spring, both in the amount and character of the work to be done.

It is understood that our Chamber of Commerce will not erect a new building, but will cover their present lot with an addition, to cost approximately $50,000. Architects were hoping that a well-conducted local competition would spring from the erection of a new building. The present one is such an eyesore and so inconvenient that a new and more representative structure is devoutly wished for by those interested in our city artistically.

Architect George E. Bertrand has begun an education of the public on good architecture, and has presented some very tasty designs for the various problems arising in general practise, showing the adaptability of Greek models to our present needs. Let us hope his labor may not be in vain.

Two of our leading architects have turned their attention to the manufacture of acetylene gas, each having devised a generator that is superior to the others, and formed stock companies, and disposed of territory, etc. They will certainly find it more profitable than architecture, as it is practised in these parts. An architect, to be thoroughly conscientious and dignified, must either be independent or be content with a bare existence.

A medical building to be operated in connection with Hamline University by Minneapolis College of Physicians and Surgeons; cream brick and cut stone trimmings, and to cost about $50,000.

Governor Clough has recommended a prison for women, to be located near the twin cities, and to cost approximately $100,000.

Among the larger enterprises of the month may be mentioned school buildings at Waterloo, Ia., and Kaukauna, Wis., by Orff & Joralemon. The former 68 by 108 ft., 8 rooms, of Gladbrook brick, cost, $30,000. Latter, 80 by 100 ft., 12 rooms, of brick with slate roof, cost, $50,000.

MONMOUTH COLLEGE AUDITORIUM BUILDING, MONMOUTH, ILL.
D. E. Waid, Architect.

Flat building on Dayton Avenue, St. Paul, planned by F. A. Clarke, 18 apartments, to cost $75,000.

A bill has been introduced into State legislature calling for an inebriate department at Rochester Insane Hospital, to cost $50,000.

There is an effort being made to so shape legislation as to allow of completing our new Capitol Building within a reasonable time, and permit of a saving of from $20,000 to $50,000 dollars. There seems to be a disposition to use the full ten years contemplated by the bill, but those conversant with the matter hope that it may be put through in a more business-like manner and within a reasonable time, say by the time our next session of legislature sits, two years hence.

THE International Correspondence Schools of Scranton, Penn., have been in existence less than six years, but have amply demonstrated their reason for being by drawing pupils not only from Pennsylvania, but also from all over this country and from several foreign lands. We have received the Circular of Information of the Correspondence School of Architecture, which covers only one of the many branches in which instruction is offered. The method of these schools is implied by their name, and while they are not as far reaching as our higher technical schools and colleges, they are certainly a boon to the busy man; to the poor artisan who seeks to better himself; to the engineer in charge of a power plant, who feels the lack of education; and to the aspiring office boy in a busy architect's office, who wants to rise but cannot afford a college education. They offer a substitute, but a most excellent one, and to judge by the sample pages of instruction papers, the fifty dollars invested in one of the scholarships, if followed by a couple of hours of daily application, would certainly result in vastly enlarging one's powers, even if it did leave a few architectural facts and experiences still to be acquired.

BOHEMIAN CLUB HOUSE, EAST 71ST STREET, NEW YORK CITY.
Julius Franke, Architect.
Built of gray brick and terra-cotta made by the Excelsior Terra-Cotta Company.

NEW CATALOGUES.

THE STANDARD DRY KILN COMPANY, Indianapolis, Ind., present their case in one of the handsomest and best gotten up catalogues that has ever come to our notice. The covers are bound in leather, padded in album style; in fact, it is nothing less than an album, containing as it does some forty or more fine half-tone illustrations of large clay-working plants in this country. These illustrations are accompanied by testimonial letters from manufacturers, which must be accepted as conclusive evidence of the worth of the dryers and various other clay-manufacturing appliances which are made by this company. We presume this catalogue will be sent to any one upon application to the company, and certainly it should be possessed by every one interested in the manipulation of clays.

THE CUTLER MANUFACTURING COMPANY, Rochester, N. Y., have issued another interesting number of their series, entitled, "Details from Italian Palaces," measured and drawn by Claude F. Bragdon. The enterprise shown by this company in giving a series of sketches of subjects that have not been "published to death" is refreshing and commendable.

THE half-tone process as a means of effective illustration is being made good use of by the Chambers Brothers Company, Philadelphia, in a series of pamphlets, showing their various patterns of brick-making machinery. The latest which has come to our notice shows two pugging mills and a clay disintegrator, in a manner that leaves little to be desired.

PRESS-BRICK CONVENTION.

THE annual convention of the general managers of the various branches of the Hydraulic Press-Brick Company of St. Louis was held in that city, beginning with Monday, February 8, and was continued for several days.

The various plants of the company, located in nine different cities, were represented by their general managers.

These yearly gatherings are important to the company from the fact that they bring together representatives of leading industries, covering a large section of the country. The reports of the managers of the general conditions prevailing, as made at the meeting, declare that the outlook for the coming season is very much better than has been experienced in the past two years, and a general revival of the building interests may be fairly expected. Mr. E. C. Sterling and Mr. H. W. Eliot, as president and secretary, respectively, of the parent company, hold the same offices in the various branch companies, and the proceedings of the convention are conducted under their direction. The combined product of the companies represented by these gentlemen, it is said, now amounts to more than 300,000,000 pressed bricks annually, and the capital invested in the various companies exceeds $13,000,000. Mr. G. F. Baker has had charge of the arrangements of the convention, to whom, as well as to the other officers of the company, the success of the meeting was largely due.

Among the interesting subjects for discussion was the "Chemistry of Clays," on which a very able address was made by Mr. W. M. Chauvenet, in which he took up this very broad question, and explained the characteristics of the large number of clays worked by companies in all sections of the country, in their relation to the actual manufacture of bricks. The address was unique, as being probably the most practical lecture on the subject ever given before a similar body.

A NEW THING IN BRICK.

WE have had brought to our notice a novel production by the well-known manufacturers of fire-proof building material, Henry Maurer & Son, 420 East 23d Street, New York City, and believing the same will be of interest to our readers, we give a few of the claims made for it by the manufacturers.

It is a brick which they have named the "Centaur," patented in the United States, Great Britain, Canada, and France, and is claimed to possess the following characteristics:—

It is absolutely fire-proof, yet, while seemingly as hard burnt as a front building brick, and nearly as dense, has the peculiar quality, and one heretofore deemed impracticable in a brick of allowing nails, to be driven into it as closely as one pleases, without either splitting or chipping, and the tenacity inherent in said material is such that after being driven "home" it becomes as difficult to draw the nails as though driven into hard wood.

They are impervious to all weather, and will not disintegrate upon exposure, a failing hitherto associated with porous terra-cotta.

They can be employed jointly with common brick on inside of walls in any and all cases where nailing is requisite, providing a thorough and reliable surface for nailing furring strips to the wall, giving also excellent "grounds" for all trim (hard or soft).

If these claims are substantiated, and we have no doubt they have been, it becomes readily apparent that their use will make a great saving in time, labor, and expense in construction, to say nothing of their other novel features.

INTERESTING NEWS ITEMS.

MESSRS. G. R. TWICHELL & Co. have been appointed the agents of the New Jersey Terra-Cotta Company for New England.

THE AMERICAN MASON SAFETY TREAD COMPANY has made a contract with the city of Boston to apply its non-slipping material to the worn granite steps of all police stations.

THE PERTH AMBOY TERRA-COTTA COMPANY will supply the architectural terra-cotta used in the residence for George J. Gould, Esq., at Lakewood, N. J., of which Bruce Price is the architect.

THE face brick used in building the Yerkes Observatory at Geneva, Ill., were gray in color and not buff, as stated in our January number. They were furnished by the Columbus Brick and Terra-Cotta Company, Columbus, Ohio.

THE new cream-white brick made by the Pennsylvania Enameled Brick Company are a solid body mud brick that give a true ring when rapped with a hammer. Meeker, Carter, Booraem & Co., New York, will handle the output of these bricks.

G. R. TWICHELL & Co., Boston, are supplying an old-gold face brick for the new hotel at Providence, R. I., for which Cady & Co. are the architects. They are also supplying a gray brick for the new block of stores on Massachusetts Avenue, Cambridge, C. Herbert Clare, architect.

THE PERTH AMBOY TERRA-COTTA COMPANY have closed contracts for terra-cotta for the following buildings: Hotel Cheltenham, A. H. Bowditch, architect; Gardiner H. Shaw, builder. Office building, Washington and Bromfield Streets, Winslow & Wetherell, architects; the Geo. A. Fuller Company, builders; both contracts being made through their Boston agents, Waldo Brothers.

WALDO BROTHERS have secured the New England agency for the Atlas Cement Company. This company is enlarging its plant at Northampton, Penn., and will have the largest output of any of the American Portland Cement companies. They will continue to have but one brand and one quality, every barrel of their output carrying a specific guarantee for strength and fineness.

SUCH an indorsement as is given in the following letter, received by the Folsom Snow Guard Company, from F. W. Chandler, Esq., Professor of Architecture, Massachusetts Institute of Technology, and consulting architect on Boston public buildings, is of value, not only to the favored manufacturer, but to the architect and builder as well.

To Whom it may Concern: I have often used Folsom Snow Guards because I consider them better than the rail. The former hold the snow where it falls, while the latter makes the snow bank up with the consequent danger of back water and a wet interior.

F. W. CHANDLER.

THE ZANESVILLE MOSAIC TILE COMPANY have closed the contract through their agents, O. W. Peterson & Co., Boston, for the tiling in the five-story apartment house on Westland Avenue, Boston. Arthur H. Bowditch, architect.

The contract includes the tiling of twenty bath rooms, two porches, two vestibules, two main halls, and twenty fireplaces. The tile selected for this work is designated by the company as the Parian Vitreous Tile, of which they are the sole manufacturers.

THE STANDARD TERRA-COTTA COMPANY have secured through their agents, O. W. Peterson & Co., Boston, the terra-cotta to be used in the Masonic Temple, Pawtucket, R. I., Wm. R. Walker & Son, Providence, R. I., architects; W. T. Dearborn & Son, contractors.

They have also closed the contract for the terra-cotta (gray) to be used in the Odd Fellows' Building, Attleboro, Mass., Alfred Humes, of Pawtucket, architect; Benj. Smith, contractor; and the contract for the terra-cotta (light buff) to be used in a business block now being erected in Pawtucket, R. I., Wm. R. Walker & Son, Providence, R. I., architects; Benj. Smith, builder.

MEEKER, CARTER, BOORAEM & Co. have recently secured two contracts for furnishing the University Library of Columbia College. One contract calls for some sixty thousand brick, including a large number of special brick for the base course in the hall and stairways of the library. These will be furnished by the American Enameled Brick & Tile Company, who are expert at making special brick.

The second contract calls for the furnishing of some thirty odd thousand pure white front brick for the same building, from the output of the Pennsylvania Brick Company, for whom they are agents.

The architects of this work are Messrs. McKim, Mead & White. The builders are Messrs. Norcross Bros.

THE NEW JERSEY TERRA-COTTA COMPANY has now completed the terra-cotta work for the Y. M. C. A. building at Cambridge, Mass., and Masonic Temple, Newton, Mass., Hartwell, Richardson & Driver, architects; the Ninth Precinct Police Station, New York City, John Du Fais, architect; and the Osterweis Building, New Haven, Conn., Brunner & Tryon, architects.

Of new contracts this company has received: stores 37th Street and Broadway, New York City, Hoppin & Koen, architects; warehouse, 455, 457, 459 West 14th Street, New York City, Thos. R. Jackson, architect; apartment house, Pineapple and Hicks Streets, Brooklyn, J. G. Glover, architect; chapel and lecture hall, Van Nest, N. Y., James H. McGuire, architect; apartment house, 65th Street, New York City, Geo. Keister, architect.

W. S. RAVENSCROFT & Co. have recently purchased the village of Daguscahonda, Penn., together with a large clay bed of several hundred acres which adjoins the town. The property was purchased for the purpose of developing the clay deposits located there, and the company are at the present time equipping a large plant for the manufacture of front brick, by the most approved methods. The character of the clay gives them quite a range of color in the variety of bricks produced, varying from the dark mottled shades to old gold, light buff, and the various effects of gray. The company state that it is their intention to make a specialty of their gray and buff bricks, as they have been able to produce particularly desirable shades in this respect, and anticipate that the demands on these two lines alone will equal the capacity of their plant. These bricks are similar to the well-known Ridgway gray and buff that have won such extensive favor during the past two years. The two plants are only a few miles distant from one another, and the clays are said to be identical. The town of Daguscahonda is situated on the Philadelphia and Erie branch five miles east of Ridgway. Mr. Ravenscroft organized and built the Shawmut and Ridgway plants, and is still a stockholder in the last-named company. He is also a director in the Savage Fire Brick Company of Keystone Junction, Penn.

EVOLUTION IN BRICKMAKING.

BURNT clay is the oldest and most primitive of all building materials, and has been used for untold centuries in much the same manner as we use it to-day. But although bricks have always been fashioned out of clay, the evolution from the primitive brick-yard, with its crude appliances and laborious manual devices, to the modern plant, with its highly organized mechanical equipment, is a development of the past two generations, and brickmaking at the close of the nineteenth century can be classed as an exact science, representing results of long and costly experiments, and calling for investments of capital and vastness of operations on a plane with the largest of American enterprises. The extent of the development of brick manufacturing is well illustrated by the plant of the Sayre & Fisher Company, at Sayreville, N. J., which was originally established in 1851, by Jos. R. Sayre, Jr., and Peter Fisher, who remained in partnership until 1887, when the firm was incorporated as a stock company, with Jos. R. Sayre as president, Peter Fisher as treasurer, and E. A. Sayre as secretary, and has continued since that time without any change in the management. The manufacture of brick was begun at this plant in 1852. Only 3,000,000 common bricks were produced the first year, whereas in 1896, 73,000,000 bricks of all kinds were turned out, and the daily consumption of clay and sand, which in 1852 was about 75 tons, rose to 1,000 tons in 1896.

The company controls over a thousand acres of clay beds. A force of from six hundred to eight hundred men is employed in buildings which are fully equipped with modern machinery, exclusively devoted to the manufacture of brick, and extend along the full length of the frontage on the Raritan River, with a wharfage a mile in total length, from which the output is shipped directly by water or by rail to any part of the world. All the Sayre & Fisher common bricks are made by the soft mud process, while the stiff mud process is used for front bricks, the regulation machinery being utilized for each.

As the front bricks are the ones in which most of our readers are presumably the more interested, we would briefly explain the stiff mud process as follows. The clay, after being thoroughly seasoned, is mixed dry, then run through crushers, where it is pulverized, then through a "wet" mixer, where it receives additional mixing, then through a die, to form the clay into the proper shape for cutting, thence being delivered to a machine which cuts it into bricks of the required thickness. The bricks so formed are then subjected to a heavy steam pressure, then dried by hot air, then burned in the kilns. The ordinary down-draft kilns are used, of which there are sixty-three in all, with a capacity running from 30,000 to 600,000 bricks, the average capacity being about 300,000 bricks. The process of manufacturing is in every way facilitated by the adoption of the best approved machinery, every stage of the work having its particular appliance. From the loading of the clay on the cars by the steam shovel to the transfer of the burnt bricks from the kiln there is everywhere employed the best possible device to save labor, and with a view to still further economy of labor the company has recently, at a great expense, equipped its entire plant with electricity.

The clay banks of the company contain no less than eighteen different kinds of clays, and hence it can produce a great variety of shades in brick, not by artificial coloring matter, so apt to fade, but by the careful selection, intermixture, and burning of the clays. The annual output of the plant is over 73,000,000 brick. Of this some 64,000,000 are common, and the remaining 9,000,000 face and enamel brick.

THE QUEEN INSURANCE COMPANY'S BUILDING, CEDAR AND WILLIAMS STREETS, NEW YORK CITY.
W. A. & F. E. Conover, Contractors. Harding & Gooch, Architects.
Brick furnished by Sayre & Fisher Company.

The Sayre & Fisher Company was among the first, if not absolutely the first company, to offer a variety of shades in brick. The first departure from the ordinary "red" was a gray buff, which was put on the market in 1863. This was the first buff brick made in New Jersey, and used to easily bring sixty dollars per thousand. The company at the present time is making white, buff, red, gray, brown, old gold, mottled, and all the intermediate shades of brick, and these have acquired for themselves an enviable reputation for holding their color and being hard and fire-proof in character.

The enamel brick department is of a size and character in keeping with the vast proportions of the rest of the plant. The method employed here is what is known as the English process, wherein the enamel is placed on a fire-brick body and burnt with one firing. The number of shades which the company manufactures and keeps in stock, as illustrated in their catalogue, is over twenty-eight. This gives a wide range for selection in the choice of color.

Nearly all of the machinery used in the works is manufactured by the company in a large machine shop of its own. All of the departments are kept in the most thorough working order, so that the vast organization operates with a smoothness and uniformity which makes possible the uniform excellence of the output. The attention to detail which the company shows is evinced in the consideration given to the men in its employ. Among its thousand or more employees there is a large proportion of single men, and for their benefit the company has erected a large building which is to all intents and purposes a regulation club house, in which the men can sleep and have their meals, and where they can enjoy, with some necessary restrictions, all the comforts and privileges that men desire in a well-equipped club.

The New York office of the company has been since its establishment, seven years ago, under the efficient management of Mr. A. J. Fletcher. The large and ever-increasing sales in the New York market, of brick made by this company, testify to the genuine merit and popularity of the output, combined with the energetic and conscientious management of the department through which this output is sold. The company has branch offices in Baltimore, Philadelphia,

BOWLING GREEN BUILDING, NEW YORK CITY.
W. & G. Audsley, Architects.
White brick furnished by the Sayre & Fisher Company.

Buffalo, Newark, Chicago, and Boston, and in all of these cities the number of Sayre & Fisher bricks used annually is rapidly increasing. and deservedly so.

The list of large and prominent buildings in which Sayre & Fisher bricks have been used is so long that we can only cull from it a few of the most well-known structures.

NEW YORK.

Bowling Green Building	800,000 white brick.
Cable Building	500,000 ,, ,,
Bank of Commerce	400,000 cream-white brick.
Lord's Court Building	500,000 gray brick.
Central National Bank Building . .	300,000 ,, ,,
St. Luke's Hospital	300,000 white enameled brick.
American Surety Building	80,000 ,, ,, ,,
	and 115,000 light-gray brick.
Presbyterian Building	40,000 white enameled brick.
Manhattan Life Building	140,000 buff brick.
Mutual Life Building	160,000 ,, ,,
	and 40,000 gray brick.
The Dakota Apartment House . .	360,000 buff brick.
Colonial Club	60,000 ,, ,,
Museum of Natural History . . .	30,000 ,, ,,
Life Building	30,000 ,, ,,
Metropolitan Museum	200,000 ,, ,,
Fifth Avenue Theater	25,000 ,, ,,
Manhattan Athletic Club	80,000 ,, ,,
Residence of Mrs. W. K. Vanderbilt	45,000 mottled brick.
Central Building	250,000 old gold ,,
Taylor Building	185,000 ,, ,, ,,
Postal Telegraph Building . . .	160,000 gray brick.

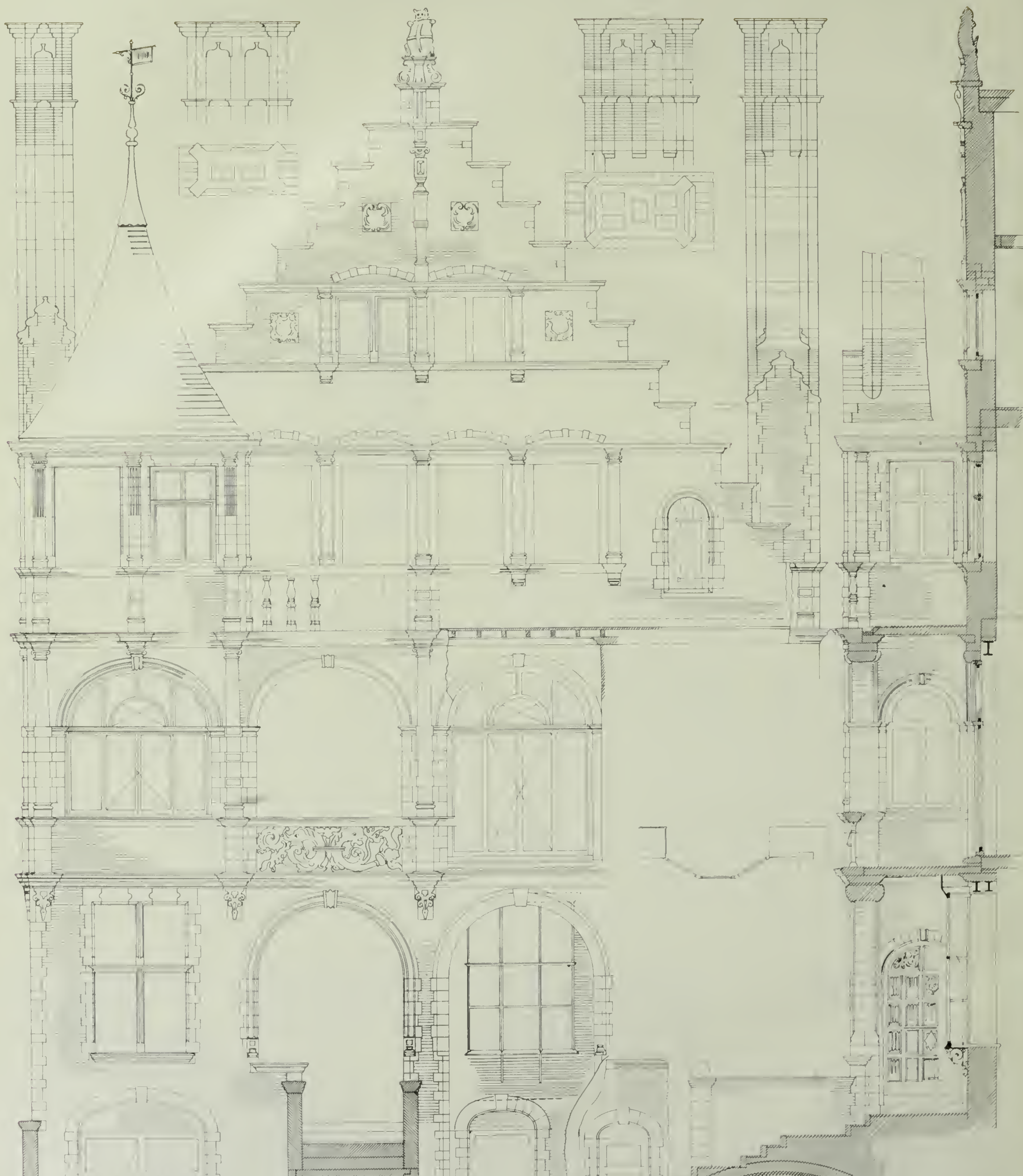
BOSTON.

State House Extension	200,000 buff brick.
Castle Square Theater	120,000 white brick.

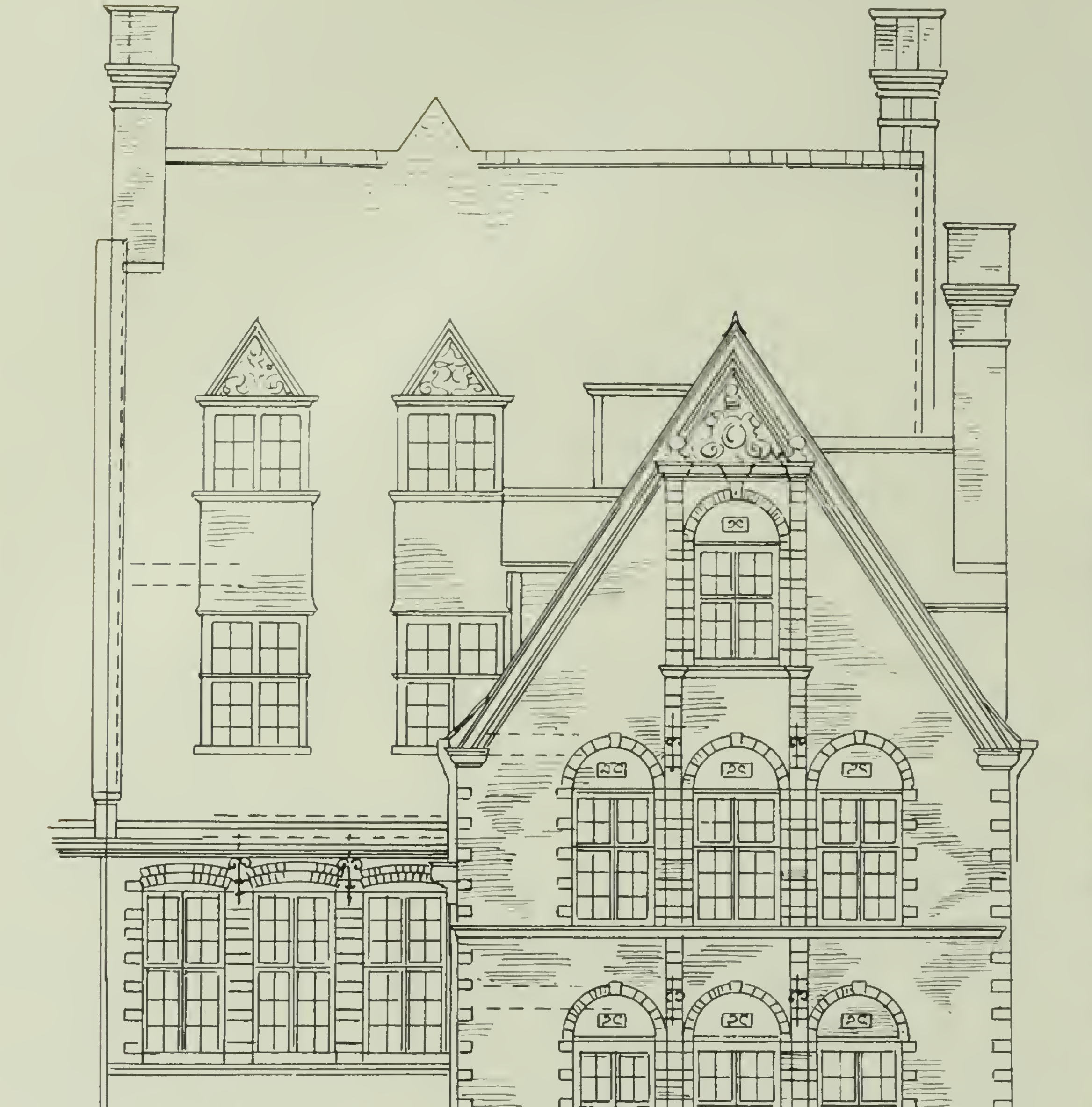
In a general way it can be said that the Sayre & Fisher bricks are used very largely throughout the Eastern, Middle, Western, and Southern States.

A very good view of the company's extensive plant is shown in their advertisement on page xvii.

INDEX TO ADVERTISEMENTS.



DETAILS OF RESIDENCE, COLLINGHAM GARDENS, LONDON, ENGLAND.
ERNEST GEORGE & PETO, Architects.



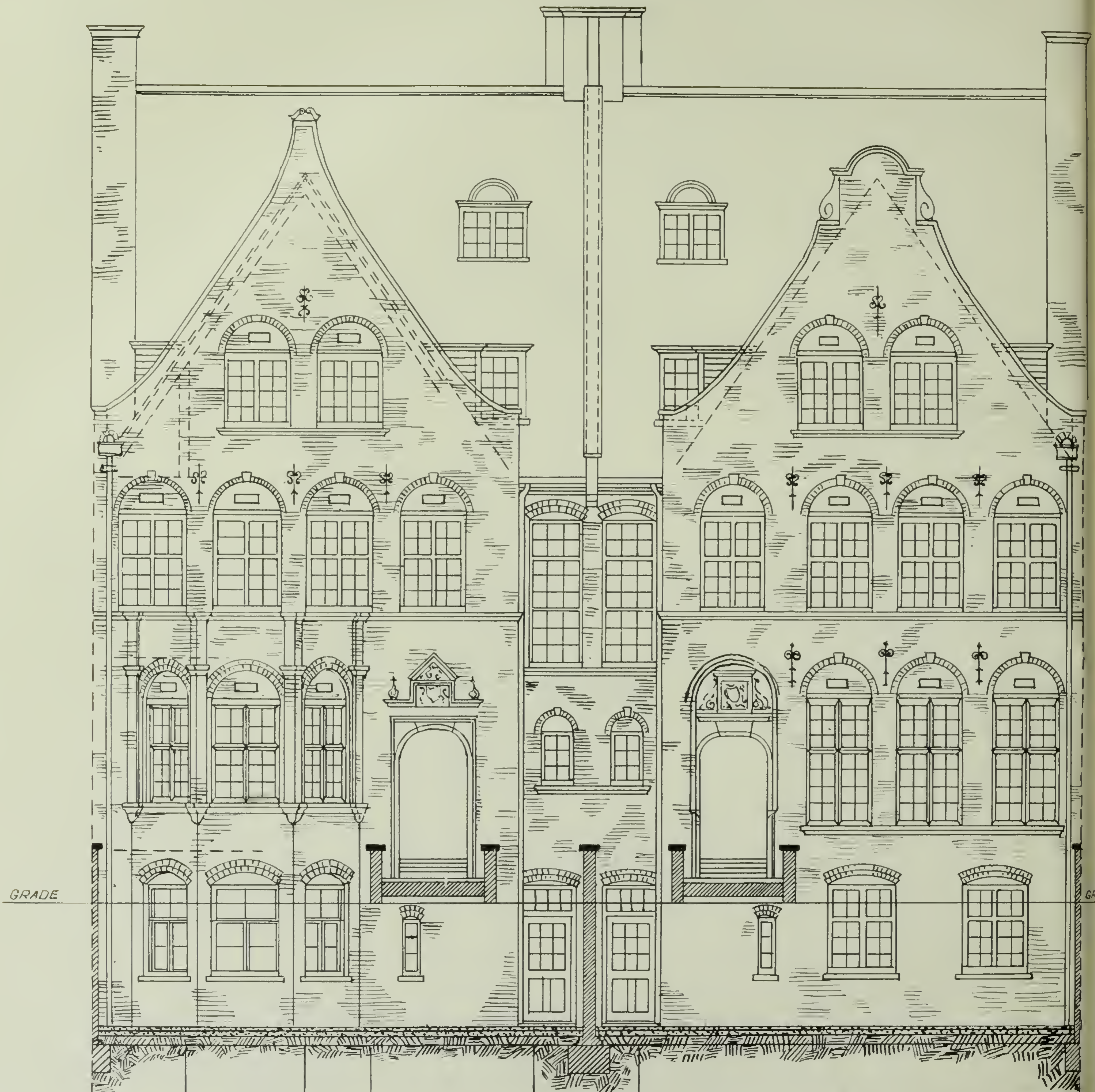
FLOOR PLANS OF RESIDENCES SHOWN ON PLATES 29 AND 30.

FRONT ELEVATION.

RESIDENCE, COLLINGHAM GARDENS, LONDON, ENGLAND.

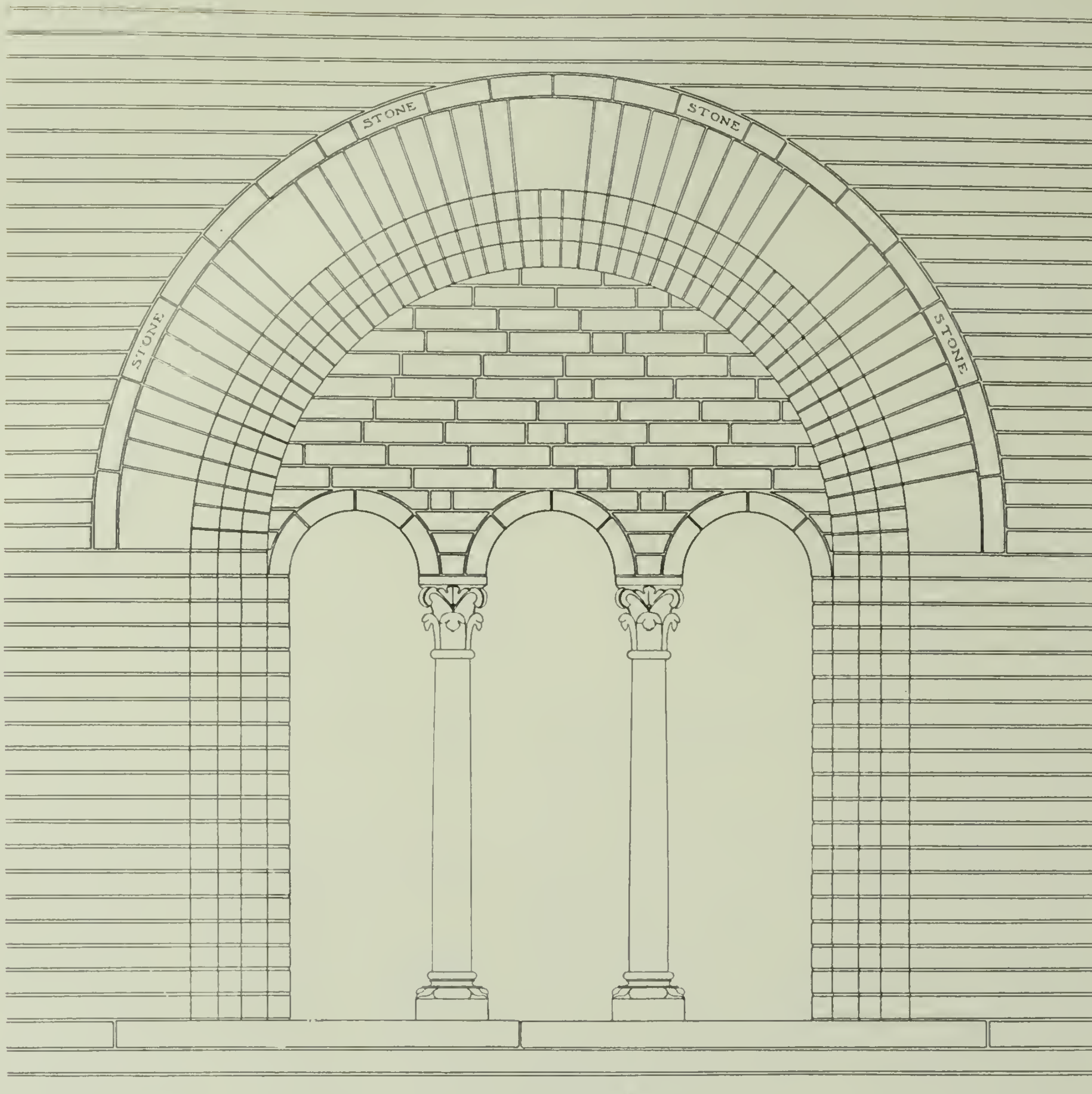
ERNEST GEORGE & PETO, Architects.

THE BRICKB
VOL. 6. NO. 3.

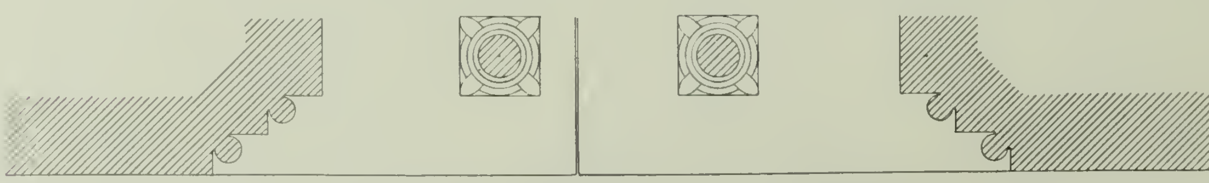


FRONT ELEVATION.

RESIDENCES, COLLINGHAM GARDENS, LONDON.



ELEVATION

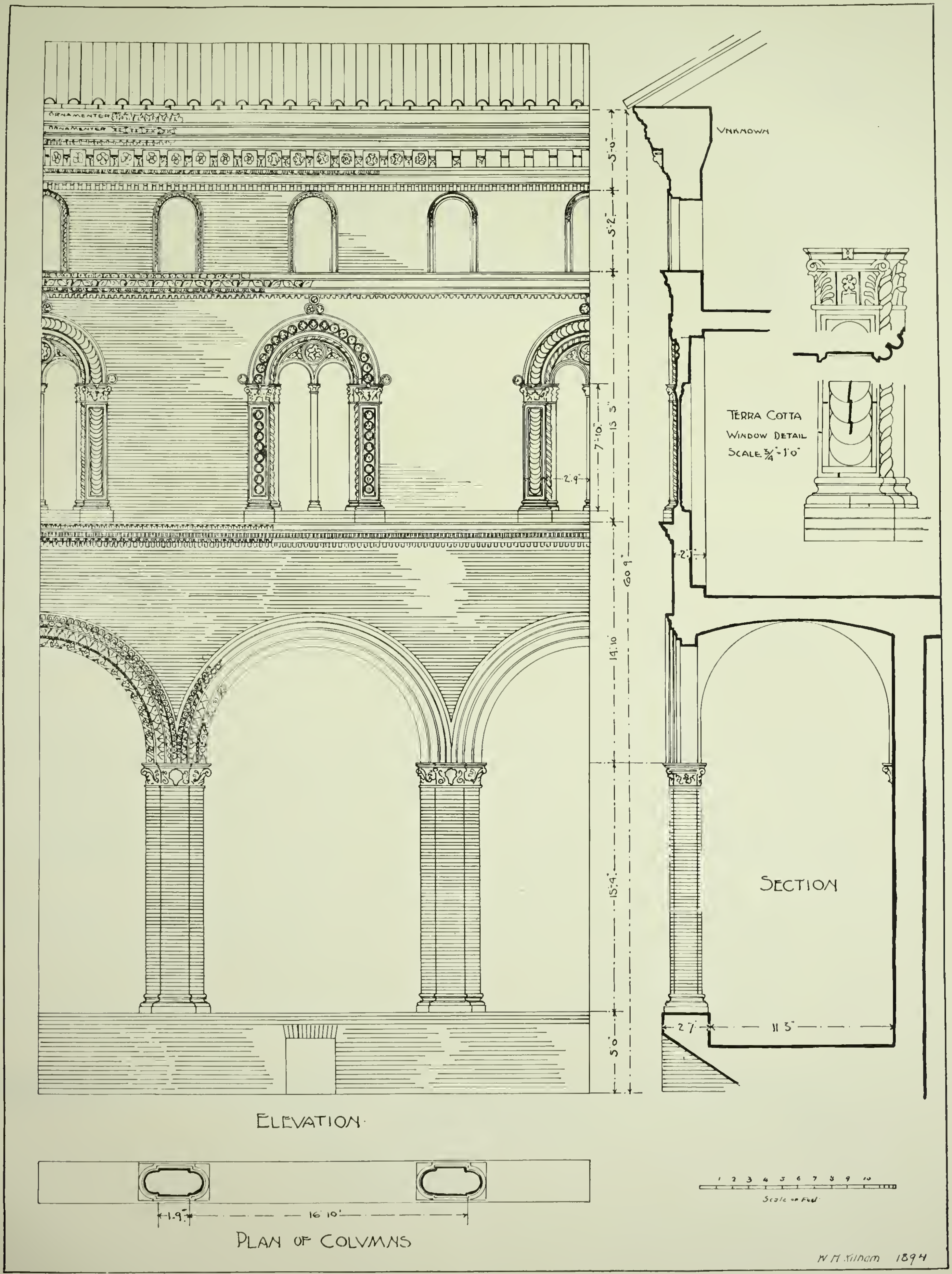


PLAN

SCALE

NOTE. Voussoirs Brick and Sandstone.
Columns and Sill Stone.
All other Work not marked differently, of Brick.

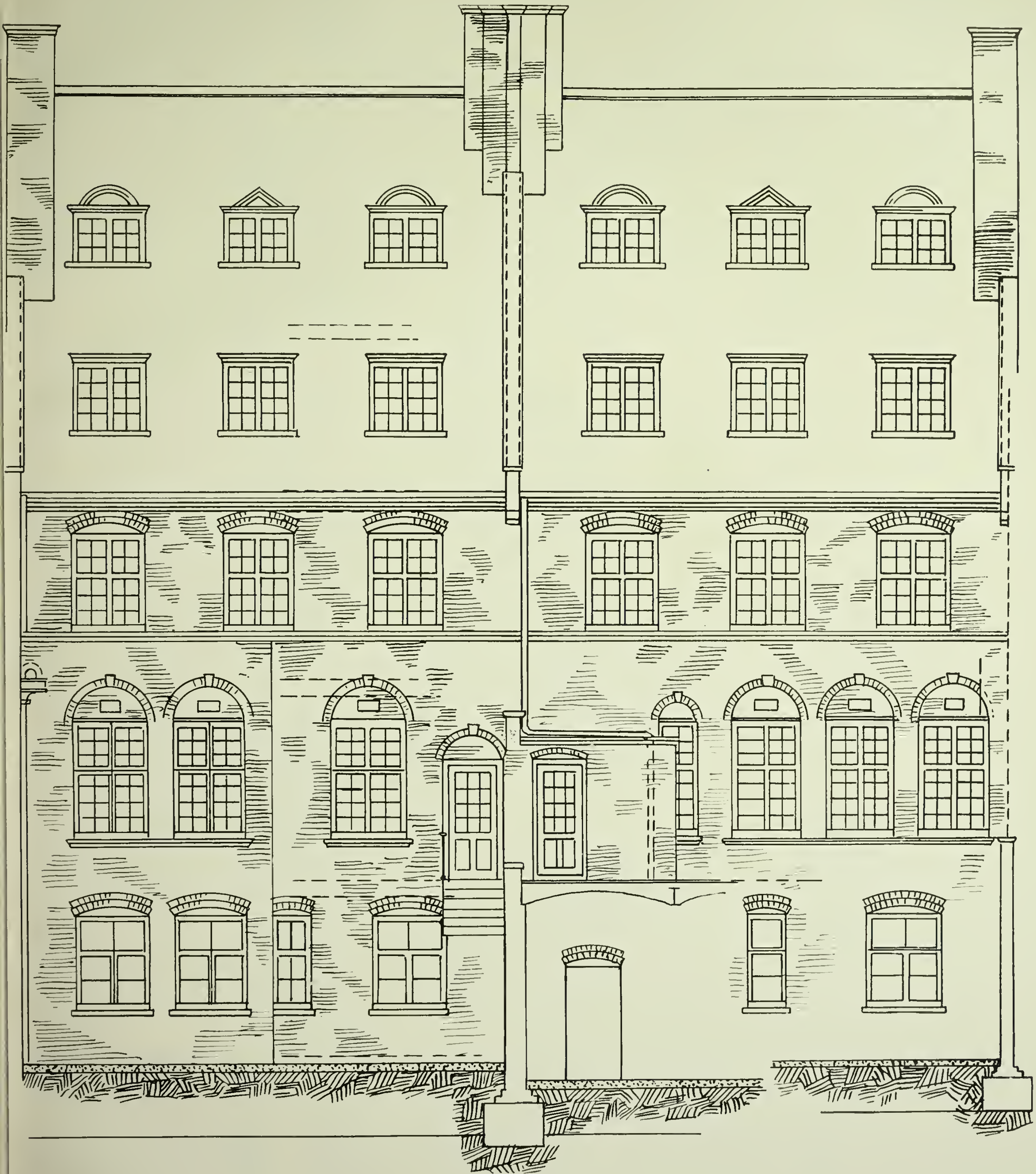
MEASURED DRAWING OF WINDOW IN SOUTH SIDE OF MUNICIPIA, MONZA.
THIRTEENTH CENTURY.



PALAZZO FAVA, BOLOGNA.

MEASURED AND DRAWN BY WALTER H. KILHAM, ROTCH SCHOLAR.

DER.
.ATES 29 and 30.



BACK ELEVATION.

ND. ERNEST GEORGE & PETO, Architects.

THE BRICKBUILDER.

VOL. 6. NO. 3. PLATE 28.

BACK ELEVATION.

RESIDENCE, COLLINGHAM GARDENS, LONDON, ENGLAND.

ERNEST GEORGE & PETO, Architects.

DETAILS OF RESIDENCE, HARRINGTON GARDENS, LONDON, ENGLAND.
ERNEST GEORGE & PETO, Architects.

VOLVME VI MARCH 1897 No. 3

THE BRICKBVILDER

OFFICE 85 WATER STREET BOSTON

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

PUBLISHED BY

ROGERS & MANSON,

CUSHING BUILDING, 85 WATER STREET, BOSTON.

P. O. BOX 3282.

Subscription price, mailed flat to subscribers in the United States and Canada	$2.50 per year
Single numbers	25 cents
To countries in the Postal Union	$3 50 per year

Entered at the Boston, Mass., Post Office as Second Class Mail Matter, March 12, 1892.

THE BRICKBUILDER is for sale by all Newsdealers in the United States and Canada. Trade Supplied by the American News Co. and its branches.

PUBLISHERS' STATEMENT.

No person, firm, or corporation, interested directly or indirectly in the production or sale of building materials of any sort, has any connection, editorial or proprietary, with this publication.

THE BRICKBUILDER is published the 20th of each month.

NOT long ago there occurred in this city one of those lamentable accidents which are of unfortunately only too frequent occurrence in our large cities, and which, in nearly every case, are so needless and could apparently have been so easily prevented that it is hard to have any toleration for the conditions which directly or indirectly lead up to them. In the Everett School, as the pupils were being dismissed, smoke was seen issuing from one of the rooms and an alarm for fire was raised, with the result that in their blind, unreasoning haste to escape from a possible danger, a panic seized the children and they were crowded together at the foot of the stairs leading to an inadequate exit to such an extent that many of them were badly injured, and it seemed for awhile as if very serious results would follow. The fire proved to be confined to a waste-basket, and was promptly extinguished by one of the teachers, but the occurrence itself, coupled with the fact that the schoolhouse is in no sense modern in its construction, ought to be the means of arousing a more decided public sentiment which would compel municipal authorities to adopt a better and more secure construction for every schoolhouse, no matter where located, or under what surroundings. There is no excuse in these days for the existence of a schoolhouse which under even the most extreme cases is liable to destruction by fire. If the Everett School had been built according to modern methods, with terra-cotta floors, steel beams, solid furrings, and as far as possible a total absence of wood, it is quite within the bounds of possibility that the pupils might even then have been seized with a panic, and quite as much harm might possibly have ensued; but the moral influence upon the children of knowing that they are in a fire-proof building would naturally tend to lessen their liability of becoming excited upon an alarm of fire, while the chances are that if our municipal authorities should insist on all occasions upon a fire-proof construction, it would mean as a consequence more care devoted to arrangement of the schoolhouse, with the probability that better staircases and better exits would be provided and the likelihood of any occurrence such as we have cited would thereby be greatly lessened. It is no excuse to say that the Everett Schoolhouse was provided with fire-escapes. It has been said with perfect truth that only a person of mature mind and well-balanced head is competent to successfully descend even our best constructed external fire-escapes, and children are as likely to meet death on an iron fire-escape attached to the exterior of a building as they are to be overcome by the conflagration within. We do not by this imply that fire-escapes should be omitted; on the contrary, they should be provided, but on a much more ample and secure scale than is adopted at present, and instead of being aerial balconies perched on the exterior walls, they should consist of thoroughly fire-proof stairs enclosed in brick walls, with the access to each story cut off by self-closing fire-proof doors, the landings being of sufficient size to accommodate the greatest number of pupils that might use the stairs.

The fire-proofing of schoolhouses is a point which cannot be too strongly insisted upon. The trend of modern thought is entirely in this direction, and in our larger cities nearly all of the recent schoolhouses have been constructed on fire-proof lines. A few years ago the so-called slow-burning construction was advocated for schoolhouse floors, and a number of very fine buildings have been erected in accordance with this system. But however slow the combustion may be, it remains a fact that wood in any form is in no sense fire-proof, and that though the wooden beams may burn for quite a while without actually failing, it takes a very little wood to make a deal of smoke, and the moral effect on the pupils is what is to be most carefully considered rather than the ultimate resistance long after the building itself is uninhabitable. Wood in any form should be seduously avoided. With the floors constructed of steel beams and terra-cotta blocks, with mosaic or terrazzo finish for the floor surfaces throughout, with plastering applied directly to the masonry, and all partitions of terra-cotta or brick, a schoolhouse would be more durable, easier to keep warm in winter and cool in summer, would cost less for repairs, and the moral influence it would exert upon the students would in a very short time be such as to give them sufficient confidence to see a blaze start in one room without necessarily rushing panic-stricken to the nearest exit. It is contrary to all experience, contrary to the best interests of the community, and in the long run contrary to true economy, to build a schoolhouse with wooden floor construction; while as for schoolhouses constructed entirely of wood, they ought not to be tolerated anywhere, and the use of such where they exist ought to be immediately discontinued by the public authorities.

In this connection we regret to note the report that one of our neighboring cities is about to commence the erection of a Latin high school, costing upwards of $200,000, in which the entire floor construction is to be of ordinary narrow wooden beams, and in which the partitions, though mostly of brick, are carried only to the ceiling of the upper story, leaving a large roof space undivided by brick walls. This is so fundamentally wrong that we can only hope our information may be incorrect, or that the authorities in charge may substitute steel and terra-cotta before it is too late. The introduction of so-called fire-proof paper between the upper and under floor boards is too insignificant a protection to be even considered. We repeat that the danger in a schoolhouse lies not so much in the total destruction of the edifice as in the possible destruction of life ensuing from a panic on the part of the pupils. The life of a single boy or girl is worth too much to be put at a risk on account of false economy, and so long as there is wood used in the construction of a schoolhouse, just so long are we liable to a recurrence of disasters similar to that in the Everett School; and until the parents can feel that their children are attending school under conditions abreast with the most intelligent thought upon the subject, just so long our school committees will continually fail to meet and properly provide for the fulfilment of a manifest duty.

THE PALAZZO FAVA, BOLOGNA.—PLATE 32.

THE Palazzo Fava is one of the largest and finest palaces in Bologna. Its finely proportioned brick façade of two stories carried on a graceful arcade is decorated with delicate red terra-cotta ornamentation around the windows and arches, and a strong cornicione at the top. As in most Bolognese buildings, the upper stories are carried out to the curb line, the ground floor being arcaded to form a covered sidewalk. The mullion columns of many of the windows have been cut away to make room for modern window frames, but several are left intact and are among the most interesting in Bologna. Inside there is a handsome court, the upper stories of which on one side are carried on handsome Renaissance corbels. The columns both of the court and outer arcade are built of rounded brick with carved stone capitals.

PERSONAL AND CLUB NEWS.

THE Tenth Annual Exhibition of the Chicago Architectural Club opens at the Art Institute, Tuesday evening, March 23.

A. WARREN GOULD, architect, Boston, has removed from the John Hancock Building to 2 A Beacon Street.

A. W. PUTNAM, architect, Dayton, O., has formed a copartnership with Frank L. Sutter, the firm name being Sutter & Putnam. Offices, Louis Block, Dayton, O.

AT the Chicago Architectural Club, on the evening of February 26, Mr. Hugh M. Garden read a paper on "Style," prepared by Mr. John W. Root for the club ten years ago.

On the evening of March 8, "Bohemian night" was observed, Messrs. Herbert Edmund Hewitt, Harry Dodge Jenkins, and E. Greble Killen being the hosts.

Monday evening, March 22, was Ladies' Night at the club, a reception being tendered the lady members of the Ceramic Club, who in turn served refreshments during the evening.

THE regular meeting of the New Jersey Society of Architects was held on March 12, at the Board of Trade Rooms, Newark. All sections of the State were well represented, and subjects of general interest were discussed. Three new members were added, Messrs. Brouse, Arend, and Poland, all from Trenton.

The entertainment committee announced that the annual banquet would probably be held in April. The association has permanently engaged the Board of Trade Rooms as a meeting place. Mr. John H. Post was elected to fill a vacancy in the trustees. A committee to obtain, by competition, an association seal, was appointed.

SATURDAY night, March 6, was Poster night at the St. Louis Architectural Club. There was a good collection; among them a number from Paris, exhibited by Mr. Ernst Klipstein. There were also a number of original designs by members of the club, of considerable merit. Among them one entitled "After the Symposium," *i. e.*, after returning home, by Mr. Ben Trunk. Also a very excellent one by Mr. Oscar Enders.

A number of visitors from the local chapter of the A. I. A. were entertained during the evening.

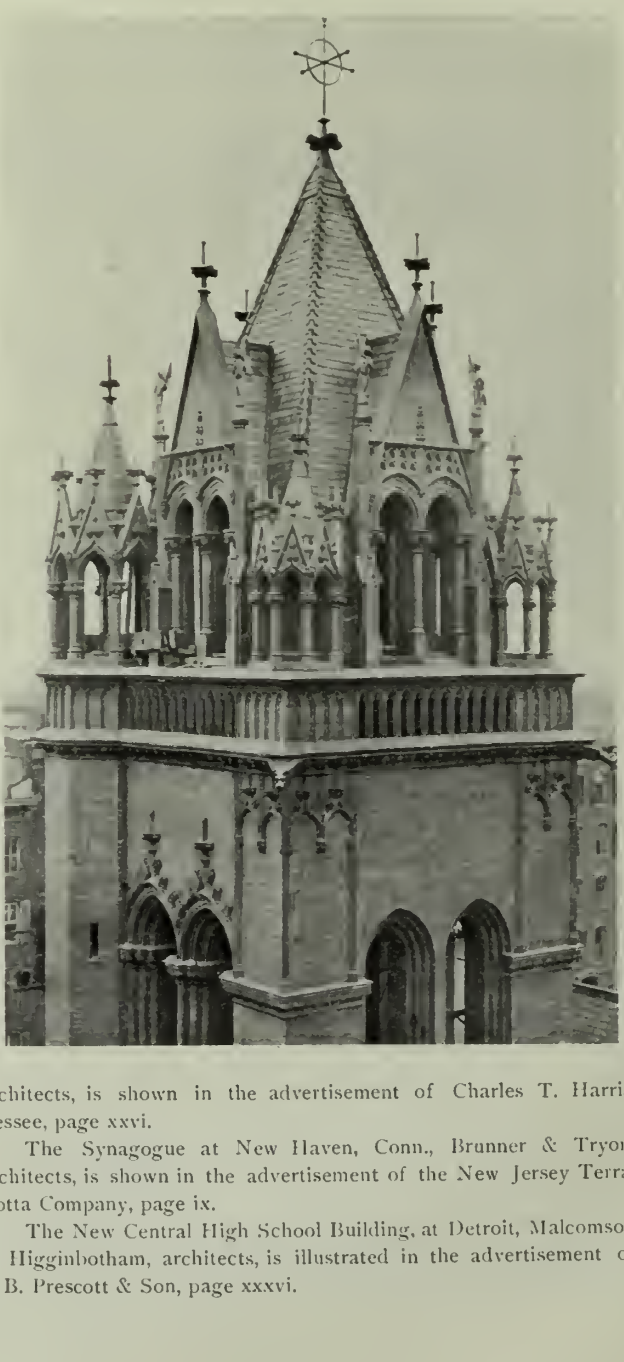
Messrs. Manny, McArdle & Ramsey acted as judges in the competition for a water tower. Mr. Ernst Helfensteller was given first place.

THE Detroit Architectural Sketch Club will hold, during the spring months, several competitions which are open to members only. The regular meetings of the club take place on Monday evenings of every week. The officers of the club are Emil Lorch, president; Geo. H. Ropes, vice-president; Edward A. Schilling, secretary; Richard Mildner, treasurer. Directors, Alex. Blumberg, W. E. N. Hunter, M. T. Wilcox.

ILLUSTRATED ADVERTISEMENTS.

THE New York Architectural Terra-Cotta Company send for illustration the upper portion of tower on Grace Church Mission Buildings, East 14th Street, New York City. Messrs. Barney & Chapman were the architects.

Trinity Memorial Church, Binghamton, N. Y., Lacy & Bartoo,



architects, is shown in the advertisement of Charles T. Harris, Lessee, page xxvi.

The Synagogue at New Haven, Conn., Brunner & Tryon, architects, is shown in the advertisement of the New Jersey Terra-Cotta Company, page ix.

The New Central High School Building, at Detroit, Malcomson & Higginbotham, architects, is illustrated in the advertisement of J. B. Prescott & Son, page xxxvi.

Spanish Brick and Tile Work. V.

BY C. H. BLACKALL.

THE picturesque qualities of Spanish architecture are due in no inconsiderable degree to the effect of the tiling which is used throughout nearly the whole of the peninsula for covering the roofs. Tile roofs of the same general description are found to greater or less extent throughout Italy, and in a few cases, in other parts of Europe; still the semi-cylindrical form of the dull, unglazed tile is more generally associated with Spanish work than with that of any other country, and if not a direct development of Spanish thought, it has certainly found a very large application in Spanish construction. The fringed, scalloped effect produced along the eaves by the use of these tiles is a very pleasing break in the sky line of a building which aims to be picturesque, and the color, which is almost invariably of a light red, adds a great deal to the effect. Tile roofs are used indiscriminately upon all classes of buildings. The illustration of the Antigua, at Valladolid, shows the picturesque effect of these tile roofs in a very striking degree, and the combination of the strong tones of the burnt clay with the clear, tawny shades of the stone, and the deep, rich purple shadows which are always a part of Spanish buildings, give a delightful charm to this old structure, and though the walls are themselves of stone, the terra-cotta plays a very considerable part in the effect. The lower roofs are covered with the semi-cylindrical tiles, and the view shows a very good general average of the way in which these roofs look after they have been repaired a few times. The tiles themselves are quite soft, so much so that in walking over a roof one is very apt to break a tile at nearly every step; but in Spain, where the rains are neither copious nor long continued, the easy-going inhabitants do not seem to consider this as a great calamity, and besides, it is so easy to patch one of these roofs by simply inserting a tile at intervals that the break is soon remedied. So far as I have been able to discover, such a thing as flashing is little known, and the tiles, after being carried up from the eaves in a more or less direct manner to the side walls or the apex of the roof, are literally swathed in good cement mortar, and if the side walls are to be stuccoed the cementing is carried up on the walls, so that to judge by external appearance these roofs, though very irregular and unworkmanlike in appearance, answer every purpose of protection. The very irregularity, which from a utilitarian point of view might be deplored, is an added element of charm to the artist, and the scalloped eaves throw long, irregularly fringed shadows on the walls below in a manner which would be impossible with any other construction. The tower of the Antigua itself is covered with flat tiles, laid in much the same manner as our slate.

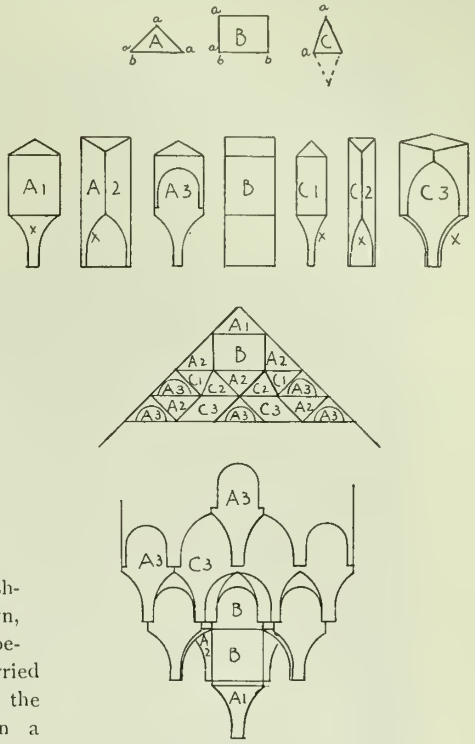
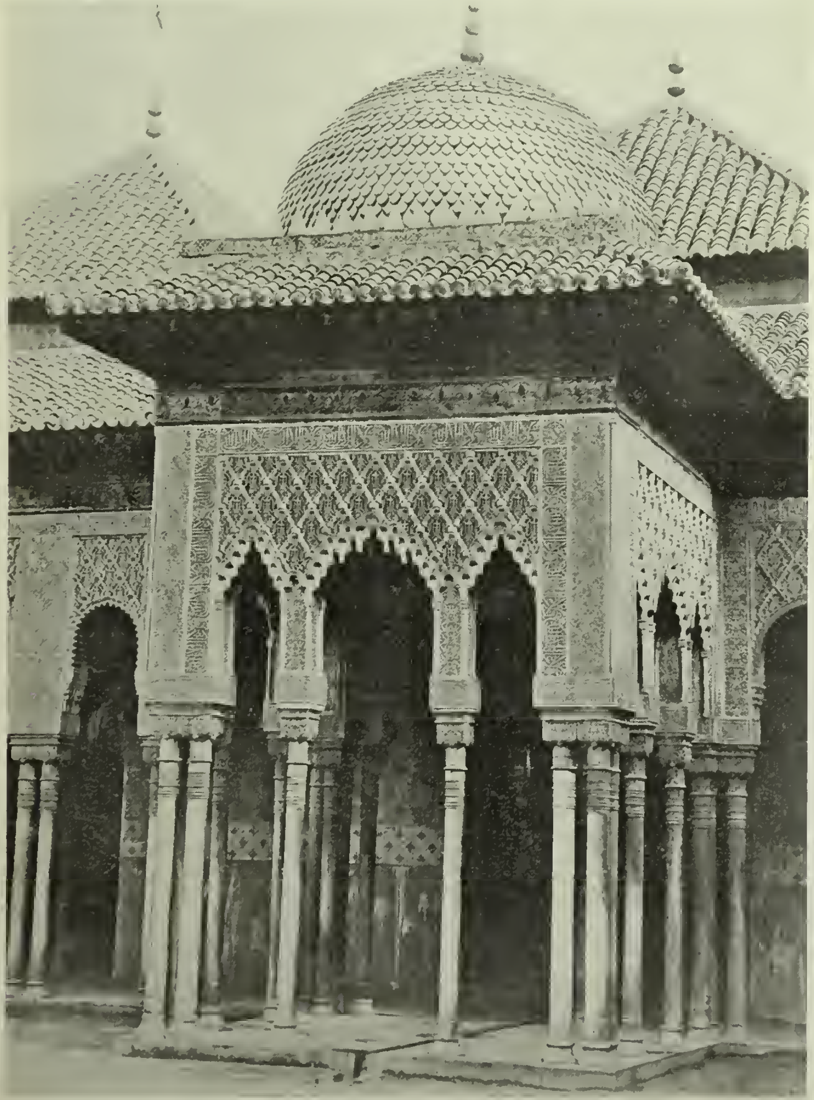


DIAGRAM SHOWING COMPOSITION OF STALACTITE WORK.

The porch of the Court of the Lions is an admirable example of what is done with the Spanish roofing tiles. Of course this roof has been thoroughly restored and repaired, and as the buildings are not in actual use and are subjected to a careful oversight, these tiled roofs have a finished, workmanlike appearance which is, on the whole, rather un-Spanish. The usual experience is to find the tiles so broken and patched that the surface is very much cut up and has a texture-like effect which is eminently picturesque, even if not a sign of first-class repair. A narrow band of colored tile is introduced below the base of the dome immediately over the eave tiles, and is capped by a row of the peculiar cresting tiles which are so often found in Moorish work, with a zigzag palm-leaf pattern. The effect of the vivid color interposed between the two masses of dull tilework is very striking and effective.



PORCH OF COURT OF LIONS, ALHAMBRA.

The view of Toledo from the Alcazar consists principally of roofs, and illustrates the various ways in which a simple tile unit can be used on different slopes and under different circumstances. The secret of the durability of a roof of this kind, of course, lies in the fact that there are no surfaces for the water to remain in, there is no snow and ice to work under the tiles, and cement is used very liberally throughout. Tiling of this description has been manufactured to a certain extent in this country, but has never met thus far with the encouragement which it deserves. Our climate is, of course, against it to a considerable extent, but climatic disturbances can be provided for, and there seems to be no good reason why we should not avail ourselves of this excellent aid in general color treatment of a building.

TOLEDO FROM THE ALCAZAR.

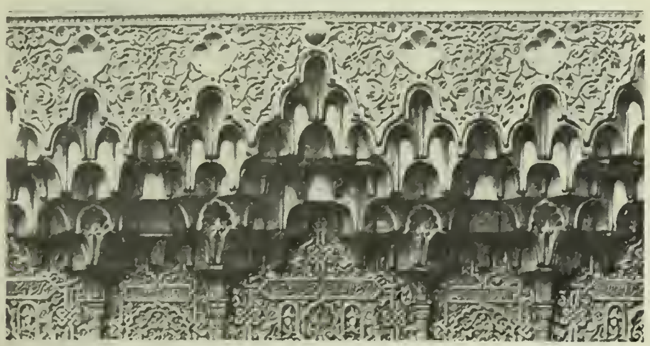
The Collegiata at Toro is roofed entirely with semi-cylindrical tiles. The roof has stood so long, and has been repaired so often, that it is at present in a most delightfully artistic state of delapidation, and when I visited the church a few years ago and had occasion to walk across the roof to measure the tower, I found the tiles were so friable that two or three of them would crush with every step I took. This did not seem to at all alarm the custodian who accompanied me, and he seemed to think a few broken tiles more or less a very slight matter easily obviated by a few trowelsful of mortar.

THE COLLEGIATA, TORO.

In the south of Spain along the Mediterranean coast, where the Moorish element has been most marked in its influence, there are several very interesting examples of enameled or slightly glazed roofing tiles, usually flat rather than semi-cylindrical, and in some cases worked out in color. The tiles in this part of the country are also very much darker red than those in the north, and are made of much stronger material.

There is a species of decorative treatment which is peculiar to Moorish work, and in fact has been used by no other race. It is the decoration of vaulted surfaces forming what is known as the stalactite vault. The illustration from the Alhambra will show the appearance of the work. This same treatment is often carried entirely across quite large rooms, forming a delightfully complex ceiling, which at first sight has the appearance of a maze of frost work, though closer examination shows it is constructed strictly upon mathematical principles. It is composed of numerous prisms of plaster which are united by their contiguous lateral surfaces, there being seven different forms of blocks proceeding from three primary figures in plan. They are, by reference to the accompanying diagram, the right angle triangle *A*, the rectangle *B*, and the isosceles triangle *C*. In these the sides *aa* are equal, *ba–bb*, and the vertical angle of *C* is the same as the lesser angles in *A*, or 45 degs. The figure *B* has one form in section, the figure *A* three, and the figure *C* three, the third figure, *C*3, being a rhomboid formed by the double isosceles triangle. The curves marked *x* of the several pieces are similar. By this it will be seen that a piece can be combined with any one of the others by either of its sides, thus rendering the blocks susceptible of combinations as various as the melodies which may be produced from the seven notes of the musical scale. So far as I know, this kind of work has never been successfully copied outside of Spain. It is probably a development from brick construction. This, however, is only a theory based upon the manner in which the individual blocks are used, upon the appearance of the work when finished, and upon the fact that it would be a not unnatural development of the attempt to cover a room with a brick vault without the use of centering. In the Moorish examples the blocks are usually of plaster and are, of course, set in fresh plaster of Paris. There is no reason why a similar construction could not be applied to terra-cotta or molded brick with most interesting results. A very few patterns would suffice to answer for a great variety of designs, and with a little intelligent oversight a vaulting of this kind could be put up for moderate spans without the need of any centering, using a very quick-setting cement, as when once in place the blocks would key together thoroughly.

LA ANTIGUA, VALLADOLID.



STALACTITE WORK FROM THE ALHAMBRA.

Brick Vaults Built Without Centers.

Translated from the "*Anales de la Construccion y de la Industria.*"

BY A. C. MUNOZ.

(*Concluded.*)

IF the space to be vaulted is very long, it is customary to divide it into nearly square bays, by means of arches built with centers either by the ordinary method or by that of vertical leaves. In this latter case generally only the middle leaf is made vertical, while the other leaves are built in pairs on both sides of the first, and increasing their inclination in each succeeding leaf until the desired inclination is reached. The vault is then completed as explained above.

By whatever method these dividing arches are built, the construction of the vault must proceed from both sides simultaneously, so that the thrusts will neutralize each other.

These vaults, as well as those of vertical leaves, may vary in thickness. If the thickness is equal to the length of a brick, the bricks may be laid as shown on Figs. 10 and 11. If the thickness is one and a half bricks, they may be laid as shown in Figs. 12 and 13. The vault may also be built in separate concentric rings, which method is preferable when the thickness exceeds the length of the brick, for the reason that the joints do not then open so much at the extrados, and further, the labor of filling the joints a b c (Figs. 12 and 13) with chips of stone or brick is avoided. The lime from Badajoz is of very good quality, and when used in making the mortar, the inclination of the leaves is generally increased beyond 45 degs., which is the limit for ordinary mortar.

In Extremadura most vaults are constructed in the manner last described, and are used in wells, cellars, basement rooms, and in farmhouses in which the upper floors are used for granaries. They are made more or less decorative by varying their forms, etc.

The advantages of being able to build vaults with ordinary mortars and without the use of centers are so obvious that it is not necessary to enumerate them.

GROINED AND CLOISTERED VAULTS.

The construction explained in the last chapter may be applied to a groined vault as follows: —

Let a, b, c, d (Fig. 14) be the space to be vaulted; as in the previous cases, grooves determining the curvature of the intrados are cut in the walls; then the corners a, a′ a″ a‴, b, b′ b″ b‴, c, c′ c″ c‴, d, d′ d″ d‴ are first built by laying the bricks as for an ordinary vault and until their faces reach an angle of 38 to 45 degs. From this point the construction is changed. To do the work properly four bricklayers are needed, who, placing themselves each in front of one of the walls respectively, fill in the spaces a′ a″ e and c‴ c″ e, a‴ a″ e′ and b″ b‴ e′, b′ b″ e″ and d′ d″ e″, d″ d‴ e‴ and c′ c″ e‴, setting the bricks in courses as shown by a″ e′ b″, b″ e″ d″, etc. This construction is carried on until the vault is closed, each mason building his portion as if it was a barrel vault, and when near the vertex, when the workmen would interfere with each other, the construction is carried on from the outside. Of course, at the groins the bricks have to be cut, and care should be taken to well bond the bricks which form the groins.

The construction is guided by two strings stretched between the vertices of opposite arches, as e e″, e′e‴ (Fig. 14), marking the highest points of the vault, and by five plumb lines, to determine the plane of the groins; one at C (Fig. 14, Plan), the intersection of the diagonals; the other four also on the diagonals but near the springing points, as at a a″ b″ c″ d″. The plumb lines of opposite angles together with the one at the vertex determine the plane of the corresponding groin, the curvature of which is generally given by the eye. This requires skillful workmen, and to facilitate the work the lightest kind of frames having the desired curvature may be used, and thus obviate the irregular groins which are very common in this kind of vaults.

In the construction of groined vaults of this kind for a factory recently built in Badajoz, the engineer determined the curvature of the groins by using four strings, which, being stretched in pairs from opposite points of the head arches, and in the same horizontal plane, were thus elements of the barrel forming the vault, and therefore the intersection of these strings were points of the groins. By increasing the number of strings great accuracy may be obtained in determining the curvature of the groins.

CLOISTERED VAULTS.

The construction of this kind of vault is very similar to that of a groined vault.

Suppose a b c d (Fig. 15) to be the space to be vaulted. Having cut grooves on the walls determining the curvature of the vault and beginning at the four corners simultaneously, the portions a p e-p c f

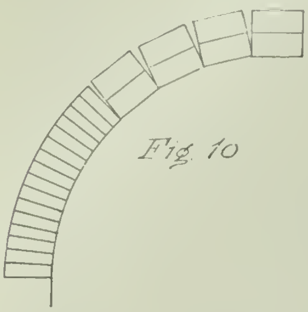


Fig. 10

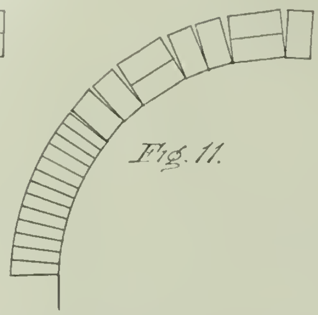


Fig. 11.

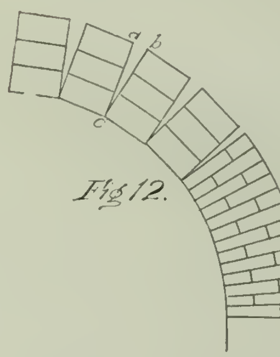


Fig. 12.

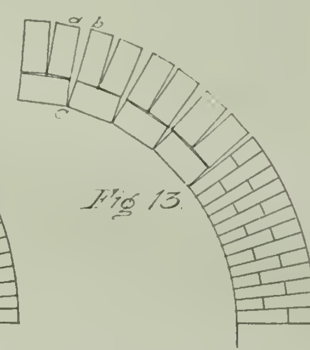


Fig. 13.

and b g q-d h q are built first. Then between these, the portions i e r-r g o and l f s-s v h are built, after which the other courses are similarly built in alternating series, as i k l m, o n v t and k w x n-y m t z.

To close the vault the bricks are cut to a wedge shape, as the key of the vault is a truncated pyramid.

The construction is guided by a straight edge M-N placed

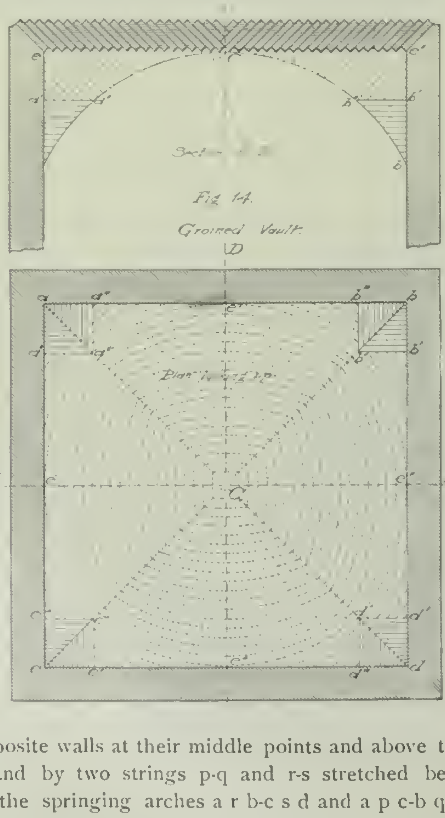


Fig. 14. Groined Vault.

between opposite walls at their middle points and above the apex of the vault, and by two strings p-q and r-s stretched between the vertices of the springing arches a r b-c s d and a p c-b q d. Their points of intersection V, which marks the vertex of the vault, may be made higher or lower by means of the string V'-j attached to the middle of the straight edge M-N, and according to the desired camber.

The two greatest advantages of vaults built without centers are the rapidity of their construction and their small cost. Below is given the average cost per square meter, in Spain, of a vault 14 c. m. thick, as deduced from several examples.

0.20 day mason's work at 60 cents	$ .12
0.40 day mason's assistant's work at 30 cents . .	.14
70 bricks at $4.50 per 1,000	.31
0.038 c. m. ordinary mortar	.10
10 liters water	.02
Stone for wedges, wear and tear of tools, etc. . .	.07
Total cost per square meter	$ .76

Groined and cloistered vaults cost somewhat more on account of the greater difficulty in their execution, but with skilled workmen it is safe to say that the cost per square meter would not exceed 80 cents. Comparing these prices with the cost of a center in that part of Spain, it will be found that in most cases the center costs more than the vault.

The following examples will prove the durability and resistance of vaults built as described above.

Within the precincts of the castle of Badajoz there is an old ruined building called the house of the Zapatas, which was purchased in the year 1779 to be used for barracks. All the roofs, the floors, and most of the walls are now destroyed, but a portion remains 13.50 m. long by 5.50 m. wide, covered by a barrel vault which has been preserved intact, notwithstanding the long time which it has been exposed to the weather. This vault has a uniform

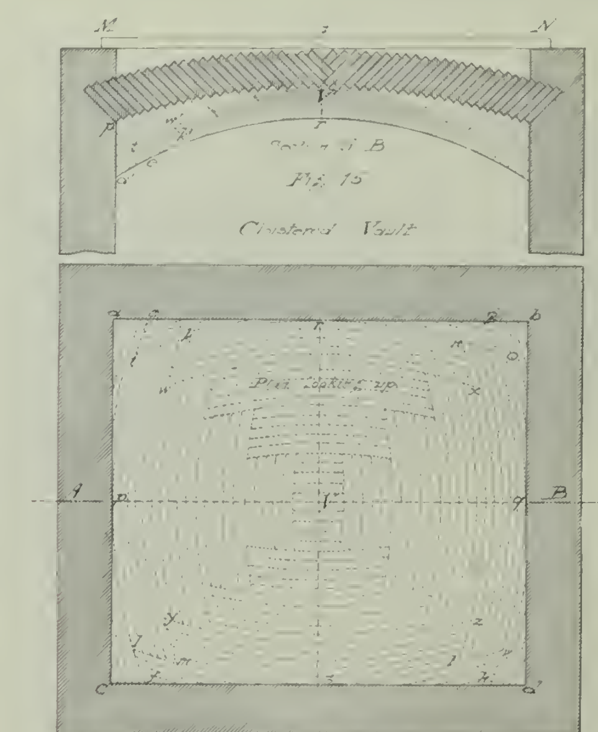


Fig. 15 Cloistered Vault

thickness of 0.14 m., and is formed by a single thickness of brick. The backing is of masonry and 0.28 m. thick. The springing line is 3.50 m. above the floor, the wall being 1 m. in thickness, while the thickness of the head walls, which are of adobe, is 0.84 m.

In the casemate to the left-hand side of the bastion of Santiago, in the same castle, there are six vaults; one of them is a barrel vault consisting of three sets of superposed rings of curvilinear rows, the bricks in each row being placed with the ends tangent to the curve of intersection of the intrados with a plane forming an angle of 50 degs. with the horizon. The other five are segmental barrel vaults with four sets of superposed rings; the three first sets of rings are laid as in the former vault, with their ends tangent to the curve of the intrados, while in the last or outer ring the faces of the bricks are the tangent ones. The thickness of the vault is 0.90 m. about 3.5 times the length of the bricks; the springing line is 1 m. above the floor with walls 1.70 m. thick, all of ordinary masonry. The vaults have a backing of rammed earth 1.10 m. deep at the crown; over this the upper batteries of the fort are placed. These vaults were built in 1866, and are in very good state of preservation.

In the Normal School a cloistered vault was built in 1866 and has the following dimensions: Span, 7.90 m.; camber of springing arch, 1 m.; height of crown above top of springing arch, .30 m.; thickness of vault, 0.14 m.; thickness of walls, 0.84 m.

In the barracks of San Francisco and military hospital of the same city all the rooms on the ground floor have vaults executed without centers, the rooms in the first floor being used as dormitories for the troops and as hospital wards. These vaults vary in dimensions and in shape; some date from the time of the convent which formerly occupied the site, and others were built between 1853 and 1856. Among these last the most noteworthy of all is a segmental barrel vault 20 m. long, 8.80 m. clear span, and 0.28 m. thick, the springing line is 3.20 m. above the floor and the walls 0.80 m. thick.

In Merida there are many vaults of this kind, some built before the sixteenth century, well preserved; and in those which have been neglected and that the action of time is slowly destroying, the cracks have appeared as one would expect, considering the manner in which the forces act in these vaults. In the old convent of Santo Domingo, in the same city, there is a groined vault in which one of the walls has been destroyed and only the portion of the wall that transmitted strains to that wall have fallen in.

The following fact is worthy of notice: in 1876 the Guadiana River overflowed its banks, inundating the surrounding country and the farmhouses in the neighborhood. In one of these, as in most of them, the ground floor rooms had vaults as those described, the vaults being loaded with grain. The ground floor of this farmhouse consists of four sets of chambers around a central court and forming a rectangle. The main suite, more than 40 m. in length and divided by a few partitions, is covered by two parallel barrel vaults 4 m. span; the vaults are 0.28 m. thick at the springing and 0.14 m. at the crown; the outer walls are 0.84 m. and the central wall between the two vaults was for the greater part of its length built of mold and 0.56 m. thick, strengthened by a few stone quoins and by the stone jambs and lintels of the doorways. The water completely undermined and destroyed the mold, leaving the vaults supported only by the stone quoins and by the stone jambs and lintels, and a large crack started between the two vaults not far from the springing line. To repair the vault a new wall of brick, laid without mortar in order to avoid shrinkage, was built in place of the mold wall. The crack was then filled, and soon afterwards the vault was again loaded with grain and has ever since been in perfect condition. The vaults had been built in 1840. The head wall of one of the vaults was also damaged and two small cracks appeared, separating from the rest of the vault that portion which exerts a thrust on the head wall. After repairing the wall and filling the cracks the latter have not separated.

These examples speak for themselves and sufficiently prove the strength and durability of vaults as built in the province of Extremadura.

Architectural Terra-Cotta.

BY THOMAS CUSACK.

(*Continued.*)

PASSING from the construction and manipulation which experience has thus far proved most advantageous in terra-cotta columns, we now proceed to a consideration of the work commonly resting upon them. The introduction of iron as an auxiliary support has been suggested in the examples already given; and in those that are to follow, a free use will be made of it wherever necessary or expedient. We are aware of the objections that have been urged against the principle of composite construction, such as we now propose to discuss, but they are all of a purely academic kind, and may be put to rest without extended argument. A bare recital of the stubborn facts of every-day practise, in which iron and steel are being so extensively used to supplement or displace other materials, furnishes a conclusive answer. There is no inherent antagonism between these two materials, which in their natural state are closely allied.

We are willing to admit the scarcity of precedents for the use of iron in buildings of antiquity, but it will not be denied that the present generation of builders are doing their share to supply that defi-

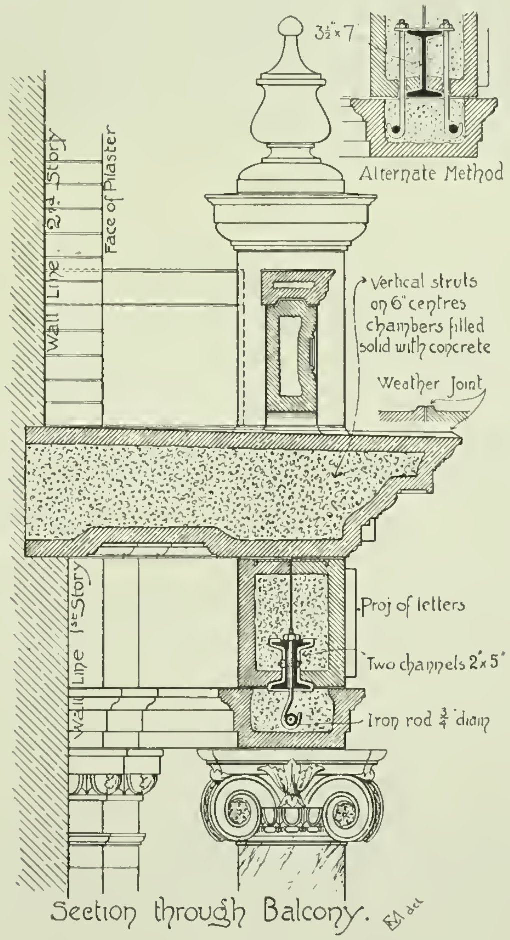


FIG. 15.

ciency on behalf of posterity. Whether posterity will approve of all that is being done for it, is, of course, an open question, and one which must await an answer from that inexorable tribunal. Meanwhile we shall be content to stand by the assertion, that a material of practical utility, however new, or a new way of using such a one to advantage, however old, should not be allowed to go begging through lack of a precedent. Let them all have a trial, free from trammels that are merely traditional, and in so far as they survive the test of service, the innovation of to-day will become the custom of to-morrow, with a good chance of being cited as a precedent on the following day. To deny the subsidiary use of iron, as a partial support in terra-cotta construction, when almost everything in the building is in some measure dependent upon it — when in fact the fabric of the building itself is often largely composed of it, would indeed be "straining at a gnat and swallowing a camel."

The constructors of past ages did not have the superabundance of iron and steel, or the means of producing it which we possess. Wren, most scientific of constructors, made the best possible use of the scanty supply at his disposal, when he encompassed the dome of St. Paul's with four tiers of chain bond, wisely inserted in the masonry. As a further precaution, a complete ring of bar iron,

FIG. 16.

riveted together in short segments, was sunk into the stone gallery behind the parapet, and to make doubly sure, run with lead, instead of being bedded with mortar. Unlike us, he did not have Portland cement in which to set his Portland stone: nor yet a catalogue of rolled sections at his elbow, from which to select the shape, size, and weight best suited to the particular work on which he happened to be engaged. What use he would have made of these, we are at liberty to infer from the skillful way in which he applied the meager resources at his command. Of one thing we may be certain; he would not have used wood,— not even oak of English growth, and of which the "wooden walls" were built, until retired in favor of armor plate,— in the framework of the outer dome. But with him, as with all his predecessors, the supply of iron was limited, its cost relatively high, and the size of the forgings no more than could be hammered into shape, or welded on an anvil. So far, however, as it was available, they did not hesitate to employ it in connection with both wood and stone, and had they possessed half our facilities for the production of iron and steel, they would certainly have turned the product to good account. Possessing these serviceable materials we must be at liberty to use them, in an age of electicism, of which it may be said, that sufficient for the day are the resources thereof. Like many other things in the affairs of life, the use of iron as an ally to terra-cotta becomes censurable. only when it is abused, by being applied in the wrong place, or in an injudicious manner. and (as often happens) when no extraneous support is required. On the other hand, the converse of all these furnishes an unanswerable vindication of the legitimate use of both materials.

The availability of these resources being granted, it is part of our self-imposed task to show in what way the best possible use may be made of them. under various conditions. Some of these conditions are unalterably fixed: and may as well be frankly accepted as such, without wasting words on theories no better than a spider's web, as to "what might have been." Others again are so variable as to be considered in the light of an unknown quantity, until they assume definite shape. These must be met; if not by existing methods, then by special devices; or by the readjustment of those with the practise of which we have become somewhat familiar. There are, however, other conditions, — and they by no means the least important — which are entirely of *our own making*. It is with these that we propose chiefly to deal. And, as it is but a new reading of an old axiom to say in this connection that "example is better than precept," we shall give "line upon line"; backed up in most cases by what some idealist has been good enough to term "the brutal fidelity of a photograph."

Beginning in each case with the more elementary problems of the class to which they belong, we shall in due time deal with others of a sufficiently complex character, most of which will be from work actually done. A simple portico having but little projection from face of building is shown in section at Fig. 15. The maximum distance between columns being about 9 ft., the necessary support is supplied by two 5 in. channels placed back to back, and bolted together at intervals of 4 ft., with just enough room to receive the ¾ in. hangers; which, passing between them, take the place of separators. The soffit blocks are made in lengths of 1 ft. 10 ins., with two hangers placed 3 ins. from the ends. The ¾ in. rod having been inserted in the hole, which passes longitudinally through each piece, the chambers are then filled with concrete before being set in position. A level staging should be erected in line with top surface of abacus, on which to rest the blocks. The ¼ in. rebate left in the ends to form a receptacle for the mortar, and each block being pressed against the preceding one, a sufficient body of mortar will be retained securely between the ends of the blocks, though the vertical joint need not appear more than three sixteenths of an inch on face of the work when pointed up. The two channels having an independent bearing on each capital, the hangers may all be adjusted to requisite tension by nut and washer until the whole architrave is in line. When a slightly wider soffit has to be suspended, that may be done by means of an I beam of sufficient weight. instead of the two channels. A plate of ⅜ by 4 in. iron, with a hole in each end, is laid across the upper flange; and from it two (or if necessary, four) hangers take hold of each block in the manner indicated in alternate section.

The blocks forming frieze are molded to fit on flanges, with just enough allowance for cement, and have a continuous chase made to clear the heads of nuts. etc. The vertical joints of the inner and outer courses should alternate, and the two thicknesses may then be cramped together on top bed. The platform is made in single blocks with paneled soffit, and bonded into wall as indicated in section. These blocks contain from 9 to 12 cu. ft., which, in some situations, are certainly much larger than it would be advisable to attempt. But in the present case, their *shape* is so suitable and the other requirements so convenient, that no special difficulty was experienced in turning them out free from cracks and fairly accurate in size. Scuppers are provided in parapet panels to

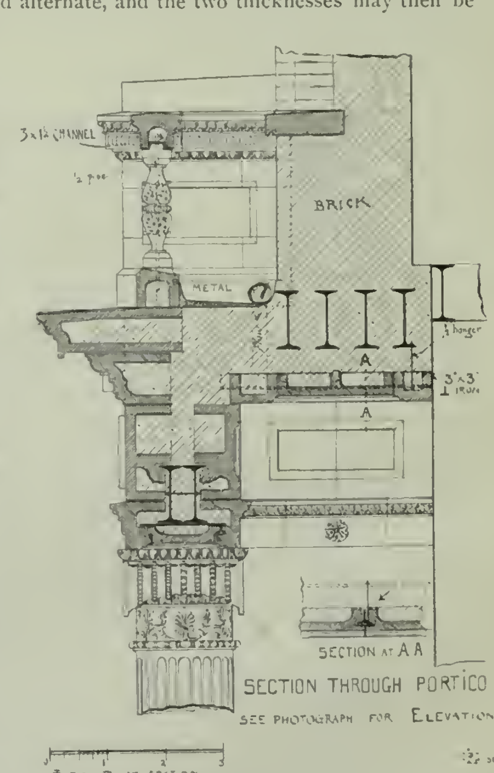


FIG. 17.

allow rain water to escape, and a raised fillet on each end of the block, prevents any of it entering the vertical joints. It will be seen from the photograph (Fig. 16) that the actual result obtained is quite presentable, and that the same principle of construction as shown in this simple example may be adopted in work of greater magnitude and importance.

In the portico shown at Fig. 17, where the span is wider, and the load to be carried much greater, a somewhat different arrangement has been made. A girder composed of two 12 in. I beams and

FIG. 18.

an 18 in. cover-plate is necessary in that case. The soffit being 2 ft. wide (which is equal to the size of column at its greatest diameter), it could not be made in single blocks with sufficient accuracy to give good alignment in the architrave on *both* faces. This member is made in three sections, two of them being molded to fit on the flanges of cover-plate, with the panel resting on rebates between them. The architrave and frieze are continued around vestibule, and the paneled ceiling is carried on the inverted tee sections inserted in joints at A.A. The space between the inner and outer blocks of frieze is backed up with brick, and the two thicknesses anchored together on top bed. Balusters are usually jointed in short sections for greater convenience of pressing. In this case they are made in two pieces with a ¾ in. hole in center for an iron rod, one end of which presses down into plinth, the other extending through channel, which has been holed to suit spacing of balusters. The ends of this channel are built into pedestals, and it but remains to set the coping to line on a good bed of cement, taking care that the vertical joints are all well filled and neatly pointed. The enclosed space behind balustrade is covered with metal, flashed into a continuous groove around plinth and graded to outlets with leader at each side of portico. So much for the anatomy of the subject; which, however needful, is usually forgotten after the components have been assembled. There are, of course, several ways in which an entablature of this kind could have been supported, and some of them will be embodied in subsequent examples. This one, however, was found to answer its intended purpose and was favorably spoken of by the men who set the work, whom, it would seem, did their share of it with more than ordinary intelligence. Among other evidences of care and forethought may be noted the slight camber over the opening; just sufficient to correct the optical illusion, which makes a perfectly straight architrave appear to sag. In Fig. 18 we see the skeleton clothed, and are better able to judge whether or no — in a materialistic sense at least — "the end justifies the means."

Fire-proofing Department.

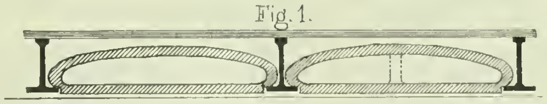
ORIGIN AND HISTORY OF HOLLOW TILE FIRE-PROOF FLOOR CONSTRUCTION.

BY PETER B. WIGHT.

In preparing the following notes the writer feels the necessity of offering an apology in advance for the use of the first person singular, for there does not seem to be any possible way to avoid it if this history is to be complete. In the places where this has to be done the reader will kindly bear in mind that he has no financial interest now in the matters to be referred to.

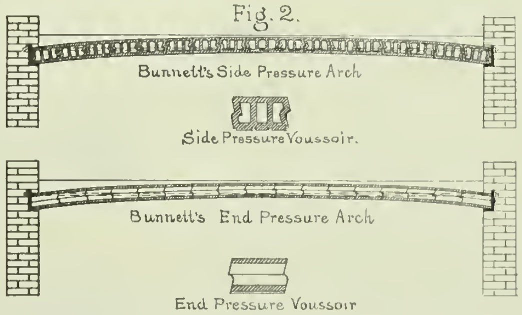
The use of brick arches for floor construction was coincident with the introduction of the manufacture of I beams into this country, and had preceded it to a certain extent; for, a few floors had been constructed before 1850 in which cast-iron I beams had been used, and in some of these the I beams had been strengthened by the insertion of a wrought-iron rod shrunk in a recess on the under side where the flanges of the I join the web. Rolled deck beams inverted had also been used for floors. In all these cases brick arches were used. I beams of the general section now employed, or double T beams, as they were sometimes called, were first rolled in France in 1853. Their introduction was generally followed in that country by the "Thausne System," which consisted of filling the space between with plaster béton reinforced by occasional iron bars. I beams were first rolled in this country by the Trenton Iron Works, in 1854, and were first used in the Cooper Institute in New York; though the beams of the first floor were made of two channels riveted together, and those of some of the upper floors were of inverted deck

Fig. 1.



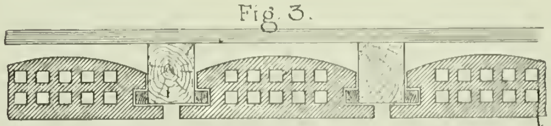
American Patent issued to F. A. Peterson, April 3. 1855.

Fig. 2.



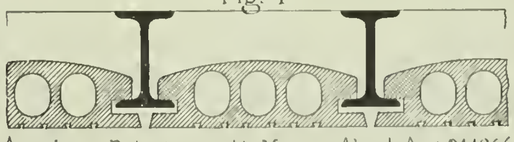
English Patent issued to Joseph Bunnett June 8 1858.

Fig. 3.



English Patent issued to Maurice Abord, July 2. 1866.

Fig. 4.



American Patent issued to Maurice Abord Aug. 21 1866

beams. The first building in America in which I beams were used throughout was the brownstone Court House in City Hall Park, New York.

It is a fact, however, that hollow burned clay tiles were used in this country as soon as I beams were rolled, though their employment cannot be considered as having been anything more than experimental. They were invented for the Cooper Institute, and used in the first story only, by Frederick A. Peterson, the architect of the building, whose name, by the way, appears among the "Founders" of the American Institute of Architects in the last printed *Proceedings*. These, according to the best evidence obtainable, were the first hollow burned clay tiles for floor construction ever designed, made, and put into a building, and the invention and introduction can be fairly claimed as American. As proof of this assertion I will add that I am in possession of the records of two important lawsuits involving the authenticity of the invention of flat hollow arches and the fire-proofing of I beams, and that the records of all inventions and publications bearing on the subject were exhaustively searched by the parties in interest for evidence affecting their respective sides. The patent taken out by F. A. Peterson, April 3, 1855, anticipates all others, and while it would in these days likely be considered impracticable, it was put in use in this one building through the perseverance of the architect, and the determined pertinacity of Peter Cooper. When a schoolboy I remember seeing the work set. When involved in a lawsuit in which it was thought necessary by my attorneys to present evidence of what was then done, I found the building in process of alterations, and was enabled not only to make drawings of the construction on the spot, but to remove some of the tiles. I found that they were all made of a semi-fire-clay and molded by hand. The following section drawing is taken from the patent issued to Peterson, and shows exactly how the floors were built. (Fig. 1.)

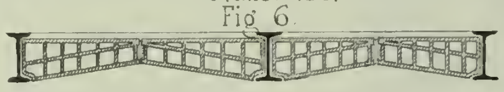
The drawing shows inverted deck beams; but double 3 by 6 in. channels were used, so that they were 6 ins. wide top and bottom. They were set about 2 ft. 6 ins. from centers. The bottoms of the beams were covered with cement, flush with the bottoms of the tiles. The ceilings then received two coats of plaster.

The above construction was never repeated, to my knowledge. The usual method for filling between I beams, thereafter used for many years, was with segment brick arches, and flat ceilings were obtained by furring off, in some cases with wood, and in others with iron, using corrugated iron lathing. There were some instances in which sheet iron, with very deep corrugations, and flat in form, was laid on the bottom flanges of the beams and covered with concrete. In these the ceilings were furred off for lath and plaster. I know of one instance where slabs of sandstone were set on the bottom flanges of the beams and carved with tracery patterns to form an ornamental ceiling pattern. In this the bottoms of the beams were covered with ornamental cast iron. In one building the space between beams was filled with heavy boiler plates riveted to the top, and a patent was taken out by Samuel P. Snead, of Louisville, the founder of the Snead family of iron workers, for filling between the beams with ornamental cast-iron plates. It was many years before corrugated iron arch plates were used.

Fig. 5.

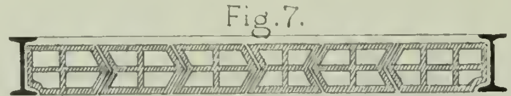
Illustration in Descriptive Pamphlet of E. Muller & Co. France 1867.

Fig. 6.



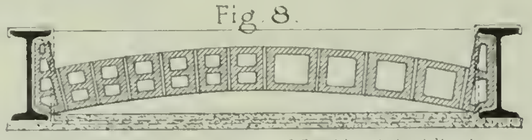
Another Form of Arch by Professor Muller, from the Gazette des Architectes Paris, 1867.

Fig. 7.



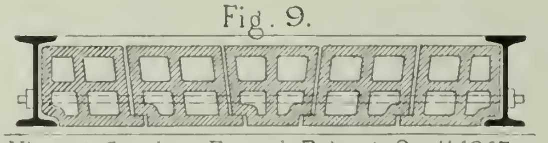
M. Verdier's flat Arch from Illustration in the Gazette des Architectes. Paris 1867.

Fig. 8.



From Leonce Reynaud's Traite d'Architecture Paris, 1867.

Fig. 9.



Vincent Garcin's French Patent Oct. 11 1867.

Three years after the date of the Peterson patent, Joseph Bunnett, of Deptford, England, on June 8, 1858, took out a patent for constructing very wide span segmental arches of hollow tiles between wall plates of angle iron, connected by iron tie-rods. The Bunnett arch was shown by two sectional drawings, and in each the arch was of sufficient length to cover a moderate-sized room, and with very slight rise, so that the tie-rods were contained within the arches. One of these arches was on the side-pressure, and the other on the end-pressure plan. The tiles were described as being pressed out through dies, with hollow chambers and webs. Those for the side-pressure arches had peculiar notches on the sides, and were cut off square at the ends, while those for the end-pressure arches were of the same section, but cut off in the ends to the same section as the sides. The result was that the side-pressure arches could be set with broken joints, and the end-pressure arches so that each course could be notched into the adjoining course, thus avoiding a defect in all end-pressure arches that have lately been used so extensively. The key tile of the side-pressure arch was made with notches on both sides. In this patent we find the earliest claim for using independent voussoirs for hollow-tile arches, and the first for pressing them out through dies by machinery. It also establishes the early date of the invention of arches constructed on the end-pressure principle. The following illustration is reproduced from the drawings attached to Bunnett's patent. (Fig. 2.)

Bunnett was a well-known clay manufacturer, and brought his invention into use. I remember finding, with great surprise, a sample arch of this construction set up on a vacant lot in the rear of the temporary office of architect W. W. Boyington, at Chicago, in 1872, very shortly after the great Chicago fire. At that time several architects had temporary offices in the burned district, my own among them. But I have never heard of the Bunnett arch being used in Chicago, or elsewhere in this country. The sample was of about 12 ft. span, and with only a few inches rise, and was not more than 6 ins. thick. It must have been sent over from England in expectation that the lessons of the great fire would result in the erection of many fire-proof buildings. But this was not the case. There was no time to study up the subject. The most that was done at first was to greatly increase the thickness of brick walls between buildings, to which architects and owners then agreed, as a provision against the spread of fire, even before any special laws had been passed. As one of the results, the building laws of Chicago now require an average thickness for party walls in high buildings greater than those of any other large city. Another is seen in the fact that the fire records since that time show that fires in Chicago are almost invariably confined to the building in which they originate. The second great fire of 1874, which raged through frame buildings for several blocks, was stopped when it reached the new five-story brick party walls on Wabash Avenue.

Invention in this direction seems to have ceased for eight more years. The Americans were using brick floor arches, and in some cases corrugated iron; the English were using solid concrete arches, that invented by Dennett being a favorite, and the French used the plaster concrete filling, called the Thausne System. On July 2, 1866, Maurice Abord, of Buissonniers, France, took out an English patent for a solid-tile arch in one span with arched top and flat bottom, for use between wooden floor joists. He had probably previously patented it in France. But very shortly after, August 21, 1866, he took out a similar patent in the United States, in which he showed the combination of his arch brick with I beams. While his arch tile was similar in general form to that of Peterson, it differed from it in that the soffit was set much lower, and projections on the sides formed a covering or protection to the beam which he specifies as being useful in fire-proof work. This appears to be the first invention patented in which burned clay is used for the protection of the bottoms of both wooden and iron beams from fire simultaneously with the construction of flat plastered ceilings. Illustrations from but the English and American patents are here given. (Figs. 3 and 4.)

Following this invention there seems to have been a great revival of interest in the subject, though there is no evidence of Abord's invention having been put into practical use. The objection to it was the same that held against Peterson's. It was very difficult and expensive to make such large hollow tiles of clay, and not economical to set the beams close enough together to use tiles of a size within the practicable limits of manufactures of clay. But the interest in fire-proof floor constructions with hollow tiles found its expression in the French International Exposition of 1867 in many ways, and several inventions appeared which there is no record of having been patented. They are, however, described in many publications of the time. Emile Muller, professor of construction at the Central School of Arts and Manufactures, Paris, in 1867, made many inventions for floor and ceiling constructions with I beams and hollow tiles. Among these is one described and illustrated in the price-list of E. Muller & Co., called " Light hollow filling, termed plate band brick, for filling in of floors," of which I give a reproduction. (Fig. 5.)

It will be seen that he used in some cases two bricks, and in others three. In the latter the third brick acted as a key. In these there appears to be no protection for the bottom of the beams except by carrying the plaster over their surfaces. The circular shows many other kinds of hollow tiles for segment arches (in which they are arranged in voussoirs), partitions, and other purposes for which they are used to-day.

In the *Gazette des Architectes* for 1867 I find a description of some of the French exhibits of hollow tiles. Here is an illustration of another invention of Professor Muller, similar to the last described, the arches being in two pieces. (Fig. 6.)

Another interesting exhibit is thus described: " Mr. Verdier has exhibited a floor formed of hollow brick, fitting the one into the other; one of them forms the key, and those which touch the beams are of variable length, so that the joints may be broken on each row. Very little mortar suffices to unite together these bricks which are held together, so that if one takes care to bond them in setting, the soffit of the arch shows a concavity of two centimeters between the beams." (Fig. 7.)

It will be observed that this is a flat arch though built of symmetrical tiles, and is equally strong as against a weight or upward pressure. The utility of this is not apparent where the floors are only intended to carry loads on top.

In Leonce Reynaud's *Traite d'Architecture*, Paris, 1867, is a description of hollow-segment and flat-arch construction between I beams accompanied by two illustrations. The former shows the style of segment arch now in use. The latter is the first flat hollow-tile arch in voussoirs as now generally used of which there is any record, and was the invention of Vincent Garcin, who patented the same in France, Oct. 11, 1867. These two styles of beam filling arches are here shown. (Figs. 8 and 9.)

To Vincent Garcin, therefore, must be ascribed the invention of the practicable flat hollow-tile arch as now so extensively used in this country. It will be noticed that this arch still leaves the bottoms of the beams exposed, to be covered only with plastering. But it has another feature. There are projecting lugs on the bottoms of the voussoirs and corresponding recesses, as if to prevent each successive voussoir and the key from slipping down. This idea seems to have taken hold of many succeeding inventors, and several patents have been taken out in this country for similar devices, evidently without knowledge, on the part of patentees or examiners at the patent office, that they were anticipated by the Garcin patent. But the idea was not even new with Garcin, for it was anticipated by the Englishman Bunnett. The futility of all such changes from the simple form of voussoirs with straight joints was long since established.

(*To be continued.*)

Mortar and Concrete.

AMERICAN CEMENT.

BY URIAH CUMMINGS.

CHAPTER VII.

CEMENT TESTING.

(*Continuation of tests made by Prof. Cecil B. Smith.*)

PAPER II.

Frost Tests.

IN a previous paper, read before the society, the writer promised to place before its members the results of certain frost tests, which were being made at that time.

They are now given, in hope that they may be of some interest to those engineers who are contemplating the building of cement mortar masonry, or cement concrete in cold weather.

Method of procedure. — The briquettes were all made in the same manner, the 1 to 1 mixtures having 18 per cent. of water, and the 3 to 1 mixtures 15 per cent., being purposely greater than the amount used in ordinary laboratory tests, so as to get the mortar softer, and resembling more closely the condition in which masons use mortar in ordinary construction, as the effect of frost may be greater on soft mortars than on dry ones.

The briquettes were all rammed into the molds in 3 layers, and the briquettes to be subjected to frost tests were immediately put

FOUR MONTH TESTS.

BRIQUETTES MADE DURING MONTH OF NOVEMBER, 1894.

Date of Exposure.	No. of Brand. (See Paper I.)	Ordinary time of setting. Initial.	Ordinary time of setting. Full.	Mixture.	Temperature at time of mixing. Lab. air.	Temperature at time of mixing. Water.	Temperature at time of mixing. Materials.	Temp. of outside air.	Time elapsed from mixing to time of exposure.	Tensile Strength. Lab. Tests.	Tensile Strength. Exposed specimens.	Remarks concerning exposed specimens.
Nov. 14	1 old sample	6°00′	12°00′	1 to 1	59°	56°	59°	36½°	10′	321	236	All these were of natural cements. They were brought in and kept 2 or 3 hours before testing, and allowed to warm so as to drive out the frost, and insure a test not being made on a frozen specimen. There were no external signs of any effect produced by 4 months' exposure.
16	2	5°30′		1 to 1	64°	60°	64°	53°	7′	302	220	
2	2	45′	2°45′	1 to 1	65°	58°	60°	60°	10′	484	250	
1	15	1°00′	2°30′	1 to 1	65°	62°	64°	66°	10′	541	237	
			Averages		63°	59°	62°	51°	9¼′	412	236	
Nov. 5	3	5°00′	20°00′	3 to 1	68°	65°	65°	37°	12′	143	147	All these were of Portland cement. They were, when necessary, brought into the laboratory and kept there for 2 or 3 hours before being tested, so as to insure that no tests were made on frozen briquettes. No signs of the effect of frost were visible on any of the specimens.
26	4	37′	3°10′	3 to 1	64°	58°	57°	29°	7′	236	200	
27	5	1°00′	5°00′	3 to 1	61°	62°	56°	36°	9′	237	183	
28	6a	2°00′	6°30′	3 to 1	68°	64°	63°	28°	8′	222	128	
6	8	3°20′	6°30′	3 to 1	63°	59°	60°	42°	9′	172	114	
9	9	13′	2°00′	3 to 1	64°	57°	61°	32°	11′	194	182	
13	10	25′	50′	3 to 1	62°	57°	57°	35°	7′	174	176	
19	11	30′	1°0′	3 to 1	60°	55°	57°	34°	8′	153	141	
21	12	25′	3°00′	3 to 1	60°	52°	58°	39°	9′	119	102	
20	14	20′	2°30′	3 to 1	61°	54°	58°	26°	9′	131	125	
22	19	2°40′	7°40′	3 to 1	58°	54°	56°	37°	7′	253	387	
			Averages		62½°	58°	61°	34°	8⅔′	185	171	

outside on a window-sill. In a few hours, after the briquettes were frozen hard, they were removed from the molds, and left exposed on the window-sills for two, three, or four months, care being taken to keep the snow swept off so as to allow the frost to have its full effect.

The tables, given, speak for themselves, and probably each engineer will draw special conclusions of his own; the writer will only mention a few points that seem obvious to him.

I. FOUR MONTHS TESTS.

It would appear, from these tests, that it is quite safe to build masonry work in November, in Montreal climate, when the materials are mixed and exposed to the air at about the freezing point. The proportion which the strength of the frost tests bears to the submerged ones is about that which would be obtained under the most favorable circumstances. The briquettes were all firm, smooth, and hard on the surface, and although subjected to 4 months of severe frost in an exposed position, they did not seem to have been at all damaged.

II. THREE MONTHS TESTS.

These were all made in December, and the coldest days were purposely selected. Yet the only briquettes which were blown in pieces were those made from two very inert, slow-setting, poor Canadian natural cements. The two other natural cements (one Canadian, the other Belgian) were quicker setting, and stood the test well. With the Portland cements, the diminution in strength is more apparent than real, the proportion of 90 to 164, which is the average of 11 brands, is really between briquettes ¾ to ⅞ in. square, and briquettes 1 in. square, the frost specimens being weathered off.

It is reasonable, however, that a briquette 1 in. square, exposed on 3 sides to the direct action of the frost, is rather more severely tested than mortar would be if placed in a wall, even the bottoms of the briquettes resting freely on the stone window-sills were largely uninjured, and the centers of all the briquettes appeared uninjured. As a result of these experiments, the writer would feel perfectly safe in laying cement mortar in December, with Portland or active natural cements, in weather 10 to 15 degs. above zero, and in the most exposed situations, expecting in the spring, to find ¼ to ½ ins. disintegrated at exposed joints, and needing re-pointing, or better still, the pointing could be left till spring, and done once for all.

III. TWO MONTHS TESTS.

These tests were much more severe in their nature, the sand and cement were exposed for hours in the open air, in small quantities, until they were absolutely down to the temperature of the outer air, and in the cold water and salt water series the water was also exposd, until it was, in three cases, actually below the freezing point, being in a slushy condition.

These materials were put together in the laboratory, as rapidly as possible, and exposed again at once, the usual interval being about 6 minutes, and the actual temperature of the mortar just before exposure having reached about 33 or 34 degs. F., while in the hot water tests the mixture rose, on an average, to 58 or 60 degs., just before exposure, which was just about laboratory temperature.

The experiments are hardly extensive enough to be fully conclusive, being made only on 7 brands of cement, but they point clearly to the advantage of the use of salt. Those briquettes made with salt showed good strength and little injury; although made with materials, at low temperatures exposed in severe cold, they seemed to be chiefly affected only on the surface.

THREE MONTH TESTS.

BRIQUETTES MADE DURING THE MONTH OF DECEMBER, 1894.

Date of Exposure.	No. of Brand. (See Paper I.)	Ordinary time of setting. Initial.	Ordinary time of setting. Final.	Mixture.	Temperature at time of mixing. Lab. air.	Water.	Materials.	Temp. of outside air.	Time elapsed from mixing to time of exposure.	Tensile Strength. Lab. Test.	Exposed specimens.	REMARKS CONCERNING EXPOSED SPECIMENS.
Dec. 26	1	6 00′	12 00	1 to 1	62	60	58	+ 7	5′	247	0	Briquettes frozen long before set could take place, all blown to pieces by frost.
24	(old) 2	5 30′		1 to 1	60	52	53	+10½	7′	198	0	ditto
1	2	45′	2 45′	1 to 1	65	60	60	+19½	8′	190	233	Seemingly quite sound, but broke irregularly as to loads and position of fractures.
1	15	1 00′	2 30′	1 to 1	61	56	56	+16	7½′	484	311	Practically sound, some slight cracks on the surface.
Average of No. 2 and No. 15					63	58	58	+18	7¾′	337	272	
Dec. 3	3	5 00′	20 00′	3 to 1	60	60	56	+17°	7′	108	101	About 1-16″ on the surface, disintegrated, the remainder quite sound.
31	4	37′	3 10′	3 to 1	60°	56	56	+19°	6′	204	85	ditto
31	5	1 00′	5 00′	3 to 1	48	45	46	+14½	6′	218	111	ditto
31	6a	2 00′	6 30′	3 to 1	54°	48	49	+ 8½	6½′	247	47	Three of these disintegrated for 1-16″ on outside, the other two injured to the very center, average of three being (72).
8	8	3 20′	6 30′	3 to 1	69	63	63	+21	6½′	191	163	Seemed perfectly sound and solid.
10	9	13′	2 00′	3 to 1	68	64	64	+14	8′	151	113	These during a warm spell of three days remained quite soft, not setting at all; when tested, they showed a slight weathering on the top surface.
18	10	25′	50′	3 to 1	57°	53	53	+18½	7½′	132	154	Seemed perfectly sound and solid.
27	11	30′	1 00′	3 to 1	70°	65	65	+ 7°	7′	107	59	Disintegrated for ⅛″ on top and sides, remainder solid looking.
28	12	25′	3 00′	3 to 1	61°	55	59	+ 9	6′	89	23	Disintegrated for ¼″ on top and sides, remainder solid looking.
31	14	20′	2 30′	3 to 1	50	50	54	− 7	7′	131	49	ditto
29	19	2 40′	7 40′	3 to 1	65	61	61	− 6	6′	223	87	Only 1 briquette was disintegrated on the surface, but all were weak and brittle, crumbling if rubbed with the fingers.
				Averages	60	53	54	+10½	6⅔′	164	90	

TWO MONTH TESTS.

(With cold water.)

BRIQUETTES MADE DURING THE MONTH OF JANUARY, 1895.

Date of Exposure.	No. of Brand. (See Paper I.)	Ordinary time of setting. Initial.	Ordinary time of setting. Full.	Mixture.	Temperature at time of mixing. Lab. air.	Water.	Materials.	Temp. of mixture just before exposure.	Temp. of outside air.	Time elapsed from mixing to time of exposure.	Tensile Strength. Lab. Tests.	Exposed specimens.	REMARKS CONCERNING EXPOSED SPECIMENS.
Jan. 14	2	45′	2 45′	1 to 1	61	32	+19	40	+18	6′	295	21	Practically all blown to pieces, the solid core of two briquettes giving 105 lbs. = 21 lbs. average.
5	15	1 00′	2 30′	1 to 1	57°	36	+26	38	− 3°	6′	330	87	All the exterior blown to pieces, interior solid.
				Averages	59°	34	+22½	39	+ 7½°	6′	312	54	
Jan. 21	3	5 00′	20 00′	3 to 1	63°	32	+14	34	+13	6½′	86	0	All soft and crumbling. No strength at all.
24	8	3 20′	6 30′	3 to 1	57°	32	+ 5	36°	+ 5°	9′	214	5	Cement frozen when mixed 6′, mixed by hand, a very severe test; briquettes appeared firm on surface, but crumbled when touched.
29	9	13′	2 00′	3 to 1	60°	32	+20	37°	+18	6½′	133	92	Disintegrated on top for 1-16″; remainder solid.
Feb. 5	10	25′	50′	3 to 1	55°	34	11	30°	−11°	6′	145	39	This mortar frozen when mixed, mixed by hand on table, a very severe test, briquettes appeared firm on surface, but weakened all through.
				Averages	59	32½	+ 7°	34	+ 6	7′	144	34	
Average of Nos. 3, 8, and 9					60	32	+13	36	+12	7′	144	32	

TWO MONTH TESTS.

(With hot water.)

BRIQUETTES MADE DURING THE MONTH OF JANUARY, 1895.

Date of Exposure.	No. of Brand. (See Paper I.)	Ordinary time of setting. Initial.	Ordinary time of setting. Final.	Mixture.	Temperature at time of mixing. Lab. air.	Temperature at time of mixing. Water.	Temperature at time of mixing. Materials.	Temp. of mixt're just before exposure.	Temp. of outside air.	Time elapsed from mixing to time of exposure.	Tensile Strength. Lab. tests.	Tensile Strength. Exposed specimens.	Remarks on exposed specimens.
Jan. 18	2	45′	2°45′	1 to 1	64°	125°	35°	68°	+11°	6′	428	109	Badly blown on exterior for ⅛″, but interior still solid.
5	15	1°00′	2°30′	1 to 1	57°	126°	30°	65°	+ 3°	6′	250	23	Top surface blown off for ¼″, interior solid looking.
			Averages		60½°	125½°	32½°	66½°	÷ 7°	6′	339	66	
Jan. 21	3	5°00′	20°0′	3 to 1	63°	125°	18°	61°	+15°	6′	85	0	All soft and crumbling, no consistency at all.
23	8	3°20′	6°30′	3 to 1	64°	110°	20°	59°	+20°	6½′	99	47	Set very slowly in laboratory, those exposed were neither frozen nor set after 4 hours.
30	9	13′	2°00′	3 to 1	63°	119°	18°	59°	+18°	5½′	109	88	Disintegrated for about ⅛″ on top, remainder solid.
Feb. 5	10	25′	50′	3 to 1	55°	115°	−11°	54°	−11°	7′	132	21	Slightly disintegrated on top, and weakened all through.
			Averages		61°	117°	+11°	58°	+10½°	6′	106	39	
	Average of Nos. 3, 8, and 9				64°	118°	+19°	60°	+18°	6′	98	45	

On the other hand, the use of hot water does not seem to be of any advantage, particularly in Portland cements; a reason advanced by one writer for this fact was, that the bringing together of materials in a mortar, at widely divergent temperatures, exerted a prejudicial effect on the cement, hindering proper crystallization, and that the use of materials, at, as nearly as possible, the same temperatures would produce more rapid and stronger action. The effect of hot water on natural cements is not so disappointing, but does not show much increase over the strength of similar specimens made with cold water.

The general result of these experiments, to the writer's mind, points to the idea that in any weather, in winter, not extremely cold, say not lower than + 15 degs. F., masonry work can be laid with cold sand, cold cement, and cold water, provided the natural time of set of the cement is not more than 5 or 6 hours, and that by the addition of about 2 or 3 per cent. of salt to the water, the same work may be done in weather down as low as zero, which is as cold as men will work. The disintegration will not extend probably deeper than ¼ to ½ ins. — the remainder of the mass being quite sound.

By what process cement sets, after it has, in a few minutes, been frozen solid, and remains frozen for months, the writer will leave to others to explain, but set it certainly does, without ever having been thawed out.

THE ENGLISH METHOD OF BUILDING CEMENT SIDEWALKS.

EXCAVATE the ground to a depth of about 5 ins. below the finished level, and upon this lay about 1 in. thickness of cinder or gravel; upon this lay a layer of clean hard stone or other suitable material broken so as to pass through a 3 in. ring, well watered and rolled, filling up inequalities and leaving the surface about 2 ins. below the level of the footway (sidewalk). Divide into bays (sections) about 6 ft. in width with battens of soft wood, and complete each alternate bay by laying upon the stone foundation carefully prepared concrete composed of one part Portland cement, two parts coarse, clean gravel, or other suitable procurable material, passed through a 1 in. screen, and two parts clean, sharp sand, which must be well beaten or rolled into place; and before it is set a finishing coat 1 in. in thickness of a finer and richer concrete to be added and brought up to the finished surface of the footway, and well troweled and smoothed into place. This finishing coat may be composed of one part Portland cement to two parts granite chippings, three parts gravel or other suitable material which will pass through a ¼ in. sieve. As the work is finished the battens may be removed and the joints filled with fine sand. — *Carriage and Footway Construction.*

TWO MONTH TESTS.

(With 2 per cent. of salt in the water.)

BRIQUETTES MADE DURING THE MONTH OF JANUARY, 1895.

Date of Exposure.	No. of Brand. (See Paper I.)	Ordinary time of setting. Initial.	Ordinary time of setting. Full.	Mixture.	Temperature at time of mixing. Lab. air.	Temperature at time of mixing. Water.	Temperature at time of mixing. Materials.	Temp. of mixture just before exposure.	Temp. of outside air.	Time elapsed from mixing to time of exposure.	Tensile Strength. Lab. Test.	Tensile Strength. Exposed specimens.	Remarks on exposed specimens.
Jan. 18	2	45′	2′45″	1 to 1	64°	32°	22°	41°	11°	6′	320	73	Blown on surface for about ⅛″, interior solid.
9	15	1°00′	2°30′	1 to 1	58°	40°	9°	42°	9°	6′	280	143	Slightly blown on bottom, other fine cracks on top, otherwise solid.
			Averages		61	36°	15½°	41½°	+10°	6′	300	108	
Jan. 21	3	5°00′	20°00′	3 to 1	65°	29°	25°	39°	25°	6′	101	39	Exterior worn with loose sand, but interior hard and firm, water was slushy at time of mixing.
28	8	3°20′	6°30′	3 to 1	56°	30°	13°	30°	12°	6½′	183	224	In perfect condition, water was slushy at time of mixing.
31	9	13′	2°00′	3 to 1	57°	30°	17°	30°	19°	6′	105	92	One briquette badly affected, and others quite sound. No. 10 is not tested.
	Average of (3)				59°	30°	18°	33°	17°	6′	118	130	

NOTE.— Each test recorded in this table is the average of 5 briquettes, all briquettes rammed moderately, in 3 layers, with an iron hammer having ½″ square end, and weighing about ½ lb.

COLOR OF NATURAL CEMENT.

THE color of the manufactured cement, being due principally to the presence of a small quantity of oxide of iron and sometimes of manganese, or to the carbonates of these oxides, which for all practical purposes are conceded to be a passive ingredient in hydraulic mortar, should be a matter of indifference to consumers. In fact, the presence of a large proportion of the coloring principle, like that of any other inert substance, might be expected to have a tendency to deteriorate the quality of the mortar by diminishing the cohesive strength of the cementing substance, and, therefore, if taken into consideration at all, ought at least to direct suspicion to the darker varieties. — *Gen. Q. A. Gilmore.*

The Masons' Department.

THE ARCHITECT AND CONTRACTOR.

BY THOMAS A. FOX.

(*Continued.*)

FOREMEN.

THE one thing above all others which enables an individual, firm, or corporation to carry on an extensive building business is the ability to select competent and able foremen; and with the increasing complications involved in the construction of a large modern building, and the speed with which the work must be done, the duties and responsibilities which devolve on a foreman have materially increased. In truth, he must have practically all the qualities which go to make a successful master builder, differing only from his employer from the fact that he has no capital involved. When one considers the amount of time the average master builder must spend attending to the strictly financial side of his business in estimating travel and other details, it can readily be seen that the actual carrying out of a piece of work must necessarily be entrusted to a subordinate, and that upon his ability will depend to a great extent the success or failure of the undertaking.

Of the qualifications which go to make a competent foreman, the most important is an accurate and complete knowledge not only of his own particular trade, but of all others which come in connection with it; he must also be a thorough mechanic, for if he is unable to do work in the right and economical way himself, it is hardly possible that he will be able to show others how to do it.

After the mechanical skill as a requisite for a competent foreman should be placed foresight, which, although at first thought may seem to be a matter of minor importance, is, nevertheless, an essential quality. In order to have work which is done in a hurry (and very little, unfortunately, is now done in any other way) proceed smoothly, the foreman must be constantly planning ahead. He must have the method by which the work is to be carried on clearly in mind; he must see that the proper materials and sufficient in quantity are at hand when needed; and by no means least important, he must see that he has proper drawings from which to lay out the work in advance. While it must be acknowledged that many delays are caused by the lack of drawings, it must at the same time be admitted that if some one makes timely and reasonable requests of the architects the necessary drawings can be had, and the foreman is the man who should issue the reminders which are always necessary to keep such people up to time. A foreman who combines the two essential qualities of foresight and care will save his employer from much expense, and the architect from many embarrassing positions, for if the plain truth be told, the architect practically never pays for mistakes; the owner sometimes pays for them, while the contractor usually pays for them.

The first thing a foreman should do on receiving a roll of drawings is to look them over carefully to see if there are any practical difficulties which stand in the way of executing the work as proposed. He should also take the precaution to check the various lines of figures and make sure there are no discrepancies. In connection with this work the specifications should be read. If such a course is pursued, it enables the foreman to start the work with a clear idea of what is expected. In going over the drawings, a memorandum should be made of any discrepancies, omissions, or matters about which information is desired, and on the first opportunity which offers these matters should be talked over with the architect or his representative, when generally most of the questions which have arisen can be easily adjusted and explained. It is important, however, for the foreman to keep in mind the fact that it is out of his province, unless a special arrangement has been made, to make any changes which involve extras or allowances without first reporting the matter to his employer.

It may be the custom of some contractors to require all such transactions as have just been described to be done by the master builder in person; but as a rule, matters of mere detail, with the exceptions noted, can be settled in a perfectly satisfactory manner on the work. There is a disposition on the part of some architects and superintendents to ignore suggestions which are advanced by foremen, which, it is needless to say, is most short-sighted policy, but unfortunately practised to such an extent that many foremen, when asked why they did not call attention to some point in season to avoid trouble, reply that experience has taught them that the architect did not care to receive suggestions from their direction.

It is policy for the architect or his representative who superintends the actual construction of a building to say to the foreman at the beginning of a piece of work that there are two important things for him to remember; first, never to deviate from the plans and specifications without express permission; and secondly, if there is any point which is not fully understood or clearly shown, or if any work is shown or called for which he does not consider proper, he should invariably call attenion to the fact in time to have the matter remedied before any expense is incurred or harm done. If these simple suggestions are followed and the foreman understands that he is to work with the architect and not at cross purposes with him, many of the minor complications which ordinarily arise in building transactions will be avoided. Method and neatness are two qualities which should be cultivated by a foreman, for there is nothing which makes a better impression on both the owner and architect than to find that their work is being done under a well-defined system, and that the premises are always kept clean and free from an accumulation of rubbish. This also helps the contractor, for it is always possible under such conditions to advance the work rapidly, and with the least possible disorder and confusion.

It is particularly desirable for journeymen who wish to become foremen, and foremen themselves who have not had much experience, to make a special study of the trades other than their own which come in connection with their individual work, and it is excellent practise for such persons to take a course in draughting, which will enable them to thoroughly understand the drawings from which they are to lay out and execute their work. Such training was formerly given to a limited extent under the apprentice system, but since that has been abolished the learner is left to pick up the necessary information as best he can. With the development of night schools in the cities, however, there are ample opportunities for getting an elementary education in such matters, and it only needs the disposition to learn and some one (who can always be found) to direct intelligently the efforts of a beginner to enable a man to perfect himself in the theoretical matters which pertain to his trade, while at the same time he can be earning his living and gaining practical experience on the actual work.

LEGAL POINTERS.

A WORKMAN on a building, who fell and was injured by reason of stepping upon a joist which had just been sawed nearly through by another workman who had momentarily left it, cannot recover from his employer for such injury, on the ground that he should have been notified of the danger. — *Supreme Court, Massachusetts.*

AN architect who prepares plans for a building, and also superintends its construction, is entitled to a mechanic's lien for his entire services, but the preparation of plans alone, not supplemented with superintendence, does not give him a lien. It is the part the architect takes during the construction that draws his services within the lien law. And where only a portion of the work has been done, and the construction indefinitely suspended, the argument that the plans may be used eventually in the completion of the building does not assist the architect, for he never had a lien for his plans. — *Supreme Court, New York.*

Recent Brick and Terra-Cotta Work in American Cities, and Manufacturers' Department.

NEW YORK.— The most important event of late has been the finishing of the preparation of the charter for Greater New York, its unanimous acceptance by the commission, and its presentation to the legislature, the result of which we are all anxiously awaiting, as it is sure to have an important effect in many ways on the future of the architectural and building interests of the great metropolis. Probably as soon as the matter of government is decided the question of a new city hall will be again agitated, for the need has become an absolute necessity. We trust that the competition will be as well conducted as the late unpleasant one *promised* to be.

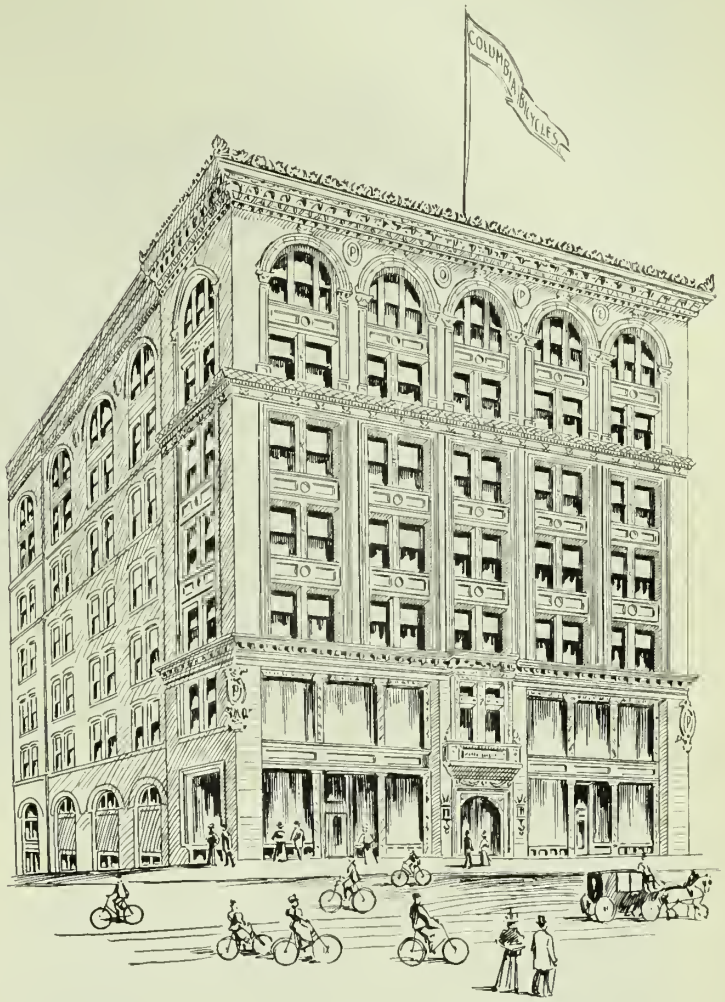
Greater interest was taken this year in the annual exhibition of the Architectural League than ever before, not only among members of the profession, but by the public at large. The lack of ability on the part of ordinarily intelligent persons to intelligently criticize a work of architecture has been especially noticeable for years past. This condition of things can be, and in fact has been, materially improved by the admirable exhibitions given by the Architectural League in New York, and by kindred societies in other cities. The exhibition is particularly fine this year, and gives a very good idea of the amount of work in hand for '97, which is encouraging. The prospects are good ; an unusual amount of large work has been announced during the past month. One item of interest, and we must say regret, to architects is the contemporaneous demolition of the two finest specimens of Egyptian architecture in this country, — the old Tombs Prison and the Bryant Park Reservoir. The old historic prison will give way to a new and complete building 186 ft. long, 45 ft. wide, and 123 ft. in height. It will have a capacity for eight hundred prisoners, and will cost $700,000. Withers & Dickson are the architects.

Bryant Park will be cleared of the reservoir and all existing buildings, and the entire block bounded by Fifth and Sixth Avenues

TERRA-COTTA CAP, POPE BUILDING, BOSTON.
Peabody & Stearns, Architects.
Made by Perth Amboy Terra-Cotta Company, Waldo Bros., Boston Agents.

and 41st and 42d Streets will be devoted to the use of a great public library to be erected by the city. It will be the home of the New York Public Library, and the Astor, Lenox, and Tilden Libraries. The city is to issue $2,500,000 in 4 per cent. gold bonds for the purpose.

The Grand Central Station is to be altered and improved at a cost of $500,000. Bradford L. Gilbert is the architect. Several stories will be added for offices, and the towers materially altered.



NEW POPE BUILDING, BOSTON, MASS.
Peabody & Stearns, Architects.
Gray terra-cotta furnished by Waldo Bros., New England Agents for Perth Amboy Terra-Cotta Company.

The new waiting room will be one of the largest in the world. It will be 200 ft. long by 100 ft. wide, and will front on 42d Street.

The Academy of Design has finally decided on a site for its new building. They have bought the entire east block front in Amsterdam Avenue, between 109th and 110th Streets. The plot has a frontage of 171 ft., and in each of the side streets 200 ft. The site is opposite that on which the Cathedral of St. John the Divine is to be erected, and is near the handsome new buildings of St. Luke's Hospital and Columbia University. A competition will probably be held, and we trust will result in a building which will be a credit to that part of the city, which promises to be most attractive architecturally.

Many new office buildings will be begun this spring, and all very close together, in the neighborhood of Wall Street. Among them are the Empire Building, by Kimball & Thompson ; Exchange Court, Clinton & Russell; Washington Life Insurance Company, C. L. W. Eidlitz; Singer Machine Company, Ernest Flagg; office building for the Crocker Estate, by C. C. Haight; and the American Realty Company, W. B. Tuthill. A new custom house is contemplated, the committee still being undecided as to a choice between the Bowling Green site and the present site on Wall Street. A new hall of records is also being considered.

PHILADELPHIA. — In building circles there certainly is seen some substantial improvement at the present time over the condition of a few months ago, and there is on all sides the usual preparation for a brisk season; whether the work expected will materialize or not will remain to be seen, but there is expressed by some of the most extensive builders and operators the opinion that all signs must fail if there will not be a prosperous season. The demand for modern business buildings in the heart of the city is as strong to-day as it ever was, and it is probable that some of the projects mentioned last month will be carried to completion. The one for the large business and office building on the southwest corner of Broad and Chestnut Streets is being pushed forward with more than usual energy, and the present status in that case is that the adjoining property, No. 1408 Chestnut Street, now occupied by the Citizens' Trust Company, has been purchased by Messrs. Widener & Elkins, and will be added to the corner plot; the tenants, it is understood, are to vacate on or before the first of April next. The property as a whole will be offered to the Land Title & Trust Company at its next meeting, on March 22, and it is this company which proposes to put up the extensive building. A competition between several invited architects was held some few weeks ago by Messrs. Widener & Elkins, but up to the present time no statement as to the selection of an architect has been given.

HORTICULTURAL HALL, PHILADELPHIA.
Frank Miles Day & Bro., Architects.
Architectural terra-cotta made by Conkling, Armstrong Terra-Cotta Company.

Considerable advance has also been made in the restoration of the old State House at 5th and Chestnut Streets. It is proposed to restore the entire group of buildings, as far as possible, to their original condition. The interior has been practically finished, and the buildings have been formally turned over and accepted by the city: the lower portion of the main and the two wing buildings will now be restored, and the arcades which originally connected the buildings will be reproduced. Estimates for the work are now being asked by Architect T. Mellin Rogers, who has had charge of the work since its commencement.

Bids are now being asked for an eight-story "housekeeping apartment" building, which is contemplated on the northeast corner of 13th and Budd Streets: this will be one of the most complete buildings of its kind, and the conveniences are first class in every respect. The entire building will be strictly fire-proof, Fawcett floors being specified, and the walls of brick, stone, and terra-cotta. There is an elevator in the entrance hall, and a lift in the rear of the building, extending from the kitchens into the basement, where the janitor's apartments and the compartments of each of the tenants for coal, wood, etc., are located. Each apartment consists of a parlor, library, dining-room, two bedchambers, kitchen, servant's room, pantry, two storerooms, linen closets, etc., besides a liberal amount of hall space, and an arrangement with the front and rear vestibules which completely isolates each apartment from the entrance as well as from the adjoining one; there are two apartments on each story. The architects are Wilson Brothers & Co., Drexel Building.

Edward A. Cameron, of St. Louis, has been appointed, after examination under the Civil Service rules, to the position of superintendent of construction of the Philadelphia Mint; his name, it is understood, was at the head of the list of applicants, and he has been highly recommended for the position by leading architects of Chicago and Boston. The contracts for the basement and area walls will be let within two months, and during the summer the contracts for the entire superstructure, including the marble, brickwork,

TERRA-COTTA MEDALLION, HORTICULTURAL HALL, PHILADELPHIA.
Made by Conkling, Armstrong Terra-Cotta Company.

and structural steel, will be placed. The intention of Architect Aiken is to carry on the work without interruption to its completion.

CHICAGO.— A matter of considerable interest to architects has been the exhibition of architectural work from the American Academy at Rome, which Mr. Charles McKim is so wisely sending

TERRA-COTTA DETAILS, HORTICULTURAL HALL, PHILADELPHIA.
Made by Conkling, Armstrong Terra-Cotta Company.

on a tour from city to city. Mr. McKim is certainly entitled to the gratitude of the profession, on which this exhibition will exercise a beneficial influence, for his personal trouble and expense in thus exhibiting the scholarship work of prize winners. Mr. D. H. Burnham generously defrayed the expense of bringing the collection to Chicago. Three of the twelve men whose works make up the large exhibit are associated with Illinois institutions. S. G. Temple is an instructor in the Illinois State University, and Messrs. MacNeil and Fellows are both instructors in the Chicago Art Institute.

A matter of concern to Illinois architects just now is a bill before the legislature which, if it passes, will institute in this State examinations and license fees to regulate the practise of architecture.

Building news continues to be depressing. The number of permits taken out is increasing with the season, but they cover, for the most part, a cheaper class of buildings.

One Chicago-Philadelphia item is that D. H. Burnham & Co. have on hand a fourteen story building, which is to be erected in the Quaker City.

Henry Ives Cobb has a large " out-of-town " building,— a savings bank at Albany, N. Y.

The underground Van Buren Street suburban station of the Illinois Central Railroad is now almost completed, and displays a very interesting variety of " burned earth " products. There are walls, floors, beams, arches, and columns covered with rough surface terra-cotta, hollow tile, variously colored glazed terra-cotta, enameled brick, and ornamental tiles. This list of finished work is varied with a considerable use of ornamental iron, marble, plaster, glass, and stone.

TRADE LITERATURE.

THE TIFFANY ENAMELED BRICK COMPANY, Chicago, have condensed much valuable information into another attractive little pamphlet, which treats in an interesting and instructive manner the uses and purposes of enameled brick. This book should be at the right hand of every one who contempletes employing this material.

TERRA-COTTA DETAIL, STEWART BUILDING, CHICAGO.
D. H. Burnham & Co., Architects.
Made by Northwestern Terra-Cotta Company.

WE have received a very attractive pamphlet issued by James A. Davis & Co., sole New England agents of the Alpha Portland Cement. It contains a number of illustrations of buildings, dams, and bridges in the construction of which Alpha Portland Cement was used exclusively; also a number of letters from prominent authorities indorsing the superior merits of this cement.

Copies of this book will be found very interesting, and may be had by applying to James A. Davis & Co., 92 State Street, Boston, Mass.

WE have received the recently published illustrated catalogue of fire-proof building material as manufactured by Henry Maurer & Son of New York. The fire-proofing products of this house are so well

STEVENSON BUILDING, INDIANAPOLIS, IND.
Henry Ives Cobb, Architect.
Built of gray brick and terra-cotta. Brick furnished by the Columbus Brick and Terra-Cotta Company and the terra-cotta by the American Terra-Cotta & Ceramic Company.

known, and have so strong a hold on the good-will of the building community, as to require very little comment on our part. There are one or two features introduced in the catalogue which are novel and interesting. One of these is the 2-in. Phœnix fire-proof hollow tile partition, which is made of hollow burnt clay or porous terra-cotta tiles, set on edge, with a long strip of band iron imbedded in cement or mortar between the courses, giving to the 2-in. partition the same tensile strength as a wall 4 or 6 ins. thick. The catalogue also illustrates the forms of hollow brick which are made to be used as bottle racks, which is somewhat of a novelty in its line. There is also illustrated the Eureka system of hollow tile floor construction, which comprises three tiles, two skew-backs which fit the beams, and one center or key tile, forming a flat ceiling of floor requiring no centering during the erection, which can be put in rapidly with or without the use of cement, as the tiles cannot work out or get loose in any manner. In addition there are the standard shapes manufactured by this company, together with reports of tests, etc., and many very valuable suggestions as to fire-proofing methods.

The pamphlet recently issued by Fredenburg & Lounsbury, Metropolitan Building, New York, sole agents in New York and New England for the Hydraulic Press Brick Companies, contains a concise and splendidly arranged description of the various structures erected of the Hydraulic Press Brick during the years 1895 and 1896, together with mention of color and shape of brick, character of trimming of the buildings, and the names of the architects and builders.

TERRA-COTTA CAP, Y. M. C. A. BUILDING, NEW YORK CITY.
Parish & Schraeder, Architects.
Made by Excelsior Terra-Cotta Company.

The book has been carefully compiled with a view to making it particularly serviceable to an architect desiring to adopt a shade of brick different from those he is accustomed to employ. By consulting its contents, he can ascertain the location and general character of the buildings wherein a particular brick in which he is interested has been used, and he is then in a position, if he so desires, to make a systematic inspection of the work in question, and see the various shades in actual use, in buildings of varied designs, and note the effect of same with the several combinations of stone, terra-cotta, etc.

We can commend Messrs. Fredenburg & Lounsbury on the general good style and character of their contribution to trade literature, and are glad to recommend it as being of real interest to those engaged in the building profession.

OF INTEREST.

Waldo Bros. have closed a contract with Hootons & Hemmenway, of Providence, for furnishing the terra-cotta for the new building for the William F. Low estate, Westminster Street, Providence.

The Celadon roofing tiles have been specified for the Municipal Building, Yonkers, N. Y., E. A. Forsythe, architect. Also for the residence for Phillip Kleeburg, Esq., New York City, H. P. Gilbert, architect.

The Union Akron Cement Company, of Buffalo, are furnishing their Akron Star Brand of cement for the new building of the Brooks Locomotive Works, at Philadelphia, and also for the Willard State Hospital, at Willard, N. Y.

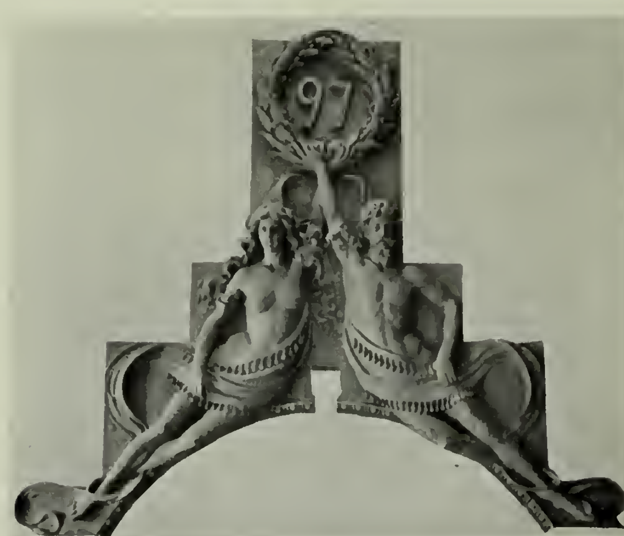
Waldo Bros. will furnish the terra-cotta roof tiles for the Newton Bank Building, Newton, Mass. They will be a very rich dark-red glaze, making a pleasing contrast with the rest of the building.

In the February Brickbuilder, under the illustration of the Y. M. C. A. Building, it was stated that the brick for the building was furnished by the Excelsior Terra-Cotta Company. The statement was incorrect, the terra-cotta only having been furnished by the Excelsior Company. The Raritan Hollow & Porous Brick Company, New York City, furnished the gray brick used.

The New Central High School Building, of Detroit, is a structure of which the citizens of that city are justly proud. The utmost care has been used in constructing the building on the most approved lines, and under most up-to-date methods. The building is faced throughout with pressed brick, and the Board of Education, having the matter in charge and adopting the Morse Patent Wall Ties for bonding the same, realized that, considering every feature, this was the most approved form of bonding in use. That they were entirely satisfied with the result is conclusively proven as the ties were also used for the same purpose in the construction of the Delray School Building and Lysander School Building, of the same city. Attention is called to the illustration of the Central High School Building, on page xxxvi.

The Matawan Terra-Cotta Company is the name of the new corporation which has succeeded the firm of K. Mathiasen & Co. This firm has, until the later part of last year, been doing business at Trenton, N. J., in a leased factory; but with the growth of the company this factory had become inadequate for the amount of business done, and it was decided to move the works to Matawan, where the large pottery and brickmaking plant formerly known as the I. S. Rue Pottery was secured. This plant, with its machinery and four large kilns, is admirably fitted in every respect for the manufacturing of architectural terra-cotta.

The Matawan Terra-Cotta Company is composed of all the old members of K. Mathiasen & Co. Karl Mathiasen, the president and general manager, has been known for many years in the terra-cotta field as a successful manufacturer of architectural terra-cotta. He is also the president and general manager of the New Jersey Terra-Cotta Company, of Perth Amboy, N. J. The other members of the company, the Eskesen Bros. are well known throughout the terra-cotta trade as enterprising and progressive business men.



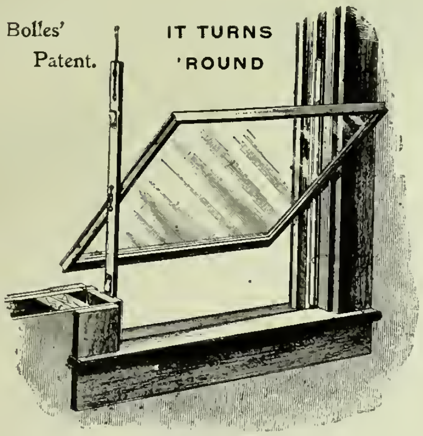
TERRA-COTTA DETAIL, BUILDING FOR WM. WEIGHTMANN, PHILADELPHIA.
Willis G. Hale, Architect.
Made by Standard Terra-Cotta Company.

The Boston agents of this concern are G. R. Twichell & Co., 19 Federal Street.

A meeting of the Philadelphia Brick Manufacturers' Exchange was recently held in the Master Builders' Exchange, when a scale of prices for brick during the ensuing year was formed. The meeting was attended by the members of twenty firms in that city, representing three fourths of the brick manufacturing interests of the vicinity. The scale agreed upon places the price of salmon brick at from $5.50 to $6 per thousand; hard brick, $7 to $8; stretchers, $9 to $13; pressed brick, $17 to $19, and pressed stretchers, $12 per thousand for the average haul. The brick production for the past year was about 400,000,000, a decrease of about 40,000,000 over the preceding twelve months, caused by some of the yards becoming exhausted and the firms owning them going out of business.

A NEW REVOLVING SASH.

IN every large city there occurs each year a number of fatalities through the operation of cleaning the windows of the large buildings from the outside, and we are glad to call the attention of our readers to the Bolles Sliding and Revolving Sash, as being a device which will eliminate all such danger and render accident from this cause an impossibility.



This window is so constructed that both sides of it may be cleaned from the inside. It can be revolved, reversed, or placed at any desired angle whatsoever for the purpose of ventilation, besides sliding up and down the same as any ordinary sash. To turn the window, reverse it, or place it in a slanting or horizontal position, all that is necessary to do is to raise the sash slightly, and then push the bottom rail outward.

In order to obviate all possible rattling and to render the sash both wind and dust proof, a special device is attached to each end of the strips which press firmly against the window jamb. The sash is snugger and closer fitting by far than the old-style sash, and runs with equal ease and smoothness. The joint is self-locking.

The upper sash is similarly constructed as the lower, and both sashes may be turned either way, separately or together.

The patentees call particular attention to the following important points: Its simplicity, the entire absence of complicating mechanism, the fact that it can be hung with as great ease as the old-style sash, its low price, and the doing away with all the dangers incident to the cleaning of windows.

Further information in this matter may be obtained from Edward Diggs, General Agent, Builders' Exchange, Baltimore, Md.

FOR SALE.

TWO COMPLETE OVER-GEARED 8 FT. DRY PANS, WITH 48-IN. PULLEYS, ENTIRELY NEW.

FOR PARTICULARS INQUIRE OF SMITH & CAFFREY, SYRACUSE, N. Y.

AGENCY WANTED.

A GENTLEMAN having well-located office in Boston would handle some building specialty as side line; is in thorough touch with building work throughout New England, and has good acquaintance among architects and builders. Would prefer something in fire-proofing or structural work. Address, SPECIALTY, care THE BRICKBUILDER.

INDEX TO ADVERTISEMENTS.

VOLVME VI APRIL 1897 No. 4

THE BRICKBVILDER

OFFICE 85 WATER STREET BOSTON

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

PUBLISHED BY

ROGERS & MANSON,

CUSHING BUILDING, 85 WATER STREET, BOSTON.

P. O. BOX 3282.

Subscription price, mailed flat to subscribers in the United States and Canada	$2.50 per year
Single numbers	25 cents
To countries in the Postal Union	$3.50 per year

Entered at the Boston, Mass., Post Office as Second Class Mail Matter, March 12, 1892.

THE BRICKBUILDER is for sale by all Newsdealers in the United States and Canada. Trade Supplied by the American News Co. and its branches.

PUBLISHERS' STATEMENT.

No person, firm, or corporation, interested directly or indirectly in the production or sale of building materials of any sort, has any connection, editorial or proprietary, with this publication.

THE BRICKBUILDER is published the 20th of each month.

BRICK BRACING.

THE constructive importance of brick masonry has during the past twenty years undergone several distinct modifications. Before 1880, the approximate date when skeleton construction first made its appearance, the masonry construction was depended upon to resist static loads as well as to afford rigidity to walls when subjected to lateral or angular strains. The principle was entirely one of inert resistance to thrusts, and the mass of masonry by its cohesion and dead weight afforded the required stability. The introduction of the steel frame brought about what at first seemed to be a radical change in the function of masonry, which from being a supporting member was considered simply as an envelope, a protection, or a mere external adornment to the hidden vital sinews of steel; and all of the calculations of recent years which have been made looking to a determination and resolution of wind strains have assumed that these are taken care of entirely by the bracing or the arrangement of the members of the steel work. There is, however, another function which brick masonry in these modern structures should possess, the necessity for the observance of which is being recognized by our constructors. In the newspapers, which often reflect only a suggestion rather than an exact statement of fact, we sometimes read that a certain building is constructed so strongly that if it were set up on edge it would not distort, and that to all intents and purposes the high building, if properly constructed, is practically a huge cantilever or beam, the lower end of which is thoroughly fixed in the ground. There is no scientific reason to believe that this is an exact statement of fact, and yet after the steel frame has been calculated to provide for every possible strain that would theoretically come upon it, the building receives an enormous addition of rigidity by reason of the brick filling which is added to it; and if, as is the practise in much of the work, the supporting and bracing members are reduced to a minimum expanse of cross section and thoroughly built around by the masonry so that the bricks can tie in through all the parts of the frame, the resulting rigidity is a very considerable element in the stability of the structure. Any one who has had occasion to investigate the stiffness of the steel skeleton before the terra-cotta floor arches and the brick envelope are in place must have noticed the extent to which the frame is affected even by the rumbling of passing teams in the street, and in a high wind the steel frame is jarred very perceptibly; whereas in the completed structure, when the steel frame is properly housed in the brickwork and the floor arches are thoroughly laid, even the tallest of the buildings which have been erected within recent years are not perceptibly affected by the most severe gales, while they seem to be absolutely unresponsive to any jarring or rumbling caused by teams on the surface of the ground. In other words, while the steel skeleton has in a sense replaced a very considerable portion of the constructive value of brickwork, by itself it is not sufficient to afford the necessary rigidity required in a modern structure, and the brickwork plays a very vital part in making the building habitable, and preserving it from the vibrations which in time would cause disintegration if not destruction. We have in mind at this moment a sixteen-story office building which was constructed by a firm of architects who are acknowledged masters of their profession, in which the system of cross bracing to provide for vibrations and wind strains was carried to the scientific limit, the brick walls being treated, however, merely as curtains, and reduced to the least possible areas of cross section, with the result that after an occupancy of a little over a year the vibrations in the building were found to be so great that it became necessary to build two heavy brick cross walls inside of the building from foundation to roof in order to acquire the needed stiffness. In another very prominent building, the movements of the steel frame before the brickwork was in place were such that it was not thought prudent to even build in the floor arches until after the external walls were carried to a considerable height, lest the action of the wind upon the floor surfaces should bring undue strain upon the steel work. These examples illustrate the necessity of care and good workmanship, and serve to emphasize the constructive functions of brick masonry, even when the envelope is carried independently by a scientifically designed steel skeleton.

THE QUESTION OF COLOR — A CONTRAST.

A POPULAR belief does not differ from a popular skepticism in point of endurance. When once fairly established, it becomes a cherished habit of thought, and whether right or wrong, is not easily effaced. It clings to the imagination and continues to influence our judgment in spite of overwhelming facts to the contrary. The evidence of our own eyes, though admittedly conclusive in ordinary affairs, is not always sufficient to eradicate a prejudice of long standing. "Give a lie twenty-four hours' start, and it will have accomplished its mission before the truth has overtaken it." This maxim, though formulated by an experienced politician, has a substrata of truth, and may be accepted — in this case *cum grana salis*. It is notably the case in regard to the supposed want of uniformity in the color of terra-cotta, when compared with that which may be relied upon in stone taken from the same quarry. Yet the facts do not justify any such sweeping conclusion. We have seen terra-cotta rejected, or what is nearly as bad, belied, on these grounds, though it was not less uniform in color than stone which had been accepted and set in the same building without a murmur of complaint. In like manner we have seen stone accepted simply because it was stone, when the same variation in color would have been deemed sufficient cause for the rejection of terra-cotta. Or, if its use had been permitted at all, it would have been under protest, and after the whole vocabulary of opprobrium had been exhausted. Such is the force of unreasoning prejudice. In this respect, at least, the captain's "choleric word," coming from the mouth of a corporal, is still held to be "flat blasphemy."

Whatever may have been the relative condition of things, say ten, or even five years ago, they have undergone changes in the interval of which the general public — even the building public — are not fully cognizant. Not only have they changed, but there is good reason to believe that they have in many instances been reversed. Indeed, the signs pointing in the direction of this reversal are so general and emphatic that their existence cannot much longer remain a subject of debate. We will give a few of them for the benefit of any one who may doubt this proposition. We would invite him to take an impartial look at the Sixth Avenue entrance to the Siegel-Cooper Building. Plate glass and steel constitute most of the first story, but the elaborate entrances are limestone. All other parts of the immense building are cream-white terra-cotta and brick of remarkable uniformity. We need not rest our contention on any isolated example, for instances of this kind are becoming plentiful, and they are not confined to buildings of minor importance.

The new Astor Hotel, on Fifth Avenue and 34th Street, now approaching completion, is an operation of such magnitude and grandeur that the adjoining Waldorf appears little more than an annex. The prevailing color in this case is a glowing hospitable red. The predominating material is terra-cotta. Seventeen stories of Flemish Renaissance towering into space, and terminating in a highly picturesque sky-line. Fourteen of these stories are red terra-cotta and red brick, the three lower stories being stone of varying degrees of redness. The *absence* of uniformity in the color of the stone is sufficiently marked to attract the attention of a casual observer. It becomes more aggressive if he lingers long enough to inquire into the cause, or speculate upon its ultimate effect as an aptly instructive object lesson. Tenacious indeed must be the popular belief, or delusion, that survives the shock of this silent, unanswerable demonstration.

At first sight it might be surmised that the stone had been obtained from at least two quarries, but we have been assured that this is not so. It is of course supposed to be cut in a way that will permit it being set on its natural bed, but this good rule may not have been adhered to in all cases, and wherever departed from, in addition to being less durable, we get a different texture, which would to some extent account for the difference in shade. The method employed in working the stone is another element that has now to be reckoned with, viz., whether it has been tooled by hand or by machine labor. A conspicuous case of this kind may be seen in the cartouche window transoms on the westerly side of the 34th Street elevation, which, being richly carved, represent the color effect produced by hand labor. The contrast presented by the work on the intervening piers, which has evidently been tooled in a mill, is very decided. The more delicate touch of the carver has cut without abrading, leaving the grain of the stone favorable to the absorption of light. The automatic and less sympathetic action of the machine has stunned the surface of the stone, producing an entirely different effect, which, in turn, goes far to produce a difference in color, that otherwise would not have been so pronounced. But it must be remembered that this is in stone; and being so, we are expected to close our eyes to its defects and shortcomings, lest anybody should think us capable of flying in the face of nature.

We may not go so far as the satirical Mr. Whistler, who, when a patron remarked that a certain landscape called to mind one of his pictures, replied, "Ah! I'm glad to hear that nature is learning. But we will go far enough to assert that men are learning to assist nature by taking advantage of nature's laws and of nature's bountiful store of raw material in the production of building blocks more even in color, and altogether free from the laminations inherent in her own product.

THE removal of brick edifices which were erected in the early part of this century often causes comment upon the thorough manner in which many of them were constructed. While there are numerous exceptions to this rule, and it by no means follows that all of our old buildings were well built or substantial in character, it is true that the work of the early part of this century was in the main of a very high constructive value. This was due largely to care and intelligence in the use of material, but also quite largely to ignorance. With the idea of making things strong enough, a pier or wall would often be made widely in excess of the exact strength required. It is only within quite recent years that the extent to which first-class brickwork can be loaded has been fully appreciated. The practise twenty or twenty-five years ago was to allow a load of not more than 6 or 7 tons per square foot bearing upon thoroughly first-class brickwork, whereas now by law in Boston we are allowed to put as high as 15, and judging by experiments which have been made at Watertown and elsewhere, there would be a sufficient margin of safety in some cases if the bricks were loaded to 25 tons per foot. This, of course, implies the utmost care in construction, with the best of mortar and intelligent bonding of the bricks. While the statute limitations are advisable, the tendency of modern building methods has been to reduce the factor of safety in proportion as the extent of positive knowledge of resistance of materials has increased; and whereas in the days of our forefathers the intelligent engineer would use a factor of safety of 6 to 10, we are now perfectly content with one of from 3 to 4, and this with our best modern constructors is really a factor of safety, based upon actual knowledge, and not a factor of allowance for ignorance.

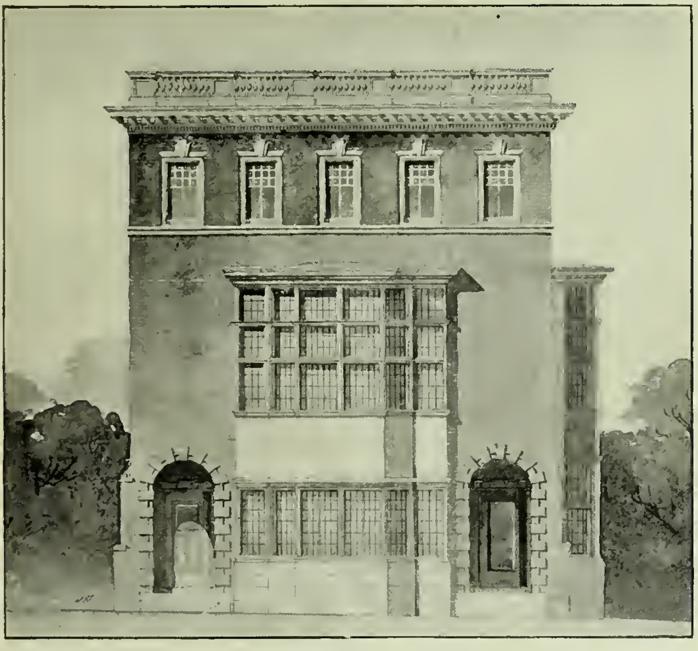
ILLUSTRATED ADVERTISEMENTS.

THE accompanying triple window is one of four used in a block of high-class residences in New York City, of which Messrs. Neville & Bagge are the architects. The illustration shows the work set up temporarily just as it came from the kiln, and previous to its being shipped along with other work of equally good design, from the works of The New York Architectural Terra-Cotta Company.

CHARLES T. HARRIS, LESSEE, takes a full page (xxvi) this month on which to give a partial list of buildings which have been roofed with the Celadon Terra-Cotta Company's tiles. This page will be found to be of especial value, as not only is the name of building given, but location, style of tile used, and architect, as well.

Brick and Terra-Cotta at the League Exhibition.

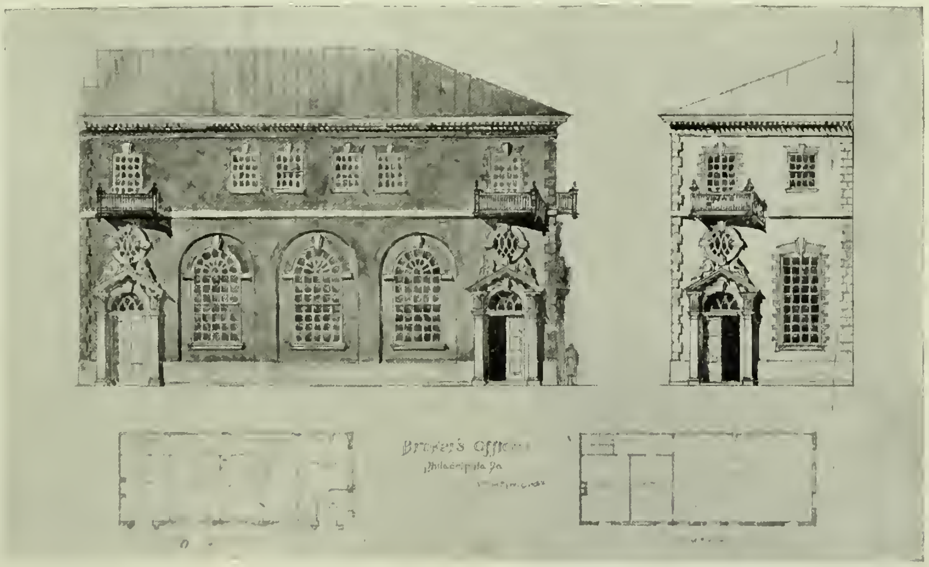
THE annual exhibition of the Architectural League of New York offers an excellent opportunity for studying the tendencies of current work and for observing the lines upon which study for future work is being conducted. The exhibitions held by the league have every year grown in interest and in scope, and the one which closed the fifteenth of last month is quite in the line of regular progression, including work from many parts of the country, and to a very considerable extent representing the best talent of the profession. As in previous years, a considerable space is devoted to the work of the so-called allied arts, a term which can be conveniently stretched or restricted to suit almost any desired classification. Had the exhibition been confined more closely to purely architectural effort, it would in some respects have been more interesting to the architect, though, judging by observation the day we were in the galleries, the arts and crafts attracted more visitors than the drawings, and the combination is always a good one even if it goes no further than to show how haltingly architecture has developed of late years by comparison with the sister arts.



HOUSE FOR DR. J. W. PUTNAM.
Green & Wicks, Architects.

The first impression given by the architectural portion of the exhibition is that an immense amount of work has been expended by exhibiting architects merely for the production of show drawings, which, as far as actual study or application to real architecture is concerned, have a relatively slight value. Many of the drawings are overdone, and not only is a great deal of detail work suggested, but a great deal is actually put on drawings which, if they were rendered more lightly, with less attempt to produce pictures, would in many cases gain directly in proportion to the simplicity of treatment. This is emphasized by the few, but very large French drawings which are exhibited together at one end of the hall, which, however one might criticize the design, are certainly rendered in a style which somehow or other seems to be acquired only in Paris, the least possible work being expended to secure the greatest effect. The over-working of the American drawings seems to be specially noticeable in connection with the buildings which are intended to illustrate brick or terra-cotta designs. Brick suggests color, and color evidently means paint, for the majority of the brick drawings shown are very strongly colored, and instead of being indicated, the tones are laid on with a heavy brush. Somehow, simplicity and terra-cotta are hard to combine on paper, at least, and though a quiet, dignified treatment is naturally associated with brick, when we begin on terra-cotta the details run riot; and the knowledge that ornament will repeat so easily in this plastic medium without arousing the bugbear of expense, that *bête noir* of true art, seems to limber one's fingers and stimulate one's inventive faculties until it requires firm repression and deliberate self-control to abstain from encoring one's designs.

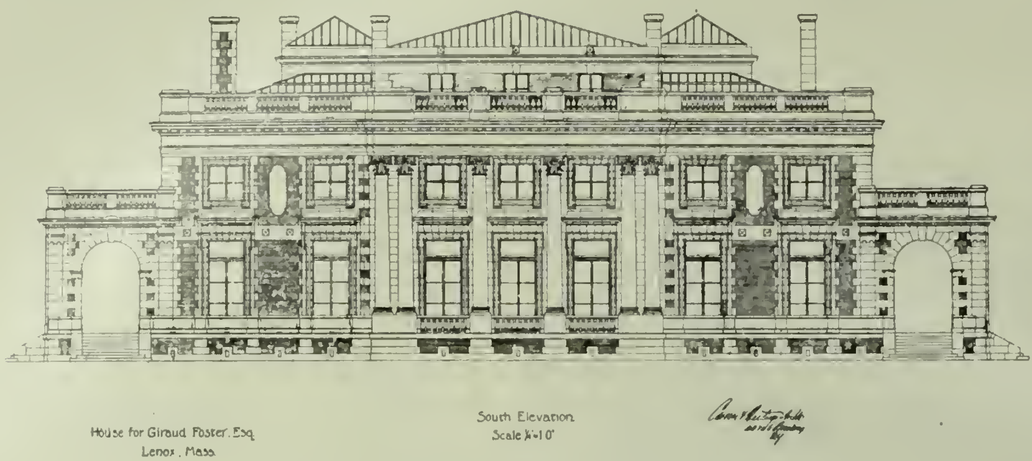
Brick and terra-cotta alone, and in combination with other materials, were very much in evidence in the exhibition, — indeed, we cannot recall any collection of architectural designs in which so large a proportion were intended to suggest burnt clay. And this is speaking simply from the external evidences. Undoubtedly there were many drawings which were intended to represent brick or terra-cotta, but which for the purpose of the exhibition were not specific. The distinction in style between stone and terra-cotta is one that is seldom made in a perspective drawing, and consequently many designs which have the appearance of monumental stonework may be intended in the mind of the designer to be worked out in terra cotta; so that while terra-cotta work, as such, was not specially prominent, there were a quantity of designs which one would reasonably expect to be carried out in clay, though there was less special attention to giving it a terra-cotta character than we would like to see. But of brick there was a lot, and on the whole very satisfactory. One of the first designs near the entrance of the gallery was the government drawing of the proposed post-office at Pawtucket, a combination of brick and stone worked out in a quiet, dignified manner and forming a very pleasant composition. And, by the way, what a relief it is to feel that at last we have a government architect who is competent to design a creditable building! There were exhibited two other post-offices due to Mr. Aiken's taste, that at San Francisco and the one at Pueblo, Cal., both of which are admirably designed, seem fitted for the location, and are in marked contrast to the stuff which the government architect's office has put out in the past. And to think that we, of Boston,



DESIGN FOR A BROKER'S OFFICE.
Wilson Eyre, Jr., Architect.

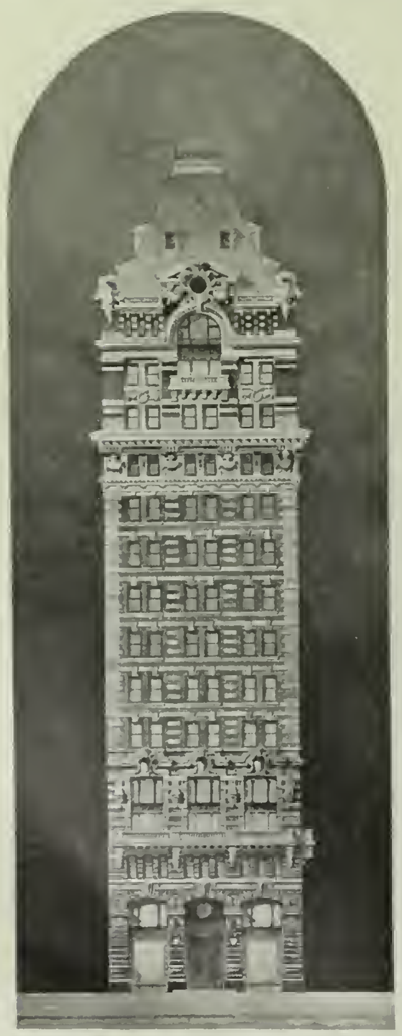
have that horrible, cold granite monstrosity for a post-office, which is too solid to wear out, is not built to burn, and we cannot hope that a providential cataclasm will ever remove it from our midst!

The drawings exhibited by E. Raymond Bossange, of the house



HOUSE FOR GIRAUD FOSTER, ESQ., LENOX, MASS.
Carrère & Hastings, Architects.

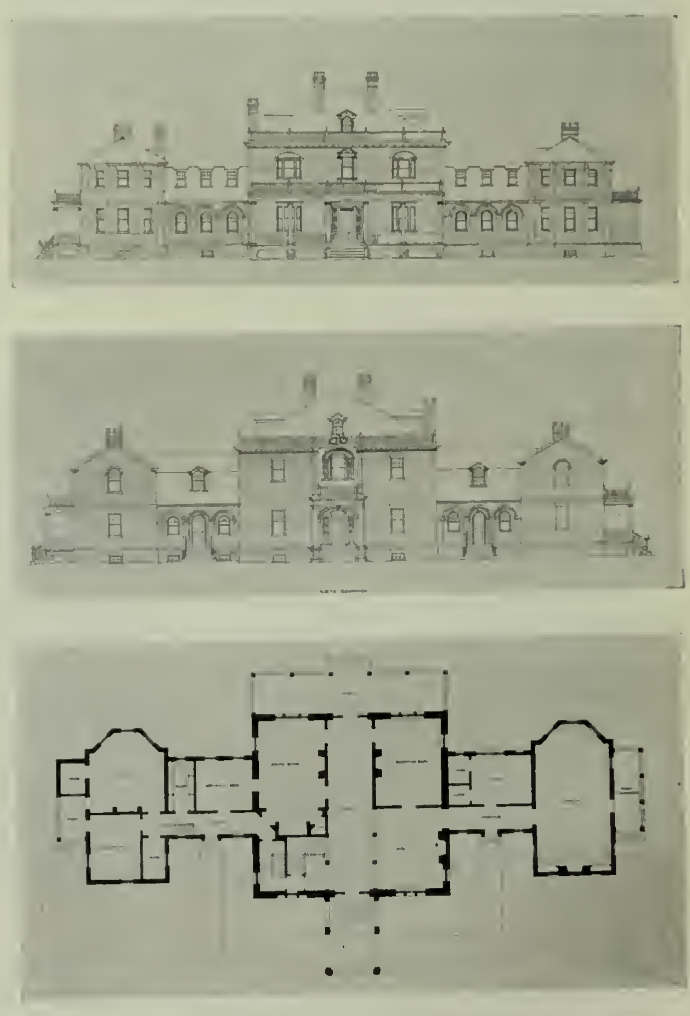
at Scarborough-on-the-Hudson, presented a charming combination of brick and half-timbered work, rendered in the most delicate water-color, and affording, with its green roof and polygonal tower, a charming composition in color. The house is perched on a high knoll, with irregular plan, permitting of a large brick tower; the lower story is all of brick, the upper stories half timbered and plaster work. Close beside this was a design by Edward P. York and Philip Sawyer, for a recitation hall at Vassar, a straightforward, well-worked-out Elizabethan composition of red brick with stone trimmings. Longfellow, Alden & Harlow exhibited a drawing of a large house at Alleghany, also in red brick, with an added red tone in an intensely strong tile roof.



DESIGN SUBMITTED FOR WASHINGTON LIFE INSURANCE COMPANY BUILDING.
Walker & Morris, Architects.

One of the most charming studies in the exhibition was Carrère & Hastings' house for Giraud Foster, at Lenox. It is indicated to be constructed of brick, with trimmings of light stone or terra-cotta, and is thoroughly delightful in every respect, with a carefully studied academic setting, not shown in the cut which we publish herewith. The drawing exhibited was rendered in full color with all the accessories, and the accessories are so charming that one questions whether the trees and shrubbery which are shown to such an advantage were planted for the house, or whether the house was planned to come so nicely between such well-balanced, mighty oaks. As an example of the possibilities of an architectural treatment of masses of foliage, and of symmetrical gardening, it is eminently successful.

The design for York Hall, New Haven, by Grosvenor Atter-



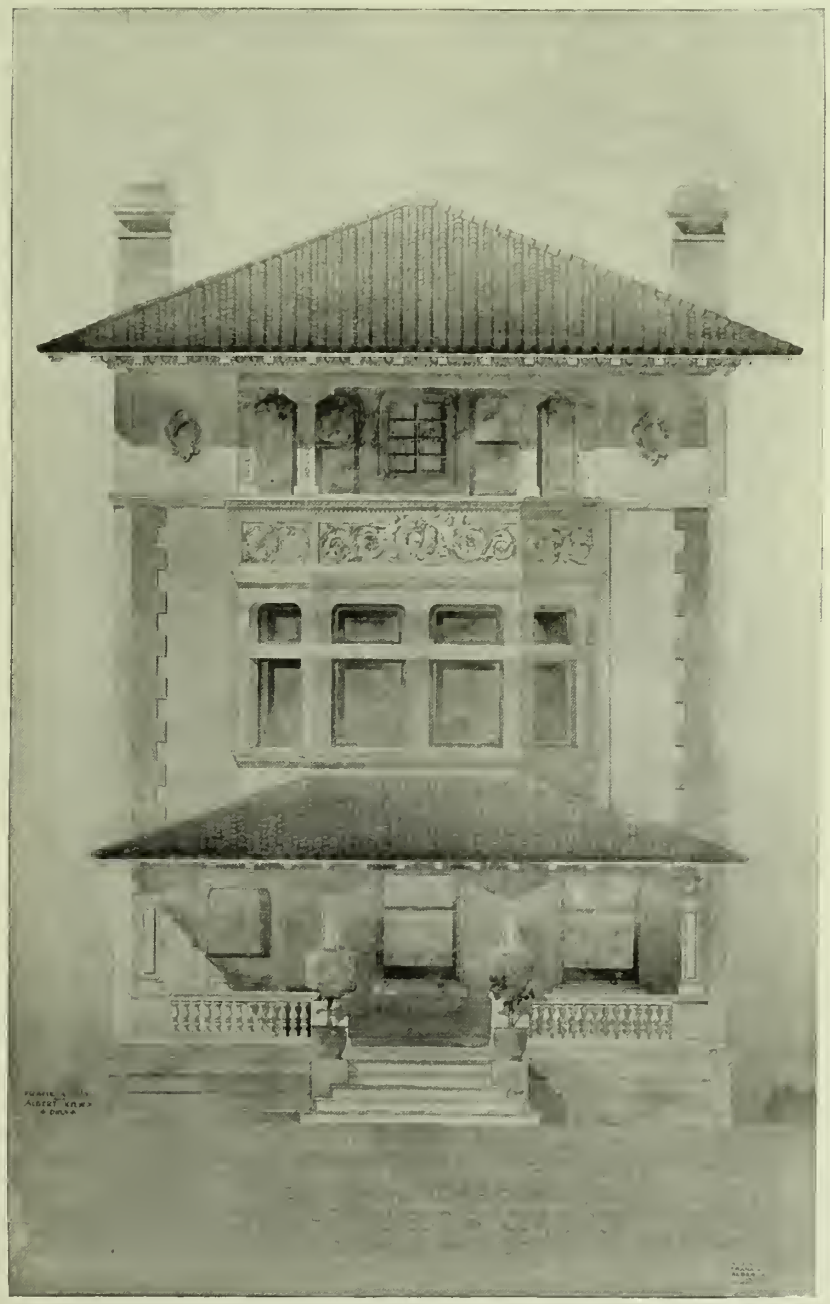
COUNTRY HOUSE AT RINGWOOD, N. J.
Thomas Henry Randall, Architect.

bury, which was hung close to Carrère & Hastings' design, showed a Venetian treatment of buff brick with an elaborate central motive and a crowning story richly worked out apparently in terra-cotta. Collegiate buildings, by the way, seemed to be quite plentiful in the exhibition. Another recitation hall for Vassar, shown by Rossiter & Wright, was a simple, well-studied design, in the style which seems to have come to be accepted as the American Collegiate, a pretty straight adaptation of the best features of the English Tudor Collegiate buildings. Lamb & Rich exhibited their design for Barnard College, New York, a strong, restrained, well-studied effect in brick.

Of a very different kind was the perspective showing the garden and wing to Union League of Philadelphia, Keen & Meade, architects, a strong composition in yellow brick and white stucco, recalling somewhat the feeling of Southern Spain, or Pistoja, with a foreground formed by a simple garden, charmingly arranged, with a fish pond in the center. The drawing, by Hughson Hawley, is a very striking one, both in composition and rendering. It is a pity that it should have been hung so high, and so immediately over one of the partitions of the alcoves that it was hard to get a really fair view of it.

The country house in Maryland, by T. H. Randall, architect, which we publish herewith, is the kind we should be glad to see more of, and it shows that Mr. Randall has studied to excellent advantage the brick country houses of the South. It was a delight to find these straightforward, direct elevation drawings in the midst of highly colored perspectives. After all, though clients demand a perspective, and are easily caught by brilliant coloring or effective if impossible effects of light and shade, the real study is shown on the elevation drawings. Green & Wicks appreciate this, as is evidenced by the happy design for house for Dr. S. W. Putnam, also published herewith, a very successful treatment of a city house.

Mr. Bruce Price exhibited an interesting design for the St. James Office Building, which attracted considerable notice, and which presented a very successful decorative feature in the use of colored brick diaper work. The unfortunate results which accompanied the use of this treatment in the church which formerly stood on the corner of 42d Street and Madison Avenue, which gained for it the designation of the Church of the Holy Oil Cloth, have prevented a fair recognition of the effectiveness of this method of decorating a wall surface, and it is encouraging to see that some of our best architects are returning to this perfectly legitimate system of color treatment. Mr. Price also exhibited a large drawing of Mr. George Gould's house at Lakewood.



RESIDENCE OF CHAS. E. BUZBY, ESQ.
R. G. Kennedy, Architect; Kennedy, Hays & Kelsey, Philadelphia.

The office buildings exhibited were less distinctively of brick and terra-cotta, though there was Walker & Morris's design for the Washington Life Insurance Company Building, in brick and terra-cotta, and the proposed Woman's Hotel, by Gannon & Hands, in buff, or old gold brick and light terra-cotta (?), the drawing of which was very strong in tone with a color effect helped out by the banners at top of the building.

A building we should have liked to see illustrated to better advantage was the new Astor Hotel, Fifth Avenue, adjoining the Waldorf, both by Mr. H. J. Hardenberg. The combined Fifth Avenue fronts were shown on a single highly rendered elevation, the scale of which was, however, too small to do justice to the beautifully designed and executed terra-cotta details. The 35th Street front of the Astor Hotel is an especially good example of the best and most recent adaptation of terra-cotta and brick. The new Delmonico, by James Brown Lord, is another building presumably in brick and terra-cotta which was tantalizingly suggested rather than shown by a large rendered drawing in full color.

Philadelphia was well represented. Cope & Stewardson exhibited a design for a city residence, conventionally treated, in thoroughly good taste, well balanced and exquisitely proportioned. This was indicated as in red brick with white trimmings. After all, there is a good deal of satisfaction in being able to revert to a type and polish away on that type until the proper degree of finish is attained. Wilson Eyre, Jr., contributed one of his charming studies, designated as "A Design for a Broker's Office." Mr. Eyre is so unique in his style, and his work has such a delightful personal quality, it is always anticipated with pleasure. The drawing seemed to indicate purple-black brick. It is quaint, jolly, convivial, representing just the sort of structure we would expect some of Howard Pyle's characters to inhabit, and to issue from with church-warden pipe and bowl of punch for solace. The residence by Mr. R. G. Kennedy is a picturesque, sunny treatment of a city front, one of the few designs exhibited which showed a use of terra-cotta roofing tiles.

Howard & Cauldwell exhibited an interesting drawing for a church at New Brighton, Staten Island, showing a very conscientiously developed design in gray brick and Spanish roof tiles. The brick might be buff or gray, the drawing being graded in different parts. The building is Romanesque in style, recalling some of Vaudremer's work, with large windows on the sides separated by buttresses, diaper work of deep red brick in the spandrels, and the same deep red or orange tones carried out in the tympanum of the door. The door itself was painted on the drawing a bright green, affording a very emphatic contrast, which, however, was warranted by the general result. The plan is a very irregular one, with the tower on the side, and the whole church, while perfectly individual, suggested in arrangement and design S. Pierre de Montrouge, Paris, but without the coldness of the French church.

As a scheme of color treatment may be noted a design for three residences, in a single block, by Marcus T. Reynolds, showing a high basement of rusticated terra-cotta in simple courses, and a perfectly plain brick surface above, the whole in a monotone of gray buff except for streaks of strong red marble used as mullions of the windows of the upper story, adding just enough emphasis to relieve the tones of brick.

Around the central gallery of the exhibition rooms were placed eight terra-cotta columns with Ionic capitals, the whole standing 8 or 10 ft. high and executed in a light-colored buff. The workmanship, while not perfect, was so nearly so as to recall the days, not so very long ago, when such true work with evenly matched flutings and symmetrical entasis would have been impossible in terra-cotta. These columns were set up apparently without any mortar, but seemed to stand perfectly true, and were excellent examples of what can be done with the material.

A CITY RESIDENCE.
Cope & Stewardson, Architects. Rendered by Chas. Z. Klauder.

The exhibition showed by inference our national timidity in the handling of color. When we undertake to indicate color, we do not, like the Japanese, use real color, but rather make colored pictures, a distinction which will be appreciated by any one who has tried, for his own satisfaction and without any reference to what a client wants or thinks, to study out on paper in advance the actual colors which should be used in a chromatic treatment of a front. It is really a question how far we can to advantage undertake to study in perspective, for if we apply color directly to a perspective without graduations it ceases to have the effect of a picture, and pictures are what clients and exhibitors demand. The real study can to best advantage be put upon the elevation, as is shown by Mr. Price's excellent study of the old house at Lakewood, which is in direct elevation, and from an architectural standpoint shows the building to a great deal better advantage than any perspective could possibly do.

The exhibition emphasized a statement which has frequently been made during the past few years, that architecture is not advancing as rapidly as her sister arts, and that within recent years decoration, sculpture, and the applied arts generally, have developed a wonderful vitality and have made rapid strides in every direction, while in architecture we seem to be making way for our artistic craftsmen and perfecting our own art by its accessories rather than by its intrinsic advance. The exhibition shows the tendencies of our public work far better than the actual work itself would make them manifest, for an architect will very often put himself on record on paper where he would hesitate to carry out the same thought in actual practise, and consequently an exhibition of this sort is better able to measure what the architects want to do than if we should go around and see what the same architects were actually doing.

PERSONAL AND CLUB NEWS.

Messrs. Shepley, Rutan & Coolidge have removed their Chicago office to the Old Colony Building, Dearborn and Van Buren Streets.

Cleverdon & Putzel, architects, New York City, have removed their office from 13 Astor Place to the Hartford Building, Union Square.

H. E. Bouitz, architect, having opened an office at Wilmington, N. C, would be glad to receive catalogues and samples of building materials.

On the evening of April 19, Mr. Peter B. Wight, architect, delivered an address before the Chicago Architectural Club on the "Fundamentals of the Development of Style."

The Art Institute of Chicago has invited the Chicago Architectural Club to make its home within the Institute Building. Aside from the desirable location, the club will have special privileges in connection with the Art Institute.

Architectural Terra-Cotta.

BY THOMAS CUSACK.

(*Continued.*)

THE twenty-six Ionic columns used on the Hoffman Library, and referred to in a preceding chapter (Fig. 6, page 8), were, we believe, originally intended to carry an entablature and two pediments in the same material. It was afterwards proposed to substitute metal, and this, we regret to say, was ultimately done in the building shown at Fig. 7. If the wisdom that is said to repose in "sober second thought" be open to exceptions, we think that the latter determination should count as one of them. Had the original intention been adhered to, it could have been executed without serious difficulty, and a scheme of construction such as that shown at Fig. 19 might have been adopted with confidence as to the result. This particular cornice is, of course, an incident beyond recall, and we refer to it merely as an abstract proposition, which will serve as a convenient illustration of what may be done in terra-cotta under similar conditions. The methods employed have a wide range of adaptability, and are open to whatever modification may be found necessary or desirable under other circumstances. It will be noticed that in point of detail our design does not differ materially from well-known classical examples, while the construction has been modernized to date of writing, and made not only practicable in terra-cotta, but quite simple of execution.

The two 12 in. continuous I beams constitute the principal support between columns, and will be found ample for the load resting upon them. To the bottom flanges is bolted a series of straps, at intervals equal to the length of the pieces of terra-cotta, and from these straps the blocks forming soffit of architrave are suspended. While these blocks were being pressed they would be made to receive a rod of ½ in. round iron, which, being inserted from the back, would pass through the partitions without penetrating the finished face. Two hangers would then grip this bar as at section *A.A.*, and passing through holes in the strap would be adjusted by tension nuts until perfect alignment was obtained in the soffit. Similar provision would be made for rods in the blocks forming upper portion of architrave, and they in turn would be bolted to I beams through holes previously located, making it possible to have all punching done at the mill, for greater convenience and economy. These rods should be a trifle shorter than the blocks into which they are inserted; all cavities being then filled with cement, each piece is ready for being bedded solidly against I beams, carefully adjusted at the joints, and tightened up to line by means of nut on the inside. Separators should be introduced between the I beams to give greater rigidity, and to prevent any tendency to spread or buckle. The whole of the space between beams should then be filled with concrete, special care being taken to grout down into chambers showing on top bed of soffit blocks, also around and between the straps until every crevice has been filled. These blocks, being now embedded into a concrete core, would no longer depend for support upon the hangers, which, however, would be allowed to remain undisturbed as an extra margin of safety.

We are aware that work of the kind contemplated in this last item is frequently forgotten, or done (if done at all) in a very perfunctory manner. It would therefore require close supervision to ensure its being done uniformly and thoroughly. But, assuming that a reliable brand of cement has been used, and that conscience, as well as the requisite amount of skill, has been put into the work, we would in this way obtain a terra-cotta architrave of composite construction that would be stronger, and perhaps more durable, than a monolith in stone of corresponding section. Cement is an excellent preservative of iron, and the interior skeleton being completely protected from the effects of fire and water, there would be little to fear in the line of deterioration or discoloration from rust.

The inverted tee of light section at *X.X.* would be inserted in joints of ashlar ceiling, which would be made in slabs of convenient length. This has no weight to carry, but it, too, should have its chambers filled, and the top bed floated in cement. Another inverted tee would be inserted at every joint in lower member of cornice, and should extend back some distance into main wall. These cantilevers would carry the direct weight of the top member of cornice, which, having been set to line, should be securely anchored back to roof; the hooks taking hold of a rod, for which provision would be made, as in the case of architrave. In backing up the frieze, the bricks should be built into the chambers of every block; and if this is done, no additional anchors would be required.

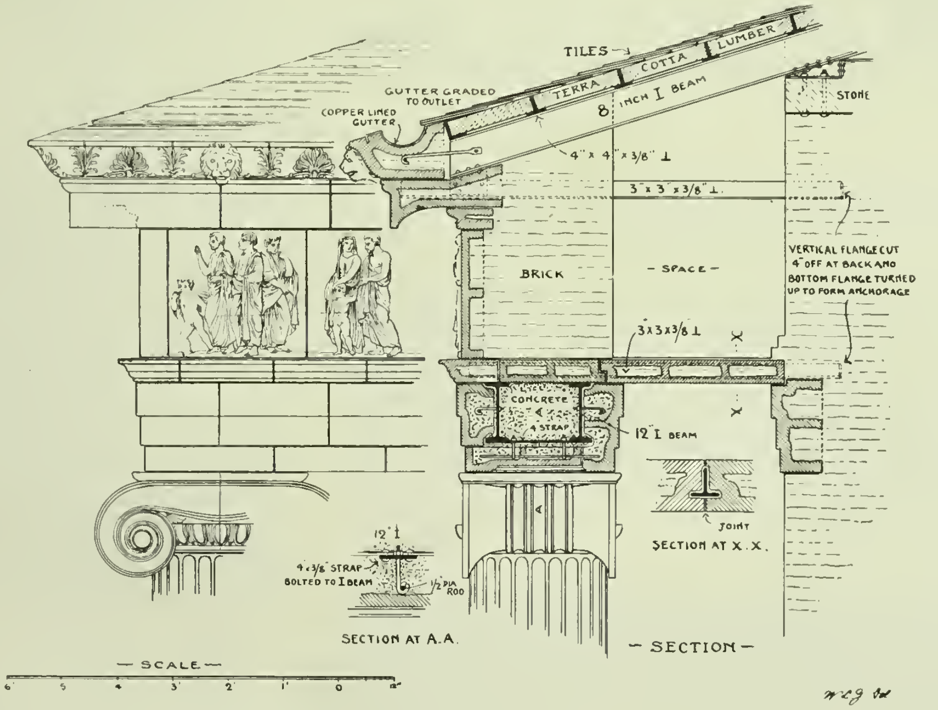


FIG. 19.

The frieze and tympana may, of course, be finished in plain ashlar, where a simple or severe treatment is considered preferable. But in most instances the plasticity of them aterial would, no doubt, furnish tempting inducements for the introduction of allegorical subjects, suggested by and befitting the character of the building. The jointing of the actual work would be much less conspicuous than it has been made to appear in the drawing, in which, as in previous examples, the joints have been intentionally exaggerated. None of these drawings were prepared with any view to pictorial effect. Their primary object is not to clothe or conceal, but to dissect and exhibit the anatomy of the subject. The aim is to show as clearly as possible the exact relationship which one block bears to another, and on what the whole of them must ultimately depend for support. For the same reason we have selected this particular subject, because it embraces in a comparatively small compass a number of the chief difficulties usually met with in work of a similar character. Granted that we are not called upon to duplicate a Greek temple every day, the fact remains that such a thing could be done very successfully. The system of composite construction now proposed does not differ in principle from that which has frequently been tested on a smaller scale in actual practise. The example before us merely calls for its extension under favorable conditions.

In almost every phase of modern Renaissance work troublesome problems of the same kind are frequently encountered, and, whether we like it or no, have to be met by the adoption of similar expedients. Nearly all the latest and best work is but a free adaptation of classical forms, with very often a literal application of classical detail. Wherever the architrave, frieze, and cornice becomes part of a design, certain portions of it have, at times, to depend upon some form of invisible support. So long as the architrave rests directly on a wall, the making and setting of the work remains a simple affair indeed. But when it has to be carried across openings of considerable extent, between piers, columns, or pilasters, the problem is to all intents the same as the one now in question. In such cases, the solution usually resolves itself into an iron core of sufficient strength, to which is attached a terra-cotta casing.

The actual construction of an entablature such as that to which we have just referred is shown in Fig. 20. It was adopted in the erection of the new City Hall, Elmira, N. Y., and when submitted to a practical test was found to work admirably. If any doubt had existed on the point, it would have been set at rest by the very reassuring reply just to hand from the architects, to whom we are likewise indebted for a confirmatory photograph, showing this portion of the building at Fig. 21.* In answer to a specific inquiry on this subject, they write: "In regard to the construction of the terra-cotta, and the manner of supporting it, we would say that we cannot suggest any improvement on the method adopted. It has answered the purpose perfectly, and no settlements

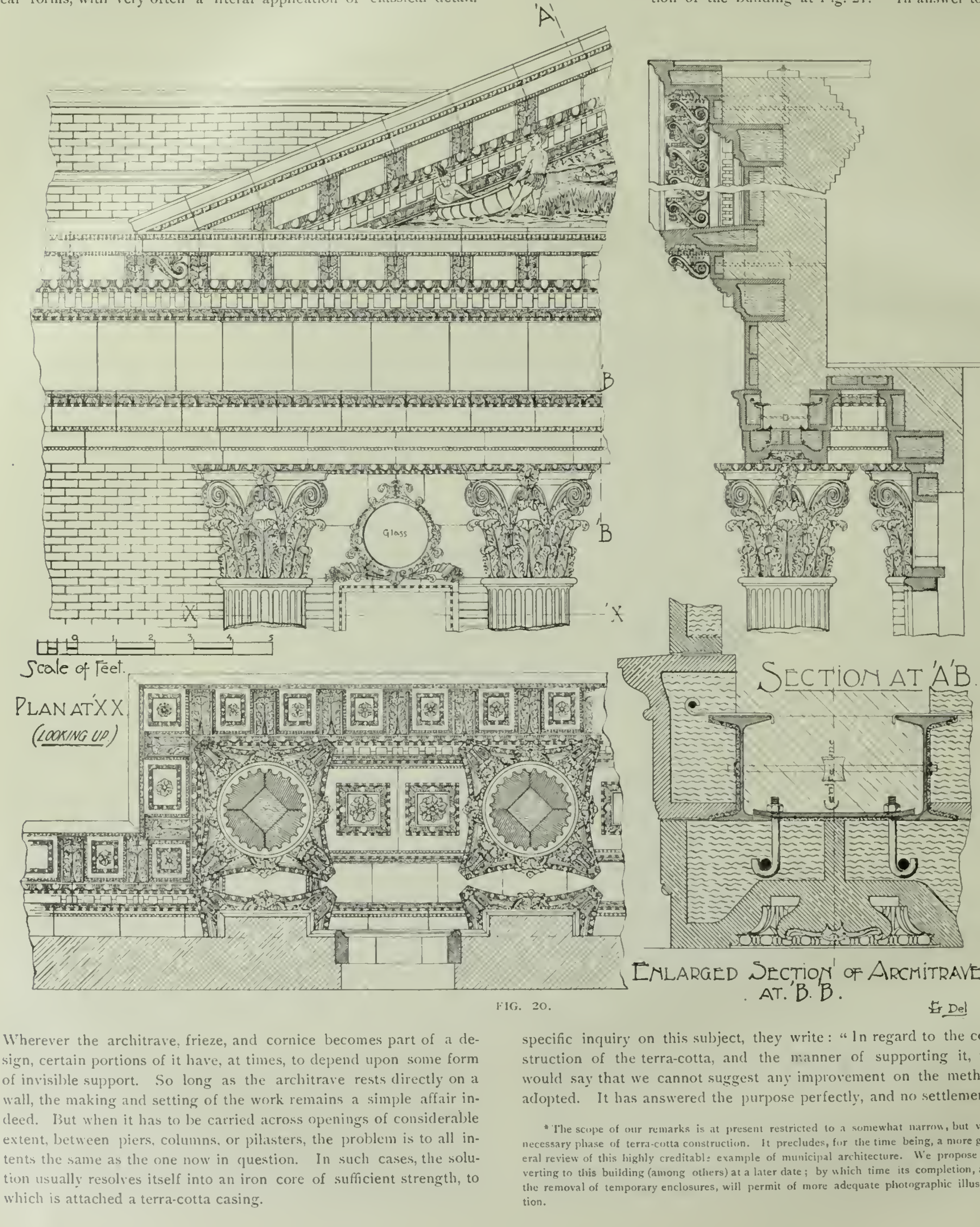


FIG. 20.

* The scope of our remarks is at present restricted to a somewhat narrow, but very necessary phase of terra-cotta construction. It precludes, for the time being, a more general review of this highly creditable example of municipal architecture. We propose reverting to this building (among others) at a later date; by which time its completion, and the removal of temporary enclosures, will permit of more adequate photographic illustration.

or cracks have developed since the work was finished." In this particular case the soffit was made in single blocks, with a panel and rosette in the center of each, and the joint passing through the center of rail. This allowed the iron rods to be inserted longitudinally, passing clear through the ends and partitions of the block. Separators, bolted at intervals between the I beams, prevent lateral deflection and thereby greatly increase their rigidity. Being held at a uniform distance apart, the flat bars (through which the hangers pass) may be placed where required during the setting, as they merely rest on the bottom flange of each beam and do not need any other fastening.

We cannot be too emphatic in urging the use of cement filling in all work of this kind, and that for the reasons given in speaking of Fig. 19. It has already been spoken of as a good preservative of iron, which it undoubtedly is; but in saying this two conditions are implied which cannot always be had for the asking. To be effectual,

FIG. 21.

the iron should be entirely sealed up in the cement, and it must be well protected from moisture. If allowed to corrode, it then becomes merely a question of time when something must give way. But long before that could happen, the terra-cotta is liable to suffer irreparable discoloration from iron stains. A solution of rust will find its way to the surface, and if accelerated by damp will soon trickle down through joints of soffit, in work such as that to which we are now giving attention.

We think the best way to prevent such an occurrence is for the architect to anticipate it in his specification. This he can do by directing that all bolts, cramps, anchors, etc., coming into direct contact with terra-cotta, be *galvanized*. In much of the work of past ages which we profess to admire, and (in a superficial way) seek to imitate, the cramps and anchors were often made of copper. Similar precautions against oxidation are sometimes adopted in modern work, but the tendency of the times is against burying anything of intrinsic value in places where it will not "show for all it is worth." A deposit of zinc on the surface of the iron usually reaches the limit of allowable expenditure in this direction. It may, however, be trusted to protect the smaller appliances, and with two coats of metallic paint on the larger sections, no serious consequences are likely to ensue.

(*To be continued.*)

Fire-proofing Department.

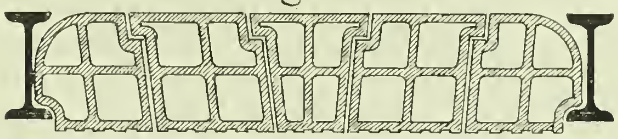
ORIGIN AND HISTORY OF HOLLOW TILE FIRE-PROOF FLOOR CONSTRUCTION.

BY PETER B. WIGHT.

(*Continued from March Number.*)

RESUMING our historical narrative, we find in Edward Dobson's "Rudimentary Treatise on the Manufacture of Bricks and Tiles," printed in London, 1868, a description and illustration of hollow brick construction used in H. R. H. Prince Albert's model houses. These arches were segmental in form, and used to span

Fig. 10.

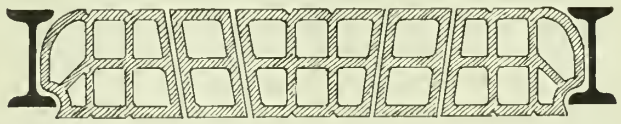


From drawing attached to Roux Frères' Fr. Patent. Mar. 25. 1868.

entire rooms 10 ft. 4 ins. wide. The external springers were of cast iron, built in the brick walls, and connected by wrought iron tie-rods. This construction so much resembles the Bunnett arch that it is hardly necessary to reproduce the illustration. Its main difference is that the joints are straight, and side pressure tiles only were used. The rise of the arch was also greater than in Bunnett's, so that the tie-rods were exposed.

We now come to the invention of Roux Frères, which soon followed that of Garcin. They were manufacturers of all kinds of tiles and hollow bricks at St. Henry, Marseilles, France, and pat-

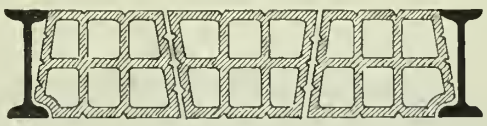
Fig. 11.



ented a flat hollow tile floor and ceiling arch on the twenty-fifth of March, 1868. Fig. 10 is a copy of the drawing attached to their patent.

Their invention was of the nature of an improvement on that of Garcin. They placed alternate notches and ledges at the upper corners of their tiles. They also brought the soffits of the voussoirs below the bottoms of the I beams, so as to allow a thickness of cement between the heels of the springers and covering the bottoms of the beams. This kind of tile was the same that was first made in the United States of burned clay, about 1872, but they were much heavier. The first tile ever made in the United States as light as those of Roux Frères were those of the Wight Fire-

Fig. 12.



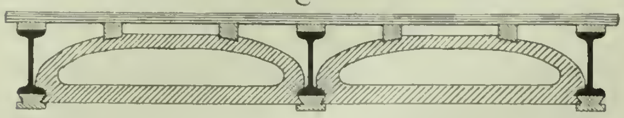
From Circular issued by Roux Frères. 1868.

Proofing Company, made in Ohio, in 1881, for the Montauk Block at Chicago. The burned clay body was only ½ in. in thickness, yet the New Jersey manufacturers continued to make much heavier arch tiles for many years after that time.

In a circular issued by Roux Frères, in 1868, are illustrations of two other forms of flat hollow tile arches, which are shown in Figs. 11 and 12.

The first is a flat arch, very similar to that described in the patent; but it will be noticed that the lugs and recesses at the upper corners of the tiles have already been omitted. The second is a construction in which three keys are used to form an arch, a method which has been frequently used by American contractors

Fig 13.



From drawing attached to Johnson and Kreischer Patent. Mar. 21 1871

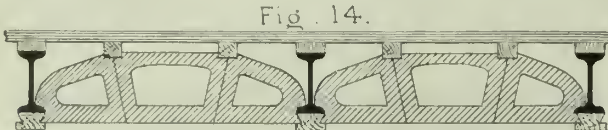
where the beams were very close together. The same circular shows many other interesting forms of hollow tiles for fire-proofing purposes.

We have now reached a point of time which is still nearly thirty years back, and find that then flat hollow tile floor arches were invented in all particulars except the use of tiles under the I beams. Naturally, there are no more records of French patents; but in the United States there was a lapse of three years before any patents appeared.

The first was that of George H. Johnson and Balthazar Kreischer, dated March 21, 1871. Fig. 13 is a copy of the drawing attached to this patent, and Fig. 14 is a copy of the drawing attached to a patent granted to Balthazar Kreischer alone on the same day, and bearing a number only four greater than that of the partnership patent.

The curious nature of this sequence of invention is obvious without explanation, and forms an illustration of some of the strange methods of inventors and what can be accomplished through the Patent Office; but the sequel shows that neither inventor ever received any benefit, unless it may have been from the sale of the patents. It

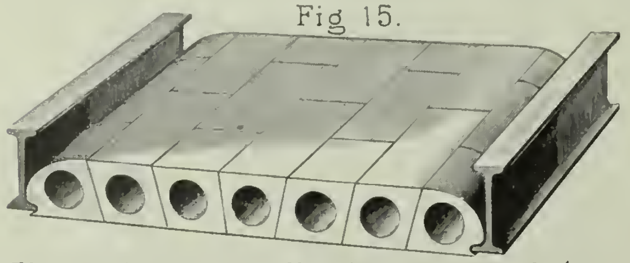
Fig. 14.



From drawing attached to Balthasar Kreischer Patent. Mar 21.1871.

was evident, and the records of the Patent Office show that the form of arch in the first patent had been anticipated by the Peterson and Abord patents, and that the division of the arch tile into three parts had been anticipated by many English and French inventions. So the office recognized invention by only allowing claims in the Johnson and Kreischer patent; first, for the recesses on top to hold the wooden floor strips; and second, "The removable clay filling strips, D, in combination, etc., etc., . . . for the purpose specified," the only purpose specified in the description being "a good finish to the ceiling." The part enacted by the last claim will be referred to hereafter. The only claim allowed in the Kreischer patent was for making the arch tile in three pieces. This patent was reissued Dec. 3, 1872, with two claims substantially the same, but the number of pieces is not stated. In the drawing attached to the Kreischer patent (Fig. 14), the strips under the beams are cross-sectioned like the

Fig 15.



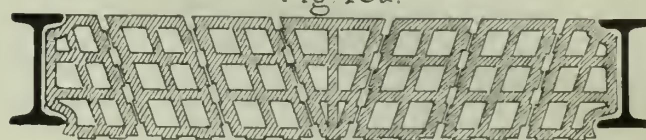
Flat Arch from circular of Heuvelman, Haven & Co N.Y. 1873.

floor strips, as if of wood, but are not referred to in the description or claims. When this patent was under fire eleven years later in the United States Circuit Court, these strips were always referred to as wooden strips, and this was not disputed.

Flat beam arches of hollow tile were manufactured in 1872 and 1873 in this country, and I believe that these were the first in which voussoirs of burned clay were used in America. They were employed in the floors over the outer corridors of the New York post-office, in the Kendall Building, Chicago, and in the Singer Manufacturing Company's building, at St. Louis, and a few others. Fig. 15, taken from a circular of Huvelman, Haven & Co., of New York, who were licensees under the Balthazar Kreischer patent, shows what these arches were.

About the same time flat hollow arches were made at New York by the Fire-proof Building Company of that city, which was organized to introduce French methods of construction for fire-proofing purposes in this country, the company controlling certain process patents for using cement and plaster. But they do not concern this historical review, which is intended to cover only manufactures in clay, except as throwing side lights upon constructive methods. The methods

Fig. 16a.

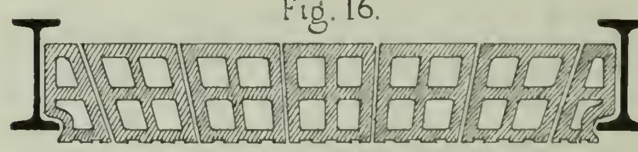


Flat Arch made by Henry Maurer. N.Y 1875.

employed in building fire-proof floors followed mainly those of Garcin and Roux, but the material was French cement, plaster, and coke breeze. These received great favor from architects at the seaboard cities, mainly on account of the confidence reposed in the scientific attainments of Leonard H. Beckwith, who was at the head of the enterprise. But at the same time the late A. H. Piequenard, architect of the new Illinois State capitol at Springfield, introduced the Garcin and Roux systems into that building, using only plaster and cinders in making the hollow blocks. These he also had seen in France, and such floor construction was used generally in the upper floors of the capitol.

The Fire-proof Building Company of New York commenced to use flat hollow arches made of burned clay in their contracts on the Coal and Iron Exchange and Tribune Buildings in that city in 1874. The avowed object at the time was that they would be better than cement in hallways and rooms which were to be finished with encaustic tile floors. The following section shows the system of

Fig. 16.



Flat Arch made by Fire Proof Building Co. N.Y. 1874.

floor arch built at that time, and very similar ones are even now employed (Figs. 16, 16 a).

Flat arches of essentially the same section were soon after made and sold by other manufacturers of fire-clay goods, located in New Jersey and Staten Island, notably Henry Maurer and the Raritan Porous and Hollow Brick Company.

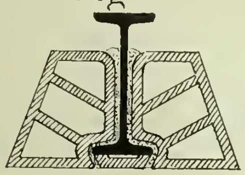
It was many years after the Kendall Building was constructed at Chicago before any more hollow tile arches were used in that city. About the year 1878 they were used for all the floors of the new Court House, having been manufactured in Ohio. They were made of common clay, straight at top and bottom, rather crude in form of voussoirs, and without interior webs. When the City Hall adjoining the Court House was built a few years later, hollow tile floor arches were used. They were flat on the soffit, and arched at the top, and were without interior webs. These were manufactured at Utica, Ill., for the Ottawa Tile Company, now the Pioneer Fire-Proof Construction Company.

There was little or no change in the form of flat floor arches used in the seaboard States before 1885, but they were extensively employed for nearly all buildings in which iron beams were used.

In 1882, the Montauk Block was built at Chicago, being the first of the distinctively high office buildings of that city. The architects were Burnham & Root, and the writer was consulting architect up to the time that the company of which he had just become the general manager was awarded the contract for the fire-proofing. This building signalizes several departures in construction which are historic. It was the first in which iron rails were used in combination with concrete in the foundations, the account of which has heretofore been described in THE BRICKBUILDER, and the first in which the walls of an adjoining building were supported on adjusting screws during its construction and settlement. The original intention was to construct the floors of iron rails and concrete, similar to the Southern Hotel at St. Louis; but this was abandoned and 6 in. I beams were substituted in most of the floors, while 8 in. I beams were used in some parts where necessary. The spacings between the beams were consequently narrow. The floor arches used were of the section here shown (Fig. 17).

The main object sought was the least weight consistent with requisite strength. These arches weighed only 25 lbs. per superficial foot. Diagonal webs were introduced in the skew-backs, and vertical webs in the skew-backs and wide keys. The material was reduced to a thickness of half an inch. This was only possible by using great pressure. In addition to this I determined to make them of pure fire-clay. They were therefore made on a vertical sewer pipe press, and I believe that they were the first tiles ever made to demonstrate how the weight of floor arches could be reduced to the minimum, at the same time using fire-clay. Before this, the only floor arches made of fire-clay had been those for the City Hall, but the walls were all ¾ in. thick. Up to this time the weight of hollow tile floor arches had been little considered in this country, and no thought had been given to the importance of using fire-clay outside of Chicago, any refuse clay, worthless for other purposes, being considered good enough. The development of the business became rapid in the Central Western States after this, too rapid to here describe in detail. Two companies were in operation at Chicago, and their imitators soon sprung up in other localities.

Fig. 17



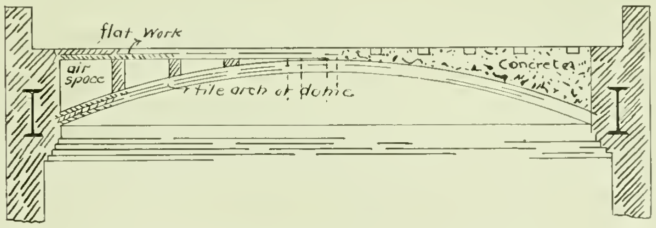
Ordinary Method of covering beams.

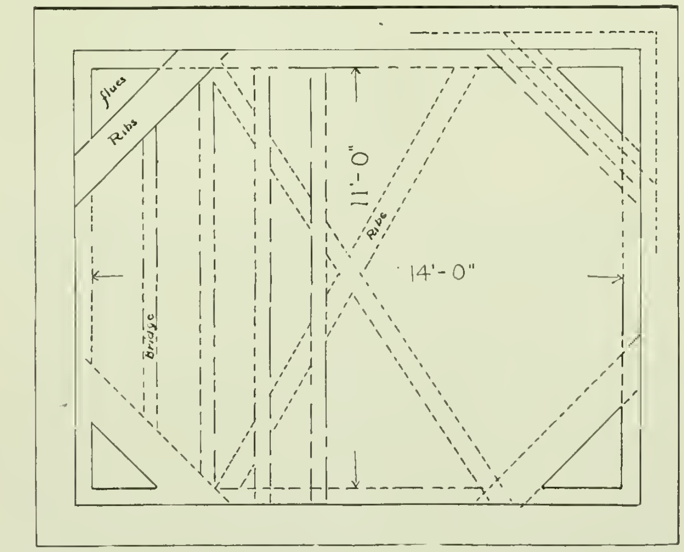
The next advance came in the use of porous terra-cotta for floor arches. This valuable material had been employed in Chicago for other fire-proofing purposes as long ago as 1873, and was first used in making roof blocks set between T irons at the Chicago Water Works, and for fire-proofing iron columns in the Mitchell Building at Milwaukee, and the Chicago Club Building. The first use for flat beam arches was in the roof of the old south wing of the Patent Office at Washington. As nearly as I can remember, this was about 1885 or 1886. The north wing had been burned out and restored in a fire-proof manner. Then Congress appropriated a sum to be expended in reconstructing all that part of the original building now called the south wing. The architects were Chiss & Shultz, of Washington. It was found that the whole roof of the pediment would have to be rebuilt, including the attic story and rooms in the same. There was considerable girder, column, and truss work also to be protected. On my suggestion, the architects decided to use only porous terra-cotta. The contract for the roof fell to Henry Maurer, of New York. As continuous flat ceilings were not necessary, and lightness a great desideratum, each of the beams was first covered with porous terra-cotta to about one third of its height from the bottom. Then a flat, hollow, porous terra-cotta arch was sprung from beam to beam flush with their tops, and resting on the porous terra-cotta filling on the sides of the beams. The whole was plastered and hard finished, showing the shapes of the beams.

(To be continued.)

A VERY interesting test was recently made of the Guastavino arch construction. The experiment was conducted at 68th Street and Avenue A, New York, and combined a fire and a weight test. A space 11 by 14 ft. was enclosed by brick walls and covered by an ordinary Guastavino vault laid with three courses of tiles, 3½ ins. thick in all, with a rise of 10 per cent. Over half of the surface of the vault there was laid a concrete filling to a height of 2 ins. above the crown, while the haunches over the other half were built up with ribs or bridges connected by two level courses of tiles, leaving hollow spaces as indicated by the diagram. This was to ascertain whether one construction would be more affected by heat than the other. A fire was built in the chamber under the vault, the gases being carried off through flues at the corners of the rectangle.

The resulting temperature in the combustion chamber varied from 2,000 to 2,500 degs., rising sometimes as high as 2,525 degs. During this time there was a fixed load of 150 lbs. per superficial foot upon the arch. The closest observation did not indicate any deflection due to the load before the fire. During the test the ceiling and the walls rose by expansion one half an inch, and the crown of the vault of one fourth of an inch more. After being exposed to the heat





for five hours, water was thrown on the vault from below, and the fire put out. Through the action of the sudden lowering of temperature when the water was applied, the templet course fell in a few places. When the vault was cooler the deflection of the ceiling was only .22 of an inch, but when the load was removed the vault rose again so the deflection was only .17 of an inch. After this, the load was again applied, and increased until 600 lbs. per superficial foot, something over 50 tons in all, was imposed. The operation of loading took some six hours, during which time the ceiling gradually deflected in the crown to a total deflection of .37 of an inch, remaining in that position thereafter.

The load and the fire were much more severe in this than in any previous test, especially the loading after the fire. There was no perceptible difference in the behavior of the two methods of construction above the vault.

Mortar and Concrete.

AMERICAN CEMENT.

BY URIAH CUMMINGS.

CHAPTER VII.

CEMENT TESTING.

(*Continuation of tests made by Prof. Cecil B. Smith.*)

ALTHOUGH the utilization of natural cement rock for Portland purposes is not practised to any great extent in Europe, owing, no doubt, to the uneven quality of such rocks, yet in this country more than two thirds of the Portland cement produced is from this source.

Limestone to the extent of 10 to 15 per cent. is added to the cement rock, which, in the section where such Portlands are manufactured, contains an excess of clay.

Portland cements produced in this manner are fully equal in quality to those which are compounded by an artificial admixture of clay and carbonate of lime, and it may be said, in passing, that there are no Portland cements in the world superior to those produced in this country.

The consumer who uses imported brands in preference does so at his own risk, for no manufacturer in Europe guarantees the quality of his cement after it is delivered into this country. The Portland producers here guarantee their product, as do the rock cement manufacturers, and they are here on the ground ready at all times to make good any damage which may be caused by the failure of their cements.

And yet, at the present time, there are three barrels of imported Portland used in this country to one of our home production. Such is prejudice. Still, it is pleasant to note that it is gradually dying out, and it is to be hoped that the time is not far distant when American Portlands will be used in preference to those from other countries.

If we take a few pounds of correctly proportioned cement rock in one piece, and divide it into two equal parts, and designate them as samples No. 1 and No. 2, and take No. 1 and calcine it, and then grind it to powder, we have converted it into a natural hydraulic cement.

If we take sample No. 2 and first grind it to powder, and then calcine it, and again reduce it to powder, we have converted it into a Portland cement. This comprises all the difference in the manufacture of the rock and Portland cements.

Now if we mold these samples separately into briquettes and submit them to a tensile strain test per square inch of cross section, treating them alike as to time in air and in water, it is probable that when tabulated they would appear about as shown in the following table, provided, of course, that both samples had been calcined in accordance with the methods now in vogue by the manufacturers of each class.

TABLE A.

Time.	Lbs. 1 Day.	Lbs. 1 Week.	Lbs. 1 Month.	Lbs. 6 Months.	Lbs. 1 Year.
No. 1	65	125	175	350	500
No. 2	125	400	500	750	1,000

Granting that this table is approximately correct, and we have a large collection of tables gathered from many sources which substantially verify the figures given, what are the conclusions to be drawn therefrom?

If the actual values are to be measured by the pounds in tensile strength which the briquettes are capable of sustaining, and this is the prevailing belief at the present time, and has prevailed during the past thirty-five years, it would seem indisputable that up to one year No. 1 had but one half the value of No. 2.

It is safe to assert that not one engineer or architect in a thousand carries his tests beyond one year.

It is equally safe to assert that not one in a hundred carry tests beyond three months.

It is not difficult then to understand, in the light of the table given, how the prevailing opinion became so firmly established.

The idea that the highei the test the greater the value has come to be firmly fixed in the public opinion as being sound beyond question.

The manufacturer whose cement tests higher than that of his neighbor in a one or thirty day test, wears an air of superiority which is simply indescribable.

It is settled in his mind that his cement is better than that of his neighbor.

And the neighbor who is defeated in the test is correspondingly depressed. He has a feeling akin to that of the speculator in Buffalo, N. Y., who walked across the road to bestow a kick on a certain sleeping omniverous mammal lying in the gutter, because pork had taken a drop in the market that day.

And well may the defeated cement maker feel somewhat depressed, for the chances are ten to one that the engineer who made the tests believes the higher testing brand the better of the two.

It does not follow that the lower testing cement is the better, although it is not impossible, by any means. Neither does it follow that the same results would obtain had some other engineer tested the same brands from the same packages.

But in the table we have another problem to deal with. Here the two classes are made from identically the same material, and the differences in the testing can only be attributable to the different modes of manufacture.

The Portland cement has set much more rapidly than the other during the first year, and it is this fact alone that has brought almost, if not quite, all the cement-making and cement-using world to believe that Portland cement is vastly superior to the rock cement.

The question arises as to whether or not the prevailing opinion is founded on fact. If the answer is confined to the one year's showing, then it must be said that the opinion is sound.

But if the public could be brought to realize that one year is but the beginning of the test, that the real trial is but fairly started, and is on, so long as the work endures, in which the cement is used; if it were understood that after five years not one engineer in a hundred can tell either by simply looking at a wall laid in cement, or by the use of the hammer, whether the cement used was rock or Portland cement, and if it were known that it is a fact, that when we have occasion to blast out old concrete laid in rock cement twenty-five years before, we find it as hard as any rock; and if it were possible for the public to become as familiar with three to five year tests as they are with the prevailing tests, then there would be a remarkable overturning of preconceived notions in regard to cement values, and thinking men to undertake a readjustment of their opinions, for nothing is more certain than that if the samples Nos. 1 and 2 of the table given were carried along in the tests yearly from one year to five, the table A continued, would appear substantially as follows:—

TABLE B.

Time.	2 Years.	3 Years.	4 Years.	5 Years.
No. 1	700	800	900	1,000
No. 2	1,000	800	750	600

The following table of tests was made by C. E. Richards, cement tester on the new Croton Aqueduct at Brewster, N. Y., from American rock cement manufactured by the author.

Briquettes one square inch in cross section, one hour in air, balance of time in water.

No. of Briquette.	Time when Made.	Time when Broken.	Tensile Strength lbs.
1	Oct. 4, 1886.	Nov. 18, 1889.	910
2	Oct. 11, 1886.	Nov. 18, 1889.	860
3	Oct. 11, 1886.	Nov. 18, 1889.	960
4	Nov. 29, 1886.	Nov. 18, 1889.	960
5	Nov. 21, 1886.	Unbroken at 1,000 pounds.	
6	Nov. 30, 1886.	Unbroken at 1,000 pounds.	

The Riehlé 1,000 pound testing machine used.

The following is an extract from "Records of Tests of Cement," made for the Boston Main Drainage Works, 1878–1884, by Eliot C. Clarke, M. Am. Soc. C. E., page 160: —

"The following series of tests may be of interest on account of the age of the specimens. The mortars were made with an English Portland cement, both unsifted as taken from the cask, and also after it had been sifted through the No. 120 sieve, by which process about 35 per cent. of coarse particles were eliminated.

TABLE NO. 12.

BRIQUETTES 1 SQUARE INCH CROSS SECTION.

Kind of Cement.	Neat Cement.		Cement 1. Sand 2.		Cement 1. Sand 5.	
	2 Years.	4 Years.	2 Years.	4 Years.	2 Years	4 Years.
Ordinary cement unsifted.	603	387	339	493	182	202
Cement which passed No. 120 sieve.	374	211	478	580	250	284

"This table also shows that fine cements do not give as high results, tested neat, as do cements containing coarse particles, even coarse particles of sand. It also shows (what is often noticed) that neat cements become brittle with age, and are apt to fly into pieces under comparatively light loads."

It cannot be denied that at five years artificial cements are extremely brittle, and briquettes made from this class of cements, if let fall on a stone floor, after they are four or five years old, will fly into as many pieces as would a glass bottle falling from the same height, and this is not true of the better quality of rock cements.

But engineers tell us that they cannot wait five years, or five months even, to learn whether a cement is good or bad, which is true enough, but does not alter the facts in the case; and the facts are that very high short-time tests are unfailing evidences of subsequent weakness.

These facts are demonstrated in every table wherein the tests have been carried from one day to five years, that has ever come under the observation of the author.

The following is an extract from a lecture delivered by the author before the Society of Arts of the Massachusetts Institute of Technology, Boston, November, 1887: —

"The testing machine reveals many curious freaks, and taken on the principle that "everything is for the best," it may yet reveal to us that a cement may test too high, that this modern demand for high-testing cement, and the tremendous struggle on the part of the Portland cement manufacturers to supply it, striving by every conceivable means to beat the record, is all wrong.

"This may sound strangely at first, but a study of the tables of long-time tests of Portland cements, as compiled by such engineers as Clarke, of Boston, and MacClay, of New York, and others eminent in the profession, reveals the rather startling fact that briquettes of neat Portland do not test as high at three or four years as they do at one or two years old. Clarke says: —

"'They become brittle with age and are apt to fly into pieces under comparatively light loads.'

"If this is the result with neat cement at that age, what is to prevent the same results with sand mixtures at fifteen to twenty years or so?

"The ten years' tests of Portland cement, made by Dr. Michaelis, of Berlin, show that the maximum strength was reached at the end of two years, and this point held fairly well until the end of the seventh year; but from that time until the end of the tenth year there was a remarkable falling off in values. We do not recollect ever having seen any table of long-time tests of Portland cement that did not exhibit similar results, and it is more than probable that it may yet be shown that our best natural, slow-setting American cements may, in ten to twelve years' tests, surpass any artificial cements. The excellent condition of some of our old work, done many years ago with American cements, would seem to indicate as much.

"At all events, we have no proof that the Portland is superior in the matter of durability, and we do not believe that clay and lime can be suddenly thrown together, and kept there by any skill of man, that can, in any manner, compare with the staying qualities as found in first-class natural cements, where the clay and lime have existed in the most intimate contact for countless ages."

It is now over nine years since the foregoing was written, and in the meantime the only changes in the views of the author on this subject have been to strengthen rather than to weaken the proposition then advanced.

Years of close observation as to the changes constantly occurring in a cement subsequent to its use in masonry or concrete leads to the inevitable conclusion that a cement which hardens too rapidly in its early stages, whether it may be a natural rock or an artificial cement, should be looked upon with suspicion rather than with approval.

It is patent to every observer who has had occasion to examine briquettes made from both classes, and broken at three to five years, that those which by the records are shown to have tested high in their early stages are at a later period extremely brittle and glassy, and are entirely devoid of that peculiar toughness which characterizes the slower setting varieties.

A cement which attains its limit of tensile strength rapidly will, the moment that limit is reached, commence to become brittle, and from that time on there will be a continual loss in cohesive strength in direct ratio with its increasing brittleness.

Brittleness and weakness are synonymous.

Mr. C. H. Brinsmaid, city cement inspector, City Engineer Department, Minneapolis, Minn., has had twelve years' experience in cement testing in the department named, and has compiled some valuable tables of tests, some brands of Portland running as high as nine years.

In a correspondence with the author, he remarks incidentally: — "Lacking experience, nothing would surprise me more than to see how very brittle these old Portland samples become, and how they snap and fly into fragments by a blow of trowel or hammer. There is no question but that old Portlands are more brittle than rock cements of the same age, however difficult it may be to note the proper comparison."

In Mr. Brinsmaid's tables of neat Portland tests, the figures disclose that three of the leading German and five of the English Portlands reach their limit of strength at one year, after which time they begin to deteriorate, at seven years the German falling to 476 lbs., and the English to 592 lbs.

Referring to the table (A) continued, it is pertinent to repeat the question, "What are the conclusions to be drawn?"

Both No. 1 and No. 2 are produced from identically the same materials and in the same proportions, but No. 1 being a solid rock, and No. 2 a porous mass, they are not affected equally by the same amount of heat, and it is from this cause alone that one hardens much more rapidly than the other, and consequently tests higher in its early stages. But that is no evidence of superiority, notwithstanding public opinion to the contrary.

There are certain classes of work wherein it may be necessary to use the higher testing varieties, such, for example, as sidewalks and similar work, but for heavy foundations and massive masonry, to use the higher priced cement, simply because it tests higher in short time tests, is expensive folly, for the slower setting variety, or, in other words, the natural rock cements, have been successfully used in the heaviest masonry in the world.

It is well understood that the process of hardening of a cement is simply the crystallization of the silicates, which commences shortly after they have become hydrated by the application of water. Some hydrated silicates crystallize much more rapidly than others.

Rapid crystallization means imperfect crystallization, uneven in size, shape, and texture. In fact, a mere jumble of irregular crystals, and the very rapidity of their formation insures subsequent brittleness and weakness, while those silicates which crystallize slowly form crystals perfect in shape, size, and texture.

Dana, in his "Manual of Geology," page 627, in speaking of the texture of rocks, says: "The grains are coarser the slower the crystallization, or, in other words, the slower the rate of cooling during crystallization: and with rapid cooling, they sometimes disappear altogether, and the material comes out glass instead of stone."

So in the crystallization of the silicates in a cement. If it tests high in its early stages, the breakings of the briquettes disclose the glassy texture, which is quite unlike the stone-like texture exhibited in the slower varieties.

It is possible, then, that the testing machine may yet be the means of convincing the public that a cement may test too high, as stated in the quotation of nine years ago.

The author does not consider it wild or extravagant to assert it as his deliberate opinion that the specifications drawn by the engineer of the future will stipulate that the cement to be used shall not exceed nor fall below a given number of pounds in tensile strength per square inch in cross section at one, seven, thirty, and ninety days.

When that day arrives there will cease this unseemly scramble for high short-time tests. Reason and common sense will prevail, guided by a practical knowledge of the chemistry of cements.

It is not the purpose of the author to disparage or discredit Portland cements, but rather to point out their defects, in the hope that in so doing, more consideration may be given to the subject, and juster conclusions reached.

Unquestionably an ideal hydraulic cement can be produced by what is known as the Portland process, and there is but little doubt it would have been much in use at the present time, had it not been for the unfortunate misinterpretation of the readings of the tensile strain-testing machine in the early stages of its existence.

At the time of its first introduction into England, Portland cements were selling at one shilling per bushel, and rock cements were selling at eighteen pence per bushel.

Such was the public opinion as to the relative values of the two classes of cements sixty-two years after Parker had brought out his Roman (rock) cement, and thirty-four years after Aspdin had produced his artificial (Portland) cement.

Even at the difference in prices, the Roman cement had by far the larger share of the market, and the only means of ascertaining the relative values was by the behavior of the cements in actual work, and making such tests as placing balls of the cement under water.

Then came the tensile strain-testing machine, and it was soon ascertained that the Portland brands tested higher than the Roman cements.

It must have been an important event, an epoch, in fact, in the lives of those engineers, to be confronted with the revelations disclosed by the testing machine.

They had been using both classes of cements, and the rock cements stood, if the price is any criterion, 50 per cent. higher in their estimation than the Portland cements. And yet the testing machine showed them that the Portland cements were the stronger, and so, they reasoned, that if stronger, they must be better. Therefore they had been laboring under a hallucination for, lo, these many years.

Judging by their experience in the use of both classes, the cement which had seemed to them to be the best, that had given them the least trouble, was not the best, after all.

They never questioned the soundness, or rather unsoundness, of their new-found scheme for determining values.

It did not occur to them that the higher testing cement was not necessarily the better cement, and they accepted the result as indisputable.

With their former teachings and experience on the one hand, and the testing machine on the other, the question was not long in doubt. The machine was victorious, and thenceforward all judgment founded on experience was laid aside, and they became blind believers in the tensile strain tests.

What matter though they were continually befogged by the frequent, unreasonable, and capricious pranks of the machine, they had found a god, and were determined to worship it.

And so it came to be established as a fixed belief among engineers and architects that the best cement was the one which tested the highest, and the manufacturer had no alternative but to strive to make his product test as high as possible.

The next step was in the direction of forcing higher tests by using an excess of carbonate of lime, or by adulterations.

(To be continued.)

LIME, HYDRAULIC CEMENT, MORTAR, AND CONCRETE. II.

BY CLIFFORD RICHARDSON.

CHARACTERISTICS OF GOOD LIME.

PURE calcium oxide consists of 71.4 per cent. of calcium and 28.6 per cent. of oxygen. Its ordinary form is that of a more or less porous earthy white solid which, in a pure condition, is very resistant to heat. It has, as has been shown, a great affinity for moisture and must be preserved out of contact with air from which it absorbs water and carbonic acid.

Caustic lime, for building purposes, should have the following properties: —

Except when made from coarsely crystalline marble, or from marl or shells, it should be in hard lumps.

It should be white, or nearly so, in color. Lime of a yellow or brownish color, with veins of silicious matter, is inferior.

It should be free from semi-fused or fused stone, showing overburning, and from unburnt ash of fuel or clinker.

It should contain less than 10 per cent. of impurities, but often has more.

It should slake rapidly, showing that it is rich and fresh.

Good lime in lumps should weigh, as packed, with about 40 per cent. of voids, 60 lbs. to the cubic foot, 75 lbs. to the bushel, and from 220 to 230 lbs. to the barrel of 3 bushels. If ground or in powder it will weigh less when packed loosely, but when well shaken down it will weigh as much as 270 lbs. to the barrel. A lump of hard lime, 1 ft. cube, would weigh about 95 lbs., having a density of 1.52.

THE SLAKING OF LIME.

Caustic lime combines with water with the evolution of heat to form calcium hydrate. Every 100 parts of caustic lime require 32 parts of water for its conversion into hydrate. If one third of its weight of water is sprinkled on quicklime it becomes very much heated, cracks open, if of the massive variety, swells up and falls to powder. The heat developed is sufficient, at times, to ignite wood. The quicklime becomes slaked lime. This consists of 75.7 per cent. of calcium oxide and 24.3 per cent. of water. It has a specific gravity, when pure, of 2.07. The increase of volume in the process of slaking is due to the formation of steam, which tears the particles of lime apart and expands the mass. If a current of dry steam is passed over heated caustic lime confined in a tube it becomes slaked without any increase of volume.

The smaller the amount of impurities the more energetic is the act of slaking and the greater the increase of volume. In rich and pure limes the increase of volume under ordinary conditions will be over twice that of the unslaked material, including the voids, while with very poor limes it may be much less. The statement frequently made that lime increases three volumes in slaking is based upon the increase in volume due to the excess of water often used in slaking. In this case it may be as great as 3.4. The amount of increase of volume for the same lime may be very variable, depending on the conditions under which it is slaked. We have seen that it is a reaction between water and caustic lime where much heat is generated, and that to the steam evolved is largely due the expansion of the lime. It is evident, therefore, that the provisions for augmenting and retaining this heat are of importance. If water is added slowly but comparatively little heat is developed, while slaking in an open space will not give as much as when it occurs in a closed box. Cold water also will not accelerate the action as well as warm. The amount of water used has a marked effect on the volume of slaked lime produced. With an equal volume of water the increase for a good, rich lime is from 2 to 2.4. An increase or reduction in the amount of water or in the volume weight of the lime may increase or diminish this.

The following experiment shows the effect of different amounts of water on an ordinary lime.

Volume of Water.	Increase.
½	1.6
1	2.0
2½	2.5

With a poor dolomitic lime the volume increase was only

2	1.7

It appears, therefore, that the increase of volume to be expected of any lime is dependent on conditions which may be very variable. For example, a peck of lump lime with 44 per cent. of voids between the lumps gave, on slaking with its own volume of water, 2¼ pecks of fine powder of slaked lime, which is a fair increase in volume for lump lime. From 1 peck of closely packed lime, however, 2.5 volumes of slaked lime were obtained. The difference in volume is of course due to the difference in weight of the lime as packed in the two ways.

The proper comparison, therefore, is one of volume from weight. 10 lbs. of caustic lime, for instance, should give 6.8 bushels of slaked lime, an increase of volume of 2.25. Gilmore found in some of his experiments increases as great as 2.46, 2.83, 3.21, 2.40, and 2.14, but the weight of lime in his unit volumes was much greater than occurs in practise, and large amounts of water were used in slaking so that he was dealing with paste instead of dry slaked lime. His experimental results, as compared with our own, are as follows:—

	Rockland. Gilmore.	Roundout. Gilmore.	New York. Richardson.
Weight of lime in lbs.	5	5	5
Volume of lime in c. c.	1557	1806	2350
Volume of water to slake	2983	3300	2000
Increase of weight, per cent.	2.24	2.24	1.60
Increase in volume	2.46	2.14	1.91

It will be seen that 5 lbs. of Gilmore's lime occupied a smaller original volume than ours, and an excess of water was used in slaking, which accounts for his results. The theoretical increase in weight should be 1.53 per cent.

General Totten found in experiments on slaking limes no increase in volume greater than 2.27 when no more than an equal volume of water was used. The increase of volume is commonly used as a test of the quality of lime.

Air Slaking. Slaked lime is also produced by exposure of caustic lime to the air, from which it absorbs sufficient water to become hydrated, as well as some carbonic acid. This is known as air-slaked lime. It is of little value for mortar making, because there has not been enough heat produced in its formation to tear apart and expand the particles which will alone enable it to form a rich paste. The larger particles have also to a certain extent become hardened on their surfaces by a kind of setting, and by the absorption of carbonic acid from the air.

Practise in Lime Slaking. In practise, the slaking of lime for mortar is conducted in several ways. Either sufficient water is sprinkled over the lime to combine with it and resolve it to a powder, providing also an excess for that lost in the form of steam, or an excess is added at once, sufficient to make the finished mortar.

The first method is in some ways the best, because a finer, looser powder is produced, in the manner already described, and because the poorer limes are much more easily and thoroughly slaked in this way with the aid of the greater heat evolved. When too large an amount of water is used the development of heat is prevented, and the operation is much less complete. The particles of lime which are left unslaked go into the mortar in that condition and, being subsequently slowly hydrated by the moisture of the air, expand with injurious effect after it has been used. The popping of mortar, frequently noticed in the walls and ceilings of dwellings, is due to this cause. For the same reason, given above, all the water which is to be used should be added at once or nearly so. If it is added in small portions the effect is to cool down the whole mass and prevent thorough slaking.

We have seen that a third of its weight of water is theoretically necessary for slaking lime. In practise, however, to allow for vaporization as steam, and for the slight excess necessary to bring all the particles in contact with moisture, this amount must be increased to at least an equal weight. It is difficult to say what volume of water should be used, as this depends on the volume weight of the lime, which is variable. It is ordinarily about that of the lime itself plus its voids. Practically it is convenient with fat lime to use two and a half volumes of water, which will suffice for slaking and for the production of a paste. Poor magnesian limes require less.

As heat assists in the expansion of the lime, the operation is best carried on in a covered box. One half of the water is added at first, and as soon as the lime begins to fall to pieces the rest is poured in and thoroughly mixed with the slaking material. The entire mass will thus be raised to a high temperature. The operation thus carried on takes place rapidly, but it can hardly be considered completed until the mass has become cool, or until even after a longer time. In cold weather it is advantageous to use warm water, especially with poor limes.

Water for Slaking and Mixing. Water used for slaking lime and making mortar should be pure. When it contains salts, such as chlorides and sulphates, the mortar effloresces and gives rise to stains. For this reason sea water is unsuitable, although it has been used successfully with hydraulic cement.

LIME PASTE OR CREAM.

The lime paste made in the manner previously described may be too stiff for mortar if a very rich lime has been used, or if a very large volume of sand is to be employed in making the mortar. There is no difficulty in thinning it, however, to the proper consistency, depending on the character of the mortar to be made. If, however, more than two and a half volumes of water are added to the lime at first the resulting paste will have a tendency to be granular and to contain lumps which, in the thin cream, it is impossible to break up. In careless practise as much as three or four volumes of water are sometimes used in slaking lime, when it is intended to make a mortar with a large volume of sand. Stretching the cream in this manner to make a small amount of lime fill a large volume of sand voids makes the resulting mortar very porous when dry.

Good paste of lime should not contain at the extreme more than three volumes of water as compared to the measured volume of the quicklime.

As there are generally some hard and unslaked particles even in the best limes, the cream should be run through a sieve if possible, after standing over night, before mixing it with the sand. It should be remembered that the longer the paste stands before use the smoother it becomes. As will be seen later, this improvement goes on after the mortar has been mixed.

The Masons' Department.

THE ARCHITECT AND CONTRACTOR.—(*Continued.*)

BY THOMAS A. FOX.

THE LOWEST BIDDER.

THE recent controversy between the mayor of Boston and the Master Builders' Association of the same city, regarding the award of the contract for building a public bath house, although carried so far as to become merely a war of words, has nevertheless raised several questions of importance to all persons interested directly or indirectly in the building business. The simple facts of the case are as follows: The city advertised for bids on a bath house, and the contract for the work stated that preference would be given to "union labor." The bids were opened and taken under advisement, as is customary, but after the usual time allowed for the examination of the proposals had elapsed, instead of awarding the contract to the lowest bidder, it was given to the second lowest, whose figure was some three hundred dollars higher. This action at once aroused the indignation of the Master Builders' Association, one of whose missions is to guard the interests of the lowest bidder, providing his qualifications for the performance of the work are unquestioned, and the mayor was at once asked to explain the reasons for such discrimination. The reply was made that as the labor unions had taken special interest in this particular scheme, it was thought desirable to have, so far as possible, only union labor employed on the work, and that the contract had been awarded to the concern which was known to employ this class of help. Subsequent correspondence, however, brought out the fact that the lowest bidders employed union labor as well as those who had received the award, and the mayor's action in the end seemed to be justified only by the right which is always reserved to reject any or all bids, should it be for the interest of the city so to do, which doubtless justified the transaction from the legal, but not necessarily from the moral point of view. As almost all of the labor unions of the city have since passed resolutions indorsing the mayor's action, the motive in this particular instance seems to be apparent. Although the incident in itself is of no great importance, there are several principles involved which justify a brief consideration. First, as to the advisability of awarding public work to any but the lowest bidder, providing he is responsible. While in many instances it would undoubtedly be for the interest, both of the public and the architect, to discriminate in the awarding of such work, nevertheless, where contracts are thrown open to general competition, as is usually required by law, it is establishing a dangerous precedent to permit the work to be given to any but the lowest bidder, unless he may be proved irresponsible, and the amount of difference between the bids should have no bearing whatsoever in the case, as it was intimated was the fact in the instance above noted. The difference of a dollar, under these conditions, should be respected just as much as a difference of a thousand or more.

If discrimination in the award of contracts for public work is to be permitted at all, it should be done by allowing the architect, or other qualified person or persons, to select a certain limited number of contractors to figure the work, thus preventing the work being placed upon the open market, and the consequent liability of being obliged to accept an inferior grade of work; but where this method is employed the rights of the lowest bidder should always be respected, as well as under an open competition.

The award of this bath-house contract, moreover, shows the labor unions in rather a new rôle. It is true they have for some time been asking for various forms of legislation in their behalf, and have appeared in politics to a considerable extent, but this is one of the first instances where they have requested or gained favoritism in the award of a building contract. But this step is only following some of the numerous examples which we have constantly before us, in the direction of asking the government to do something for somebody for no valid or particular reason, a policy which, if not checked and rooted out, will soon prove, if it is not already, a serious menace to our republican institutions. There is no ground on which a labor union can ask for preference in the awarding of contracts for public work, unless it may be for the same reason that such organizations as our largest trust and most extensive monopoly receive aid from the native government, which is, of course, no reason at all, and the sooner such things are stopped the better. The evils of special legislation and class preference are in direct antagonism to the spirit of republican institutions, and admit of no argument. The example in such directions is set by those who ought to know better, but whose avarice and greed overcome their rather shallow ideas of justice and honesty. Who can wonder that such example is blindly followed by those who see the government being used to bolster and enrich private individuals and corporations, and from this spectacle gather the impression which soon becomes conviction, that legislation is the panacea for all ills?

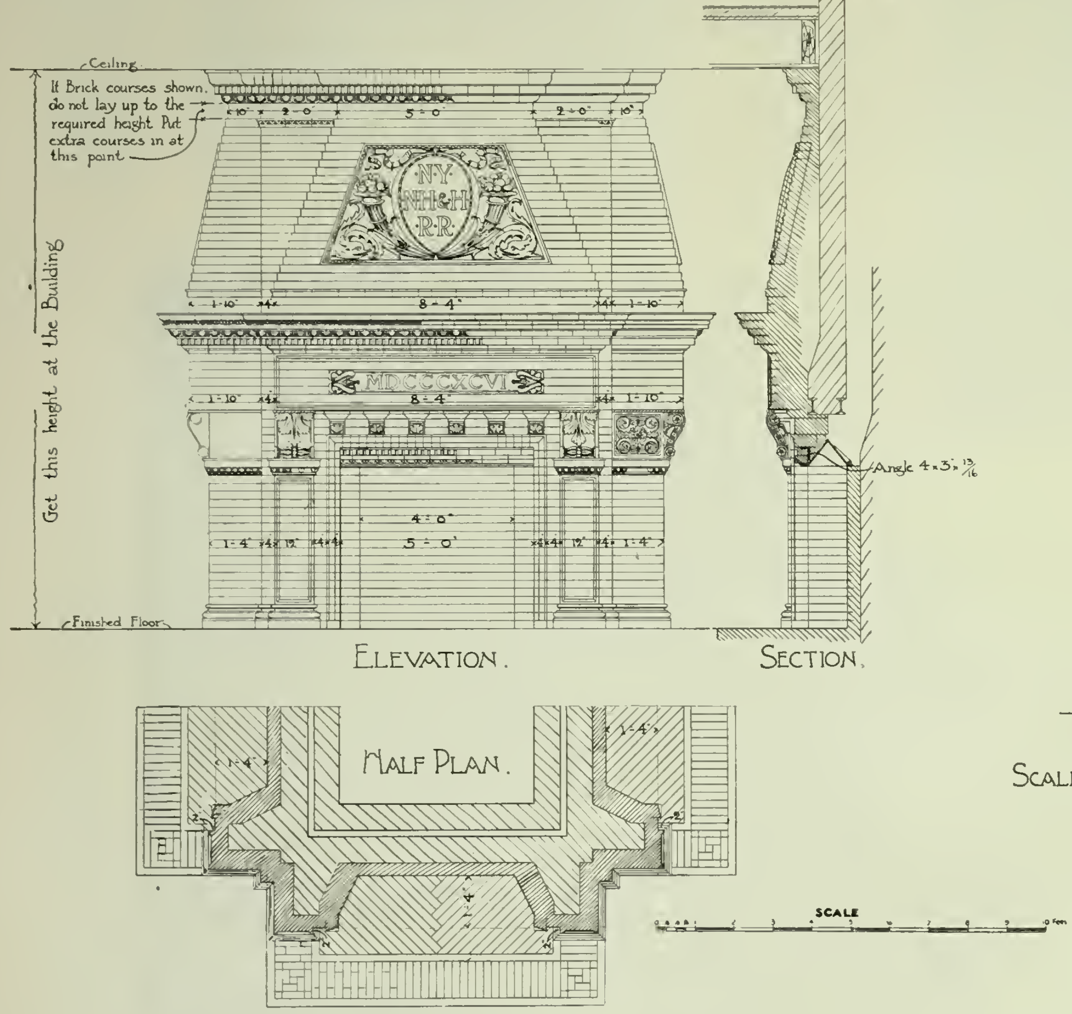
It was intimated during the controversy regarding the award of this contract, that one of the reasons for giving a preference to union labor was that it would insure better work, which is at best a most doubtful statement, for the simple reason that most unions are run to help the poorest rather than the best men, a principle which, being in direct violation of one of the fundamental laws of nature, namely, "the survival of the fittest," is bound in the end to fail. The truth is that the management of the great majority of unions is in the hands of incompetent men, those who like to talk but not to work, and very often a man who is too poor a workman to earn a day's wages at his trade is found high up in the councils of the union, or an active member of the board of walking delegates. It is certainly a fact that at the present time union labor insures no better work than the average, and there is consequently no just reason for discrimination in their favor under the impression that superior results will be thereby obtained. No one who has followed the work of the labor organizations can deny that in many ways their work has been beneficial and progressive but in this matter they have shown as they too often do their weakest side. The award of the contract for this building and the controversy which followed it have certainly raised several novel questions, and it will be interesting for all those who are concerned in such matters to watch the future developments, for the affair has raised several interesting points which will take time and further experience to decide.

HEIGHT OF FACTORY CHIMNEYS.

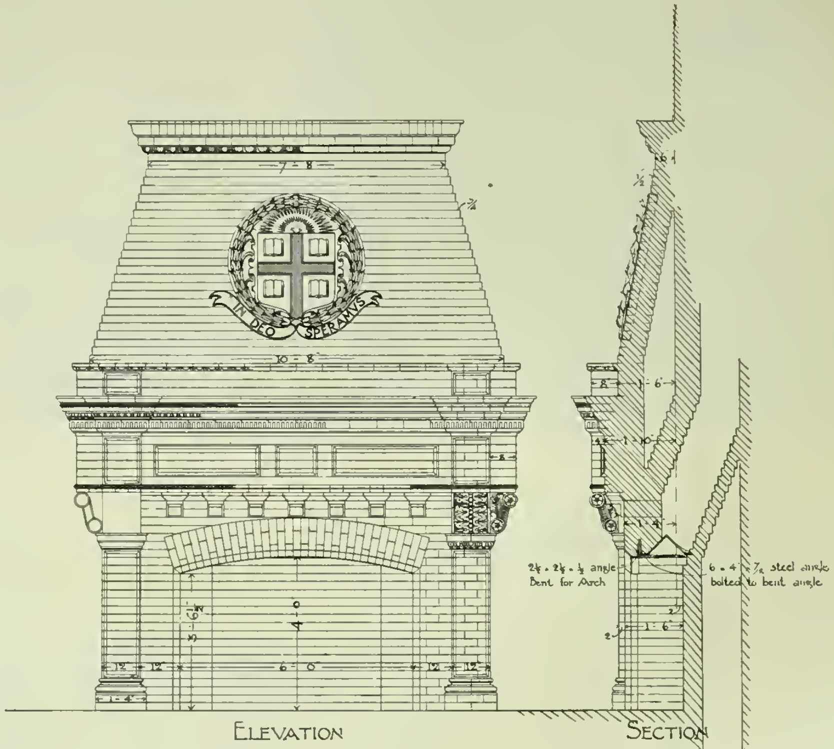
THE notion that the greater the height of a chimney for a boiler plant the greater will be its draught-producing power is responsible for the existence of many chimneys of imposing size, and, at the same time, unnecessary expense. A very tall chimney, well proportioned and gracefully outlined, may be a striking architectural adjunct to a factory, but it is also one that costs considerable money without doing any measurable amount of good. Where chimneys are intended to carry off noxious fumes from chemical works, there is, of course, some method in providing for unusual height, since the aim in such a case is to insure as complete as possible a diffusion of the vapors and prevent their mingling with the air of the lower strata; but for boilers simply unusual height, as stated, is rarely based upon a good reason.

As a matter of fact, the draught-producing capacities of chimneys having flues of the same size are in proportion to the square roots of their heights, so that if one were to have double the power, if it may be so called, of the other, it would have to be four times as high, and not merely twice as high, as many would suppose. A height of 150 feet may be considered, on good authority, as the maximum necessary in any case for producing the requisite draught, providing, of course, that the area of the flue has been properly proportioned. This latter should be made to bear a pretty nearly direct ratio to the combined areas of the boiler flues connecting with it. A chimney much beyond 150 feet is generally suggestive of misspent money.—*Cassier's Magazine for August.*

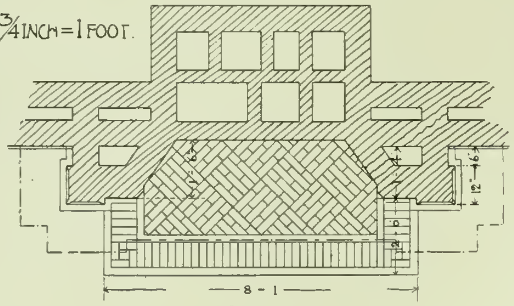
MANTELS IN THE RESTAURANT OF PASSENGER STATION PROVIDENCE, R. I. FOR THE NEW YORK, NEW HAVEN AND HARTFORD RAILROAD



SCALE 3/4 INCH = 1 FOOT.



SCALE 3/4 INCH = 1 FOOT.



DETAILS OF BRICK MANTELS IN THE THIRD STORY OF THE RECITATION HALL WOMENS COLLEGE BROWN UNIVERSITY

November 17 1896

STONE, CARPENTER AND WILLSON ARCHITECTS

49 Westminster St Providence, R. I.

Recent Brick and Terra-Cotta Work in American Cities, and Manufacturers' Department.

NEW YORK. — During the past month there has been a decrease in the number of plans for large and important buildings which have been filed with the building department, but there has been a decided increase in the number of contemplated dwellings and apartment houses, both city and suburban. This is the best possible indication of gradually restored confidence and the passing of "hard times." Business men will risk a great deal of money at almost any time when a large return seems assured to them, but the luxury of a new dwelling house cannot be indulged in when the future is uncertain. One unfortunate instance of misplaced confidence has been brought to our notice this week in the Syndicate Building, sold for the third time within two years, and at a great loss to its original owners, injured to a great extent by its name.

A very interesting new building is the Telephone Building, on Dey Street, just completed. It has a very refined Italian Renaissance façade, constructed entirely of blocks of terra-cotta, with a great deal of elaborate detail beautifully executed. This building is so successful that a great many are of the opinion that terra-cotta will be largely used in place of stone for facing in the future.

Great changes will be made this month on lower Broadway to make room for the many new office buildings, as announced in our last number. Many old landmarks will have to go; one particularly

TERRA-COTTA FRIEZE, ENTRANCE TO STANDARD BUILDING, CLEVELAND, OHIO.
Made by Northwestern Terra-Cotta Company.

interesting, as it is the last residence remaining on Broadway in what was once a fashionable section, the handsome building corner of 19th Street, known for generations as the Geolet Mansion. It will be destroyed to make way for an eight-story brick store and loft building, to be erected by Almy & Gallatin, from plans by J. B. Snook & Sons, architects.

ST. CHRISTOPHER'S HOSPITAL, FAIRHILL SQUARE, PHILADELPHIA, PA.
Frank Miles Day & Brother, Architects.

Another sky-scraper is to be erected overlooking Battery Park. R. A. and W. H. Cheseborough have filed plans for a fifteen-story brick office building, to cost $200,000. To be erected from plans by Clinton & Russell, at the southeast corner of State and Pearl Streets, opposite the present six-story Cheseborough Building.

J. C. Lyons has filed plans for a twelve-story brick store and loft building, to cost $800,000, to be erected at Nos. 294 and 296 Broadway, extending to Manhattan Place. Buchman & Diesler are the architects. This building will adjoin the fifteen-story R. G. Dun Building, for which excavations are now in progress, while the Astor estate will build to the north at the Duane Street corner.

Barney & Chapman, architects, have designed a sixteen-story office building, to be erected at 684 Broadway, for the Rhinelander estate.

Harding & Gooch have filed plans for an eighteen-story hotel, to be erected on the Paran Stevens property, 44th Street and Fifth Avenue, at a cost of $1,500,000.

Wm. Rankin has filed plans for four five-story brick stores and flats, costing $100,000, to be erected at the southwest corner of Manhattan Avenue and 102d Street.

The city has filed plans for a five-story brick public school building, to be erected on the east side of Avenue A, between 77th and 78th Streets, at a cost of $260,000.

The trustees of the Cathedral of St. John

OFFICES OF THE NEWARK GAS COMPANY, BROAD ST., NEWARK, N. J.
Henry J. Hardenbergh, Architect.
Front brick furnished by Raritan Hollow & Porous Brick Company.

the Divine ave decided to complete the choir at once; $1,000,000 has been appropriated for this purpose. A bishop's palace is to be commenced as soon as the plans are approved, which will cost $100,000.

KEYS TO FIFTH-STORY APARTMENT HOTEL, 83D STREET AND RIVERSIDE DRIVE, N. Y.
James R. Ware, Architect.
Executed in terra-cotta by the Excelsior Terra-Cotta Company.

CHICAGO. — The exhibition at the Art Institute, under the auspices of the Chicago Architectural Club, which closed April 11, eclipsed all former exhibits. Some eight hundred drawings filled the walls of four galleries. There were very few pen and ink renderings, most of the work being in water color, and many were exceedingly well done. There were no photographs, with perhaps one exception, and no regular working drawings which would show office methods. Very few products of the "allied arts" were admitted, one interesting instance being a bronze door for the new public library.

The Illinois chapter of the American Institute of Architects had offered as a prize to members of the Chicago Architectural Club, who had not been in independent practise more than two years, a gold medal for the best individual exhibit. Instead of the gold

LEHIGH BUILDING, PHILADELPHIA.
Addison Hutton, Architect.
Brown mottled terra-cotta bricks furnished by the Perth Amboy Terra-Cotta Company.

medal, however, three silver medals were awarded, to Messrs. H. M. G. Garden, H. T. Ross, and Victor Traxler.

The Art Institute has provided club rooms for the use of the Chicago Architectural Club in the Institute Building. This step is the first looking toward an affiliation of various kindred organizations at Chicago's art center. New York architects can appreciate the enthusiasm of the Chicago Club over the new departure by imagining the Metropolitan Museum located near their business center, and offering them not only the use of private club rooms, but access to all the gallery, lecture, and schoolroom privileges.

One more matter in connection with the Art Institute: it will soon have a new auditorium for its lecture courses.

Director French has a plan for distributing the work of the interior decoration which will greatly interest students and graduates. The work will be under one direction, to avoid as far as possible the criticism made even against the decoration of the new Congressional Library—a lack of unity. Mr. Chas. Coolidge is the architect.

BUSINESS BLOCK, MINNEAPOLIS, MINN.
H. W. Jones, Architect.

The Institute of Architects is making some of their meetings interesting by devoting the greater part of a session to a very frank and free discussion and criticism of the buildings of a particular architect. Vivisection is good-naturedly indulged in to determine why a building is a failure or success.

The business depression and the large number of new office buildings in Chicago have combined to make offices a drug in the market. Good offices can be rented at a very low price.

As to prospective work, R. Bruce Watson has completed the drawings for two pumping stations for the city. The designs, which are very agreeable, are to be executed in brick.

Architect S. A. Treat has designed a new lecture hall.

N. S. Patton, architect to the Board of Education, has several new school buildings on hand.

S. S. Beman has made plans for the Studebaker Hotel at South Bend, Indiana, to cost $125,000.

GROUP FOR THE BAPTIST PUBLICATION SOCIETY BUILDING, PHILADELPHIA, PA.
Frank Miles Day & Brother, Architects.
Executed in terra-cotta by the Conkling-Armstrong Terra-Cotta Company.

The City Council has been juggling again with the limit of height of buildings. An ordinance was passed reducing it to 90 ft., but it has been raised again to 150 ft.

A matter exciting general interest on the streets, lately, has been the delivery and erection of the colonnade for the new Illinois Trust and Savings Bank. Each shaft is a monolith of Maine granite weighing some twelve or fourteen tons.

ST. LOUIS.—The unusual activity among builders in the suburbs is regarded as an encouraging sign. There are rumors of numerous large schemes in contemplation, but few are taking definite shape.

The Union Club, which was destroyed by the cyclone, has been rebuilt by architects Grable, Webber & Groves. It is an admirable piece of colonial work in rich red brick with white trimmings. A fine porch with large columns surmounted by a pediment marks the entrance. The building has also been enlarged and arranged for stores on the Jefferson Avenue side.

The original building, which was an interesting piece of Romanesque in white stone, was designed by architect T. C. Link, and had only been completed a year or so when it was destroyed.

The new St. Augustine Church on

TERRA-COTTA COLUMN, BUILDING FOR WM. WEIGHTMAN, CHESTNUT STREET, PHILA.
Willis G. Hale, Architect.
Made by Standard Terra-Cotta Company.

Herbert Street is a good example of Gothic architecture. It is built of pink brick with terra-cotta trimmings. The interior is to be finished with groined ceilings which extend to a height not usually seen at the present day. It will cost about $175,000.

The Lionberger Building, a noble example of Richardsonian work, which was destroyed in our million and a quarter dollar fire

TERRA-COTTA CAPITAL, BUILDING FOR WM. WEIGHTMAN, CHESTNUT STREET, PHILADELPHIA.
Willis G. Hale, Architect.
Made by Standard Terra-Cotta Company.

last month, is to be rebuilt by Shepley, Rutan & Coolidge. It is their intention to reproduce the original building as nearly as possible.

PITTSBURG. — Business in the architectural and building lines is brightening, and a considerable amount of work is promised during the coming season.

Architect Wm. Kauffman is the successful competitor in the Greensburg Court House competition; the building is to cost about $400,000.

The Carnegie Steel Company, of this city, has been awarded the contract for the first steel fire-proof building to be erected in the Orient. It is an office and mercantile building to be erected at Tokio, Japan.

Several prominent business men here are interested in the erection of a new family hotel opposite Highland Park. Plans call for a fourteen-story, fire-proof structure, to cost $300,000.

The Exposition Society have planned to expend about $100,000 on improvements to their buildings this year.

The Third Ward Allegheny School Board are contemplating the erection of a brick school building to cost $150,000. It will contain a manual training school and all departments for the education of children in various industrial lines.

Architect Wm. Ross Proctor has completed plans for a new hospital which he will submit to the board of managers of the West Penn Institution. The complete plans call for fourteen buildings.

Architect S. F. Heckert is receiving bids for the erection of the convent building at Millvale, which is to cost $250,000.

The same architect is also preparing plans for a five-story brick Casino for the St. Michael's Roman Catholic congregation on the South Side.

Architect J. L. Beatty was the successful competitor for the

FRIEZE IN MAIN CORNICE, PHILADELPHIA DENTAL COLLEGE, 18TH AND BUTTONWOOD STREETS.
Wilson Brothers & Company, Architects.
Executed in terra-cotta by the Excelsior Terra-Cotta Company.

Woman's U. P. Hospital, which will be erected on Sandusky Street, Allegheny, at a cost of $40,000.

Architect Edward Stotz will prepare plans for the new South Side High School.

Prof. H. L. Braun will build a four-story brick and stone business block, auditorium, and apartment house on S. Highland Avenue, to cost $50,000.

Architect F. C. Sauer has been commissioned to prepare plans for a large brick and stone church and monastery for the Capuchin Fathers, to be erected at Canal Dover, Ohio.

MINNEAPOLIS.— An inquiry among the architects of the Northwest, conducted by the "Improvement Bulletin" of Minneapolis, brings out the fact that few, if any, architects are anticipating any very large undertakings this season.

The architects of Wisconsin have secured the passage of a bill requiring all persons desiring to practise architecture to pay annual fee and be subject to an examination. Illinois architects are also agitating a similar bill. We sincerely hope this will spread until it is requisite in every State.

Our Governor covered himself with glory recently by vetoing a bill framed and engineered through the legislature, changing the site of proposed new hospital for the insane, from Aroka to Hastings. Inasmuch as the State had purchased a site at the former place in good faith, the citizens making a liberal donation to same, the matter was considered by him as closed, and any further agitation as unworthy the dignity and honor of the State. He was upheld by a large majority of the legislature.

Among the larger improvements under way at present may be mentioned: brick residence for Geo. H. Partridge, by Long & Kees, architects, to cost $20,000. Public Library at Rochester, Minn., by C. S. Sedgwick, architect, to cost $18,000, won in competition. School building at Kaukauna, Wis., by Orff & Joralemon, architects, to cost $21,500; and another at Jordan, Minn., same architects, to cost $15,000.

There will evidently be large improvements in the smaller towns, but the cities will do no very great building.

TRADE LITERATURE.

THE recently published catalogue of the Fawcett Ventilated Fire-proof Building Company is before us. The particular system of fire-proof construction which is manufactured and put on the market by this company is in several respects quite different from the ordinary arch block construction. It assumes that fire will readily heat through thin terra-cotta, just as water can be made to boil in an earthen pot, and that if the flange of a beam be once heated sufficiently the beam will expand, deflect, and come down with the floor, causing damage to the building, as well as to the floor itself; and therefore, in order to afford insulation of the lower flange, the Fawcett blocks are so devised as to interpose between the metal and the terra-cotta, a space through which air, when heated, may freely circulate. This is the principle of the Fawcett floor, and it is claimed that though a fire may heat through a plaster ceiling, or may heat the terra-cotta to even a white heat, before it can reach the one vulnerable point, the I beam itself, it must heat through a layer of air which is not confined, and the more intense the heat the more rapid the circulation of the air.

Another claim of the Fawcett construction is that the fire-proofing blocks or sections can be laid without any centering whatever, and will form a ground for a perfectly level and even ceiling. The sections are made in the form of a horseshoe cylinder. These are cut with a bevel at each end of a length so as to just fit between the flanges of two beams, the ends being further rebated so that the lower portion of the terra-cotta section dips below the flange of the beam. As soon as these sections are in place the spaces above are filled in with concrete to receive the finished floor. This construction is doubtless familiar to all our readers, for the Fawcett construction is long past the experimental state, and has been used and recognized by many leading architects in this country and abroad. It can be adapted to any building or any circumstance, and can be built to carry a superimposed load of anywhere from 50 to 1,500 lbs. per square foot. The catalogue gives a list of the buildings in which this construction has been used, which includes many prominent buildings in our large cities.

NEWS OF THE MONTH.

The contract for front and inside brick for the Dover Street Bath House has been given to Waldo Brothers.

Waldo Brothers have secured the order for front bricks for Paul Revere Schoolhouse, Boston.

The White Brick and Terra-Cotta Company have removed their New York office from 92 Liberty Street to the Presbyterian Building, 156 Fifth Avenue.

The Fawcett Ventilated Fire-proof Construction Company have contracted for the structural steel work and fire-proofing for the new Probate Court Building, East Cambridge, Mass.

Powhatan face bricks will be used on alteration of building on Beach Street, Mr. Hennessey, the owner, having placed the order with Waldo Brothers.

The Ralston Brick Company has secured the contract for supplying the brick that will be used in the buildings of the University of the State of New York.

Waldo Brothers have sold Alsen Portland and Hoffman Rosendale cements to Richardson & Young for use on section 9, Boston Subway.

Having completed the improvement in their plant, which consisted of putting in new machinery, the Ralston Brick Company is running to the limit of their capacity on orders that had accumulated.

C. Everett Clarke & Co., builders of the new building on Congress Street, near Atlantic Avenue, have contracted with Waldo Brothers for Brooks, Shoobridge & Co. Portland and Hoffman Rosendale cements.

The Pittsburg Terra-Cotta Lumber Company has closed contract for the fire-proofing of the new Baltimore Court House, John Gill & Sons and D. W. Thomas, general contractors. This contract amounted to about $65,000.

The Nelsonville Sewer Pipe Company, of Nelsonville, have purchased an Eagle Re-press from the American Clay-Working Machinery Company. The Nelsonville people report the outlook for business much improved.

Waldo Brothers have closed a contract with the city of Newton for the supply of Portland cement for the season of 1897. The city decided to use Brooks, Shoobridge & Co. Anchor brand, although other brands were offered at lower figures.

The Union Akron Cement Company, Buffalo, is furnishing their Akron Star Brand Cement on the following work: new building for the Buffalo Street Railway Company; No. 1 School House; also for the fire-proofing in the Lenox Flats, the Otto Building, and the Evans' Building.

Contracts have been recently closed for placing the Bolles Sliding and Revolving Sash in the following buildings: United States Government Hospital, Brooklyn, N. Y.; warehouse, Geo. Blome & Son, Baltimore; Fourth Regiment Armory, Baltimore; large apartment house, Washington, D. C.

The Des Moines Brick Manufacturing Company, of Des Moines, Iowa, one of the most progressive firms in the West, are making some extensive improvements and will put in the Eagle Re-presses, and an automatic table of the American Clay-Working Machinery Company's make.

The Standard Terra-Cotta Company have secured through their New England agents, O. W. Peterson & Co., the contract for the terra-cotta on the Registry of Deeds and Probate Court Buildings, East Cambridge, Mass., O. W. Cutter, architect, Thomas H. Connell, builder.

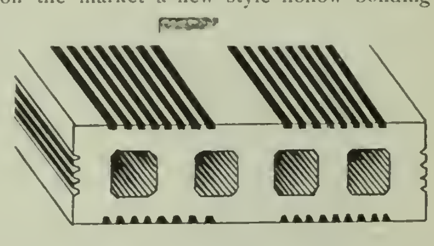
The new brick plant of W. S. Ravenscroft & Co., at Daguscahonda, Penn., has begun operations, and has already enough orders in hand for gray and buff brick to keep them going on full time for several months. The plant is equipped with Simpson Brick Machines.

The American Clay-Working Machinery Company, of Bucyrus, has found it necessary to further increase its force both in the mechanical and clerical departments.

The shops are working full time in every department, some branches putting in extra time in their effort to keep abreast of the orders. More traveling men have been put on the road. There is a general air of old-time business rush with this establishment.

The Philadelphia and Boston Face Brick Company have closed the following contracts: 250,000 plain buff brick, all the molded buff brick, for new passenger station, Boston & Maine Railroad, Manchester, N. H. Red face and molded brick for new high school at Great Barrington, Mass., Henry Vaughan, architect. Molded brick for Norwood Press Company Building, at Norwood, Mass. Molded brick for Phillips Building, at Washington, D. C. Molded brick for Pope Manufacturing Company Building, Washington, D. C. Molded brick for Schiller Turn Verein Building, at Pittsburg, Penn.

The New York and New Jersey Fire-proofing Company has just placed on the market a new style hollow bonding brick, an illustration of which we show herewith. These bricks differ from the regular make of hollow brick in that the holes run crosswise instead of longitudinally. Their size is 8 by 2⅜ by 3½. The idea was suggested by Mr. Snyder, architect of public schools, New York, and they are now specified in the new school buildings.



Chambers Brothers Company are about making shipment of some $15,000 worth of brick-making machinery to Nashville, Tenn., to be exhibited at the Tennessee Centennial during the coming summer. They have erected a building especially for their own use, and will have a very interesting exhibit of machinery in practical operation. It is the largest exhibit of the kind that they have ever made, and will embody both end-cut and side-cut auger machines, steam power re-press, disintegrators, dry pans, clay elevators, and dryer equipment, etc.

The American Mason Safety Tread Company, which has nearly completed its work on the Boston Subway, has closed several important contracts lately. It is remodeling the great stairway of Jordan, Marsh & Co., Boston, the iron edge left for the purpose of retaining rubber mats having proved a source of danger. Safety treads are to be placed upon the steps of the Administration Building of the Metropolitan Park Commission, at Revere Beach, Mass., Stickney & Austin, architects; the new Tufts Building, Boston, Rand & Taylor, Kendall & Stevens, architects.

The granite steps of the Lowell Post-office are to be made safe with this material. The company is now putting out a non-slipping, unwearable sidewalk light, to be known as "The Mason Light."

Panels over Entrances, eleven feet diameter.

Illustrations of Romanesque work, executed in brown terra-cotta, for store for Messrs. Abraham & Straus, Brooklyn, N. Y.
Geo. L. Morse, Architect.

BY

Excelsior Terra-Cotta Co.,

WORKS:
Rocky Hill, N. J.

105 East 22d Street, N. Y.

THE BRICKBVILDER

VOLVME VI MAY 1897 No. 5

OFFICE 85 WATER STREET BOSTON

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

PUBLISHED BY

ROGERS & MANSON,

CUSHING BUILDING, 85 WATER STREET, BOSTON.

P. O. BOX 3282.

Subscription price, mailed flat to subscribers in the United States and Canada . . . . . $2.50 per year
Single numbers . . . . 25 cents
To countries in the Postal Union . . . . . $3.50 per year

Entered at the Boston, Mass., Post Office as Second Class Mail Matter, March 12, 1892.

THE BRICKBUILDER is for sale by all Newsdealers in the United States and Canada. Trade Supplied by the American News Co. and its branches.

PUBLISHERS' STATEMENT.

No person, firm, or corporation, interested directly or indirectly in the production or sale of building materials of any sort, has any connection, editorial or proprietary, with this publication.

THE BRICKBUILDER is published the 20th of each month.

CARE OF MASONRY.

WE understand that Mr. Barnard R. Green, who has been in charge of the work of the Congressional Library in Washington for a number of years, if not from its start, has been appointed by Congress permanent superintendent and custodian of the building. This appointment points a moral which is deserving of more frequent application than is unhappily the case in American cities. Our architects and builders may put up a building never so fine, may use the best of material and the utmost care in application, but unless the structure receives intelligent care after it is occupied, and the repairs, which, from time to time, are necessitated in even the best of structures are made judiciously and with consideration for the character of the construction, the building is bound to deteriorate quite rapidly. And the fact that Congress has seen fit to recognize this condition and has placed the magnificent building permanently under the care of a person who is thoroughly familiar with it, and is competent to keep it in its pristine excellence, is, we hope, at least the beginning of a new order in regard to our public buildings.

The excellence, suitability, and permanent qualities of burnt clay as a building material, preeminently fitted for use in connection with modern structures, can hardly be questioned in view of the greatly increasing application of this material in our large cities. If properly taken care of, there is no reason why a brick and terra-cotta building should not last for centuries in perfectly good condition. On the other hand, any material is bound to suffer from neglect. It is not enough to build a brick wall and expect it to stand forever without any care, nor will the utmost skill in the use of concealed iron supports for terra-cotta avail to keep it in thoroughly good order indefinitely. It must be watched, and especially in our climate it must be repointed whenever the mortar shows signs of decay, and must be cleaned at sufficient intervals to prevent the formation of any of the fungous growths which attach themselves quite readily to building materials and speedily cause disintegration. For these reasons a custom ought to be adopted here, which has been for many years prevalent abroad, of assuming that the architect who builds a building is naturally the one in whose care as a structure it shall remain indefinitely, and that it is as much his function to guard his creation after it is turned over to the owners as it is to see that proper materials are used in the first place and laid up in the best manner. We believe that a great deal of the objection which has at times been urged against brick or terra-cotta has been suggested by observation of structures imperfectly cared for, which, with perhaps not the best of materials to start with, afford a too easy prey for the elements; and the fact that there are so many buildings of brick which have endured in this immediate vicinity for over one hundred years, and are still in a perfectly good condition, shows that with even ordinary good care brick or terra-cotta are practicably indestructible. Any one has but to examine the Harvard and Massachusetts Halls at Cambridge, which were built in the last century, to see how well brick will endure under proper conditions. On the other hand, we have seen buildings in which was used thoroughly first-class brick laid in the best of cement, which had been allowed to go to pieces, the frost had worked into the joints, and ten years after the structure was handed over to the owners it looked older and of apparently poorer materials than the Cambridge examples just noted. The practise now seems to be for the architect to build his building, and as soon as the contract is completed, roll up his drawings, pack them away, and speedily forget the structure, to concentrate his energies on the next job he is hunting for. Even if he remonstrates with his former client against neglect of his building his warnings are seldom heeded, for few property owners appreciate that a building must be not only well constructed but well groomed.

The points at which a building will suffer most are in the weatherings, where vertical joints are exposed on top of a horizontal course, such as top members of cornices, sills, copings, etc. Some constructors are unwilling to use terra-cotta for any of these purposes, knowing how seldom an owner will intelligently appreciate the necessity for attention to such features, though so much better effect can often be secured that it is well worth the price of a careful inspection each spring by a competent mechanic, and a few dollars expended in some good old-fashioned pointing with a mortar of lime and sugar, or of one of the cements which will not stain the terra-cotta. We recall at this moment a prominent commercial building all of the details of which are of terra-cotta, including a heavy, foliated band at line of upper floor which serves at intervals as a sill for the windows, and of necessity presents many vertical joints, protected only at top by the pointing. The annual bill for repointing, during the last five years, has not averaged twenty-five dollars. In September and in March it is gone over under the architect's direction, and possible repointing anticipated. If this supervision is continued, the terra-cotta ought to last for centuries.

But pointing is not all. Conversing with a builder from a city where soft coal soot is painfully in evidence, we found he was not in favor of using enameled terra-cottas or brick for external treatment of city fronts, for the reason that even the best enameled surface will catch the dust and soot and in a short time will look like ordinary brick or terra-cotta. He seemed to think a suggestion of applied soap and water was impracticable. That is like saying, if one's hands are dirty, there is no use washing them, for they will soon become dirty again. We, in Boston, are fortunately spared the sooty atmospheric conditions which afflict our Western cities, but there is plenty of dirt here, nevertheless, and if a building is to be the joy forever which its possibilities will permit, its toilet must be regularly attended to. A terra-cotta front of 90 ft. by 125 ft. high can be thoroughly cleaned and repointed for less than $250, and this ought to be done at least once in three years, and in some localities once a year. And in the long run, it is believed that property owners would find such care bestowed upon a building would be well worth all it would cost in money, while the esthetic gain to the community would be no less real, if less easy to reckon in dollars.

BRICK, TERRA-COTTA, AND MOSAIC MANTEL, BANQUET ROOM, ST. NICHOLAS HOTEL, ST. LOUIS, MO.
Louis H. Sullivan, Architect.

THE PALAZZO POLLINI SIENNA.

THE Palazzo Pollini is one of the smaller brick palaces of Sienna, but it at once attracts attention by the beauty and correctness of its proportions. The façade is divided

into three stories, of which the first has a very decided batter. There is no ornament of any kind about this story. The principal story has marble architraves, and caps to the windows, and the third story has also marble architraves.

Some of the belts are of marble, and some of molded brick. The wall is capped with a very rich terra-cotta cornice, and wide projecting eaves. The interior presents nothing of interest; the design is attributed to Baldassan Peruzzi. A measured detail of the building is shown on plate 48.

OBITUARY.

MR. W. S. FRASER, architect, of Pittsburg, Pa., after an illness of nine months, died at his home, April 27, at the age of forty-five years.

Mr. Fraser studied architecture at the Royal Academy, London, and with William Burgess, one of the best known of English architects. In 1879, he opened an office at Pittsburg for the practise of architecture. Among the buildings designed by him are the Bank of Commerce Building, Arbuckle Building, Joseph Horne Building, and the Sixth U. P. Church, all of Pittsburg.

ILLUSTRATED ADVERTISEMENTS.

IN the advertisement of the Excelsior Terra-Cotta Company, page iv, is shown an interesting series of terra-cotta details of the Romanesque style, employed by Architect George L. Morse in the new store building for Abraham & Straus, Brooklyn.

BOHEMIAN NATIONAL HALL, New York City, the architectural terra-cotta for which was made by the New Jersey Terra-Cotta Company, is illustrated in the advertisement of that company on page ix.

A VERY interesting illustration of fire-proof floors is shown in the advertisement of R. Guastavino Company, page xiv. It shows to good advantage their system of fire-proof construction, the first floor being of the dome type carried on tile ribs with tension angle

WINDOW PEDIMENT.
Executed in terra-cotta by the New York Architectural Terra-Cotta Company.

irons built inside of same, and the upper floors of barrel arches with tile bracing ribs. The same dome floor construction is to be used for the first floor of the adjoining building and its duct system for hot air. This system of floor construction was selected because of the very heavy loads required. Rand & Taylor and Kendall & Stevens, architects.

Architectural Terra-Cotta.

BY THOMAS CUSACK.

(*Continued.*)

IN responding to numerous requests for reliable data on cornice construction, it may be advisable to start with one of rather commonplace character. Where the projection of a modillion cornice does not exceed 2 ft. 6 ins., it may be supported in the simple and inexpensive, but very effectual, manner shown at Fig. 22. Provision is made for a piece of 1 in. galvanized iron pipe, which is passed through the partitions of every modillion, the chambers of which are then filled from the top bed before setting. The wall would not be less than 12 ins., or more than 1 ft. 4 ins., and in either case the bond could be made the full thickness. If not, the end of the pipe would be allowed to extend to the inside face of wall. The introduction of the pipe serves a twofold purpose. It increases the strength of the bracket *per se*, and it affords a ready means of anchoring it down. Placing the anchor bolts on inside face of wall, instead of building them into the wall, has likewise some important advantages. It gives additional leverage, saves the trouble of exact spacing, and the rods do not stand up in the way of the masons while the wall is being built. The anchor plates are built in joint of brick piers, say, 4 ft. below cornice, and when over the window openings, as near the lintel as possible, in which case shorter bolts would be used. One end of the bolt being forged so as to fit tightly into end of pipe, the other end, passing through the hole in anchor plate, is screwed down to required tension by nut on the under side. The spaces between brackets being then built up level, the top member of cornice is set to line, and in most cases it may be anchored back to roof beams, after the manner indicated in section (Fig. 22).

Where a parapet wall is intended, its weight when built would help to counterbalance the projection of cornice. That is a factor worth taking into account in fixing the length and size of the anchors, but must not be used as an excuse for abandoning them. There have, however, been instances known to the writer where they were omitted by the contractor, although provided for in making the terra-cotta, and specifically called for on the setting drawings that accompanied it to the building. This kind of "economy" is usually shortsighted, and in one or two cases it has proved criminal.

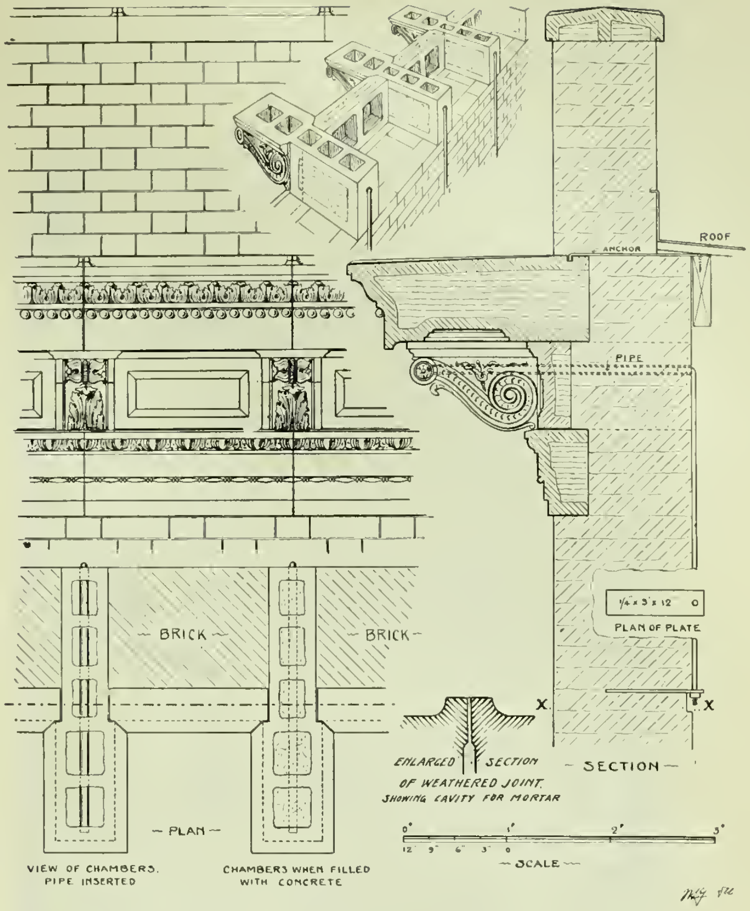


FIG. 22.

A portion of the cornice toppled over onto the scaffold, which also gave way, and in each case with disastrous consequences, resulting in a loss of life, which was directly due to the omission of a few inexpensive and easily applied anchors. In all work of this kind it is certainly "better to be sure than sorry."

Within the limits stated, viz., 2 ft. 6 ins. projection, this arrangement possesses a wide margin of safety. A glance at the diagram will show that if this cornice, when set, be tested by loading it beyond the verge of stability, it would not be the modillions, nor yet the anchors that must fail, but the wall itself, which would break at x x,—obviously its weakest part. To do this, however, would require a much greater weight than is at any time likely to be placed upon a cornice, and the tendency in that direction is fully counteracted by the anchors attaching it to the roof timbers. A scheme substantially the same as this was submitted some years ago, by the writer, to a leading firm of architects, and having received their approval, was carried out. It has again been adopted by them, and

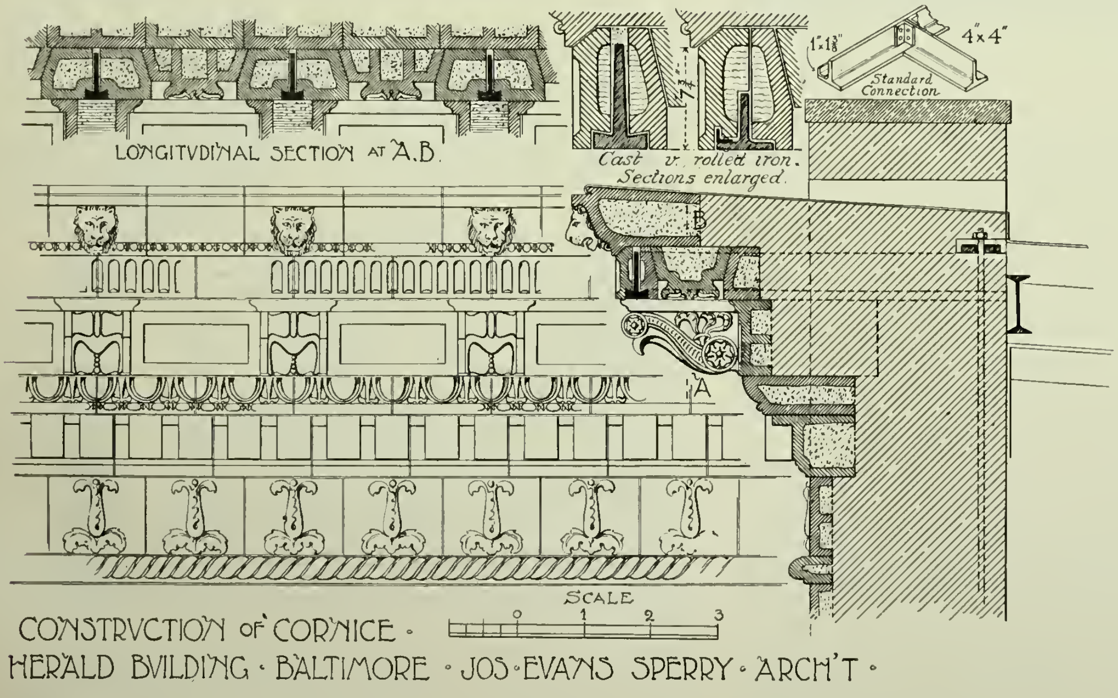


FIG. 23.

by other architects on several occasions, from which circumstance its efficiency may reasonably be inferred.

In cornices of greater projection, other schemes of iron support become necessary. One of these — and an excellent one it is — we

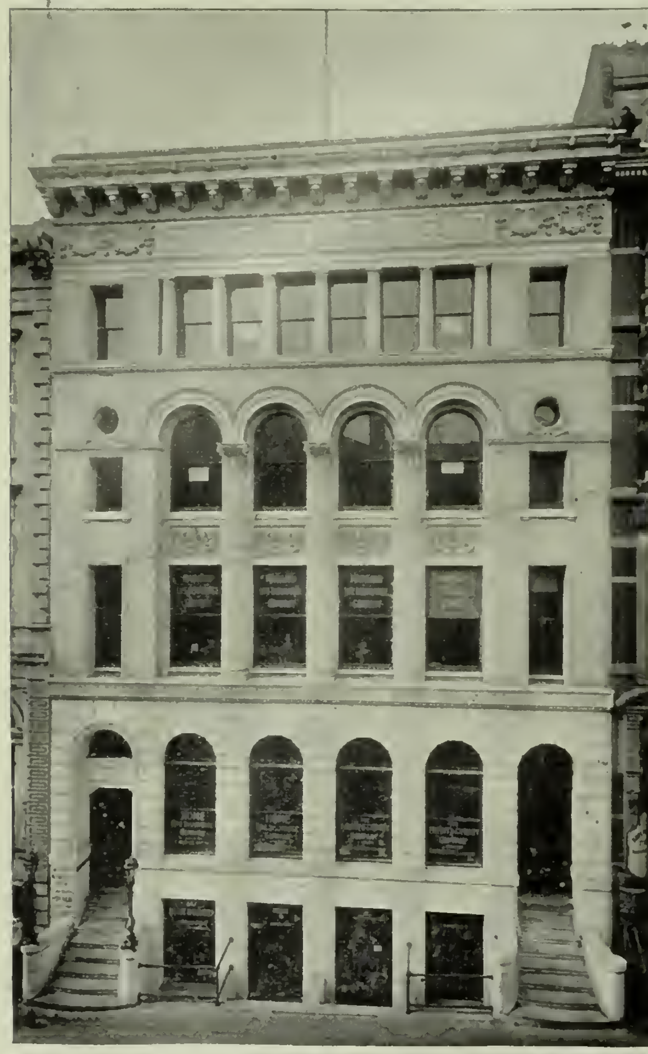


FIG. 24.

give at Fig. 23. For this device we are indebted to Mr. J. E. Sperry, Baltimore; and considering the number of times he has used it on important buildings without much modification, there can be no doubt as to its practicability. The first special feature to be noticed is that the cantilevers, as well as the inverted tee running parallel with the building, are *cast* iron. In this he claims two advantages: one being that they are less liable to rust; the other, that a flange such as shown in drawing cannot be obtained in rolled sections. In so far as the cantilevers are concerned, the value of this particular section is not apparent, but in the longitudinal tee its advantage is very decided. The pieces of terra-cotta forming fascia fit into the dovetail angle in such way that when the crown molding has been set they are securely locked, and do not require any additional anchors.

We think, however, that the same thing could be accomplished by using an ordinary rolled section, on one flange of which a small angle of, say, 1 by 1½ ins. may be riveted, as shown in the enlarged section. Or, a special tee, known as No. 156, may be obtained from the Carnegie works which approximates sufficiently close to the casting to change places with it. This would not be required in the soffit blocks, where eight pieces are fitted into each compartment, with an iron frame on three sides, and a brick backing on the fourth. Seven of these pieces being set in place separately, it but remains to drop in the center panel as a key, and the whole thing is then rendered immovable. There can be no doubt as to the stability of a cornice made and erected in this manner. The only serious objection to any part of it is the exposure of the longitudinal tee, in soffit between the modillions, which would have to be painted to match the terra-cotta. How that may be avoided will be shown in subsequent illustrations, where cornices of much greater projection are carried without exposing any of the iron construction. In view of what has just been said in connection with this one, however, we have taken the liberty of reproducing another of Mr. Sperry's cornice designs, applying to it a style of construction and support which would be less expensive, and, we think, preferable in other respects.

The Maryland Life Building, Baltimore (Fig. 24) has a cornice, the construction of which is substantially the same as that discussed in the two preceding paragraphs, and shown in detail at Fig. 23. In the revised method now proposed (Fig. 25) two radical changes are introduced, which, being made, would involve a third. Instead of the cast-iron cantilevers, which have been shown to possess no special merit, we would use a 4 by 4 inverted tee of rolled iron, tailed down by similar anchor bolts; and as these pass through a continuous channel, they need not be less than, say, 5 ft. apart. The longitudinal tee bolted to the cantilevers is omitted altogether, it, as we shall see, being rendered quite unnecessary. These two changes compel, or rather permit us to make each piece of cornice in one piece from center to center of modillions, with coffer panel and rosette in soffit solid and complete. The blocks so made rest directly on the flanges of the cantilevers, the web in each case being provided for by a slight rebate in the joint. The modillions have little more than their own weight to carry, and being deep in proportion to their projection, might well be considered self-supporting. Yet, in view of possible fracture in transit, or of chance knocks during setting, we would insert a pipe in each of them, filling the chambers with concrete, as in Fig. 22. The terra-cotta maker would not charge any-

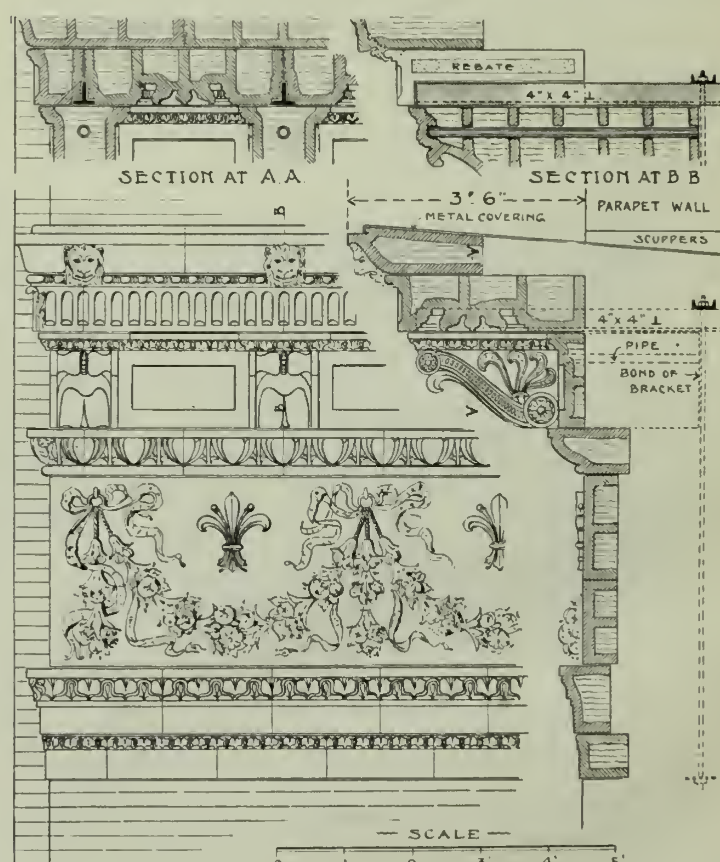


FIG. 25.

thing for the hole; and the use of a few feet of pipe and a little cement, while enabling the contractor to sleep soundly in his bed, would never drive him into bankruptcy.

In saying that this arrangement would *permit* these blocks to be made in one piece, instead of in ten pieces, we use the word advisedly, for in that there are certain advantages that do not appear on the surface. To joint work into pieces unnecessarily small is hardly less objectionable than to insist upon having them made too large. Excessively small blocks were often resorted to in past years by men who had not learned how to make large ones. The alleged intractability of the clay was often enough made a convenient scapegoat for their own shortcomings in the use of it. While it is gratifying to know that some of these men are gravitating towards the rear of the procession, there is reason to fear that the class still survives. A few instances of recently executed work show but too plainly that it is not yet wholly extinct. Architects have at times been talked into acquiescence, accepting in half a dozen small pieces a single member that any really competent clay-worker would have elected to make in one, and that, too, without doubt or misadventure. We see in Mr. Sperry's scheme a well-considered and altogether praiseworthy effort to overcome a supposed deficiency in the material, but one which, we are glad to assure him, can be overcome to a much greater extent than he has been led to suppose.

The particular block which we propose to make in the present instance is 3–0 x 2–9 x 10 and would weigh, when burned, about 500 lbs., or less than one third the weight of blocks which have been made with unqualified success. This, indeed, would be considered an almost ideal block in point of shape, as well as in that of size, and, what is of equal importance, its situation is such that true alignment is imperative only on face and soffit. It, as the drawing shows, may be pressed open on the top bed, which would compel the mason to fill the chambers, in itself a thing to be commended. In this and in many other respects, not only would it be *better* in one piece than if made in ten pieces, but it would likewise be produced at considerably less cost.

One mold of medium size would certainly cost less to make than eight separate molds, required under the previous system of jointing. In like manner, we have but one block to press against the ten distinct pieces otherwise necessary to make up its equivalent in cubic inches of work. The comparison begins, but it does not end here. Instead of one piece, we have ten pieces to handle in all subsequent stages. Even when burned, we have them to assemble, to fit, mark, ship, and finally to set when they reach the building. Whether viewed as a question of good construction, or as one of profit and loss, the balance is decidedly in favor of the solid block, as against the ten pieces. It will therefore be seen that even in terra-cotta making "the first false step" is fraught with and followed by a train of evil consequences — a sufficient reason why it should be eschewed at the outset.

(*To be continued.*)

We haven't been very busy in the office lately. In fact the hard times have left us almost stranded, a condition which we feel we share with a great many others. It has some compensations, however. I have been amusing myself lately with a design for an office building, and as it costs no more to build one way or another on paper, I ran to the limit, and piled on some fifty odd stories, with a total height of about 750 ft. Of course it is a beast, and no client in his senses would ever allow an architect to indulge in such vagaries except on paper, but it is good fun, all the same, and some of the problems which have cropped up have been very interesting. Of course I am building the whole thing of brick. That goes without saying. But of course, also, the brick is only 16 ins. thick with the steel skeleton inside of it. To carry out the delusion of persuading myself that this was serious fun, I figured up the wind strains and found that with a pressure of 30 lbs. per square foot on the off side of the building, which measures, by the way, 100 ft. wide and 600 ft. high, the added strains on the opposite columns at the maximum would only amount to about 54 tons, which is pretty inconsiderable when we reflect that each column has about 2,500 tons load upon it. It looms up in great shape and is an example of brick construction which would delight your editorial heart and would strike terror to the souls of our legislators who are trying so hard to slice off all our buildings horizontally to a ridiculously minimum height. — *Subscriber.*

CLUB NEWS.

At the annual meeting of the T Square Club the following officers were elected for the ensuing year: president, David Knickerbacker Boyd; vice-president, Edgar V. Seeler; secretary, George B. Page; treasurer, Horace H. Burrell.

These officers, together with the following, also elected, comprise the executive committee: Walter Cope, Louis C. Hickman, and Chas. Z. Klauder; house committee: Adin B. Lacey, chairman, Chas. E. Oelschlager, and Percy Ash.

In the regular monthly competition entitled "Farmstead," first mention was awarded Lloyd Titus.

The St. Louis Architectural Club held its regular monthly meeting on Saturday evening, May 1. The club decided to hold an exhibition at the club rooms on May 17 to 22. An interesting talk was given by Mr. Frank A. P. Burford, about Mexico, where he has spent the past year.

The semiannual meeting of the Detroit Architectural Sketch Club was held April 26, and elected the following officers: Alexander Blumberg, secretary; vice, Edward A. Schilling; directors, Augustus O'Dell and John A. Gillard; vice, Alex. Blumberg and M. S. Willcox.

The Pittsburg Architectural Club gave its first reception in honor of Prof. Wm. H. Goodyear, April 23, 1897. The club rooms in the Ferguison Block were artistically decorated to suit the occasion, and many architects, artists, and their friends were present. A table covered with hundreds of photographs of medieval Italian churches, taken by Professor Goodyear while abroad, was the center of attraction. He spoke of his discoveries of curves in these churches in a very interesting manner. Save a Bohemian night that was indulged in a short time ago, this was the club's first entertainment.

NEW BOOKS.

Mr. Russell Sturgis has rendered a service to the student of art by forming, in a very handy, compact volume, an annotated bibliography of the subject, [1] to which is added a similar annotated list of works on music. It does not claim to be exhaustive; in fact, many of the works, which are chiefly illustrative, are not included in the list, but it mentions all of the well-known works and has a brief description, with price, etc., for each. It forms a very valuable aid to reference.

"Hydraulic Cement, its Properties, Testing, and Use," is the title of a new work by Frederick P. Spalding, Assistant Professor of Civil Engineering at Cornell University, member of the American Society of Civil Engineers.

The pages contain the results of a careful study of the nature and properties of hydraulic cement, and the various methods which have been proposed, or are in use, for testing cement.

The views of the author, as derived from his own observation of the behavior of cement in use or in the laboratory, have been stated without reserve, and free use has been made of the results of available European investigations. The recommendations of the recent commissions appointed in Europe for the study of the methods of testing materials are fully given in so far as they relate to cement. New York, John Wiley & Sons.

[1] "Annotated Bibliography of Fine Art: Painting, Sculpture, Architecture, Arts of Decoration and Illustration." By Russell Sturgis. "Music." By Henry Edward Krehbiel. Edited by George Iles. Boston, 146 Franklin Street. Published for the American Library Association Publishing Section by The Library Bureau. 1897. Price, 50 cents in paper; $1.00 in cloth.

Color in its Relation to Architecture.

BY ELMER ELLSWORTH GARNSEY.

THE importance of color in its relation to architecture has not been sufficiently recognized or emphasized among those who teach or practise architectural design; and it is difficult to understand why one of the universal sources of esthetic pleasure, one of the most compliant and resourceful aids to artistic expression, should be so neglected in our day.

It is no new thing, for the best architectural tradition exhibits an intense appreciation of and love for color from the Egyptian to the Renaissance periods, and we find it employed both within and without all sorts of buildings, in all sorts of materials, constructive and applied.

The love of color is a natural instinct; the children of civilization no less than the children of nature are sensitive to the brilliant hues of bird and flower, of sky and sea, and they are equally influenced by the gaiety and joyousness of certain colors, and the saddening hues of others.

Civilization and its refinements have given us a higher appreciation of color, as well as other things, and we crave harmony in its use, just as we demand harmony as well as melody and rhythm in music.

So we need not, and indeed ought not to think of architectural color as a violent laying on or building up of masses of crude and glaring hues, but rather as a skillful blending and refining of surfaces to a more harmonious *ensemble*.

Upon the walls of Egyptian temples were emblazoned the triumphs of kings and the every-day occupations of the people; and the Assyrian palaces bore long processions of men and beasts enduringly pictured on vitrified bricks; the Greek temples were made splendid by painted and gilded sculpture; and all of these, even in their decay, are evidences that the ancient architects considered the color of their buildings as the crowning finish of their work, and perfected this, as other details, as far as their abilities permitted.

It cannot be denied that to our modern ideas the lavish use of strong and even very brilliant color on the exterior walls of buildings and statuary seems barbaric and in questionable taste; yet we are not obliged to go farther in this matter than to experiment with small quantities of color, used with that reserve and caution which should characterize ornamentation of any sort.

We need emancipation in our art and architecture, not that each may follow some original and bizarre method of design, but emancipation from a state of mind which prejudices us against any legitimate means of increasing the efficiency of our artistic expression.

We are not to become archæologists, but we may begin by trying our experiments along the lines which have been followed by others before our time, that we may benefit by their experience.

It will be found that the Greeks used color with a fine appreciation of its value as a means of expression, that they employed cold and warm, light and dark colors to express depth and retreating surfaces, or brilliancy and advancing lines and spaces. The grounds of marble friezes were colored, that the figures of men and horses might receive the greatest distinctness and relief; capitals of columns and moldings were emphasized by strong colors, while shafts of columns and large wall surfaces received simpler and broader treatment in quieter colors.

Recent investigations have shown that these master artists employed polychrome decoration in architecture and sculpture much more generally and liberally than a superficial acquaintance with their ruined monuments and buildings would suggest; certainly to a degree absolutely unknown in modern work.

They sought to express the beautiful in all they attempted, and they touched nothing which they did not beautify. We may therefore be assured that polychromy, as practised by the Greeks, cannot fail to have been as carefully considered, and the results of as great value to us, comparatively, as their other accomplishments in architectural design.

Beneath the deep blue sky of Greece, the association of superb marble and glowing polychrome decoration suggests a most inviting mental picture; one which we may hardly expect to realize, with less responsive materials, beneath a gray and smoke-beclouded canopy. We may add greatly to the charm of our architecture, however, by considering more carefully the colors and textures of the materials of which it is constructed, and seek to combine "ideal color with perfect design."

Students of architecture are taught to think in gray, because, the professors say, the "mass and void" may be best studied and expressed in monochrome, and this seems to be sound doctrine. In the same way the young painter studies from casts in charcoal or crayon; but when the latter has mastered the rudiments of his art, drawing from the round, he is no longer held absolutely to a single gamut of grays and black, he begins to paint in color.

Why should not the student of architecture be taught in the same manner? Study the plan and elevation in gray monotone, but do not stop here; let the color of the composition be considered, and make a separate color study for each problem.

Surely if such a system were carefully followed up, we should not see so many "queer-colored" buildings along our city streets, many of which cause us to wonder if they are brick buildings with stone trimmings, or stone buildings with brick enrichment!

There is no dearth of fine materials at hand in America, quarries are giving up their treasures, and great establishments supply all sorts of brick and terra-cotta, varied in form, texture, and color; but there is a lack of taste on some one's part, or our buildings would be more interesting and creditable examples of architecture.

Our manufacturers of building materials deserve high praise for what they have accomplished, and no age has had so much reason to congratulate itself on intelligent labor successfully applied; and if American architecture does not reflect credit on its creators, no blame can be attached to those who supply the materials from which it takes its form.

The manufacturer supplies the demands made upon him; he does not create the demand; and when architects require brick or terra-cotta of a certain quality or color, a host of skilled men stand ready to execute their wishes. Science becomes the magician, and the whole world of nature is transformed into material ready for the artist's hand.

Color, like taste, is not a matter of simple individual preference or fashion; it is good or bad according to its suitability for given purposes or conditions. It is not for us to say this or that color must be the general tone of your building, for the wishes of the client must be considered, the site and its surroundings must affect our choice; but when the indicated material has been decided upon, and its color fixed, we may so combine it with other materials that it may become harmonious, not only as to its surroundings but to the best artistic traditions as well.

How to study color in its relations to architecture is to study the theory of colors and their relations to each other; and no one has made a more careful and complete analysis of these phenomena than the great Chevreul, a man who died, full of years and honors, a few years ago.

His book on color has been translated into English, and may be had in any of our libraries; but no architect or worker in the allied arts should lack a copy in his own studio. His theory of the harmony of the contrast of complementary colors may be considered the foundation of the study of color harmony; and while it is the most intense and powerful of color combinations, it is as well the simplest and widest in application.

Upon the hypothesis that there are three primary colors, red, blue, and yellow, combinations of any two of these producing the secondaries, violet, green, and orange, he arranges a diagram in which two concentric circles, divided into three segments, display the primaries in the inner and the secondaries in the outer circle.

Thus, red is opposite green, blue is opposed to orange, and yellow is opposite violet. These, then, are the complementary colors, and their opposition forces each to exhibit its greatest brilliancy; and when any two complementaries are employed together or in close proximity, they heighten each other to the maximum degree.

A neutral gray, when placed beside a positive color, apparently gains some of the complementary of that color; and the practical application of this simple demonstration is to be found in the employment of small quantities of positive, primary, or secondary color in conjunction with materials which either lack tone, or whose tone should be modified to some extent.

Interior stonework may be forced to assume a warmth which it does not really possess, by placing near it a mass of colder color, compelling it to partake in some degree of the warm complementary which is opposed to the cold color near it.

Corot's landscapes display a knowledge of this principle, where in a silvery gray picture one little brilliant spot of red, possibly vermilion, is introduced in a peasant's cap or gown, and instantly the grays become greener by contrast, and the canvas fairly glistens and sparkles. Hide the spot of vermilion and you rob the entire picture of its life and brilliancy.

Delacroix, and, indeed, all the great colorists, play upon this theme, as a musician upon his keys.— from major to minor, and vice versa. And why should not the architect borrow color as well as harmony from those sister arts which so beautifully translate his own?

The employment of complementary contrasts in architectural work is so eminently valuable that it cannot fail to repay the most timid experiment; for we need great masses of quiet color, for grandeur is only possible through massive constructions; yet in and through the gray we may add the touch of color which shall " leaven the whole."

Puvis de Chavannes plays upon the complementaries in the Boston Public Library decorations, and sometimes the individual colors are separated by quite a space of gray. The rich yellow of the Sienna marble demands violet and blue for its completion as a satisfactory color impression, and the painter has carried out a scheme of this character in a wonderful way.

In one panel the pale blue sky at the top forms one point of a triangle, a dull red robe the second, and the yellow marble the third, while the eye of the beholder fuses these three into one harmonious impression.

As an illustration of this principle, certain stone, as Indiana limestone, acquires a decidedly greenish tone when associated with red brick, and the redder the brick, the greener the stone; but if a yellow brick be used in conjunction with the same stone, the latter becomes more purplish in tone. Again, if a purplish-red brick is employed, the yellow tone of the stone is strengthened in like degree.

Where brick is the only material used, it may be varied to any extent by using small quantities of an opposing tone, the kilns furnishing a wide range of yellows, reds, greens, and browns. In constructive color it will be found that large areas demand comparatively low tones of color, but as the areas decrease in size, the strength and brilliancy of color may be increased.

The same rule applies to interior work in marble, wood, or other materials, and the effect of any material may be enhanced or diminished by the judicious association with it of its complementary, or a stronger note of its own color.

A green bronze would be suggested as enrichment for a red marble like Numidian, but we should probably find a bluish patina preferable with the yellowish-red Verona.

The old brownish-red mahogany may be enriched by association with soft green carpets or hangings, but the lighter and yellower mahogany of to-day finds certain blues more agreeable and exciting companions.

Once the habit of *thinking* in color is formed, we find ourselves solving color problems instinctively; and if the attention of students is directed along this line of thought, their later work will show fewer examples of architectural aberration, for how rare are the entirely satisfactory efforts of our architects and painters.

In interiors of public buildings we find motives and orders which were always rendered in color during the best periods of architecture left in a sickly white, with a few lines of gilding as the only relief from inanity. Fancy St. Mark's or the *Capella Palatina* done in white stucco, with a few hair lines of gold carefully picked out in cornice or capital!

Their glory is in the color which bathes dome, wall, and column in golden light. They possess the tone which most of our buildings lack entirely, and which cannot be acquired by one or two tints ostentatiously covering the stucco with an even and wearisome monotone.

If mosaic was employed more generally in our buildings, we should the sooner achieve distinction therein, for it is one of the most satisfactory wall coverings obtainable. Mosaic is never monotonous; it is durable and fadeless, and, besides, it need not be inordinately expensive. There are two columns in the museum at Naples which are beautifully executed in mosaic, and it might be considered appropriate to thus sheathe the steel columns in our modern constructions, making beautiful and suitable enrichment rather than the usual painted plaster covering.

Referring to the use of applied color, we must consider that, as the greater part of our decorative painting must be executed on the wall, the questions of durability and permanence of color become all-important, and as dampness is probably the deadliest enemy of mural painting, it should be carefully excluded.

There is no preventive which compares with an air space between outer and inner walls: and as this means neither more nor less than ordinary furring of all walls and ceilings, it ought not to be as unusual as it now is to find absolutely dry and damp-proof walls, on which the mural painter may place his compositions.

Vitruvius gives an interesting account of the methods in vogue at Rome for the preparation of stucco wall surfaces for painting. Three coats of old slaked lime and sand were to be laid, and then three more coats with pounded white marble instead of the sand, each of these last more finely powdered than its predecessor, and the final coat to be polished until it reflected as a mirror!

Wax was then rubbed over the wall, and a brazier of coals was passed before it, warming the surface of the wall, and causing it to absorb the melted wax. Pigments, either ground in wax or some sort of mineral spirit were used upon this ground, and finally more wax was applied and absorbed, and the surface brought to a high polish. Many experiments have been made to discover some better or rather easier method of mural painting than the old fresco, which has so many disadvantages that it has been practically abandoned by all modern masters; and a modification of the Roman encaustic or hot wax method has been generally adopted by our most experienced men. The wall is prepared with dissolved wax, applied hot or cold, and the pigments are ground in a vehicle consisting of wax, spirits of turpentine, and either a resinous or balsamic " binder": and as the colors dry quickly, thus permitting the painter to work over or change his composition within a few hours. The method is quite satisfactory for all general work of this character. It is hardly surpassed by the true fresco in brilliancy and not by it in durability, as portraits on wood from the Fayoum and the Pompeian wall paintings attest.

The latter may have been executed in fresco in part, but were usually finished with wax, and it is possible to detect the odor of the wax to this day, on rubbing the surface of the wall with the hand.

In concluding this brief survey of color in its application to architecture, it may not be considered inopportune to refer to the increased interest in mural painting in America, and to prophesy even a greater demand for this form of monumental art among us.

Our painters display, year by year, a higher appreciation of its possibilities, and our architects are giving more attention to its employment, and if the architects could be induced to study color, and the painters to study architecture, we might more confidently predict the triumph of American art.

A

ARCHITECTURAL RENDERING IN PEN AND INK.

BY D. A. GREGG.

HOW the drawing shall be treated as a whole is a question that should be settled before an ink line is drawn upon an outline submitted for rendering. It is considerable of an item to know how to give proper touch or technique to the work, to know a good line or method for doing the ground, sky, windows, walls, roofs; but failure may, after all, occur with all this skill, for want of knowing how to treat the work as a unit.

A rendering must be designed, studied out in a way, not unlike the designing of a building. As an architect often, by the shape of the lot, has the plan of the proposed building settled and fixed, from which he must erect the exterior design, so a draughtsman similarly has before him a perspective outline upon which he must build his scheme of rendering, which scheme of rendering may be called the general design; the technique of his work being, as it were, the detailing.

The design as a whole, in pictorial effect, is of first importance; the detailing secondary, but good quality in each are necessary for final success.

The rendering scheme is a matter of arrangement of values of black and white; and as every subject is unlike every other, only general principles can be given that will be of any practical use. It is useless to advise any special method for doing the various parts of the work, for what is best in this drawing may not do at all for another. Methods must vary, and effects or values must be moved about as the general scheme may demand.

A drawing may permit several good methods, but usually there is a best way for each particular piece of work.

B

All subjects should be treated in the largest possible way, broadly, as simply as possible, few effects, the fewer the better, just one if it will permit.

B illustrates this broad treatment. Viewed at a distance, it is like one dab of a brush upon a sheet of white paper. Just one large dark from end to end, from top to bottom. Compare it with E, where starting on the left is a dark, then follows a light, finishing with another dark, — three values instead of the one in B.

F is perhaps as broadly treated as B, as a large light effect. It would be fully as broadly treated if it were not for the value of the fence and the shadow near it. But this dark value is helpful, which goes to show that there are other things to be considered along with breadth, and no principle, however good, can always be carried out unaffected by other important demands.

This principle of breadth is modified and affected by the color of the material of which the building is made. For instance, a white marble building must appear white. Also to get color and contrast in such a drawing, dark buildings at the side are necessary, which introduce a second or third effect, instead of allowing it to remain as one.

Again, if we put one side of the building in shade, as in D, we have a light front and a dark side, — two values, or three, if we count the dark on the left. If foliage is to be shown, and usually it has a dark value, this will most likely make less simple the scheme of the drawing.

It is rarely, therefore, that a subject for rendering, especially if it be a large one, will allow so simple a treatment as B. For small work it is more often possible.

Nor is it necessary that every drawing should be as one dab of the brush. It should only be our aim to comply with its underlying principle of breadth as nearly as the conditions will permit.

C

A simple treatment is restful. We take it in without mental effort. Large effects are also impressive.

Allied with this broad treatment are certain minor advantages. Illustrators of architecture may assume the right to make their special building as interesting as possible. To make a view of a street is one thing, to make a view of one of the buildings on that street is another.

A may be rightfully called "A View on Steep Hill, Lincoln, Eng." Everything on the street is shown, sidewalks and the ground with its shadows.

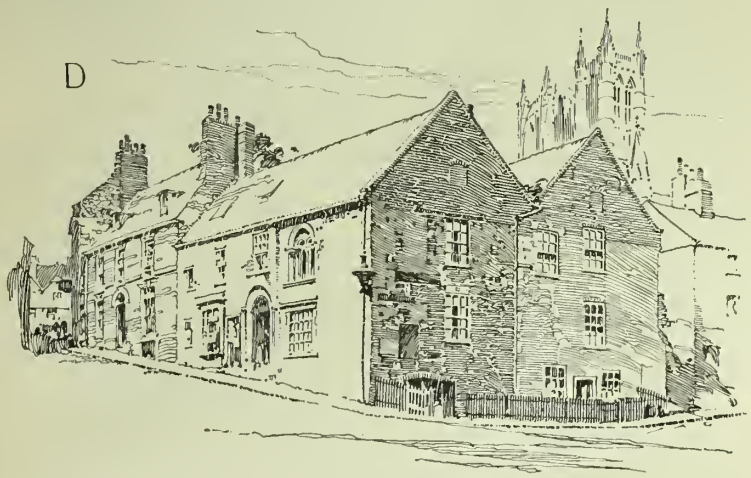
B should have another title. "Old Houses on Steep Hill, Lincoln, Eng." In this one you are bound to look at the houses, for that is all there is to be seen, except the distant towers of the Cathedral. By thus omitting needless accessory the interest is centered in the principal object. In A you cannot but observe that the houses are slightly less attractive, because of the detracting interest of even the small amount of sidewalk and ground with its shadows.

Such a wholesale cutting off of accessory is, of course, not always best. In many instances the trees, terraces, and adjoining buildings add to the interest of the picture, in giving variety of form and contrast of color, and if they be rendered with a little less strength than the principal object the effect will be altogether helpful.

There are accessories important, and accessories not important, and this latter kind are best omitted.

Another advantage associated with the simple treatment in B is one of black and white values. The white sky and ground produce a lively, snappy contrast with the dark of the buildings. The rendering of the buildings, having no competition in sky or ground, show off to their best advantage and fullest value.

D



The simplest thing to do, and it is sometimes the best, and surely always the easiest, is to omit texture entirely, and show shadows only, as in F. The only rendering here that is not a direct shadow is in the windows, but that is, after all, a shadow inside the building on the walls of a room. The necessary drawing of the fence has also the effect or value of a shadow.

This method of shadows only suits some subjects far better than it does this one, in which there is so little of projection or recess that can produce a shadow. Occasionally a building comes in hand for rendering that brings into itself so much color by shadow that more rendering in the way of showing texture or material is quite unnecessary. But it is rarely the case that texture can be altogether omitted. A little, at least, must be shown to properly tell the story.

F with texture omitted perhaps should be called a sketch only. It certainly could hardly be considered a thoroughly finished drawing. But sketches are sometimes as desirable as anything more thorough.

B shows a combined use of shadows and material color — mainly the latter. It is nearly an example of color of material only.

There is a danger connected with the making of a drawing like B which can be dodged somewhat by treating it as in C. The danger is, especially in larger work, of getting a heavy monotonous result through having too much rendering unbroken by fields of light. To show the roof white at once introduces light into the work. In the present instance it seems like using violence to do it, as the rough texture of the roof never would in sunlight permit a white reflection; but in many other instances where the roof is slated or shingled this white reflection is as often seen as not.

E

If you will observe on a sunny day the roofs of buildings and compare their color value with the blue sky, it may be surprising to observe that usually the roof appears the lighter of the two.

At another time of day, with the sun shining upon the roof at another angle, that same roof will appear almost black.

Another scheme which can easily be understood without illustration would be the reverse of C, the roofs dark and walls light, which is a very possible effect when the sun is low, reflecting from the walls, and not from the roofs.

In either case the rendering is simplified — a smaller field of half tone and a larger amount of light. The larger the amount of solid rendering, the more difficult becomes the work.

A drawing must not appear dull and heavy. A sunny, sparkling result should always be sought for.

When the area of rendering is large and close, so much the more need of a sweeping omission of accessory, that the white of sky and ground may relieve the monotony of gray or half tone. Therefore, scheme C or its reverse is a safer one, so far as values go, than B, because of less amount of half tone.

D is simply putting one side of the building in shade. It is not usually best to do this when the shade side is so conspicuously large. If we stood facing the front with a small, sharply vanishing side showing, such a scheme would be the most natural one. As a matter of values it is all right in this instance. But in the rendering of a building where both sides are equally valuable in design both sides should be about equally lighted. A sunlighted surface is always more interesting than one in shade.

E has about as much light in its make-up as D, but it is disposed in a different way. Both sides of the building are supposed to be in light, but the larger and clearest area of light is placed in the middle of the building. It is a possible natural effect, though a rare one. Such a treatment is not the one a camera would discover very

F

often, but it might occur when the sunlight happened to get right of way through a rift in the clouds or the smoke of chimneys. Anyway, it is a method capable of beautiful, artistic effect, and is very often the best one to adopt.

Attention has thus been briefly called to the different treatments which this one subject could bear, which suggestions may be found useful to some of the readers of The Brickbuilder, in work that may come under their hand. They are all based on possible natural effects of light, and shade, and color.

It should be clearly understood that all successful pictorial work is so because it appears natural. The architectural rendering that is the most like to a possible natural appearance is the best one. As all moral teachings can be tested by the standard of the Good Book, so all artistic attempts may be tried by their harmony or lack of it with nature's work in shade, shadow, and color, and correct form.

There need be no poverty in expression with such a varied and abundant store to draw from.

It is best not to heed too much what another learner has to say about these things, and so get them second hand, but go to the original source and learn for one's self. Nevertheless, hints like these I have given may do no harm if their worth is tested by thoughtful experiment.

Fire-proofing Department.

ORIGIN AND HISTORY OF HOLLOW TILE FIRE-PROOF FLOOR CONSTRUCTION.

BY PETER B. WIGHT.

(Continued.)

[In the April issue of THE BRICKBUILDER the last illustration, marked Fig. 17, was used by mistake, and will appear in the present number in its proper place as Fig. 19. The illustration of the first hollow-tile floor arch made by the Wight Fire-proofing Company, and used in the Montauk Block, Chicago, should be Fig. 17, and is here given.]

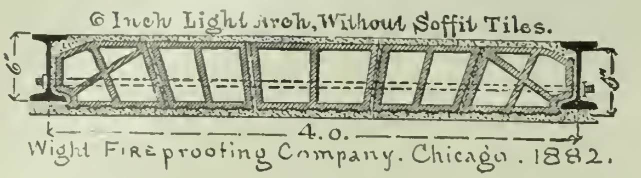


FIG. 17.

THE FIRST USE OF SOFFIT TILES FOR BEAM PROTECTION.

IT is necessary now to retrace our steps over a short space of time to the introduction of a feature which made the flat arch a complete fulfilment of the demand for a continuous fire-proof ceiling and protection for the iron beams as well as a support for the floor, independent of any construction over the beams. Up to 1884, all the flat arches that had been built were practically in the Roux system, and varied from it only in matters of detail. The beams had no protection to the bottom flanges except a plate of cement or common mortar not more than three quarters of an inch thick, gaining support from the slightly dovetailed form of the skew-back tiles. After they were plastered over, in course of time, whether the ceilings were painted or not, the location of the beams could be seen by streaks on the ceilings, and this was especially the case in locations where bituminous coal was used. In 1883, I conceived the idea that the beams could be covered with a shoe of tile on the bottom before setting the arches, and that this shoe could be held temporarily in place by giving the upper side the form of a female dovetail, and filling the joint between the beam and tile with mortar. The whole thing would thus form an extension to the bottom flange of the beam, and the skew-back tile could be made of such form as to surround its edges so that the bottom of the arch would be flush with the bottom of the shoe tile. I patented this invention in 1883, showing its connection with a 9 in. flat webbed arch, an illustration of which is here given (Fig. 18) showing its connection with a 12 in. arch.

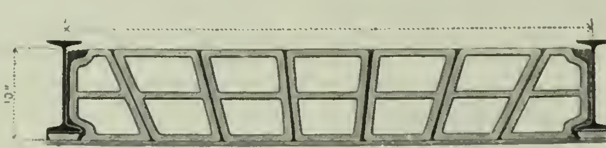
FIG. 18.

These soffit tiles were first used in the main building of the Mutual Life Insurance Company, of New York, on Nassau Street, and that is the first time I believe they were ever used in any building. From then to the close of operations of the Wight Fire-proofing Company, in 1891, they were used with every floor arch built by that company, with only one exception. The holder of the Johnson and Kreischer patent, above described (Fig. 13), brought suit against the Mutual Life Insurance Company for infringement of patent. The judgment was given in his favor except in so far as the use of mortar was concerned, his patent having claimed that the strip was "removable," and not specifying the use of mortar to hold it firmly. It was shown that such a tile had never been actually used in floor construction, in fact, was impracticable under the former patent: consequently the court refused to award damages. I have, therefore, only the satisfaction of knowing that I demonstrated what is practicable in it and have given it to the world. The same plaintiff had previously brought suit against Henry Maurer for infringement of the Balthazar Kreischer patent (Fig. 14), but a verdict was given for the defendant, the main references being the Garcin and Roux patents. In practise it was soon found that it was not necessary to cement the soffit tiles to the beams, but that they could be held in place by the centering until the skew-backs were set in place, and that the bedding of the skew-back filled not only the joint between itself and the soffit tile, but also the joint between the soffit tile and the beam. In places where the arches are removed it is found that the soffit tiles adhere to the beams.

The work on the Mutual Insurance Building was hardly done when others began to use a similar tile under the beam. The first instance that I know of was in the Stillman Apartment House at Cleveland, Ohio, built in 1884–85. There, as in all other cases of work done by imitators, the cheaper method of putting a tile under the beam only the width of its bottom flange was used (Fig. 19.) Here it will be seen that the support from the skew-back is only half as great as where the soffit tile is also dovetailed at the top. The only variation I ever made from this method was in the case of the Phœnix (now Western Union) Building, Chicago, where the bottoms of the arches were 3 ins. below the beams; and the soffit tiles were made as complete hollow tiles. The arches were 10 ins., having 7 ins. rise above the bottoms of the beams. The flat soffit tile, with a slight recess on the top to afford an air space, is still generally employed by all contractors for beam protection, with various kinds of arches. Some other methods were tried, but have gone out of use. Henry Maurer, of New York, still makes a skew-back with an arm extending half way across the bottom of the beam, having a small hollow space. Fig. 20 shows the ordinary method of protecting the bottoms of the beams as used by the Pioneer Fire-proof Construction Company, of Chicago, when side pressure hard tiles are employed. The arch tiles are 10 ins. deep.

Ordinary Method of covering beams.

FIG. 19.



10-inch Web Tile Floor Arch Weight, 40 pounds per square foot.

FIG. 20.

INTRODUCTION OF THE END PRESSURE SYSTEM.

It was not until 1890 that any advance had been made in the construction of hollow-tile floor arches over the methods used in New York, of which Maurer's was a good example, and those of the Wight Fire-proofing Company and Pioneer Fire-proof Construction Company, of Chicago. A great deal of work had been done by others which resembled these methods, and side-pressure porous tile arches had been made and used in several buildings in Kansas City as well as Chicago. Those used in Chicago were made of a light brick clay from Lake Calumet, with an admixture of a small quantity of fire-clay from Brazil, Ind. The Kansas City material was made of the very inferior loamy red clay of which the hills of that city are composed, and was about the worst material from which porous terra-cotta could be made, both for constructive and fire-resisting purposes. Its use also involved the manufacturers in great loss from breakage in the course of handling and setting. Mr. Thomas A. Lee was then the superintendent and engineer of the Kansas City Company. When he obtained the contract for fire-proofing the United States Government Building at Denver, he determined to use a white semi-fire-clay from Hobart, Ind., not far from Chicago, for the manufacture of his porous terra-cotta, this having been used successfully for side-pressure floor arch blocks at Chicago in the Metropole Hotel. But instead of using side-pressure voussoirs, he made all the tiles from one die, the section being a square of 9 by 9 ins. with cross webs in both directions. The tiles had four square holes, and the thickness of all the walls and webs was about 1 in. These were cut, before drying and burning, into skew-backs and voussoirs, and were set in courses from beam to beam, so that no joints were broken; but in all cases four joints would come together at one point. These, I believe, were the first end-pressure arches ever set in a building, and the same method, but with tiles of a different cross section, was used by him in the Broadway Theater Building at Denver. I have always thought, though I am not certain, that Mr. Lee determined to set his porous tile arches in this way at Denver on account of the difficulties that he encountered with the use of inferior porous terra-cotta at Kansas City. In any case, I think that he is entitled to the credit of having first used end-pressure arches successfully in an entire building. But the Kansas City Company had been working under patents of the International Terra-Cotta Lumber Company, which had already experimented with arches made by taking a long piece of rectangular porous terra-cotta, cutting it into voussoirs and setting them together in a flat arch.

The principle of the end-pressure arch had, however, been patented long before this. In addition to the use of end-pressure tiles for segment arches, as heretofore described as invented by Joseph Bunnett in 1858, a patent was issued in this country to Leonard F. Beckwith, of New York, for an end-pressure flat hollow arch in two pieces, in 1879.

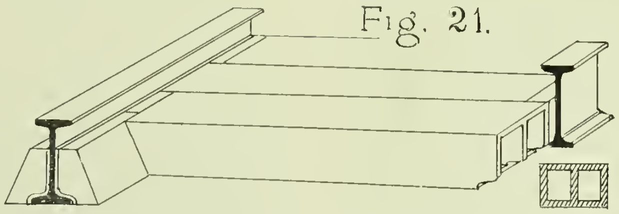
I reproduce an illustration of this system from the *Patent Office Gazette* (Fig. 21).

Mr. Beckwith made his arch in two pieces, using one long hollow tile and one solid skew-back. The end of the hollow tile resting on the beam was cut to fit it, and the other end was beveled to fit the skew-back, which also had the shape of the beam on its bearing side. He alternated the position of the skew-back at every other course, but each course was an independent structure as now used in all end-pressure arches.

I have never seen these arches put into practical use. This was not even the earliest patent touching the principle of the end-pressure arch. In 1875, a patent was issued to Levi T. Scofield, of Cleveland, O., for hollow floor arch tiles between I beams all in one piece. They were shown to be either flat or in segment form, and of many different sections, but in all, the holes ran from beam to beam.

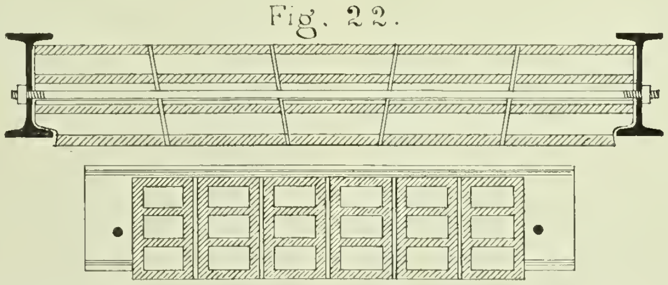
On account of the difficulty in burning long tiles this system was never used to any extent for floors, but where ⊥ irons were used not more than two feet from centers, a similar tile came in use, which was called "book tile," on account of its having the outer section of a book, so as to lock the tiles together. Mr. Scofield's patent did not cover the tongue and groove shape at the edges, and book tiles were never patented, but were extensively used long before end-pressure arches made of voussoirs.

Fig. 21.



L. F Beckwith's Patent End Pressure Arch. 1879

Fig. 22.



Cross and Longitudinal Sections of Thomas A. Lee's End Pressure Porous Terra-Cotta Arch, Tested at Denver, December 1890.

THE DENVER TESTS.

The general adoption of end-pressure arches is very recent, and followed soon after the extensive tests made by Andrews, Jaques & Rantoul, architects, before the erection of the Equitable Building at Denver. These tests have been described and commented upon in THE BRICKBUILDER (January and February, 1895,) by Mr. George Hill. They were suggested by Mr. Thomas A. Lee, who had bid for the fire-proof work on the building in competition with the two best-known fire-proofing companies of Chicago, and was the highest bidder. His tender was for porous terra-cotta floor arches, and his samples were made at Hobart, Ind., where, I believe, most of the material for the building was subsequently manufactured. He challenged the other two bidders, both of whom made side-pressure arches of dense fire-clay for strength of material, and fire-proof qualities. A section of his sample arch which was subjected to all the tests is here given (Fig. 22).

The tests for strength on all the arches were for dead weight and smashing. Those for fire resistance were for a continuous fire until destroyed, and for fire alternating with water until destroyed. It is needless to say that these were crucial tests, and it should be added that they were conducted with perfect fairness to all parties. They demonstrated the superiority of Mr. Lee's material and construction to the others in every case, and yet the published results were calculated to be very misleading to architects and the users of hollow tile floor construction who did not study the reports carefully. I entirely agree with the criticisms of Mr. Hill. But it should be added that the publication of such tests without comments, especially when they were tests to the point of destruction in all cases, is calculated to convey the erroneous impression that the two systems most easily destroyed were worthless, and the survivor the only good one. As a matter of fact, the only tests that demonstrated anything useful were the still-load tests for strength and the heat tests during the first three hours. In the still-load test the arch of the Wight Fire-proofing Company broke at exactly 1,000 lbs. per superficial foot, adding the weight of sand and box to that of the pig iron, while the report was so drawn as to imply that the weight was only from the pig iron. This is exactly the extreme weight they were guaranteed to carry, and to which they had been repeatedly tested in floors of buildings. The Pioneer Arch broke at 651 lbs. per superficial foot, but it was admitted that the sample was defective and not up to the standard of their work. So, also, with the heat tests. That for continuous fire lasted twenty-four hours in each case, and there was no way of making a record of the condition of the samples after three hours, which is about as long as they would ever have to last in any building. As for smashing tests, all kinds of material are continuously being tested by falling bodies in new buildings, and it is well known how they are affected.

The tests demonstrated that porous tiles were more fire-proof than hollow tiles, and that end-pressure arches are stronger under the same conditions than side-pressure arches, but did not demonstrate that hollow fire-clay tiles would not stop the progress of an actual fire, nor that side-pressure arches, as usually made, were not strong enough for practical use in all classes of floors.

(*To be continued.*)

Mortar and Concrete.

AMERICAN CEMENT.

BY URIAH CUMMINGS.

CHAPTER VII.—(*Continued.*)

CEMENT TESTING.

HENRY REID, in his work on "Portland Cement," London, 1877, page 315, says: "The presence of free lime thus unconverted is now frequently due to an over-dose of carbonate of lime in the cement mixture to enable it to pass successfully the modern onerous tests."

From that time until to-day the demand for higher tests has been continuous and more burdensome, and the manufacturer has not scrupled to employ any and every means within his power to accomplish the required results. He has to do it or retire from the field.

And thus, by an unfortunate misinterpretation of the readings of the tensile strain-testing machine, in the early days of its existence, the opinions then formed have passed current as sound and unquestioned through all the subsequent years.

So strong and deep seated is the belief to-day in the reliability of the testing machine, that a person who cares to be considered as "up to date" must express no doubt as to its infallibility.

An ideal hydraulic cement, as already stated, can be produced by what is known as the Portland process.

It would consist in a selection of the raw materials which were found to be best adapted for the purpose (special care being taken, at least, as to the quality of the clay), and these to be thoroughly and finely commingled in correct proportions, then calcined to a mild clinker, sufficiently vitrified to produce the desired weight, and then ground exceedingly fine.

Such a cement would test only about half as high as the present so-called Portlands, yet it would be an ideal cement.

It could not be excelled, and could be equaled only by a rock cement having its constituent parts present in exact chemical proportions.

It is only through the engineer that any improvement may be expected. He alone is entitled to the doubtful distinction of bringing about the change from the slow-setting pasty Portlands of twenty-five or thirty years ago to the harsh, high short-time testing Portlands of to-day.

It is neither pertinent nor sound to reason that, because the Portlands used twenty-five or more years ago may be in good condition to-day, the Portlands of the present are worthy of the utmost confidence, for every person at all conversant with the facts knows that those earlier Portland cements tested but about half as high in one, seven, thirty, and ninety day tests as do the Portlands now on the market.

If an artificial cement of a pasty consistency should test 80 lbs. in one day, and 175 lbs. at seven days, 300 lbs. at six months, 600 lbs. at one year, 1,000 lbs. at two years, and 1,200 lbs. at five years, and should be found at that age to be tough and stone-like in its character, can any one for a moment doubt that such a cement would be infinitely superior to the harsh, high short-time testing cements of to-day?

Is it not worth while to reflect that for every one year that harsh cements have been in use, those of a pasty character have been in use fifty years?

Is it difficult to understand that it is only the pasty cements that eventually assume a stone-like character, while those that are harsh inevitably become glassy?

It is well known to every manufacturer that the latter class is much more expensive to produce, but the manufacturer has no alternative. He must produce such grades of cement as the engineers demand.

It is to the engineers, therefore, as has already been stated, that any improvement may be looked for, and the only improvement needed, with respect to artificial cements, is to get back to the sensible Portlands of thirty years ago.

Let the engineer stipulate that cements shall not test below or above certain fixed limits, and there will be an end to this doctoring and drugging of the artificial cements, which is resorted to simply and solely for the purpose of meeting arbitrary and unreasonable requirements.

The following table of tests of English Portland Cements by Reginald Empson Middleton, M. Inst. C. E., was printed in *Engineer*, London, Vol. 65, p. 279, April 6, 1888.

The figures given represent the average strength in pounds per square inch, in tensile strain, and the ages in days of the briquettes when broken.

No.	Days.	Pounds.	Days.	Pounds.	Days.	Pounds.	Per cent. of Loss or Gain.	
1	7	258	942	440	1325	550	Gain.	113.
2	7	320	900	635	1283	577	Gain.	75.
3	7	371	982	560	1365	599	Gain.	61.
4	7	419	1040	435	1423	492	Gain.	18.
5	7	479	1088	542	1471	551	Gain.	15.
6	7	534	858	545	1241	526	Loss.	1.5

This table discloses the fact that artificial cements which at seven days test from 250 to 350 lbs. show higher ultimate results than those which at seven days test 400 to 600 lbs.

The following quotation from the "Transactions of the German Association of Cement Makers" discloses either a deplorable lack of common honesty or a desperate attempt at fulfilling the severe requirements of engineers. "In order to obtain the best results (?) the amount of plaster of Paris used must be proportionately increased in accordance with the quantity of ground slag employed." Presuming it to be a case of necessity rather than a lack of common honesty, what a commentary on the straits to which the producers are reduced to meet the requirements of engineers, knowing, as all manufacturers do know, that plaster of Paris is in no sense hydraulic, although it tests neat as high as 250 lbs. per square inch in tensile strain in twenty-four hours.

The time must surely come when it will be well understood that any and all schemes of hot-house forcing, for the purpose of obtaining high seven-day tests, constitute an unnatural interference with the crystallization of true silicates, and are therefore a serious damage to their most desirable qualities of endurance.

Verily it is the pace that kills, and even when applied to hydraulic cements, there is, if we may be permitted to employ it, no truer saying than "Soon ripe, soon rotten."

For hydraulic purposes there is no known substance that can in any way aid or improve the quality of pure unadulterated hydraulic silicates, when left to crystallize in their own natural way.

THE BOILING TEST.

During the past few years it has become quite the fashion to boil samples of cement in order to test their qualities.

If one brand sustains the test without serious results it is considered superior to others which fail down during the boiling. This is about as wise and logical a conclusion as that arrived at by some of our good old Puritan fathers during the witchcraft craze.

The witch, being thrown into a pond, if she went to the bottom and stayed there, was considered innocent. But if she managed to float, she was deemed to be possessed of the devil, and was then forced to the bottom on general principles.

By the boiling test, many of our very best brands of cement are condemned.

It is safe to assert that of the more than one hundred and fifty million barrels of American Rock cements used in all the great engineering works throughout the country during the past fifty years, and with no evidences of failure, not 1 per cent. would have sustained the boiling test.

A cement, whether natural or artificial, that will crystallize so rapidly as to sustain the boiling test, ought to be looked upon with suspicion, as it is either naturally too quick setting, or is too fresh and lacking in proper seasoning.

FREEZING TEST.

The many experiments that have been made by different authorities in the freezing of green cement samples would seem to indicate that Portland cement mortar will sustain severe freezing without appreciable disturbance of the exposed surfaces, but it suffers in loss of strength in some cases as much as 50 per cent.

While the Rock cement mortars will show disintegration to the extent of ¼ to ½ in. on the exposed surfaces, yet the portions not disintegrated are shown to have sustained no loss in strength, and in some instances the strength is above the normal.

A series of tests made by the author, the results of which are herewith tabulated, differ somewhat from those of other writers, resulting, no doubt, from having experimented with different brands of cement.

All of the briquettes were given one day in air and six days in water, those in the second column being placed in water and set outside, where they were soon frozen, and so remained in solid ice, until thawed out and broken at the end of the seventh day.

All of the briquettes represented in the second column, after being thawed out, were shown to have lost equally in area, by scale and disintegration to the depth of ⅛ in. on all sides.

There was no appreciable difference in the losses, the Portlands having suffered equally, in that respect, with the Rock cements.

The figures in the second column show the actual breaking strain of the frozen briquettes, but it will be borne in mind that the areas of these briquettes were greatly lessened by freezing; therefore the percentage of loss in strength, as shown in the third column, represents the loss without regard to actual areas.

The fourth column represents the strength of the samples in the second column when calculated at 1 full square inch, or equal in area to the samples in the first column.

The fifth column represents gain or loss in strength of the frozen samples, with equal areas of the unfrozen ones.

All of the briquettes were gauged neat by the same person, and were treated alike as to plasticity and temperature.

TABLE OF TESTS OF THE RELATIVE STRENGTH OF FROZEN AND UNFROZEN SAMPLES OF THE SAME CEMENT.

No. of Column.	1	2	3	4	5	
Kinds of Cement.	Not Frozen.	Frozen.	Per cent. of loss by freezing.	Per square inch of the frozen samples.	Per cent. of loss or gain by freezing, of equal areas.	
Medium Burned Rock Cement.	138	135	2.17	194	Gain.	40
Hard Burned Rock Cement.	226	225	0.44	323	Gain.	43
Slow Setting Portland.	388	280	27.83	402	Gain.	04
Medium Setting Portland.	419	292	30.31	419	Gain.	00
Quick Setting Portland.	433	255	41.11	366	Loss.	15

There is a surprising gain in strength of the Rock cements by freezing.

With the Portlands, the slow and medium setting samples held their own, while the higher testing Portland, under ordinary rules, lost 15 per cent. in strength of equal areas by freezing.

It is not good practise to use any kind of cement in cold weather, especially when it freezes during the night and thaws during the day, and should be avoided whenever possible.

NOTE.— Mr. Cummings's series on American Cements will be concluded in the July number of THE BRICKBUILDER.

LIME, HYDRAULIC CEMENT, MORTAR, AND CONCRETE. III.

BY CLIFFORD RICHARDSON.

LIME MORTAR.

MORTAR is a mixture of some cementing material with sand. Lime mortar is composed of lime paste and sand, with the addition, for certain parts of plastering, of hair and similar bonding material.

NECESSITY OF SAND IN MORTAR. — Good cream of lime might be used alone as cement, as it hardens on exposure to the air by drying, were it not that, under these conditions, it shrinks and cracks very badly. It is, therefore, customary, both on this account and for economy, to temper it with sand. This should be clean, sharp, and rather coarse for masonry, finer for plastering. When discussing hydraulic mortars and concretes there will be occasion for a further consideration of sand and its qualities and proper use.

PROPORTION OF SAND TO LIME. — A mortar made of lime paste should, theoretically, contain so much sand that the cream of lime will more than fill the voids, that is to say, the volume of the mortar should be greater than that of the sand. In fact it is necessary that it should considerably more than fill them in order to thoroughly coat each particle and provide for shrinkage. If too much sand is present there is not sufficient cementing material to make a firm bond, while on the other hand, if there is too little the mortar will tend to shrink and crack on drying. If too little lime is used the deficiency must be made up with water, that is to say, the paste is made very thin.

In ordinary sands the voids are from 30 to 40 per cent. of the volume of the sand. With sand, having 40 per cent., such as that which is used for the best lime mortar, 1 volume of paste would fill the voids in 2.5 volumes of sand with no excess. As a matter of fact, practice leads to the addition of only from 1.25 to 2 volumes of sand to 1 of paste which, when the caustic lime yields 2.5 volumes of paste, means 3 to 5 volumes of sand to 1 measured volume of caustic lime. In this way a plastic mortar and one that will not crack in drying is made. With fat lime and sharp sand 3 volumes of sand to 1 of lime forms a rich mortar and these proportions are often required in the best specifications. The greater part of the mortar used in ordinary brickwork is, however, made with 5 volumes of sand, or more, and is probably satisfactory.

Illustrating the results of the variation in the proportions of lime, water, and sand in mortars, the following original experiments have been made: —

MORTAR EXPERIMENTS.

Composition and Physical Properties of the Caustic Lime.

Loss on ignition, water, etc.	1.0
Insoluble silica and silicates	1.2
Alumina and iron oxide	.8
Magnesia	.6
Lime	95.6
	99.2
Volume weight of a cubic foot including voids	60 lbs.
Voids	44%
Density of lump	1.52

No. of Experiment.	1	2	3	4	5
Weight of lime used	1,000	1,000	1,000	1,000	1,000
Weight of water to slake	1,000	2,000	2,500	3,000	4,000
Weight of water for paste	1,000	500	none	none	none
Volume of water to one of lime	2.	2.5	2.5	3.	4.
Volume of paste	2,000	2,560	2,712	3,120	4,120
Weight of paste	2,720	3,280	3,392	3,880	4,850
Density of paste	1.36	1.28	1.25	1.24	1.17
Characteristics of Paste	Thick	Thick	Medium	Thin	Very thin
Volume of sand, moist	2,000	3,000	5,000	7,100	14,360
Weight of sand	3,000	4,500	7,500	10,080	20,600
Volume of sand to lime	2.	3.	5.	7.1	14.4
Volume of sand to paste	1.	1.2	1.8	2 6	3 5
Volume of mortar	3,320	4,400	5,840	7,200	13,500
Weight of mortar	5,740	7,760	10,650	13,960	25,450
Density of mortar	1.73	1.75	1.82	1.94	1.88
Consistency of mortar	Thick	Medium	Medium	Sloppy	Very sloppy
Dries	Cracks	Dries	without shrinking.		

PERCENTAGE COMPOSITION.

Water	30.0	29.3	22.5	20.7	15.1
Sand	52.6	67.9	68.1	72.2	82.0
Lime	17.4	12.8	9.4	7.1	3.9
	100 0	100.0	100.0	100.0	100.0
Relation of water to lime	1.7	2.3	2 4	2.9	3.9

COMPOSITION OF DRY MORTARS.

No. of experiment.	1	2	3	4	5
Water of hydration	7.4	4.8	3.7	2.8	1.5
Sand	70.0	81.1	84.6	88.5	95.0
Lime	22.6	15.1	11.7	8.7	4.5
Weight per cubic foot dry, lbs.	98.	99.	101.	108.	111.
Tensile strength, lbs. per sq. in. when dry	40–16.	36.	38.	40.	30.
Crushing strength, lbs. per sq. in. when dry	95			97	85

The experiments, it will be noticed, were carried out with a pure and fat lime. The sand in use was not very coarse, and had 40 per cent. of voids. From the results the following conclusions may be drawn: —

SLAKING. — Slaking with a volume of water equal to the measured volume of the lime, with 44 per cent. of voids, or with a weight of water equal to the weight of the lime, gives a volume of paste, after the addition of another volume of water, equal to that of the water used, only. This paste is very thick.

Slaking with two volumes of water, with the addition of half a volume, after slaking is finished, making 2.5 volumes of water in the paste, gives 2.56 volumes of paste which is thick and rich.

Slaking with 2.5 volumes of water added all at once gives 2.71 volumes of thick paste suitable for good mortar.

Slaking with 3. volumes of water added at once gives 3.12 volumes *of* thin paste.

Slaking with 4. volumes in the same way yields 4.12 volumes which is too thin to be of value.

It appears, then, that slaking with 2.5 volumes of water added at once is the most advantageous method of procedure, and that but a small departure from these proportions on either side will result in forming a less satisfactory paste.

Of course with poorer limes much smaller volumes of water should be used.

DENSITY. — The density of the paste naturally decreases with the increase of water it contains.

VOLUME OF SAND FOR MORTAR. — If but twice the volume of the lime is added to the paste in the form of sand, the resulting mortar is too rich. It contracts and cracks on drying. Three volumes of sand make a very rich and satisfactory mortar such as should be used for laying up fronts and pointing. Five volumes form a mortar good enough for ordinary brick masonry where not exposed to moisture, while greater amounts of sand furnish mortars which are very porous, but serve for cheap work in absolutely dry situations.

DENSITY OF THE MORTARS. — The density of these mortars is, of course, proportionate to the amount of sand they contain. Their porosity is larger the more water the paste contains.

VOLUME OF MORTARS. — With a small amount of sand the volume of the mortar is, where twice the volume of the lime is sand, 66 per cent. more than the volume of the sand; where the volumes of the sand is three times the lime, 46 per cent. more; where 5 volumes, 17 per cent.: with 7 volumes the mortar is less in volume than that of the damp sand owing to its closer compaction.

The amount of water in the paste plays a prominent part in the relation of the volume of mortar to the volume of sand and to the amount of sand which can be added to any paste.

COMPOSITION OF WET MORTARS. — Calculation shows that these varied mortars contain from 30 to 15 per cent. by weight of water or from 17 to 3.9 per cent. of lime, but the relation of water to lime increases with diminution of the amount of lime, that is to say, with the increase of sand, from 1.7 in the richest mortar to 3.9 times as much water as lime in the poorest mortar with the thinnest cream. These figures show why the richest mortar contracts the most on drying from loss of the largest amount of water, and that the poorest mortars, although not having as large a per cent. by weight of water still have not enough lime to form proper cement.

COMPOSITION OF DRY MORTAR. — The dry mortars contain from 22.6 to 4.5 per cent. of lime, but as the two extremes of combination would never be used in practice, it appears that mortars as ordinarily mixed may contain from 15 to 8 per cent. of lime. This corresponds to the results obtained by analysis of many mortars actually employed in masonry.

STRENGTH OF DRY MORTAR. — The set of mortars acquired by simply drying out gives them a tensile strength of from thirty to forty pounds per section of 1 sq. in., and a crushing strength of about 85 to 95 in 2 in. sq. section. There is not such a difference between the different kinds of mortars at this stage, but with age there would be but little increase in strength with the poorer ones. The physical properties of the latter are also against them as they cannot resist moisture.

Professor Smith's tests, given in the January number of THE BRICKBUILDER, show also that with a diminution in the cross section of the mortar there is an increase in the strength per square inch of section. This is due to the liability of shrinkage cracks in tests pieces made with larger cross sections.

GENERAL CONCLUSIONS. — It appears that fat limes should be slaked with 2.5 volumes of water, added at once in a closed box, to obtain the best and largest amount of good paste; that with this, three times the volume of the lime in the shape of moist sand may be mixed for fine work, such as pointing, plastering, and in places exposed to dampness, and that 5 volumes of sand is not too much for ordinary brickwork.

The amount of mortar which a barrel of lime, of average weight, under the same conditions as in the experiments, would yield is,

Parts sand	Parts water	Cubic feet.
3	2.5	16.5
4	2.5	20.6
5	2.5	24.8

or, 4 cu. ft. of lime with 2.5 parts water, and 4 volumes of sand would yield 22 cu. ft. of mortar, which, according to authorities, is sufficient to lay one thousand brick in ordinary brickwork with coarsely drawn joints. With more compact work one barrel of lime will lay one thousand bricks. A barrel of poor or magnesian lime will not yield more than three quarters of these quantities.

AMENDMENTS TO LIME MORTAR.

Lime mortar, made of ordinary rich lime, is not suited for masonry where it is exposed to water, dampness, or to the absorption of water by capillarity from the soil. The hardest lime mortar will absorb 15 to 25 per cent. of its volume of water. If hydraulic cement cannot be substituted for it, on the score of economy, a certain degree of improvement may be made in the mortar by mixing it with finely ground brick-dust or burnt clay, which yield the necessary silica to make it somewhat hydraulic and less porous; or a certain portion of the lime, one third, for instance, may be replaced by hydraulic cement.

This is seldom done, as it is cheaper in the end to use cement alone.

EFFECT OF FROST ON LIME MORTAR. — The most thorough experiments of Tetmaier show that lime mortar cannot be used at temperatures below freezing, especially with porous materials, and attain any bond. No additions, such as salt, soda, glycerine, or sugar will prevent lime mortar, when frozen for any length of time, from becoming a friable material.

MIXING MORTAR.

Mortar can be mixed by hand or machinery. The latter is of course preferable. When done by hand, as is the common custom, the operation should be carried on in a closed box, or on a surface through which water cannot escape, and with suitable walls of sand. Machine mixing is much more thorough than that done by hand, and is coming into vogue rapidly in our larger cities where there is such a use of mortar as to make it an economy to prepare it on a large scale. Such mortar is more regular in composition than hand made. All the material can be accurately gauged and weighed, which is most desirable.

SETTING OF LIME MORTAR.

The setting of lime mortar is the result of three distinct processes which, however, may all go on more or less simultaneously. First, it dries out and becomes firm. Second, during this operation, the calcic hydrate, which is in solution in the water of which the mortar is made, crystallizes and binds the mass together. Hydrate of lime is soluble in 831 parts of water at 78 degs. F.; in 759 parts at 32 degs., and in 1136 parts at 140 degs. Third, as the per cent. of water in the mortar is reduced and reaches 5 per cent., carbonic acid begins to be absorbed from the atmosphere. If the mortar contains more than 5 per cent. this absorption does not go on. While the mortar contains as much as 0.7 per cent. the absorption continues. The resulting carbonate probably unites with the hydrate of lime to form a subcarbonate, which causes the mortar to attain a harder set, and this may finally be converted to carbonate. The mere drying out of mortar, our tests have shown, is sufficient to enable it to resist the pressure of masonry, while the further setting furnishes the necessary bond.

There is also supposed to be a formation of lime silicate in the course of setting. The evidence in favor of this has been obtained by German investigators from the analyses of very old mortars. Some of these analyses have been collected by Feichtinger, and are of interest.

	1	2	3	4	5	6	7
Lime	23.52	17.40	18.26	45.70	13.27	22.02	14.42
Magnesia . .	8.50	9.92	5.06	1.00	0.86	1.33	0.04
Carbonic Acid .	16.24	10.30	18.94	37.00	11.31	19.59	11.37
Silica, Soluble .	10.40	3.98	1.11	——	trace	0.22	0.40
Alumina . . .	2.56	3.42	1.90	2.64	1.72	1.90	trace
Iron Oxide . .	1.56	4.25	1.90	0.92	1.72	1.90	trace
Water . . .	4.48	5.49	3.31	0.36	2.34	3.05	0.92
Sand	32.50	43.30	51.52	12.06	70.50	51.89	72.50
	99.76	100.06	100.00	99.68	100.00	100.00	99.80
Carbonic Acid calculated from lime and magnesia	27.83	23.68	20.3	37.00	11.36	18.74	11.37

1. Mortar from Vienna, 662 years old.
2. " " " 303 " "
3. " " " 50 " "
4. Athenian Mortar, classical times.
5. Munich " recent.
6. " " "
7. Old Roman, Yarmouth, England.

It appears more plausible that the soluble silica found in these mortars was derived from silica contained in the limestone from which the lime was derived, and which was rendered soluble in the process of burning by combining with lime, than that it was due to any combination of the lime of the mortar with the silica of the hard quartz grains of sand, which seems highly improbable. In these old mortars the amount of carbonic acid is high, and in several cases it is sufficient in amount to have converted the lime and magnesia completely to carbonate, although the percentage of these bases is in most cases much greater than good practice demands.

The Masons' Department.

THE ARCHITECT AND CONTRACTOR.

BY THOMAS A. FOX.

IN CONCLUSION.

IN closing this series of articles which have been intended to show briefly the relations, both as they are and as they should be, between the architect and contractor, it is desirable to emphasize the fact, to which allusion has already been made, that the way to overcome much of the friction and many of the misunderstandings which now exist is to bring about more intimate relations between the representative organizations of the architects and the builders. In almost every city of any considerable size throughout the country we now find a local society of architects, usually a chapter of the American Institute and a Master Builders' Association, generally connected with the national organization. While these two parent bodies have considered, from time to time, various matters of mutual interest, and have conjointly framed and issued the uniform contract which has done more than any other one thing to bring about harmonious practice in this important particular, at the same time there are many matters of detail in which local customs figure to such an extent that action by the national bodies is undesirable, which could be easily adjusted by conferences between the local organizations. There is little doubt that, under ordinary conditions, the average architect considers the average contractor a more or less unprincipled individual, who selfishly guards his own personal interests at the expense of every one else, and it is also true that this feeling is reciprocal on the part of the builder. But this condition of things fortunately exists only when the parties, as the saying is, deal with each other at arm's length. Let a body of men, representing the architects and builders, sit around a table and discuss, in a liberal and broad-minded way, the matters which have been the result of innumerable controversies and more or less hard feeling in the past, and each would be surprised to find how quickly and satisfactorily many of the contested points could be settled. The Boston Society of Architects, which justly prides itself as being one of the leaders in its sphere on such matters, at a recent meeting ordered its executive committee to meet the representatives of the Master Builders' Association, to consider in general the matters of mutual interest to both bodies. While it is too soon to predict in detail what the outcome of such a conference will be, it is safe to say that this action promises to be the entering wedge which may lead, eventually, to an agreement which will correct at least some of the abuses which exist on each side. Reforms usually commence from without, that is to say, while the architects on the one hand, and the builders on the other, may be aware that certain improper practises exist, there will be little hope of their being corrected until attention is called to them, and possibly some pressure brought to bear by those who suffer from the present condition of affairs; and the simplest and easiest way to accomplish the desired result is to bring the interested parties face to face, where they may listen to a frank discussion of the matter at hand. For those who have made a study of these questions it cannot be claimed that this series of articles has presented any new facts or suggestions, for such has not been the intention; the object in writing on the relations between architect and contractor has been simply to point out the fact that there is at the present time more or less friction between these two allied interests; that while much of the trouble is due to unavoidable conditions, under which much of the work is undertaken and carried out, yet at the same time many of the abuses are such that they could be corrected by the intelligent and united action of the architects on the one hand, and the builders on the other. The means for accomplishing such a result are at hand in the societies of architects and associations of builders, all that is necessary being to bring the representatives of each together; and if this can be accomplished, as it already promises to be, we shall, no doubt, see in the near future the same improvement in the ethics between these two organizations as we have witnessed within individual associations themselves.

BRICK JOINTS.

THROUGH the efforts of the architects and manufacturers the brick industry has, of late years, shown a wonderful development, for it is but a comparatively short time since there was practically but one shape and color, and the only variation to be had was in the different degrees of finish. During the period when the pressed brick was in favor, it was unquestionably the desire of both the architect and the mason to avoid, so far as possible, all appearance of texture in a face wall: the bricks were made as smooth and regular as possible. They were bonded with "cut" headers, so as not to disturb the regularity of the courses, and the joints were made as fine and narrow as was possible, one of the essential qualifications of a first-class face brick layer being the ability to make the joints as narrow and inconspicuous as possible. Such work was at first laid in common mortar, made with fine sand, which allowed the bricks to be laid very close, but later the desire to have the joint still less prominent led to the practise of putting such coloring matter in the mortar as would bring it to the same tone as the brick. This practically obliterated the joint, and made a wall of a smooth, slippery, and, as it has sometimes been called, "licked" surface.

This kind of masonry necessarily lacked two essentials of most good architecture,— texture, and a straightforward recognition of the materials employed and the method of using them. Now, the construction of a brick wall naturally consists in laying courses of bricks one on top of the other, with a layer of mortar between each one, and it is consequently apparent that if we are to use our materials honestly, the joint of a brick wall should be recognized as an architectural feature just as much as the bricks themselves; and so soon as this is done we begin to get a surface with texture. It has been difficult to convince the mechanic, who was taught, when learning his trade, to obliterate so far as possible all trace of the joint, that comparatively wide joints of mortar of a different color from the bricks themselves could make a workman-like-looking job, and it is often hard work to bring a man who has served his time to sacrifice his principles so far as to follow the architect's directions, and lay a wall where the mortar joint is conspicuous, both on account of its width and color; but in many instances the mechanic has freely admitted, when the work was finished and cleaned down, that after all it had a certain merit and pleasing appearance, which was lacking in that which was done in the old way.

Besides recognizing the joint by means of color, it is also oftentimes desirable to use a greater width, particularly in the bed joints, which necessitates the use of a much coarser sand than was formerly employed, so the bricks will not only stand up, but also stay in place. And if such work is laid in wet weather and a hard and non-absorbent brick is used, it requires some skill to keep the wall plumb and true, but this difficulty can be overcome by the exercise of a little care and attention.

While the cement or coloring matter, which may be mixed with it control to a considerable degree the color of the mortar, nevertheless, the sand has an appreciable effect, and where it is desired to get a light-colored joint, the best sand for the purpose is a coarse, white beach sand, the only objection to it being that it is not as sharp as some bank sands, but this fact is not of sufficient importance, however, to interfere with its use. It was formerly quite generally supposed that the presence of salt in mortar was detrimental to its strength; it has been proved of late, however, that just as good mortar can be made with salt water as with fresh; and the government, on its most important works, as sea walls, lighthouses, and similar constructions, allows the mortar to be mixed of salt water.

It may be said that, as a general rule, a joint lighter than the brick is the most preferable, and a strong mortar of this kind may be made by starting with a pure lime and sand putty, and tempering it strongly as it is used with Portland cement. Care must be taken, however, in cleaning down a wall which has been laid with a wide joint of lime mortar, that the lime is not taken out of the joint to such an extent that the wall is whitewashed. If acid is used, it should be in very small quantities; but it is better to clean such brickwork with soda instead of acid, which, if the mortar is fairly well set, rarely starts the joints. It is also important that walls laid as described above should be laid so as to have ample time to become set before winter weather sets in. Care should also be taken to ascertain if there is any trouble liable to occur on account of unequal shrinkage in the mortar between the face of the wall and the backing. At one time it was often customary to lay the facing of brick walls, or at least a portion of it, in clear Portland cement, to allow the brick to be carved like stone after being set in place. There are instances where the unequal shrinkage or expansion of the different kinds of mortar made the facing scale off, and in time necessitated the removal of the entire outer 4 ins. of brickwork, but such trouble is undoubtedly less liable to occur with a wide joint in the facing, for in this case the joints of the facing and backing are more nearly equal.

Before the mortar between the bricks is set it is customary to "joint" it, that is to say, to compress it more or less by running an iron tool with a smooth surface along the joint, which compresses and at the same time indents the mortar. The jointer usually has a V-shaped edge which makes a sharp, narrow line, but sometimes a U one, which makes a slight indentation the full width of the joint. A good effect is obtained in some cases by simply cutting the mortar off with the trowel flush with the surface of the brick; but as this leaves a rough surface, the mortar is more liable to be affected by frost than where it is smoothed and compressed with a jointer. In jointing brickwork, where the bricks themselves are more or less irregular in shape and laid with a wide mortar joint, it is usually desirable to have the jointer run along the top of a straight-edge, which is carefully leveled each time. Although the method of jointing the mortar may seem at first thought an unimportant detail, yet experience will soon show that it is a matter which deserves careful attention, particularly on work which comes near the eye, as in the case of fence walls, gate posts, and other similar work. If, when the architect is to build a brick wall where he wishes to obtain the best possible results, he will have several samples laid up with the same brick but different joints, he will find that the difference in joints may determine whether or not the wall is satisfactory in both color or texture, and also that a poor brick may be helped, or a good one injured, by the color and width of the mortar. The brick joint is a factor much more important than is generally supposed, and is worthy much more consideration than is ordinarily given to it.

SAND.—Sand should be sharp, gritty, and clean, free from loam, clay, and other foreign substance. For mortar it should be screened to a proper degree of fineness. To test sand, take up a handful and squeeze. Its sharpness may be determined by feeling, and cleanness by the appearance of the hand, as clay or loam will soil the hand by clinging to it. A better test for cleanness is to drop a handful into a glass of clean water; dirt will not settle at the bottom, sand will.

COST OF CONCRETE.— With Portland cement at $2.20 per barrel, sand at $1.00, and broken stone at $2.00 per cubic yard, and labor at $2.40 per day of eight hours in New York City, builders get from 30 cents to 32 cents per cubic foot for concrete in place. In the repaving of Fifth Avenue, New York City, in 1887, with Rosendale cement at 90 cents per barrel, labor at $1.50 per ten hours day, sand at $1.00, and broken stone at $2.00 per cubic yard, the contract price was $4.00 per cubic yard in place, a perfectly fair estimate, the mixture being about 1 — 3 — 5, and laid 12 ins. deep over the entire 40 ft. wide roadway.

Recent Brick and Terra-Cotta Work in American Cities, and Manufacturers' Department.

NEW YORK. — Another month of unusual activity in the Building Department has just passed. The plans which have been filed include several very important large buildings, the designing of which, we are happy to say, have been placed in good hands and we need not be apprehensive of the result. We have it on good authority, however, that several of the buildings whose plans have been filed will not be erected immediately, this formality having been gone through so that their ultimate erection need not be pre-

CAPS TO COLUMNS AT FIFTEENTH STORY, ST. JAMES BUILDING, NEW YORK CITY.
Bruce Price, Architect.
Made by Perth Amboy Terra-Cotta Company.

vented by a bill now under discussion in the State legislature, limiting the heights of buildings.

An item of particular interest is the decision of the owners to sell Madison Square Garden, the largest and most beautiful amusement place in America. All who are interested in the use of brick and terra-cotta know how successfully and how beautifully these materials have been blended in this splendid structure. The owners cannot be too highly commended for their generosity and public spirit in their endeavor to give the city of New York a building of which she is justly proud, nor the architects, McKim, Mead & White, for their eminently successful handling of the problem. The great building has proved an unprofitable adventure financially, and during only one or two years has it paid expenses. It is not likely that its sale will materially affect the appearance of the building, although the Madison Avenue section may be remodeled into an hotel.

A new building which, judging by the drawings, promises to be a handsome one, is the new Herald Square Hotel, by Hill & Turner, architects. This building will form a background to that admirable copy, the Herald Building, and will not artistically help the latter.

As a result of the generosity of Miss Rhinelander, a beautiful group of buildings will be erected on her grandfather's estate, for which purpose she has given over $500,000. The property is on the south side of East 82d Street, between First and Second Avenues, and the buildings to be erected will be dedicated to the purposes of St. James Parish.

Plans have been completed by R. H. Hunt for an addition to the Metropolitan Museum Building, which will cost $1,000,000. The bids for the foundation work have been received and the work is about to commence. This is an important step toward the completion of a grand museum, of which the present structure is only a nucleus. The proposed wing will be classic in the general style of its architecture and will be constructed of brick and granite. It is a very elaborate building and will probably take two or three years to complete.

Plans have been filed for a magnificent new home for the University Club. The building will be erected on the plot of ground at the northwest corner of Fifth Avenue and 54th Street, which was bought for $805,000. The architects are McKim, Mead & White. It is to be a handsome and substantial structure, and the interior arrangements, as indicated by the plans, are remarkably complete.

An office building will be erected at Nos. 225 and 227 Fifth Avenue for the Baroness de Salliere. It will be twenty stories high and will cost $500,000.

Harding & Gooch have prepared plans for a sixteen-story office building for John A. Roebling & Sons, to be erected at Nos. 117 to 121 Liberty Street. It will be of steel skeleton construction with a front of brick, stone, and terra-cotta. It is estimated to cost $500,000.

The same architects have also filed plans for a fourteen-story building to be erected for J. Hooker Hammersley at the southwest corner of John and William Streets. It will be only 27 by 78 ft. in size, but will cost $400,000. The front will be of granite and brick, with terra-cotta trimmings.

R. Maynicke has prepared plans for a twelve-story store and office building to be erected at No. 598 Broadway for Henry Corn. The cost will be $250,000. Also another similar building for the same owner at Fifth Avenue and 22d Street, to cost $200,000.

Neville & Bagge have planned seven flat buildings to be erected on St. Nicholas Avenue, at a cost of $190,000.

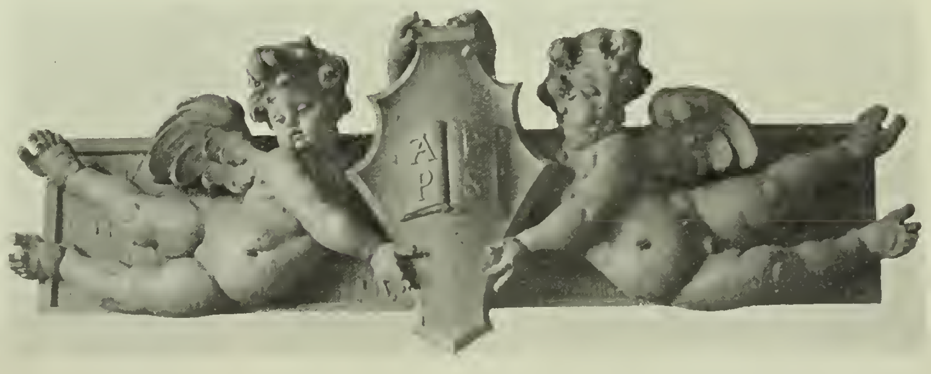
Clinton & Russell have prepared plans for a twelve-story brick building, Nos. 11 to 15 Murray Street, to be used for manufacturing purposes. It will cost $225,000.

Schickel & Ditmars have planned a five-story brick office building to be erected at Fifth Avenue and 91st Street, at a cost of $25,000.

C. C. Haight has prepared plans for an Hospital for the Ruptured and Crippled, to be built at 42d Street and Lexington Avenue. The cost will be $250,000.

Schneider & Herter have planned a six-story brick and terra-cotta tenement, 100 by 100 ft., to be erected at the northeast corner of Columbia and Delancey Streets, at a cost of $95,000.

Henry O. Havemeyer has sold to John S. Ames a plot, 150 by 200 ft., on Broadway, north of Prince Street, for $100,000. Mr. Ames intends to erect three twelve-story mercantile buildings.



TERRA-COTTA DETAIL, AMERICAN BAPTIST PUBLICATION SOCIETY BUILDING, PHILADELPHIA.
Frank Miles Day & Brother, Architects.
Made by Conkling-Armstrong Terra-Cotta Company.

PHILADELPHIA.— The removal of the capitol from Harrisburg to this city will apparently not take place, the project which was so vigorously advocated immediately after the burning of the capitol has been abandoned, and there will be a new building, for capitol purposes only, erected at Harrisburg upon the site of the burned structure.

We visited the ruins shortly after the fire. If any bricklayer or mason desires to have an object lesson which will illustrate perfectly what has been said concerning good brickwork in the editorial department of THE BRICKBUILDER in the early editions of this year, he can get it there. We were so impressed with the stability of the walls after passing through so intense a fire that we had photographs made of the ruins, and present them herewith. Nowhere throughout the entire structure are they seriously injured. Over the openings, both large and small, the lintels burned away, and a few bricks fell with them; there are no cracks to be seen, and bulged walls or even isolated piers are out of the question; everything stands as perfect as it could be built new at the present time, especially the dome, which bore the brunt of the fire, and is standing today in a condition which would require only a few days' work to place it in the same condition that it was in before the fire. Notice, also, that on the front of the building the piers which supported a large pediment are still standing perfectly vertical, the woodwork having burned away, and the rafters fallen without injuring them in the least. The slender chimneys on either side of the dome, as well as the more sturdy ones on the outer walls, are all standing, the joists and rafters fell without any damage to the walls, leaving only the black openings which once held them: the interior piers which carried girders also remain standing in good condition. These walls were built in strictly plain and logical manner with good materials, they are laid in Flemish bond throughout, there being no exterior facing shell of wall bonded to the backing every seventh course, as we now have it in nearly all of our work. We cannot see why any architect who will view this mute but eloquent example of the durability of real good, honest brick-work should allow any of his work to be constructed in any other manner.

STATE CAPITOL AT HARRISBURG, PA.

STATE CAPITOL AT HARRISBURG, PA. SHOWING EFFECTS OF FIRE.

The competition which has been announced by the Commission having in charge the selection of an architect for the new capitol, has been arranged for the Commission by their adviser, Prof. Warren Powers Laird, of the School of Architecture, University of Pennsylvania, and is designed to bring into the competition the best talent in the country, especial provisions having been made in this direction by the selection of six architects from those standing at the head of the profession, three of whom shall be from Pennsylvania and three from other States, who have been invited to submit designs, and who will be paid $1,000 each in compensation for taking part in the competition, but they shall not have any preference whatever in the selection of the design by reason of their being invited into the competition and paid by the Commission. The program insures the selection from the designs submitted, by a board of experts composed of three persons, the first of whom shall be the adviser of the Commission, Professor Laird; the second to be chosen by a majority of the six invited architects; and these two to select a third, of eight designs which in their judgment are best, giving to each their rank in accordance with their merit; these designs will be presented to the commissioners together with a full report of the proceedings of the board of experts, and such recommendations as they may deem necessary. The commissioners will select from the eight designs submitted by the board of experts, and will in nowise consider any of the others. The one which shall be selected as the most satisfactory shall be so designated, and the author of it shall be employed as the architect of the proposed buildings, with full authority as such, and shall be paid a commission of five per cent. of the cost of the work; two bronze medals shall be awarded to the authors of the designs adjudged as second and third respectively by the commissioners. No use of any other design or part of design shall be made unless by the consent and compensation of the author of it, and the drawings will be returned to the authors upon the conclusion of the competition, together with a full report of the board of experts and the Commission.

The program calls for a design for three department buildings in a group, the chief of which shall be the legislative building. The designs shall be sent to State Treasurer Haywood on or before 12 o'clock noon, Saturday, July 24, 1897, and the final selection of an architect shall be made not later than August 7. The drawings shall be enclosed in two separately sealed wrappers, the outer one of which shall be removed upon receipt of them; they shall have no marks whatever, as a number will be given each when the wrapper is removed, and this number shall be placed upon a sealed envelope containing the name of the author, which shall be enclosed with the drawings; these envelopes will be given to Judge Simonton, of the Dauphin County Court, to be opened by him after the selection of the design placed first.

The program has some unique features and is designed to overcome those which have made failures of most of the prominent competitions of the past. It is very complete in every detail, and the result will be eagerly looked forward to by every person interested in competitions of this class.

CHICAGO.— We hear much of a great undertaking in the line of building a South Side lake shore drive connecting the Lake Front Park and Jackson Park. Mr. D. H. Burnham's name is prominently mentioned in connection with this enterprise, which is vast enough to require the issue of several millions in bonds before it can be realized.

The plan contemplates not only a driveway, but also roads for equestrians and bicycle riders, and these are to lie between the lake and a series of lagoons, while trees and shrubbery aid in making magnificent effects in the conception.

" Alterations " and " additions " form a large part of building items during times of business depression. Every few days one sees another store front undergoing transformation. A temporary sidewalk crowds passers-by out into the street, rows of blocking appear parallel with the front wall, a series of tall timbers with jackscrews in their lower ends form a dense colonnade outside, while another series extend in like manner inside the wall. Very soon needles of steel (I beams and rails) are made to pierce the walls and rest on the two rows of timber columns. Then the original supports are torn out, heavy brick piers and clumsy iron columns and mullions are removed, and for a time the building looms up in the air in a very awkward way on stilts, which seem to threaten to topple over at any moment. Slender columns and large sheets of plate glass are built in to give a maximum of light and show-window space, and then the owner is ready to offer inducements to prevent tenants moving into the new buildings. These changes in store fronts one and often two stories in height are a common sight in the business center of Chicago at present.

ENTRANCE TO COMMONWEALTH AVENUE RESIDENCE, BOSTON.
McKim, Mead & White, Architects.

TERRA-COTTA CAP, WAREHOUSE, W. 14TH STREET, NEW YORK CITY.
Thomas R. Jackson, Architect.
Made by the New Jersey Terra-Cotta Company.

Mr. S. A. Treat, architect, has several buildings on the boards.

Howard Shaw and Hugh M. G. Garden each have some fine residence work for professors in the University of Chicago. The latter is designing, also, a hunting lodge or camp to be built in the wilds of Maine for a Chicago professor of philology.

Mr. Clinton J. Warren has in hand plans for transforming a four-story mercantile building into an eight-story hotel.

An organ factory costing $60,000 is being constructed under the direction of J. H. Wagner.

Some boulevard residents in Chicago have recently had the pleasure of paying $9,000 to prevent the building of an apartment building out to the lot line. This was reported to be a hold-up similar to one worked several times by a notorious builder of livery stables in residence districts.

ST. LOUIS. — The most important event in building circles this season has been the passage of the new building ordinance by the city council, and which went into effect on the 16th of April. The ordinance was prepared by a committee composed of members of the local chapter of the American Institute of Architects, the Master Builders' Association, and the Board of Public Improvements.

The committee made an exhaustive study of the building ordinances of the principal cities of this country and Europe, with a view of obtaining results in keeping with the requirements of modern times. The object has been to point out the things not to be done, rather than to prepare a specification for the architect.

The standard of buildings has been raised, and all buildings used for public purposes, such as theaters, etc., as well as buildings over 100 ft. high, are to be fire-proof, while the height of no building is permitted to be more than one and a half times the width of the street upon which it faces, and in no case to exceed 150 ft.

The passage of the ordinance occasioned quite a rush in the Building Commissioners' office the early part of the month to obtain permits before the law became effective, which resulted in permits being taken out for a twenty-story office building on 6th and Olive Streets, for which Messrs. Wheeler & McClure have prepared plans, and for a twenty-two-story building for the northeast corner of 7th and Olive Streets, opposite the Union Trust, plans for which were prepared by Architect Isaac Taylor. Also, for a theater on the corner of 6th and St. Charles Streets, for which J. B. McElfatric and Kirchner & Kirchner are the architects.

Sometime last summer, when the question of limiting the height of buildings was first agitated in the city council, a permit was issued for a twenty-two-story office building on the southwest corner of 7th and Olive Streets, and all tenants were required to move preparatory to the wrecking of the old buildings, but the scheme seems to have been abandoned, and the premises have again become occupied.

TERRA-COTTA DETAIL, BUILDING FOR FERGUSON ESTATE, DETROIT.
Mortimer L. Smith & Son, Architects.
Made by Northwestern Terra-Cotta Company.

PITTSBURG. — Building projects are on the increase and new contemplations are reported nearly every day, among which is a ten-story building which F. Nicola, Esq., will erect, corner Penn Avenue and 4th Street, to cost $150,000. The Civic Club are considering plans for a new bath house to be erected on Penn Avenue, at a cost of $25,000. Architects Rutan & Russell are preparing plans for a central armory building, to cost $300,000. Architects Alden & Harlow are preparing plans for the South Side branch of the Carnegie Free Library, to cost $50,000. Architect Miss Elsie Mercur has been selected to prepare plans for the Washington, Pa., Female Seminary. Architect J. T. Steen is preparing plans for a brick church for the Cristion Congregation at Connellsville, Pa. Architects Riddle & Keirn are preparing plans for the Ninth U. P. Church, to be erected in Allegheny, to cost $20,000. Architect F. Sauer is preparing plans for a brick hotel to be erected at New Kensington, Pa. Architects E. J. Butz & Co. are preparing plans for the Lafayette Club house to be erected at Jeanette, to cost $10,000. Architect Chas. Bickel has prepared plans for an hotel and apartment house for J. Kaufman and others, to be fire-proof, of brick with terra-cotta trimmings, and to cost $200,000.

RESIDENCE AT BUFFALO, N. Y.
Broughton & Johnson, Architects.

TERRA-COTTA CAP, OFFICE BUILDING, 78 FIFTH AVENUE, NEW YORK CITY.
Albert Wagner, Architect.
Made by White Brick and Terra-Cotta Company.

PREVENTATIVE FOR DISCOLORATION ON FRONT BRICKS.

WE have recently had our attention called to the use of carbonate of barytes for the prevention of scum and discoloration on front bricks, terra-cotta, etc., and realizing the general interest the question bears to clay manufacturers, we quote the following extracts, translated from the German essay by W. Olschewsky, C. E. in *Ziegel und Cement*.

"Nearly all clay contains salts soluble in water; of these, the sulphuric acid salts, which are present in very fluctuating quantities in the clay used for bricks, terra-cotta, etc., are the most objectionable, as they cause scum and consequent discoloration. Most elaborate and costly alterations of kilns, etc., have often been made without effecting any cure of the evil. The cause is not in the burning or construction of the kilns, but to be found in the fact that scum and discoloration are already on the surface, before the bricks, etc., enter the kiln."

"Excellent and complete as the action of carbonate of barytes is as a cure for scum and discoloration from the chemical point of view, the practical man will nevertheless rarely obtain the desired result, if he adds the carbonate of barytes at random. To make this clear it is only necessary to say that sulphate of lime (gypsum) can be present in two different forms in the clay, viz., in a finely divided state (powder) and in the crystallized state, and that the method of treatment differs accordingly."

"The most complete assimilation of the carbonate of barytes with the clay is a condition, to obtain satisfactory results quickly and with the least possible quantity."

"It is difficult, however, to make sure of such assimilation by mere grinding of the ordinary carbonate of barytes; unnecessary loss is nearly always the consequence, as part of such barytes does not act. The coarser the barytes is the greater the loss."

"A most important advance towards a rational use of carbonate of barytes has been made by Messrs. Walther Feld & Co., who now produce precipitated carbonate of barytes of a fineness and power of action which could scarcely be attained by the highest possible state of fineness of the ordinary product, apart from the great expense."

We may add that other valuable literature and practical information on this matter may be obtained by communicating with Gabriel & Schall, 205 Pearl Street, New York. They are the sole importers for the United States and Canada for Messrs. Walther Feld & Co.'s pure precipitated carbonate of barytes.

OBITUARY.

James Williams Penfield, President of the American Clay-Working Machinery Company, died suddenly, April 20, at Cambridge Springs, Pa., where he had gone in hopes of regaining his health which had been failing for some time.

Mr. Penfield was born in Euclid, O., and at the time of his death was sixty-eight years of age.

Much of the progress that has been made in the clay-working art of this country is due to Mr. Penfield's inventive genius. A life

THE LATE J. W. PENFIELD.

of ambition, vigor, and tireless energy earned not only for him a unique reputation, but brought to the industry with which he was identified that creative force which is to-day felt wherever burnt clay is employed.

TRADE LITERATURE.

"25 to 40 per cent. saved in labor!" is the announcement made on the cover of the new catalogue issued by the Gilbreth Scaffold Company. The method by which this large percentage is saved is illustrated by eighteen cuts, showing the construction of the scaffold and its use in the various stages of masonry construction. F. B. Gilbreth, 85 Water Street, Boston.

NEWS OF THE MONTH.

Messrs. Waldo Brothers, Boston, are the agents for the Atlas Portland Cement, also the Morse Wall Ties.

The Standard Fire-proofing Company have removed their New York office to the Taylor Building, 39 and 41 Cortlandt Street.

I. W. Pinkham Company, Boston, are the New England agents for the Turnbull & Cullerton Patent Steel Lathing.

The Powhatan Clay-Manufacturing Company have removed their New York offices to the Townsend Building, 25th Street and Broadway.

The White Brick and Terra-Cotta Company, New York, have removed their offices to the Presbyterian Building, 156 Fifth Avenue.

I. W. Pinkham Company, Boston, have taken the New England agency for the Brooklyn Bridge Brand of Cement, also for the F. O. Norton Cement.

The Pennsylvania Enameled Brick Company, New York, have removed their offices to the Townsend Building, 25th Street and Broadway.

The Tiffany Enameled Brick Company, Chicago, will supply the enameled brick used in the Y. M. C. A. Building at Louisville, Ky., Val. P. Collins, architect.

J. W. Hornsey has leased the plant of the Collinwood Brick and Terra-Cotta Company, Collinwood, Ohio, and will soon put upon the market a "High-Grade Impervious Brick."

The Standard Terra-Cotta Company have secured through their New England agents, O. W. Peterson & Co., the contract for the terra-cotta on the church of the Blessed Sacrament at Providence, R. I. Heins & La Farge, architects, New York.

Contracts have been closed for putting the Bolles Sliding and Revolving Sash in the following buildings: Six schoolhouses, New York City; Howard Auditorium, Baltimore; residence, John McHenry, Baltimore; residence, R. H. Yeatman, Baltimore.

The Tiffany Enameled Brick Company, Chicago, are now making enameled "soaps" having the same enameled face as the English size brick, but only one or two inches deep, as desired. Especially suitable where economy in space is necessary.

The Fawcett Ventilated Fire-proofing Company, who have the fire-proofing contract for the new Registry of Deeds Building at East Cambridge, Mass., have placed their order for cement with Waldo Brothers, specifying Atlas Portland cement.

The Philadelphia and Boston Face Brick Company report the following new contracts: Gray brick for Slamm Building, at Washington, D. C.; cream brick for Steuben Street residence at Albany, N. Y.; gray brick for Angier Chemical Company Building at Brighton, Mass.

G. R. Twichell & Co., Boston, have closed the following contracts: Mottled brick residence for R. E. Lord, at Waltham, Mass.; gray brick for Baptist Church, Warren Street, Boston; front brick apartment houses, Waitt Street, Boston; and all the common brick to be used in the Russia Wharf buildings, Boston. C. Everett Clark & Co., builders.

The Tiffany Enameled Brick Company, Chicago, have appointed as their agents for the sale of enameled brick: W. S. Nelson, Kansas City, Mo.; Wm. J. Watkins & Co., Louisville, Ky.; Pittsburg Mortar and Supply Company, Pittsburg, Penn.; The Midland Brick and Supply Company, Cleveland, O.; B. S. Lewis, Nashville, Tenn.; Illinois Supply and Construction Company, St. Louis, Mo.

The American Clay-Working Machinery Company, of Bucyrus and Willoughby, Ohio, have opened a New York office in Room 103, 39 and 41 Cortlandt Street, New York, where they will be pleased to have all clay workers make their headquarters while in New York. The office will be in charge of R. C. Penfield, who will be pleased to attend to all wants of callers, whether they are probable customers or not. The largely increasing Eastern trade of the company made it necessary to open a New York office.

D. P. Guise, one of the leading clay workers of Pennsylvania, has placed an order with the American Clay-Working Machinery Company for an Eagle Re-press. The Guise works will be further improved and will enter upon the new season fully equipped to get its share of the business.

Chambers Brothers Company have recently closed contract with the C. P. Merwin Brick Company, of Berlin, Conn., for one of their auger machines, with outfit of clay-preparing machinery in connection therewith, to make for them hollow building brick. At present there are large quantities of these bricks imported into their market from New Jersey, and after careful test they find that their own material is entirely satisfactory for the manufacture of these bricks, and have determined to equip for their manufacture.

Charles T. Harris, Lessee Celadon Terra-Cotta Company, will supply the roofing tiles on the following work: Residence for G. W. Fairchilds, Oneonta, N. Y.; A. W. Fuller, architect, Albany, N. Y. Residence for H. C. McCormick, Williamsport, Penn.; Bennett & Rothrock, architects. Residence for W. J. Frisbie, Camden, N. Y.; Gordon A. Wright, architect, Syracuse, N. Y. Art Gallery for J. W. Kaufman, St. Louis; Link & Rosenheim, architect.

The contract to furnish all the Portland cement required for the construction of the new South Terminal Station, Boston, which will be one of the very largest railroad stations in the world, has been awarded to James A. Davis & Co., 92 State Street, Boston, sole New England agents for the Alpha Portland Cement. This brand will be used exclusively in this important work. Shepley, Rutan & Coolidge are the architects, and Norcross Bros., builders.

The American Mason Safety Tread Company have just completed their contract for laying their Safety Tread on the new grand staircase of Messrs. Jordan, Marsh & Co., Boston.

These iron steps were originally made with a recess cast for rubber mats, nearly to the edge, leaving exposed, however, the iron nosings, which wore smooth, and proved a source of danger to both customers and employees.

The new Southern Railroad Station of the Boston Terminal Company, the Lowell Post-Office, the Boston Subway, and several new mercantile buildings are also being equipped with the Treads.

The American Enameled Brick Company, New York, have recently closed a contract with Norcross Bros., builders, and McKim, Mead & White, architects, for light buff front brick, including special fluted bricks for columns and pilasters in the interior of the Columbia College Gymnasium; also a large order for enameled brick to line the plunge bath there, in addition to the order recently filled for the same parties for another portion of the University Hall Building.

They have also secured contract for the enameled brick to be used in lining the Swimming Bath of the New York Athletic Club; these bricks to be made specially and glazed on the flat side.

The Columbus Brick and Terra-Cotta Company, Columbus, O., one of the very largest front brick manufacturers in the country, have recently supplied their brick for the following residences: Residence, Riverside Drive, New York, M. V. Ferdon, architect, light-gray Romans; residence for J. T. Blair, Columbus, O., terra-cotta and gray standards; residence for E. M. Huggins, Columbus, O., dark-gray standards; two residences for J. H. Outhwait, Columbus, O., gray Romans and standards; residence for W. H. Martin, Columbus, O., gray Romans; residence for Henry Flesh, Piqua, O., Peters, Burns & Pretzinger, architects, dark-gray Romans; residence for Mr. Kavelidge, Milwaukee, Wis., gray speckled and light-gray standards; residence for Mr. Manegold, Milwaukee, Wis., dark-gray standards; residence for Charles L. Kurtz, Columbus, O., Yost & Packard, architects, gray and buff Romans; residence for Dr. H. G. Campbell, Logan, O., terra-cotta standards.

THE HYDRAULIC-PRESS BRICK COMPANIES.

THE Hydraulic-Press Brick Companies, although including thirteen separate and distinct organizations, located in nine States of the Union, may nevertheless be referred to as one company, whose history is replete with records of uninterrupted success from the time of its inception. The parent company was organized in St. Louis over thirty years ago, and since then the establishment of the several branch companies at different intervals and in various parts of the country attest the tremendous growth of the business and its far-reaching influence. The various plants are located at points stretching from as far west as Nebraska to as far east as New Jersey, and in a northerly and southerly direction from Minnesota to Virginia. Thus it will be perceived that working eastward the invasion of new territory by the Hydraulic-Press Brick Companies has been so constant and thorough as to render impossible one's successfully eluding their influence or finding a place where their bricks are an unknown quantity.

There has been a wonderful evolution and revolution in brick manufacturing even during the past decade. Formerly a brick-yard need only produce a good red or a good buff to secure enough orders to make their business profitable, because a very limited number of colors were used. So great a variety of new shades have been put on the market, and at once adopted by those seeking new effects, and more perfect harmony between brick and stone trim, and so widely divergent is the taste of architects and builders, that, to successfully compete on all kinds and grades of work, a brick-yard must now be able to make a large assortment of colors that possess enduring qualities beyond question. The Hydraulic Companies, keenly alive to this necessity, have kept it constantly in mind, and by developing the full possibilities of their old plants, and only starting new ones when the clay at hand would permit of producing a variety of shades, have succeeded in obtaining a most complete assortment of colors. When it is stated that the Eastern Hydraulic-Press Brick Company alone makes thirty distinct shades of front brick, and that all the other companies have also a large and distinct variety, the reader may form some idea of the extent of the assortment. Thus it is possible for them to satisfy the taste of the most fastidious, and furnish something that will harmonize with any combination of terra-cotta or stone trimming that the fancy may prefer.

These companies have been among the first to recognize the desirability of molded brick for the use of the architect, and under the direction of one of the foremost architects in Philadelphia, a gentleman of high reputation throughout the country, they have prepared a large number of shapes suitable for a variety of cases, and are prepared to supply these moldings in any quantity or color. These shapes and a number of suggestive sketches showing what can be done with moldings in bricks are admirably shown in a very artistic catalogue recently issued by the companies, forming a volume which has elicited unqualified approval from all the architects who have seen it.

To the architect and builder, the enormous facilities and unparalleled resources of the Hydraulic-Press Brick Companies are two of their most attractive features. Their production, amounting to considerably over 300,000,000 bricks annually, enables them to serve any number of buildings requiring large quantities of bricks without subjecting any to the delays, so annoying and expensive, which in many instances have brought a large office building beyond the renting season necessitating a valuable piece of property being carried from six months to a year with all outgo and no income. Particularly in cities like New York, having strict building laws which prohibit a building being carried up to but a very limited height without the front walls being laid, is the matter of prompt and efficient service, one of the most important considerations in awarding the contract for face brick.

Also, it is of the greatest importance that a concern handling front brick should be at all times conscious of the extent of their ability to execute orders entrusted to their care, so that in estimating or submitting proposals for bricks to be furnished within a specified time they can be able to satisfactorily show their resources. The Hydraulic-Press Brick Companies are so organized that such a thing as a serious delay in supplying brick is almost an impossibility. The solicitors of the companies are constantly posted concerning the stock on hand and in process of manufacture, and know the exact quantity that may be offered for immediate delivery over and above orders previously taken. All salesmen are provided with this information in so condensed a form as to permit of their carrying with them the necessary papers for reference, and thus, wherever they may be, and without consultation with their respective offices, they can supply a customer with accurate and reliable information as to whether the bricks he wishes to purchase are available for immediate delivery, or, if needed, just the amount of time required to furnish them.

A first-class material, brought before the public by a perfect organization and a complete system, backed by the most thorough business principles, is the secret of the financial success which has attended the efforts of the Hydraulic-Press Brick Companies.

The Companies also make a great feature of their exhibits, which are arranged in panel form with a view to displaying the bricks so as to fairly represent their appearance when laid in a wall, as well as affording a visitor the opportunity of seeing the full line of colors located in a manner easy of comparison. This greatly facilitates reaching a final decision as to the shade desired, and is infinitely more satisfactory to the customer than being required to judge of the effect which a brick will produce *en masse* by seeing merely a single sample. A full line of molded shapes are also displayed, and good-size specimens of various-colored stones are kept on hand for the convenience of visitors who may desire to ascertain the effect of certain combinations of brick and stone. These panel exhibits are arranged in most all the offices, but particularly here in the East, where, without an exception, they are equipped to display the bricks in the manner explained above.

Aside from the home offices, which are located at points in close proximity to the respective factories, there are many branch offices, one of the most prominent of which is the one in the Metropolitan Building, corner of 23d Street and Madison Avenue, New York, under the direction of Messrs. Fredenburg & Lounsbury, who are, in fact, the sole selling agents in New York and New England of all the Hydraulic Companies. Notwithstanding the fact that the New York and New England markets were the last in which the hydraulic bricks have been offered for sale, the volume of business done in New York and Brooklyn alone in '95 and '96 included the furnishing of high-grade front bricks for 1,288 buildings, an average of more than two for each working day. This is entirely exclusive of the New England business, which has grown to such proportions that a spacious new exhibit room has recently been opened in the Equitable Building, Boston. The exceedingly handsome panel exhibit displayed in this office is a revelation in its assortment of shades and qualities to those who are not familiar with the operations of the company.

In dealing with any of the Hydraulic-Press Brick Companies at their home offices, or with Fredenburg & Lounsbury, the customer comes in direct contact with the manufacturer, and will, therefore, receive that attention which is to be had only when dealing with principals.

INDEX TO ADVERTISEMENTS.

The Mosaic Tile Co., Zanesville, Ohio.

MANUFACTURERS OF

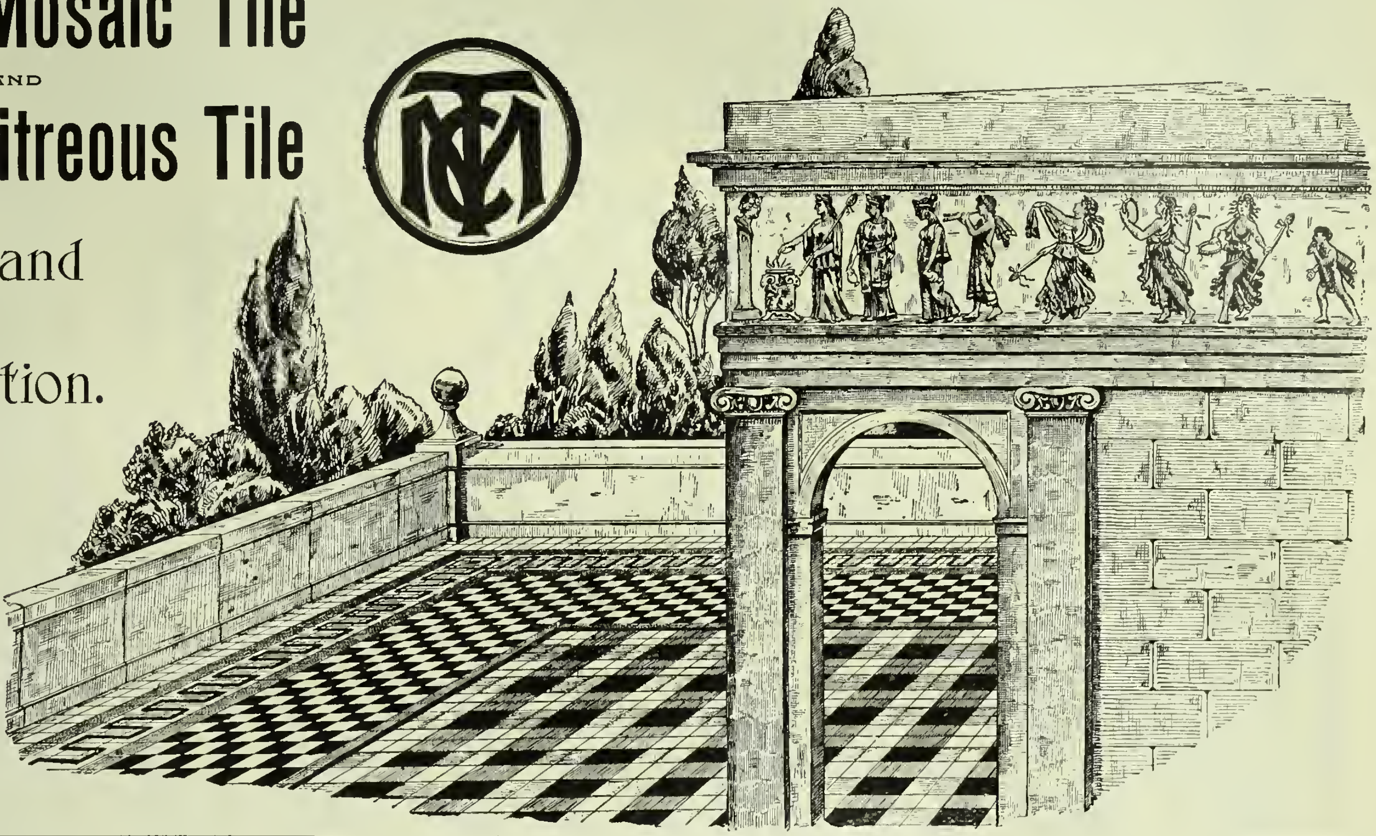
(The Strongest Tile in the Market.)

Ceramic Mosaic Tile

AND

"Parian" Vitreous Tile

For Floors and Mural Decoration.



Estimates, Samples, and Designs on Application.

Grueby Faience Company,

.....MAKERS OF

Glazed and Enameled.....
Architectural Terra-Cotta

For Exteriors and Interiors.

Faience Mantels and....
Ecclesiastical Work.

164 Devonshire Street,
Boston, Mass.

SELLING AGENTS:

New York, O. D. PERSON, 160 Fifth Avenue. Philadelphia, O. W. KETCHAM, 24 S. Seventh Street. Chicago, CHARLES T. HARRIS & CO., 1001-1002 Marquette Bldg. St. Louis, J. P. & A. H. ANNAN, Union Trust Bldg.

THE BRICKBVILDER

VOLVME VI JUNE 1897 No. 6

OFFICE 85 WATER STREET BOSTON

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

PUBLISHED BY

ROGERS & MANSON,

CUSHING BUILDING, 85 WATER STREET, BOSTON.

P. O. BOX 3282.

Subscription price, mailed flat to subscribers in the United States and Canada . . . . . . $2.50 per year

Single numbers . . . . 25 cents

To countries in the Postal Union . . . . . . $3.50 per year

Entered at the Boston, Mass., Post Office as Second Class Mail Matter, March 12, 1892.

THE BRICKBUILDER is for sale by all Newsdealers in the United States and Canada. Trade Supplied by the American News Co. and its branches.

PUBLISHERS' STATEMENT.

No person, firm, or corporation, interested directly or indirectly in the production or sale of building materials of any sort, has any connection, editorial or proprietary, with this publication.

THE BRICKBUILDER is published the 20th of each month.

THE building law of the city of Boston has for years prescribed that no portion of a building shall project beyond the property line without special permission obtained through certain designated channels. By common practise it has come to be understood that this restriction applies only to portions of the actual building, and not to string-courses, pilasters, belts, etc., and up to a very short time ago projections even of considerable size, which started from a height of not less than 7 or 8 ft. from the ground, even though they bodily overhung the street line, were not considered infractions of the law. This was common practise rather than by statute law, however, and as the building ordinances distinctly stated that no projections whatever should be made beyond the street line, it was quite natural that such regulations should give an opportunity for differences of opinion as to the right of even a cornice to overhang the street. A case occurred only a short time ago in which the owners of a certain large building were absolutely prohibited from projecting the cornice, though this prohibition was subsequently removed and the cornice was built as originally planned. When the Brazer Building was started in this city, and before the cornice was reached, a protest was made by an adjoining property owner against any projection of the cornice, which, while by no means as pronounced as many other cornices of existing buildings, was planned very naturally to project beyond the line, and this projection, if considered in the light of the letter of the law, was not permissible. The objections which were raised led to considerable strong feeling, and by a proposed compromise the total projection of the cornice, which was of terra-cotta, was to be reduced from 2 ft. to 9 ins. As one of our daily papers well stated, logically followed out, the law, according to the city solicitor's construction, would stop all cornices,— the most important and often the only redeeming architectural feature in the modern city sky scraper,— all belt courses, all ornamental features, one may almost say, in the down town commercial building, reducing it to the mere dry-goods box it is so often caricatured as being.

Such a rigid interpretation of the law is so manifestly unjust that its enforcement was bound to bring about its repeal; and a new law has just gone into effect which is in some respects better than the old uncertainty in that, distinctly recognizing the fact that the cornice of a building must project, it sets a limit of 3 ft. to such projection. In regard to the construction of cornices, the law states that if of stone, each stone shall balance on the wall, which certainly is a wise and a necessary restriction, but it is discreetly silent in regard to the construction of terra-cotta cornices, the details being subject to the approval of the building commissioner, who, without laying down urgent laws, has always advocated that terra-cotta should, where practicable, be constructed in the same manner as stone, that is to say, should be balanced fully on the wall. The introduction of the steel skeleton, which is an admitted fact in the construction of nearly all large buildings, has made it possible, however, to enormously reduce the quantity of useless terra-cotta, which would be required if every block were to run clear through the wall and balance on the other side, and by a judicious employment of steel framework it is now possible to cut down the depth of terra-cotta, to a minimum, at the same time obtaining a greater security and a more rigid construction than would have been possible without the use of steel. Our constructors have been slow to accept the possibilities of the framed cornice. Although this is a logical and perfectly natural outgrowth from the skeleton construction, the custom of years, the habits of construction which have survived so many changes in style, have operated to produce a timidity in the projections, an unnecessary clumsiness in construction, which can be entirely avoided if we once recognize frankly the possibilities of a framed construction, and proceed scientifically to hang all the terra-cotta work onto the frame. The laws and the practise in regard to this construction are not yet fully determined, but the Brazer Building, previously referred to, will have a strong influence in determining the point of view in the future. The cornice on this building as originally planned was admirably framed; there was no useless terra-cotta, and while full projection was obtained, and not the slightest sacrifice made to artistic effects, it was structurally and scientifically correct. The cornice which is now on the building in place of the one originally designed is equally well constructed, though with not so much projection, and with corresponding loss, we fear, to the general effect of the building. The illustrations which we have published of late of the various constructions for projecting terra-cotta work have served to show how some of our best constructors handled a problem of this sort, and if there were more such examples in actual practise, if we would persistently regard terra-cotta as an envelope to be clothed upon a steel frame, to treat the terra-cotta in its purely decorative spirit, ornamenting the construction rather than undertaking to construct the ornament, our public architecture would be the vast gainer thereby. Stone is too heavy to be used to advantage for projections of a steel frame building. It cannot be molded around the supporting members, it must thoroughly balance on the supports as well as be tied back to them, and it is much more expensive to set in place even if the structural difficulties could be overcome. It goes without saying that all terra-cotta cornices are not well constructed. Indeed, notwithstanding the balancing traditions, there have been several instances where terra-cotta projections have been carried to an extreme which has resulted in failure, but such failure has resulted almost entirely from attempts to diminish the thickness of terra-cotta without the use of steel framework, which is an impracticability.

There is a point to be considered in connection with projecting terra-cotta members of a street front which might easily be neglected. The terra-cotta work must not only be properly hung to the steel frame, but must also be so constructed that it will be secure against a pretty considerable blow from the outside. In case of a fire the firemen would naturally attach their ladders to the cornice. The force of a stream of water delivered from one of our heaviest modern fire engines, if at close range, would be something like 250 or 300 lbs. per inch. If the terra-cotta is made of slight thickness or is not securely held in place, it is liable to be cracked by the weight of the ladders, or even shattered by the impact of the water from the hose. In either case the result would mean a destruction of the cornice and danger to the firemen below.

Our building ordinances practically do not recognize the existence of a steel frame, at least not in this city, and all of the large buildings which have been erected within recent years have been built under a species of official tolerance rather than by direct accord with the wording of the law. Our statutes still continue to prescribe the thickness of wall for a building carried to a height of 125 ft., when as a matter of fact there has been hardly a building erected within the last five years with a wall of a height of even 50 ft.; and considering the success which has attended the introduction of the modern construction, the facilities for the use of brick and terra-cotta in an intelligent and workmanlike manner, it is high time that our laws should recognize the new construction, and the statutes be changed accordingly.

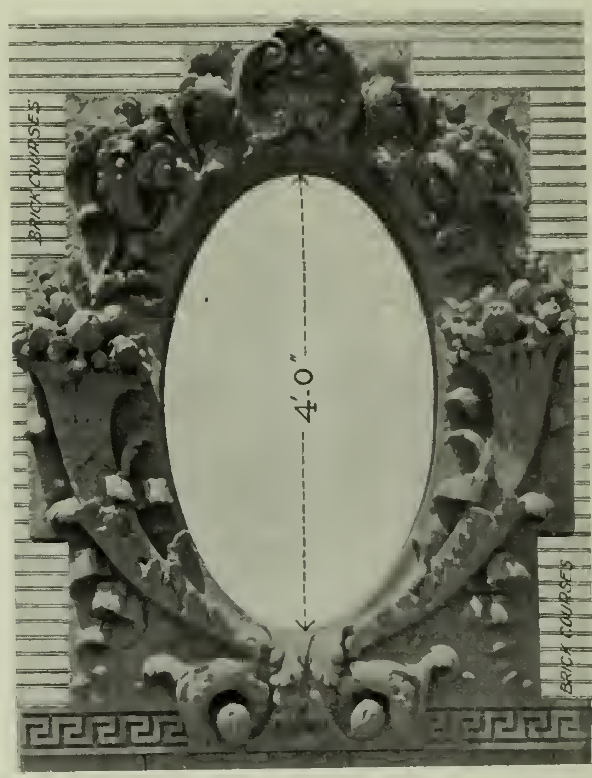
WE present with this issue the façade of three dwellings designed by Marcus T. Reynolds, of Albany, for the Van Rensselaer family, and erected on the principal residential street of that city, not far from the park entrance. While the building contains three separate residences, the connection between the several owners permitted, and the importance of the situation demanded, a more imposing palatial effect than would have been possible had each dwelling been treated as an entirety. The architect's aim in this respect must have been steady and deliberate, for he has attained the desired end with more than ordinary success.

The first story is executed wholly in terra-cotta blocks of two designs; one course being rusticated, with a vermiculated surface; the alternating courses having a reticulated pattern in low relief. With the exception of the mullions and spandrel panels in the second story windows — which are dark-red Verona marble — the architectural features of the two upper stories are likewise in terra-cotta, with Roman brick of exactly the same shade of golden buff for all plain surfaces. The second story windows resemble the characteristic double-headed windows of the early Florentine palaces. In those of the third story a square opening is surrounded by a rich architrave on which rests an entablature with a garland of fruit as the frieze. The pediment recedes towards the wall, in keeping with the ornate but unobtrusive character of the adjoining ornament, and suggesting a pediment more by its triangular shape than by its treatment. The sky line has not, in this case, been disfigured by any crowning abomination in galvanized iron, painted, and sanded with transparent artifice and fraudulent intent. The main cornice is terra-cotta. Clusters of acanthus alternate with baskets of flames along the frieze. Indeed, from the repeated use of flames as a motif on this particular building, we infer that they must have some especial significance — perhaps the crest of the Van Rensselaer family.

Mr. Reynolds seems to have studied to some advantage the many beautiful examples of terra-cotta architecture that abound in the palaces and churches in the valley of the Po. With the work of many generation of artists, in an artistic age, to draw from, he has wisely refrained from the invention of a new style. He has, however, sought to begin where they left off, and to carry terra-cotta architecture a step further by careful study, and a close observance of its capabilities. A laudable effort has likewise been made to show that the attributes of this material are different from those of stone, and that they demand a distinct treatment. The candor and consistency displayed in this is quite refreshing — a veritable oasis in a desert of sham and imitation. Whether it be in the choice of color, the peculiarity of finish, or the style of detail employed, the architect has made it plain that burned clay is the material; that it stands on its merits, that it needs no apology, and that it refuses to be considered an imitation of stone. It is on the fulfilment of these conditions that the future of terra-cotta depends, and on this basis that its ultimate destiny must rest.

ILLUSTRATED ADVERTISEMENT.

THE New York Architectural Terra-Cotta Company send us the adjoining illustration of an elliptical window. The photograph was not taken from the model, but from the actual work as it



came from the kiln, and is therefore a real, as distinguished from an ideal representation.

PUBLISHERS' ANNOUNCEMENT.

Owing to the length of Mr. Wight's detailed account of the Pittsburgh Fire, which, because of its importance in demonstrating the value of the present methods of fire-proof construction, we feel justified in printing in full in this number, we have been obliged to hold over until July, Mr. Cusack's next instalment on Architectural Terra-Cotta.

Mr. Cummings's series on American Cements terminates with this issue of The Brickbuilder. At an early date this work will be published in book form, which will comprise two very interesting chapters in addition to those which have already been printed in these columns. Due notice will be given of the date of publication.

Terra-Cotta Cornices for Steel Skeleton Buildings.

BY W. L. B. JENNEY.

As terra-cotta is the material best adapted to the street fronts of the steel skeleton, lapping around the horizontal flanges, easily secured and fire-proofing the steel, the terra-cotta cornice is in general use in high buildings. The essentials are: —

That the terra-cotta shall be very securely and substantially supported and anchored. To this end the steel and the terra-cotta must be designed together. All supports and all anchors must be shown on the designs, that the holes in the terra-cotta and in the steel may be made in advance, and the anchors provided. Usually there is a portable forge at the building for heating rivets, where the lengths and shapes of the anchors may be adjusted to fit correctly as the terra-cotta is set.

Strong Portland cement mortar only should be used; the outer one or two inches the color of the terra-cotta. Unless Portland cement is used, the mortar joints will be affected by the frost and ere long fall out, and water will enter, freeze and displace, or break, the terra-cotta.

All terra-cotta should be reasonably straight and hard burned.

The examples shown are from the finest types of office buildings. They are reduced from full-sized working drawings and are exactly as constructed in the several buildings respectively.

It will be seen by inspection that the supports and anchors vary greatly with the design of the cornice, and when it is a question of economy, this should be kept in view in designing the cornice. Other things being equal, the cost increases with the projection. It is desirable, whenever practicable, to consult with the terra-cotta company before the details are finally settled, as they must furnish and set the material, and sometimes very valuable suggestions can be obtained from them contributing to the stability and economy.

An old French professor in the Ecole Centrale at Paris was fond of telling his students, "Never lose the opportunity to consult with those who know more than you on any subject, and remember that an intelligent foreman often possesses practical knowledge on some minor points not found in the books that may be of great benefit to the professional architect and engineer."

This is quite likely to be true in terra-cotta cornices. The terra-cotta must be molded, baked, and set, and if the facility for doing these three things is kept constantly in view in designing the cornice, the most substantial and the most economical cornice will be obtained. It is often easy to add to the stability, and to diminish the cost by chances that do not injure the architectural effect.

Discussion of the examples presented: —[1]

TRUDE BUILDING: —

This is for an ornamental cornice — a reasonably simple one. The minimum projection beyond the building line is 3 ft. This projection is supported by a system consisting of steel ells nearly vertical, extending from the level of the attic floor upward about 4½ ft., and outward to the building line or face of the vertical wall, and secured at the ends by gusset plates to the I beams, at about the attic floor level, and to the horizontal 4 by 4 ells, forming cantilever that with the longitudinal ells forms the main support of the extreme projections. The system is tied back to vertical ells against the inner face of the outer wall of the building. The two lower terra-cotta members shown in the designs are the window caps. They should be filled with concrete. Particular care is required. The work is set from outside scaffold. The filling is partly in advance and partly after anchors are in place, as may be in each case found most convenient. It is easily seen that the anchors must fit with exactitude.

[1] See plate page 116.

In this example, below the cap members there is no filling of the terra-cotta outside of the face of the outer wall of the building. The inner and upper cap member rests on a longitudinal brick ledge and should be filled as far as practicable in setting. For filling there is nothing better nor more convenient than good Portland cement mortar and broken terra-cotta.

The extreme outer members are not filled. The coping of the parapet wall should be filled. In this case, it would be advisable to build short 9 in. walls in the center of the parapet wall, and of proper height and length to allow the pieces of coping to be set in place. The proper amount of cement mortar is filled into the coping before setting, that the coping may be substantially full. Every care and precaution that ingenuity can suggest must be exercised to prevent the entrance of water within or between the pieces of terra-cotta. To this end it is best to fill every piece whenever practicable. Every joint must be filled over the entire surface with best Portland cement, and clean, sharp sand, equal parts and thoroughly mixed. A thorough mixing is more important than is generally supposed. At length this matter is attracting the attention of engineers and contractors, and machine mixers are now being used. Recent tests made by Ransome with one volume of Portland cement and three of sand showed a very decided improvement in machine mixed over the usual hand mixed.

All joints that come to the surface must be scraped out and thoroughly pointed with Portland cement used neat, or with not to exceed equal parts of the best, fine, sharp sand; coloring added where necessary. In special cases, caulking with oakum or flashing with metal is to be recommended; in fact, no precaution available should be neglected, as the introduction of water within a terra-cotta cornice in freezing weather may produce most serious accidents, displace and break pieces which by falling might result in loss of life.

FORT DEARBORN BUILDING: —

In this example very little steel is required, and is a good example of how to build a showy, deep cornice at minimum expense. The risk of leakage into the cornice is also reduced to the minimum, the only exposed joints being the cross-rolled joints between the pieces in the cap course.

If every piece in this cornice were filled as it should be, this example is very substantial, leaving little to desire in that respect.

THE FAIR BUILDING: —

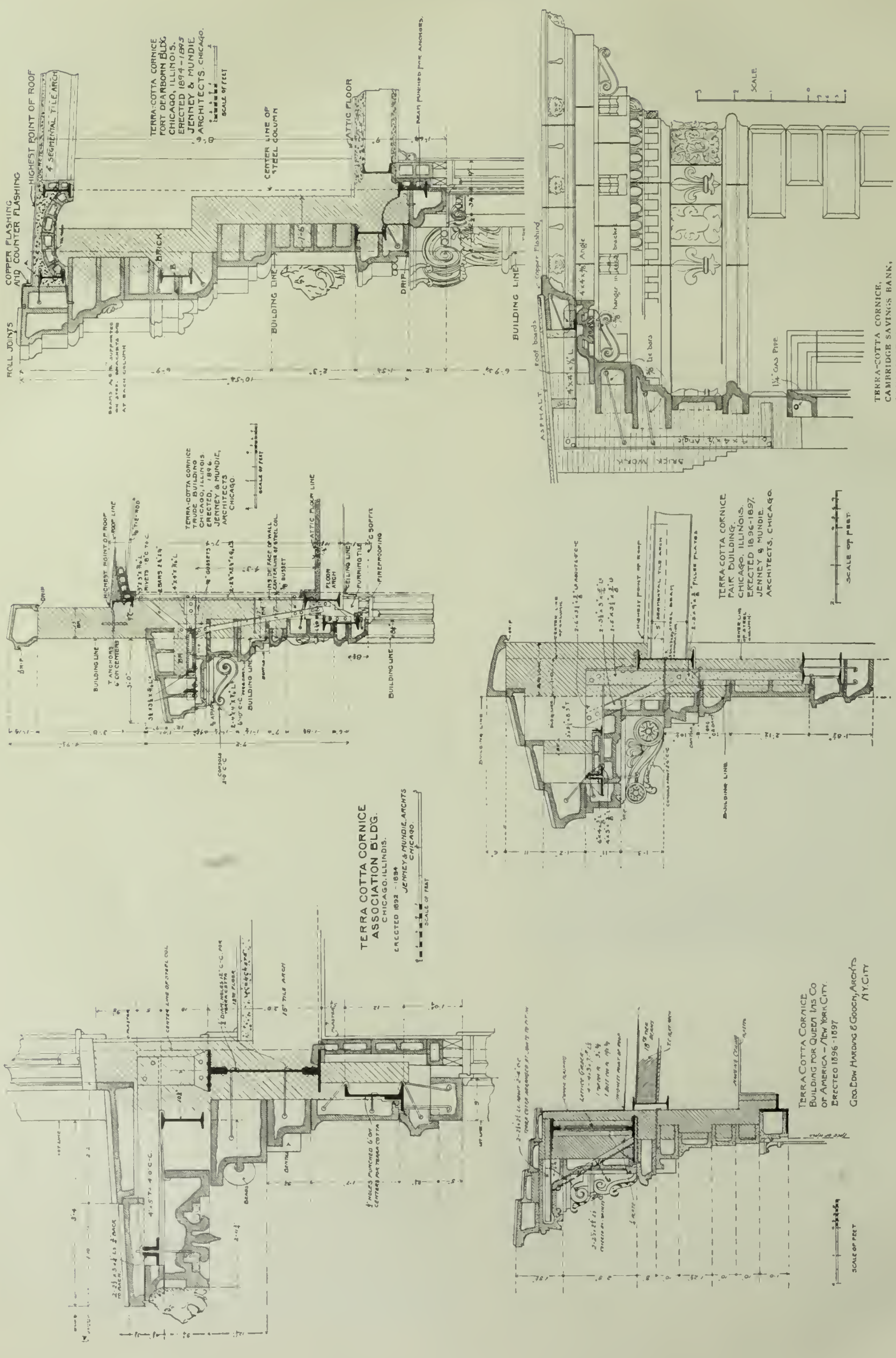
In this example, the system of steel supports is similar to that used in the cornice of the Trude Building, and there is but little to add. It is certainly desirable to build the supports strong enough to allow the cap to be filled, certainly the inner section.

THE ASSOCIATION BUILDING: —

This example is located below the attic story and tile roof. The sills to the windows above cornice might have projected with a drip beyond the face of the wall. The masonry, however, is so solid below that it is not essential. The longitudinal joints between the two cap pieces require special attention.

The filling of this cornice should extend out beyond the wall line, completely filling the lower courses and filling out to the outer edge of the outer I beam, carrying the cantilever in the upper courses. The ornamental soffit, as in some of the other examples, is suspended to the cantilever beam by concealed iron hangers. This method is often employed and offers little difficulty. It is easily managed by mechanics, who are otherwise capable.

Terra-cotta cornices in general require expert knowledge and the best of workmanship. None but the most experienced and reliable workmen should be employed in the setting. The terra-cotta should be rigorously inspected, and every defective piece discarded. The setting should receive the closest superintendence.



TERRA-COTTA CORNICES FOR STEEL SKELETON BUILDINGS.

THE RECENT FIRE AT PITTSBURGH.

A REAL TEST ON A GREAT SCALE OF FIRE-RESISTING CONSTRUCTION AND MATERIAL.

BY PETER B. WIGHT.

On the evening of the 2d and the morning of the 3d of May there occurred in the city of Pittsburgh a serious fire, which is no longer a matter of news, but rather one of great public interest. There was a great property loss in the aggregate, which fell mostly upon the underwriters, said to be from $2,000,000 to $3,000,000. But that will depend upon what they agree with the owners to be the damage to several intentionally fire-proof buildings. The main interest taken in this fire centers upon the part sustained by three new buildings in which modern fire-proofing methods were employed, as well as a fourth, which escaped without more injury than broken glass, and a fifth with a broken roof. Of these four were fire-protected mainly according to one system, while the fifth differed from all the rest; yet all were different in some respects as to construction, and the circumstances of exposure differed in every case. They will serve as the basis for comparison of methods and materials in the experience of actual and, in some parts, crucial tests, to which the most improved methods of building have never before been so exposed as to amount to a demonstration. It is doubtful if either of these buildings would have been so seriously damaged had the fire originated within it, and the fire department been promptly called, in which case the event would not have attracted more than passing comment. It has always been supposed that the greatest danger to buildings is from fire within, and that fire-proof buildings are competent to protect themselves, on account of the incombustible nature of their materials, from fires in adjoining buildings, or across the streets, without resorting to the methods employed to keep fire out of others which make no pretensions to being fire-proof. The experience of the Pittsburgh fire has shown that a failure to provide against this unforeseen danger exposes fire-proof buildings in certain localities to tests of a severity never before anticipated.

Hence the proprietors of The Brickbuilder have considered the occasion to be a proper subject for critical examination. At their request the writer visited the scene of the fire on May 25 and 26, a little more than three weeks after its occurrence, and before the buildings had been repaired to such an extent as to obliterate any of its effects.

The fire started in the wholesale grocery house of T. C. Jenkins, which runs through from Liberty Avenue to Penn Avenue, a distance of 236 ft., had a frontage of 87½ ft. on Liberty Avenue, between other stores, and of 150 ft. on Penn Avenue, between a brick dwelling and Cecil Alley, where it had a frontage of 107 ft. This store, it will be seen, was L shaped, six stories and basement in height, and covered 28,675 ft. of ground. It was in open lofts on every story with the exception of a section of 62 by 35 ft., which was partitioned off by a brick wall. It had about ten elevators. No attempt had been made to fire-proof it, and the construction throughout was with oak posts and girders and ordinary floor joists without any plastering. It was stocked with goods of the most combustible character, usual with wholesale groceries, from basement to attic, including a large stock of oil and sugar, as well as wooden ware. A switch track from the Pennsylvania Railroad in Liberty Avenue entered the building. There were standard shutters on the Cecil Alley front as well as on the court that enters from it. The general plan and location will be seen on the map, Fig. 1, together with that of all the other buildings exposed and affected in any way.

The Jenkins building was totally destroyed, as well as two 20 by 112 ft. four-story stores on the east, fronting on Liberty Avenue, and another of the same size on the west, fronting the same street. A dwelling on the opposite side of Penn Avenue was also totally destroyed. One other store on Liberty Avenue was damaged, as well as two dwellings west of the Jenkins store on Penn Avenue.

Three other buildings, which are now special subjects for consideration, were damaged in different degrees. These are James Horne & Co.'s new six story and basement department store on the corner of Penn Avenue and 5th Street, fronting 120 ft. on the former, and 175 ft. on the latter, and 112 ft. high;

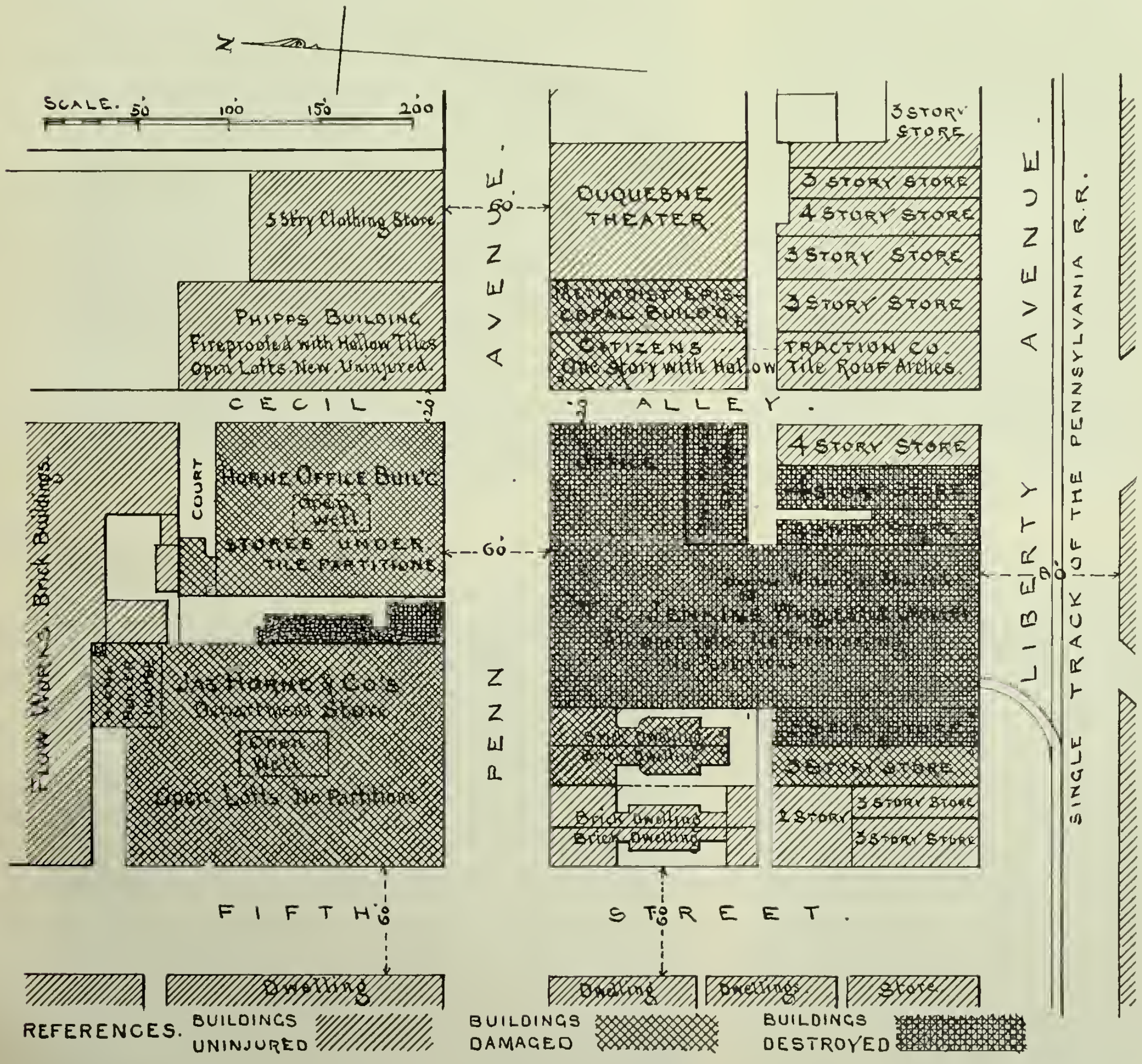


Fig. 1.—Map showing buildings at Pittsburg, Pa., affected by the great fire of May 2 and 3, 1897. The fire started near base of elevator, near center of Jenkins Building, where marked.

PLATE 1.— Showing east wall of Horne Department Store, a steel skeleton covered and enclosed with brick, which bulged out two feet at the top, where the fall of a water tank and floor beams deprived it of lateral support

PLATE 2.— Horne Department Store, showing water tank that crushed through to the first floor, carrying roof, girders, columns, and floors, as well as destroying four passenger elevators and one stairway.

PLATE 3.— Showing front of Horne Department Store and floor arches knocked out through fall of roof, caused by fall of water tank. Beams and girders uninjured except in roof.

PLATE 4.— Horne Department Store, looking up through light shaft, showing general condition after fire.

PLATE 5.— Side and rear of Horne Department Store, showing where riveted roof girder pulled out column in rear wall caused by fall of water tank

PLATE 6.— West store on Horne Office Building, showing end-pressure hollow-tile floor arches after the fire.

Plate 7.—Interior of Horne Department Store, looking south on third story, showing general condition of the interior and wood floor and sleepers burned completely out of the concrete ballast.

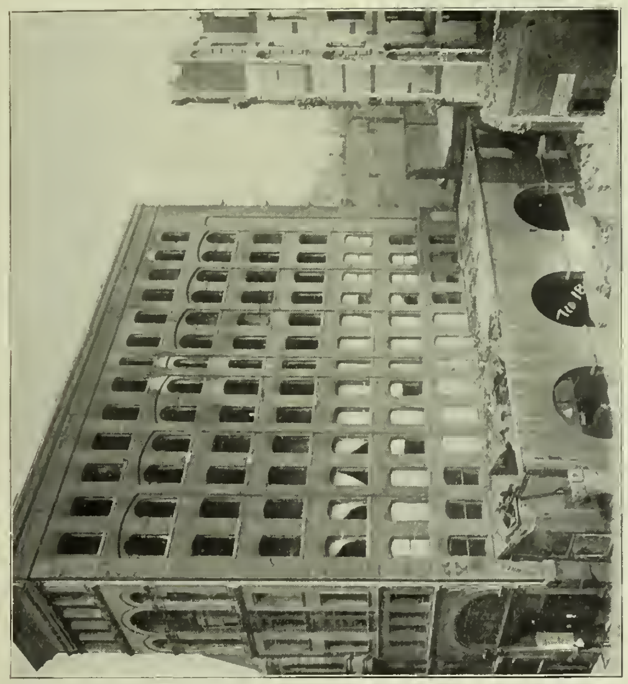


Plate 8.— Methodist Episcopal Building with Citizens' Traction Company one-story building, where the fire stopped on the east. Ruins of Jenkins Building on the right.

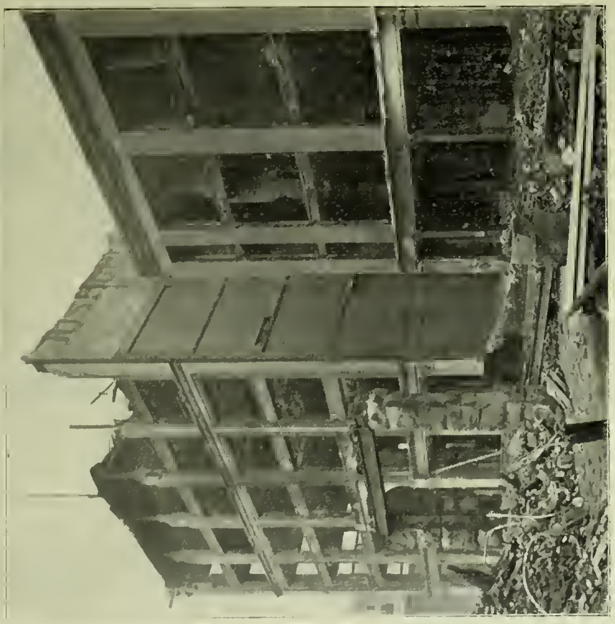


Plate 9.— Fronts of Horne's Department Store and Horne's Office Building, showing gap made in roof of the former through riveted girder, being pulled down by fall of water tank. Seen over ruins of Jenkins Building.

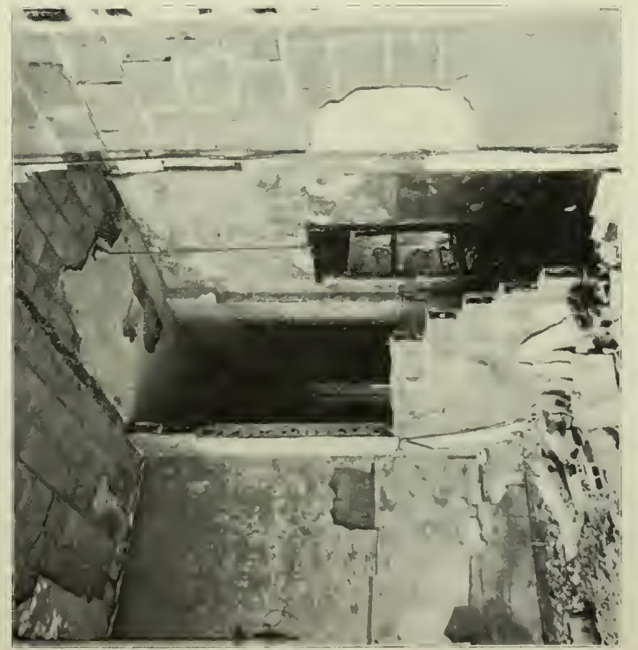


Plate 10.— Horne Office Building, front room in fourth story, showing perfect ceiling tiles and damage to partitions caused by use of wooden frames.

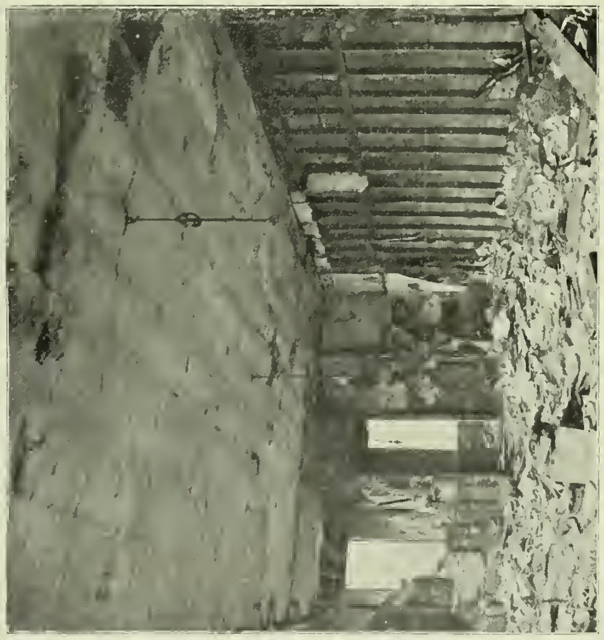


Plate 11.— Methodist Building, eighth floor, showing ceiling of expanded metal and plaster on ⊥ irons and partitions of wooden studs, expanded metal, and plaster.

Plate 12.— Methodist Building, seventh floor, showing concrete ceiling and 20 in. I beams covered with expanded metal and plaster.

the four-story and basement Horne store and office building, fronting 95 ft. on Penn Avenue, and 125 ft. on Cecil Alley; and the eight-story and basement Methodist Episcopal Building, fronting 31 ft. on Penn Avenue, and running back 113 ft. to a rear alley or court. In addition to these the new six-story Phipps Building, fronting 60 ft. on Penn Avenue, and 145 ft. on Cecil Alley, was exposed to fire from the Horne store and office building, but saved by the firemen and its own steel and hollow-tile construction, except as to its broken glass windows. This building had lately been completed and was unoccupied, hence there were no goods in it to increase the risk. The building of the Citizens' Traction Company is a covered way over the tracks of the electric railroad, being the first story of what was once intended to be a high fire-proof building. It is 25 by 236 ft., cut into two sections by the alley running out of Cecil Alley. (See Plate 8.) The walls are brick, and the floor above, which also supports the roof, is of steel beams and hollow-tile arches. There is no plastering or woodwork in the building. The east wall of the north half is the base of the west wall of the Methodist Episcopal Building, which, above the first story, is pierced with windows, which have no shutters. There are, however, standard shutters on the rear, and in the wall overlooking the Duquesne Theater.

Cecil Alley is 20 ft. wide, to which, adding the 25 ft. of the Traction Company, we find that the Methodist Building is 45 ft. from the Jenkins store, on which were standard shutters. Penn Avenue and 5th Street are 60 ft. wide, and Liberty Avenue is 80 ft. wide. Accounts generally agree that there was a light wind from the south and east, to which the fire added impetus.

PLATE 13.— Hallway, seventh floor, Methodist Building, showing concrete ceiling and unprotected I beam header warped by heat.

THE COURSE OF THE FIRE.

With the above explanation of the situation, the reader will be enabled to understand the course of a conflagration that was to put to the test some of the latest efforts of the constructors of fire-proof buildings, including architects, engineers, manufacturers, and users of fire-resisting material. Here was a huge burning structure of the most combustible character, filled with everything necessary to make a great fire, with uncovered windows on the north and south sides, and many elevators to carry the fire from floor to floor. On the north, northeast, and east were four new buildings, constructed with incombustible materials, and intended to be fire-proof, while that to the eastward had a barrier between it and the fiery furnace of the Jenkins Building, consisting of the one-story uncompleted fire-proof structure of the Citizens' Traction Company. Between this and the grocery was a 20 ft. alley, and the other four buildings were on the opposite side of a 60 ft. street. Behind two of them was an extensive plant of low brick buildings for manufacturing purposes extending to the Allegheny River. East of the group was the main business center of the city of Pittsburgh, and the nearest buildings were all of a highly combustible character, including a theater. That this group proved to be an effective barrier to the spread of fire in two directions is the universal opinion of all who saw it, is sufficient honor for those who were concerned in their erection, and a complete vindication of the modern and purely American systems of fire-proofing from the doubts and aspersions that have been cast against them. One of these buildings, the Horne Department Store, is of steel skeleton construction throughout, and is the first building of that kind ever tested by an actual fire which permeated every part of its interior. Though not as high as many others that have been built, it had conditions of exposure which it would be difficult to discover elsewhere; and while this gigantic test is a vindication of the main features of the system, it is not to be intimated that all of these buildings were without faults of construction and planning. But such faults as they have can be easily remedied in the future, and the lesson they convey is one which we now have the privilege to study and profit by. The value of burned clay in protecting steel constructions, however defectively used, has been fully demonstrated in what all admit to be a crucial test.

From information obtained from the authorities of the Fire Department of Pittsburgh, I am enabled to give some idea of the duration and severity of the test. The first alarm was given at fifty-seven minutes past eleven on the night of May 2, and the second alarm followed five minutes later. The third alarm was at 12.04 on the morning of the 3d, and the fourth at 12.33. How long the fire had been in progress before the first alarm is not fully known, and is of no special interest. It started, as has been said, near the center of the Jenkins Building and spread in every direction. In forty-three minutes from the first alarm, or at 12.40 A. M., the entire building was a mass of flames, which suddenly burst out in every direction, throwing down the entire front wall on Penn Avenue, 150 ft. in length. When it destroyed the three adjoining stores on Liberty Avenue is of little consequence, as it had no tendency to go across that street; but when it burst out of the Penn Avenue front a sheet of flame was carried across the street which drove all the firemen out of it, showing that the wind, which all witnesses said was light at first, was from the south and east. The first building to take fire on Penn Avenue was the Horne Department Store, 30 ft. of which lapped the front of the grocery house. The entire front of the Horne store and office building was exposed, but as the other one commenced to burn first, there is a further presumption that the wind was from the southeast. Between these two was an old-fashioned brick dwelling that was wiped out so quickly that no one can tell how long it took to burn. It was practically out of sight of the spectators. As stated by Chief Humphrey, in less time than it takes to tell it, every front window of the Horne Department Store, whose united surface was 60 per cent. of that of the whole front, vanished from sight, and the goods in the building seemed to take fire simultaneously on every story. The flames swept inward and roared up through the large central light court, which acted as a huge chimney for the whole. It was only the work of a few minutes to envelop in flames all the combustible contents of a building in which there were no partitions. The same results followed only a few seconds later in the Horne Office Building. The percentage of glass on the street front was about the same. In this building on the corner next to the alley was a retail crockery store, next came a retail drug store, and at the west side a store for children's dress goods. Three stories above were occupied as offices for dressmakers, milliners, and doctors. There were tile partitions between the stores and around the stairway, and between the offices on the upper stories, also around the large light hole in the center leading from the second story to the roof. But the whole of the glass in the front was burst in at one time, and the floors fired simultaneously. The contents being less combustible in the upper stories and there being many partitions, the fire did not burn as fiercely as in the department store, but as soon as it reached the light shaft *that* formed a flue, which drew the fire to the center, the draft even being sufficient to keep it from the stairway, the iron work of which was preserved all the way up. The retarding effect of the partitions and the draft in the light hole kept the fire entirely out of some of the rear rooms above the second story. But in the light shaft it appeared to have been nearly as intense as in the other building.

No water was put on either of these two large buildings until the fire had done most of its work. The fire department was obliged to withdraw and re-form its lines, and by that time everything combustible in the department store had been consumed, even the wooden floors, and only the rear part of the office building was intact. There was little necessity now for water except as a preventive for the plow works in the rear, for the rear brick walls of both buildings and the standard shutters on the department store kept the fire in. The chief fixed the time of actual burning at about two hours, which allowed one hour and ten minutes to reduce everything combustible in the department store to ashes, and for fire to go as far as it went in the office building. The ruins of the grocery continued to burn until 4 A. M., when the whole fire was considered to be under control. But a duration of one hour was too long to enable the unprotected supports of the water tank on top of the department store to keep it in place. This tank was supported by steel beams and not with wood, as has been stated in some publications. But it fell at some time unknown, carrying with it the entire steel construction of girders, columns, and floors of an area of about 50 by 60 ft. of each floor, four passenger elevators, and the grand stairway. But notwithstanding this, the entire steel framework of the east wall, which was covered and filled in with brickwork, was left standing, and only the center of this wall near the top was thrown out of plumb. This is shown on Plate 1, while the interior where the greatest destruction was wrought is shown on Plate 2. The water tank is here seen hanging in the débris from the second story beams. The view is taken from the first story looking across under the light court. This tank was a closed cylinder 7 ft. diameter, and 18 ft. long, and is said to have been full of water. The shock of this fall seems to have acted on the beams of two bays of the floors all the way to the front of building, through the tie-rods, and was so great that it dislodged nearly all the hollow-tile floor arches in these sections. The beams were only saved from fire by the fact that they were left standing free with nothing combustible near them. See Plate 3 for effects of this shock. The same may also be seen on Plate 9, in which it is seen that the fall of the tank carried away the roof and ceiling all the way to the front wall. This must have been caused by the pulling of the riveted roof girders, which broke away from the front column. The iron roof beams and débris falling through may also have contributed to carrying away the floor arches. The sixth story floor beams did not give way except under the tank. It will also be noticed on the same plate that there was some defect in the method of protecting the steel lintels carrying the wall above the sixth story windows, for they all fell carrying the wall with them and leaving the roof over them. This plate also shows the condition in which the front of the office building was left. On this the lintels held and the flat stone finish was left perfect, but the copper cornice was entirely destroyed. The front bricks of both buildings were uninjured, and it is of value to note that they were made of buff fireclay. The asphalt roofs of both buildings were unharmed except where the roof of the department store fell. Plate 5 shows the condition in which the rear and side walls of the department store were left, on which it will be seen that only the copper cornice was in part destroyed. It also shows that the two roof sections were carried away as far back as the rear wall. It is probable that the tank in falling first struck the roof girder, which being riveted together pulled off at both ends, toppling over all the sixth story columns in that stretch of girder and the rear column built in the wall. This is no argument against riveting, but a strong one against closed tanks at the top of a building.

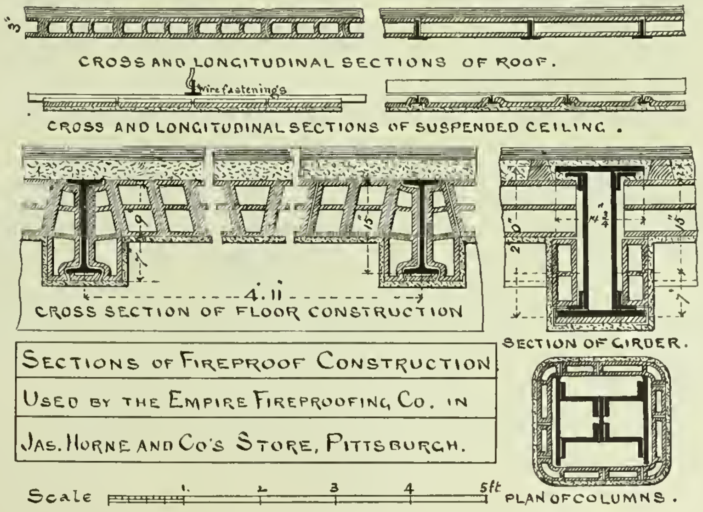


FIG. 2.

Shortly after the front wall of the Jenkins Building fell, 75 ft. of the east wall on Cecil Alley, in which the standard shutters were closed, fell with a crash across the alley and upon the roof of the north end of the Traction Company's building,— where shown in double shading on Fig. 1 and Plate 8,— breaking down the I beams and hollow-tile arches, which were made by the Pioneer Fire-proof Construction Company, of Chicago. Otherwise these arches, which had never been plastered, were unharmed. This fall exposed the west wall of the Methodist Episcopal Building to the heat of the burning ruins, which was so intense as to communicate to all the window frames of that building above the second story. (See Plate 6.) From the window frames the fire communicated to nearly all the rooms on the west side, which were more or less damaged by the fuel that they supplied. But the hall stairway and elevator were on the east side of the building, so that the fire department was enabled to fight the fire in this building, using the hall partitions as a shield, and succeeded in keeping most of the fire out of the hall. The fire seemed to catch in each room separately, and it was only on the sixth and seventh floors that it crossed the hall partition sufficiently to work up though the stair well. At the ceiling line of these stories it wrapped around the I beam headers framing the stair openings, which were unprotected by fire-proofing, and both of the beams were bent outward, carrying the cast-iron aprons with them. (See Plate 13.) The stairway was not materially injured except at these points. In answer to an inquiry addressed to M. S. Humphrey, Chief of the Fire Department, he said that the fire continued in this building probably one hour. The firemen were in the building two hours all told.

As has been stated, the active fire in all the buildings was included within the two hours from 12 to 2 o'clock. The whole department was on duty until 4 A. M., when the fire was considered to be under control. These dates are important to fix, under the circumstances. No water was thrown on the Horne Department Store, which took fire at 12.40, until nearly everything combustible in it was consumed. The firemen were then able to approach it from the west on 5th Street, and proceeded to "cool it down," to use one of their expressions. Herein I find the cause of many of the hollow tiles on the columns, beams, and arch soffits having been broken. The Chief said that very little water was used, but was free to admit that it might have been better for the building had none been used on it. It was, of course, necessary to deluge the ruins of the Jenkins Building, as in such a one there is always much unconsumed material in the ruins. They were able to approach the office building from Cecil Alley, while it was still burning, and put streams of water into it from the fire-proof Phipps Building across the alley. This building (the Horne Office Building) was also subjected to the cooling off process, but it resulted principally in breaking off the beam tiles, the end-pressure flat arches remaining intact. The powerful streams doubtless assisted in breaking down some of the 4 in. tile partitions (see Plate 6), which were all weakened by an industrious carpenter having inserted a flat piece of wood on top of the first course of tiles above the floor in every partition in the building.

THE JAS. L. HORNE & CO. DEPARTMENT STORE.

This building is of steel frame construction throughout. There are four rows of Z bar steel columns standing free, carrying 24 in. built-up girders, the columns averaging 24 ft. 8 ins. from centers. The floor beams average 25 ft. between bearings. They are 15 in. 50 lb. I beams, averaging 4 ft. 11 ins. from centers. The roof was of I beams carrying ⊥ irons and 3 in. book tiles, and the ceiling of light 1½ in. ⊥'s 12 ins. from centers, supporting flat tiles. Fig. 2 shows the steel and hollow-tile construction, the drawing having been made from remains in the building. The exterior steel frame is built into the brick walls. All the hollow tiles were made by the Empire Fire-proofing Company, of Pittsburgh, at their works at Empire, on the west bank of the Ohio River, about eighty miles below Pittsburgh. The work was set by them. The material is pure fire-clay, and hard burned. The walls of all the hollow tiles are generally ½ an in. thick, and only slightly thicker in the arch blocks. The Z bar columns are covered with 2 in. hollow tiles, with round corners, laid in courses of about 12 ins., eight blocks to a course. They are built as a wall around the columns without other fastening. The floor beams are covered with hollow skew-back tiles on both sides, supporting solid soffit tiles below the beams by dove-tailed bearings. The flat, hollow arches are of the side-pressure model, 9 ins. thick, abutting on the beam tiles. Each tile is divided by a horizontal web in the center into two air spaces. These arches are 5 ins. greater in span than the scale of Fig. 2 shows. There are seven tiles in each arch. The girders are covered on the bottom with solid tiles 15 ins. wide, supported by steel cramps which are exposed and only covered by the plastering. The exposed sides of the girders are covered with 4 in. hollow tiles, extending from the bottom flange of the girder to the under side of the flat arches. Dovetailed wooden sleepers were set on the tile arches, 16 ins. from centers, and filled between with 2½ ins. of ballast, made of cement and cinders. This was covered by a double wooden floor. The tile arches are very light, averaging about 35 lbs. per superficial foot.

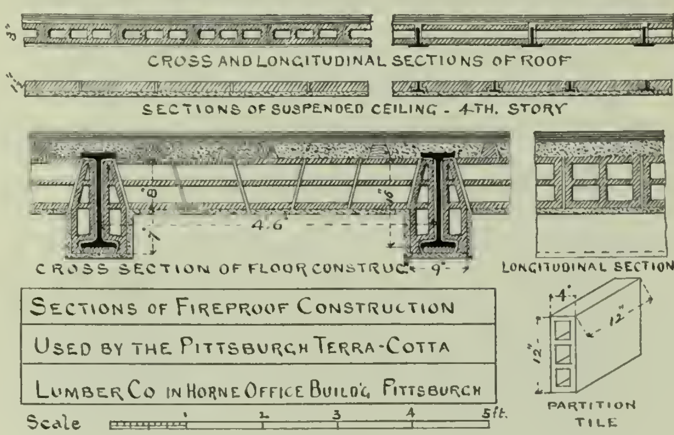


FIG. 3.

Where the fire-proofing was not destroyed by the falling of the tank and the girders, columns, roof, and ceiling which they carried down, the floor arches effectually carried the weight of rubbish remaining on them and protected the steel construction. Notwithstanding that the column covering fell from the whole length of a few columns, and from the upper parts of many others, only one steel column is said to have a slight double curvature, scarcely perceptible. The girders were all effectually protected, and no sag was observable anywhere. The ceiling and roof tiles seemed to stand better than any other part of the work, and there is no sag to either. The ceiling seems to have been a sufficient protection to prevent the exposed bottoms of the ⊥'s supporting the book tiles of the roof from sagging. In the upper stories crockery was melted, as well as cast-iron store stools; yet there is no evidence of fire having penetrated through the floors. This is not to say that the tiles themselves did not sustain considerable damage. The construction of the column covering is something not likely to be repeated. It was not secured to the columns, so that the breaking of one piece or course would let all above it fall. The main cause of the tiles falling was, however, due to the fact that there was but a very slight break in the joints on the middle of each of their four sides. This can be seen on any of the plates where the fall of plastering has revealed the joints. In many cases the middle vertical joint is almost a straight line. (See Plate 2.) Hence the slightest vertical expansion of the whole length of tiles was calculated to throw them out at the center of each column. The main injury to the floor arches was seen in the falling of the bottom plate. In most places this was only occasional, while in a few it was seen in groups; but in no place that I could find had the middle web given out. Hence the full strength of the arch was preserved everywhere. The greatest injury was to the skew-backs and soffits of the floor beams. The outer shell of the lower exposed section had flaked off in many places, but the inner shell was in most cases intact, so that the soffits fell in only a few places. In no case did enough fall to endanger the beams. The bottom plates of the girders, held up by steel clamps, kept their places with remarkable tenacity, and it was only at rare intervals that any had fallen. The tiles on the sides of girders were generally intact, and only in a few instances had the outer shell flaked off.

It is often said that wooden floors laid over concrete seldom burn, and then only in spots. In this building not only are the double floors completely burned, but the dovetailed sleepers buried in the concrete ballast of cement and cinders are reduced to ashes. And further, the ballast itself is reduced to a soft dust, and does not seem to have any of the consistency of concrete. The only theory to account for this is that combustion was set up in the unconsumed cinders.

The statement made in the report on the Denver tests that fire-clay tiles do not lose strength or consistency by reheating and throwing on water has been borne out by this experience. The cracking was evidently entirely due to uneven expansion, notwithstanding that the silly explosion theory has already been repeated. The triumph of fire-proofing with fire-clay has been reached in the Horne Department Store, in the simple fact that it has saved the steel skeleton of the first building erected under that system that has been exposed to a severe fire, and under the most unadvantageous circumstance. The predictions of croakers who claimed that buildings all of steel would be warped out of shape when protected by the modern system of light-weight fire-proofing have not been verified. These buildings looked very bad after the fire, and the photographs from which the plates are made exaggerate the apparent damage. In Plate 7, from a photograph taken on the third story of this building, can be seen its condition where the test was the greatest, showing columns, girders, floor beams, and arches, and the condition in which the floor was found. Plate 4 shows the appearance of the light court and the well-preserved ceiling and roof. The damage on the left was caused by the tank. The architect was the late W. S. Frazer, of Pittsburgh, and it was erected in 1892.

THE HORNE STORE AND OFFICE BUILDING.

This building was designed by the same architect, and erected in 1893. It has four rows of steel Z bar columns carrying double 20 in. steel girders, 16 ft. long. There is no steel in the exterior walls, all of which are brick, and there are three cast-iron columns in the first story store fronts, carrying I beam lintels. There are no lintels in the front wall above the first story except at the top of the third story windows. The front above the first story, therefore, consists of five brick piers, between which were immense wooden window frames with transoms at the third and fourth story floors, all of which have disappeared. It would be difficult to invent a front better adapted to invite fire from across the street. The interior construction and roof were, however, entirely of steel and hollow tiles. The floors are of 15 in. 41 lb. I beams, 20 ft. 6 ins. on bearings, and 4 ft. 6 ins. from centers. The roof is of I beams carrying 2 by 2 in. ⊥'s, 16 ins. from centers, and the ceilings are carried on 1½ in. suspended ⊥'s at 12 in. centers secured to 2½ by 2½ in. ⊥ purlins. The height of the building from sidewalk is 81 ft.

The fire-proofing material throughout is semi-porous red clay hollow tiles, made and set by the Pittsburgh Terra-Cotta Lumber Company. The clay from which they are made is semi-vitreous and contains considerable "grog" or ground brick and tiles. It is not porous terra-cotta in the strict sense, as to be thus called it should be made with an equal bulk of sawdust. Sufficient sawdust has, however, been used to make it burn tough, and to only slightly reduce the weight. The walls of the tiles are about ⅞ in. thick, though in many places solid 1½ in. tiles are used, as around the columns and in the suspended ceiling over fourth story. The fire test in the building showed that heating, wetting, and cooling did not destroy the structure of the material, as is sometimes the case with very light porous terra-cotta made of plastic fire-clays.

The method of fire-proofing the girders was not evident, as none of them were exposed. The columns all come in partitions, and where exposed are covered with 1½ in. slabs of the above material, not fastened in place other than by mortar, a few of which have been displaced. The illustration (Fig. 3) shows the other methods of fire-proofing used in the building, measured and drawn from the work itself, as no other drawings were attainable. The floor construction is similar in general shape to that of the Horne Department Store, but different in details. It is of end-pressure flat arches, and this is the first actual fire in which they have ever been tested. Each beam is covered with a skew-back tile on both sides supporting a solid soffit tile between dovetails at the bottom. The floor arches are of end-pressure tiles in five pieces. Each is cut from a rectangle of 8 by 12 ins., with two crossing webs, leaving four holes in each tile. Hence each tile is 8 ins. thick and 12 ins. wide, and the whole arch is 8 ins. thick, 1 in. less than those in the other building, but, I should judge, much heavier. To the honor of this material be it said that I could not find any arch displaced or the bottom of any tile broken off. The floors had the two air spaces available to the end of the fire. The same cannot be said of the skew-back beam coverings, for though they thoroughly protected the beams, the exposed corners of many of them were broken off, and some of the soffit tiles had fallen. This is shown on Plate 6, from a photograph taken from the street looking into the west store next to the stairway entrance. This is the store that sustained the greatest heat. It shows all the excellences and defects of the work in this building. It will be seen that the hall partition has fallen. This was doubtless done by a powerful stream of water, for it is just where one from the east side would strike. The insertion of the unfortunate wooden strip at the bottom of the partitions made them weak against any lateral force. It should be said, too, that this was the only partition of much size that fell. In other places all the partition tiles that were dislodged were around the halls in the upper stories where so much woodwork was used. None were really destroyed by the action of fire, but through other circumstances, for which the fire-proofer was not responsible; the tiles simply fell down. The floors throughout were built on top of the arches, as in the other building. The ceiling of the fourth story was unharmed by fire. The same can be said of the book tile roof. The asphalt covering of the roof was intact, but the galvanized iron skylight over the light court was completely destroyed, and hardly anything remained to show that it had been there. The steel-trusse framework for the skylight was standing, complete, and apparently unharmed. Plate 10, taken from a photograph of one of the front rooms of the fourth story, looking into the hall, shows the worst condition of the partitions in the upper part. The door and hall window of the hall partition have been reduced to one opening, and all the tiles supported by woodwork have fallen. The ceiling is shown intact. In the lower part of the partition on the left can be seen the place where the carpenter had put his usual strip. It has been said that this building was not subjected to as great a heat as the department store, but the whole front of it was exposed to the Jenkins Building. Plate 6 shows a store which was filled with just as combustible goods as the department store, in which nothing remains to be seen but hollow tiles, and in Plate 10 there is evidence of intense heat, and complete destruction of everything combustible. Yet in several of the rear rooms the contents were saved. The value of semi-porous tiles was completely demonstrated in this fire.

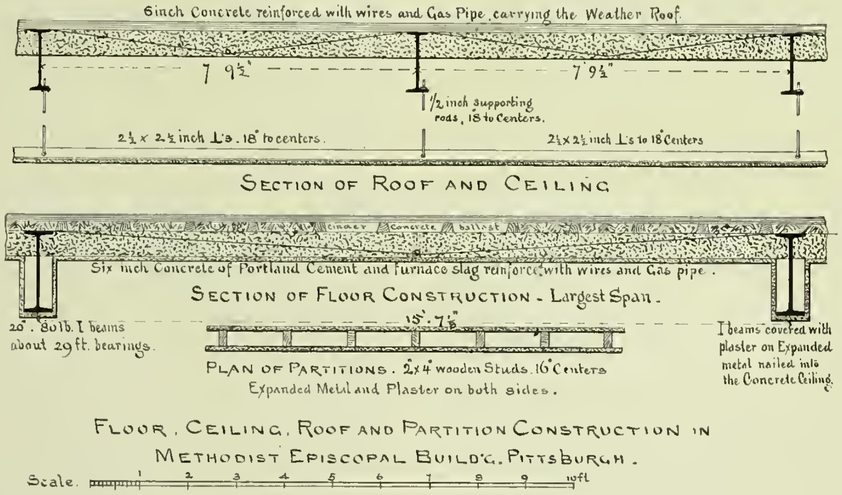


FIG. 4.

THE METHODIST EPISCOPAL BUILDING.

This eight-story and basement building was built with exceptionally heavy walls, and without steel construction except for the floors and roof. The walls on both sides in the first and second stories are 28 ins., in the third and fourth 22 ins., and in the fifth, sixth, and seventh, 18 ins. The eighth story wall on the west side exposed to fire is 18 ins., and on the east side 13 ins., with 18 in. piers to carry the I beams of the roof. The floor beams throughout are generally 20 in. 80 lb. steel, 29 ft. on bearings, and the greatest spans between beams are 15 ft. 7⅞ ins. The roof is of 15 in. I beams not more than 8 ft. from centers, to which are suspended by ½ in. rods 2½ by 2½ in. ⊥'s 18 ins. from centers, to which is attached expanded metal, plastered. Fig. 4 shows the general construction of floors, ceilings, roof, partitions, and beam covering. Plate 11 shows a room on the eighth story, looking toward the front, with ceiling plastered on expanded metal, and expanded metal and plaster partitions on wooden studs. This room with the two private rooms seen through the doors were the offices of Charles Bickel, the architect of the building. Plate 12 shows the room on the seventh floor immediately under it, with suspended concrete ceiling. Two sections of the concrete ceiling, and also of the floor of this room, sag between the beams from 2 to 3 ins. In other parts of the building which were not burned some of these sections have a permanent sag of about 1 in. Plate 13 shows a view of the hall immediately outside of the last-mentioned room. The center rooms of the sixth story were also damaged about the same as in the seventh. The damage to the fifth story was mainly in the front rooms.

This fire, in such a remarkable location, is not without its lessons to all who are interested in the use of clay materials. These will form the basis of some future suggestions.

Mortar and Concrete.

AMERICAN CEMENT.

BY URIAH CUMMINGS.

CHAPTER VII.—(*Concluded.*)

CEMENT TESTING.

THERE is no one feature connected with the subject of cements which exerts a stronger influence in the building up of opinions concerning the qualities of a cement than that of color.

The belief is almost universal that a good dark color is a sure indication of a good strong cement.

The tester is an exception who does not express surprise when he finds a light-colored cement testing higher than a dark one; and he almost invariably attributes the cause to some defect in his dark briquettes.

If he should be told that the way it came to be discovered that the world was round, and revolved on its axis, was by observing that people who did much walking in easterly and westerly directions invariably ran the heels of their shoes down at the back, while those who wore theirs off at the sides were found to do most of their walking in northerly and southerly directions, he would feel that his intelligence had been called in question; but it would not occur to him that his own theory in regard to the color of a cement was equally as whimsical.

It is remarkable how strong a hold some absurd prejudices have upon the general public.

It was not so very many years ago that any brand of Western flour, to obtain a market in the Eastern States, had to be put up in round-hooped barrels.

For more than a third of a century it has been repeatedly stated that the color in a cement was due to the presence of a small amount of oxide of iron, and that in no manner did its presence affect the quality of a cement.

General Gillmore so stated it in his treatise on "Limes, Cements, and Mortars," issued thirty-five years ago; and the same statement has been made by various writers during all the subsequent years. Yet the belief prevails that color has to do with the quality.

So strong is this prejudice, that manufacturers of Portland cements, when they find that their available clay does not carry sufficient oxide of iron to give the requisite color to their product, resort to the use of artificial coloring matter, on account of the difficulty experienced in finding a market for light-colored Portland.

Any coloring matter, whether in a natural or an artificial cement, is an adulteration, and is inherent in the Rock cements, while it may or may not be so in the artificial product.

In the Rock cements the oxide of iron is closely associated with the clay, and its quantity, as a rule, governs the shade of coloring given to the cement.

If the amount is small and the calcination is light, the color of the cement will be a pale yellow. But with a higher degree of calcination, the color becomes a deeper yellow, or a light or a dark drab, dependent upon the intensity and duration of the heat.

If the amount is large, the cement will be light to dark brown, according to the intensity and duration of the heat.

Whatever may be the color of a cement, its quality is in no way affected thereby, unless the amount of coloring matter is excessive.

The quality of a cement is governed by three important requirements, no one of which can safely be dispensed with, namely: —

First, a proper proportion of the essential ingredients, *i. e.*, silica, lime, magnesia, and alumina.

Second, a proper calcination, which must be varied to suit the requirements of varying proportions of the constituent parts.

Third, fine grinding.

It will be seen, then, that a cement may be either light or dark, and yet be of good quality, while a very poor quality of cement may be accompanied by the most taking shade of colors.

And yet, inasmuch as the constituent parts named, when free from impurities, are white, it cannot but be clear that an absolutely pure cement cannot be otherwise than white.

The Rock cements are never colored artificially, and so we find as many variations in color as there are different manufacturing centers, each having its own peculiar shade or tint, while the different brands of the same locality are usually of the same color, yet they may vary considerably in quality.

With the artificial cements, the natural coloring matter is to be found in the clay, the same as with the Rock cements, and, as has been stated, when this is insufficient to suit the prevailing taste (?) resort is had to artificial coloring by the use of some form of carbon, or pigments.

Though the appearance of Portland cement, unadulterated with extraneous coloring matter, is an indication of its merits, it is clear that if artificial coloring matter is employed, the appearance of the cement is no criterion of its quality.

TENSILE TESTS.

The system of arriving at the value of a cement by means of the tensile strain testing machine has grown to such proportions, and is so universally relied upon, believed in, and so seriously regarded as the Ultima Thule of all the knowledge necessary to determine values, and make or unmake a cement in the public opinion, that it seems almost sacrilegious to disturb the serenity of the faithful followers of this modern Juggernaut, who, metaphorically, throw themselves under its sacred wheels.

And yet the system is so permeated with inaccuracies, inconsistencies, and absurdities, that the temptation to puncture the venerable humbug is well-nigh irresistible.

The system contains many features in common with the alleged virtues of the divining rod.

And, although the comparison may seem odious to a large majority of the champions of the tensile test system, yet the author feels measurably assured that a few, at least, of the undoubted facts which he may present will be recognized at sight by many engineers and architects whose experiences with the system have led them into labyrinths of uncertainty and doubt.

The following from a paper on "The Divining Rod," presented by R. W. Raymond at the Boston meeting of the American Institute of Mining Engineers, in February, 1883, is sufficient to illustrate the parallel: —

"First. The immense literature of the divining rod shows nothing more clearly than the boundless confusions and contradictions of its advocates and professors.

"Second. Of the dozen different schools of practise, each is necessarily obliged to reject half of the asserted principles and certified facts put forward by the rest.

"Third. It will be remembered that the Egyptian sorcerers confronted by Moses carried rods, as Moses and Aaron also did.

"Fourth. Cicero, who had himself been an augur, says, in his treatise on divination, that he does not see how two augurs, meeting in the street, could look each other in the face without laughing.

"Fifth. The following formula, cited by Gaetzschmann, may serve as an example: —

"'In the name of the Father, and the Son, and of the Holy Ghost, I adjure thee, Augusta Carolina, that thou tell me how many fathoms is it from here to the ore.'"

One has but to consider that if a package of any brand of cement is divided among fifty expert testers, to be made up into briquettes, all the testers being governed by one set of rules, as to time, temperatures, percentage of water to be used, and the other ordinary requirements, the breakings, when tabulated, will show fifty tables of tests, no two of which will be alike. In fact, they will vary from each other all the way from 1 to 300 per cent., and so, if in the first paragraph of the quotation we insert "tensile tests" in the place of "divining rod," we come near to describing the present chaotic state of the art of briquette making, and, in the fourth paragraph, in the place of "two augurs" read "two testers," after they have stood side by side at the same table, and have each made and tested five briquettes from the same sample of cement, and find the results from 50 to 200 lbs. apart.

And as to the fifth paragraph, let us read it thus, "In the name of the American Society of Civil Engineers, and all the other societies under the sun, whose members practise the art of cement testing by tensile strain, I adjure thee, O thou testing machine, to tell me whether it is thy fault that I am thus befuddled, or am I drifting into incipient idiocy."

A tester makes up briquettes and tests them from a given brand of cement, and reports to his superior that "the cement runs very uneven." The fact that it is his briquettes and not the cement which "runs very uneven" never occurs to this knight of the testing machine.

When Don Quixote made his famous charge on the windmills and was unceremoniously overthrown, he had the courage to beat a rather undignified retreat.

But not so with our knight of the testing machine. He may be overthrown day after day, but he does not know it, and with an assurance bordering on the sublime he will tell you that such and such a brand of cement is not first class, for he has tested it, and the cement is not up to the requirements, for it "runs very uneven."

It is useless to confront him with the fact that other expert testers have found that the brand in question tests above the requirements, for, lacking the prudence of Don Quixote, he is overthrown, but does not realize it, when he says he "can get now and then a briquette to come up to or even go beyond the requirements, but it will not average (?) more than as shown in his tables."

It is probable that we are indebted to the engineers of a past generation for that altogether brilliant idea of giving a brand of cement a record based on its average (?) breakings. And for some unaccountable reason its utter absurdity seems to have escaped the notice of the ablest engineers of to-day.

If a trotting horse should be sent to the track, on a trial of three one-mile heats, for the express purpose of making a record, and the three trials should result as follows:—

		min. sec.
1st	heat,	2.15
2d	„	2.20
3d	„	2.10
total time		6.45

would we calculate the time thus, $6.45 \div 3 =$ average time 2.15, and seriously contend that the horse takes a record of 2.15?

Should this be done, the whole trotting world would smile, and yet it would be no more absurd than it is to give a cement a record based on the average (?) result of breaking strains of three or five briquettes, made from the same sample of cement.

The tester makes three briquettes from a single small sample of cement, and no one will deny that it is precisely the same in all its parts, and to the best of the tester's knowledge and belief, he has made the briquettes precisely alike. He has treated them alike as to every known detail, and yet one breaks at 100 lbs., while the others fall off 30 and 60 lbs. respectively, and the engineer, while knowing these results, from habit or custom, permits the cement to be deprived of its just record, which in this instance is none other than 100 lbs., and the record is fixed at 70 lbs.

If one portion of the sample tested 100 lbs., surely it is not the fault of the cement that the balance did not, and the conclusion is inevitable that it is the tester who is at fault. But the fault is laid to the cement, and so this inanimate though wonder-working material suffers in reputation by the carelessness and blunders of the average knight of the testing machine.

During the construction of the new Croton Aqueduct at New York, a certain brand of Rock cement was tested in one-day neat tests by two sets of testers,—

835 briquettes made by one set of three testers averaged $62\frac{3}{10}$ lbs.
2434 „ „ „ „ ten „ „ $85\frac{2}{10}$ „

a difference of nearly 35 per cent., and yet one set of rules governed all the testers, and the tests were made daily from the same consignments of cement.

From the table of tests of Mr. Thompson, City Engineer, Peoria, Ill., as shown in connection with his specifications as herein given, the following are selected from a large number, as a fair example of one-day neat tests of Rock cement.

No.	No. of Samples.	Highest.	Lowest.	Average.	Per Cent. Variation.
1	8	118	45	77	162
2	6	138	80	109	72½
3	6	104	65	79	60
4	10	103	47	65	119
5	5	142	50	79	184
6	8	143	48	70	198
7	9	141	57	122	145
8	8	167	80	140	108

Mr. Thompson's tables contain the unusual merit of showing the highest and lowest breakings.

The absurdity of giving a cement a record on the average (?) system is well demonstrated in No. 6 of the table.

The eight samples were made from the same cement. One of the briquettes happened to be well made, and it tested 143 lbs., and yet it takes a record of barely one half that figure. It is deprived of its just and true record presumably because the briquette maker, when he made the one which tested only 48 lbs., was either very tired, or careless, or was unduly hurried.

The table given is not an exceptional one. Tables as uneven as this are to be found in nearly every cement-testing establishment in the country, and it has always been so since the tensile test mania began, over a third of a century ago.

The prevailing practise in the making of briquettes is to apply sufficient water to produce the proper degree of plasticity, thereby enabling the operator to press the material into the molds with the thumbs or a trowel.

This method is supposed to attain medium results, and is advocated by engineers generally, under the impression that the breakings of such briquettes indicate quite closely the actual strength of the cement in the masonry in which it is used.

However true this theory may be, it opens the door to a wide diversity of results, as each briquette maker is a law unto himself as to what constitutes the proper degree of plasticity of the material; and herein lies the chief cause of the surprising difference in the strength of briquettes made up from a single sample of cement.

The author has for many years been firm in the belief that the only correct way to test a cement by tensile strain is to use just enough water to properly hydrate the silicates, then pack the material into the molds, making the briquettes as dense and solid as is possible, by tramping or ramming, the object being at all times to make the briquettes test to the utmost limit of the strength of the cement. We would then know the capabilities of each brand tested.

There is a satisfaction in knowing the full strength of a cement whether or not it is ever called into practise in masonry.

Once the full strength of a cement is known, it becomes an easy matter to estimate the strength values of different degrees of plasticity.

By this method we avoid the contradictory and unsatisfactory variations which continually arise among different testers of the same brand, which will always obtain so long as moderate results only are aimed at.

So long as the qualities of our cements are to be measured by tensile strain tests, there is no good reason why the system should not be open to improvement.

If it is self-evident that to the system of aiming at moderate or medium results is due the variations which are often so wide as to be really grotesque, why not abolish such a system and adopt that which will give us without question a full knowledge of the highest limit of strength in the cement, and at the same time reveal to us all its capabilities? And, instead of giving a cement a record based on the average breakings of five briquettes, a most absurd and indefensible system, let the highest testing briquette of the five make the record of the cement.

It is only by the employment of this system that the question of the relative strength of different brands of cement can ever be settled.

It is the only system that is fair to all brands of cement. This is shown by the wonderful uniformity of breakings of briquettes made from any brand of cement where the aim has been to get the highest possible results.

In nearly all the tables of tests that are published where the records of several brands of cement have been carried along for any length of time, it will be observed that one or more of the brands will fall off in a most inexplicable manner.

Perhaps the records are higher at three months than they are at six, or even nine months, and yet at twelve months they may have recovered all the lost ground, or even have made a substantial gain; and so we often notice in long-time tests that a cement may show a strength of, say, 500 lbs. at one year, and 400 lbs. at two years, while the three years' column will show 600 lbs.

This uncomfortable feature is common to the Rock and Portland cements alike.

Should such an uneven showing of one brand be recorded in a table among other brands which show a steady gain, the comparison is naturally unfavorable to the one with the unsteady record.

In fact, it is not at all unusual to meet with those in authority who will unequivocally express a preference for the cement showing the more steady record, even though the brand which has fallen off may have surpassed all the others at the final closing of the table.

The explanation for this curious phase of the subject is found in the deep-seated and profound faith in the infallibility of the testing machine.

If three briquettes are made from a single sample of cement by one person and they are treated alike until broken at six, nine, and twelve months, and the breakings are 500, 400, and 600 lbs. respectively, nothing is more certain than that the briquette which was broken at nine months was not as well made as the others.

If a cement is really weaker at nine months than it is at six months, it is simply impossible for it to show any gain in the twelve months' test.

The absurdity of a cement gaining and losing in strength alternately must be apparent to any person who will study the cause of its setting and hardening.

In the testing of cements by tensile strain the engineer meets with many conditions which seem to puzzle and confuse, among which may be noted that it oftentimes happens in the testing of two or more brands of cement neat, and in sand mixtures, that although the brands may be equal in fineness, the same quality of sand used for all, and all the briquettes made by the same person, yet the cement which tests the highest neat tests the lowest in the sand mixtures.

Rarely more than one set of tests is made, and so the tables are made up, and it is recorded against the highest testing cement that it "tests high in neat tests, but cannot carry sand equal to the lower testing brands."

This is a condition which often confronts the engineer, and, strangely enough, the opinion formed is almost invariably adverse to the brand testing the lowest with sand mixtures, although showing the highest in the neat tests.

In ninety-nine cases in every one hundred the opinion would be corrected by further tests, for it is certain that all conditions being equal, the cement testing the highest in neat tests will also test highest in sand mixtures, and the failure to do so may be looked for in the imperfect manner of making the briquettes.

The only possible exception to the rule will be found in the fact that a cement containing an excess of clay may test high in neat tests, yet will not carry sand equal to one that is correctly proportioned.

But such cements are so exceedingly rare in this country that the rule may be said to hold good, that the fault is in the making of the briquettes.

There are thousands of masons and contractors throughout the country who buy and use cements, in the construction of cisterns, cellar floors, sidewalks, milldams, foundation walls, and for various other purposes, who have no mechanical means for testing the cements they are using.

To such we suggest the following method.

Although the process is very simple and easy to practise, yet it involves a principle which embraces the chief and most valuable features of all other tests.

In fact, it may be said that there are no known methods for testing the hydraulicity of a cement which for effectiveness and reliability can compare with it.

The author has employed this method, whenever occasion has arisen, during the past thirty years, and he has never known it to fail to detect and expose weaknesses or imperfections, if they exist in the cement.

In the practise of this method it is only necessary to make a mold with which to form bars of cement.

All that is necessary for this purpose is a piece of hardwood plank 3 ins. wide, 2 ins. thick, and 12 ins. long.

Mortise into one side of this bit of wood a cavity 1½ ins. wide, 1 in. deep, and 8 ins. long, making the sides and ends slightly beveled, which, with the bottom, should be made smooth, and then the cavity should be well oiled, after which it is ready for use.

Wet up a sample of the cement to be tested into a stiff paste, and with a trowel press it in firmly, and smooth it off level with the face of the mold.

After the cement has hardened, which will occur in from twenty minutes to two hours, turn the mold bottom up, and let it rest on supports ½ in. thick under each end.

By careful jarring the cement bar will drop out of the mold.

Place the bar on the broad side in a pan or box, with the ends resting on supports in such manner that at least 6 ins. of the length of the bar shall be free and clear underneath, with a vertical clearance of 1 to 2 ins.

Next, fill the receptacle with water until the cement bar is completely submerged.

If the cement is strong in hydraulicity, the bar will maintain its shape indefinitely; but if it is lacking in this quality, or is weak, or defective in its composition or manufacture, it is sure to give way between the supports.

The author has known of rare cases where the bar maintained its shape ten days and then collapsed, but the ordinary defects in a cement will be made manifest within twenty-four hours.

Bars made with sand mixtures, of course, require a longer time to harden than those made from neat cements, and, therefore, should be given a full opportunity to crystallize before submersion.

In closing our chapter on the testing of cements, the thought arises, which, although somewhat tinged with impertinence, will not be dismissed without expression.

In our first chapter we quoted from "Hydraulic Mortars," by Dr. Michaelis, Leipzig, 1869, as follows: "The Eddystone Lighthouse is the foundation upon which our knowledge of hydraulic mortars has been erected, and it is the chief pillar of our architecture."

This sentence covers a great deal of ground, and is worthy of much thought and consideration; and granting that it is true, we are lost in conjecture as to what John Smeaton would have done when he built the Eddystone Lighthouse, had the cement which he used in the construction of that famous tower been passed upon by a British government engineer, with a tensile strain testing machine as his guide, and governed by the absurd rules and specifications, for this cement could not possibly have tested 25 lbs. per square inch in a seven-day neat test.

What would be thought of the manufacturer of to-day who would have the temerity to offer such a quality of cement for the construction of a lighthouse in this country or in Europe?

Everybody knows he would be ridiculed, for it is a question if Rock cement testing 150 lbs. in seven days would be considered strong enough, and it is more than likely that a Portland testing 400 lbs. in a seven-day neat test would be required.

Yet the Eddystone Lighthouse stood in good condition over one hundred and twenty years, until taken down to make way for a larger structure; and the mortar was found all that could be desired.

This being true, what becomes of our boasted advance in the art of cement making?

Where can we find a more trying place for a cement mortar than in the stone walls of a lighthouse standing out in the open sea?

Wherein lies the benefit of using a high-testing cement for such work, when a cement of the quality of the Aberthaw hydraulic lime used by Smeaton in the walls of the Eddystone Lighthouse can be supplied in this country for less than one fourth the cost of the high-testing cement?

If we care to build for all time, we must remember that that which causes a cement to set promptly in water also causes its comparatively early disintegration when exposed to the atmosphere.

A cement, therefore, which requires sixty or ninety days to harden in exposed masonry will be found in perfect condition ages after the mortar made from quick-setting cements has crumbled out and disappeared.

The investigations of Professor Tetmajer, of the Federal Polytechnical School, at Zurich, developed the fact that some German Portland cements, when used in work exposed for several years to the air, lose their consistency and crumble.

So serious had this danger become that, only a few years ago, the German Minister of Public Works issued a circular restricting within narrow limits the use of Portland cement in work exposed to the air.

Professor Tetmajer found, after careful examination, that the cause of the disintegration of Portland cement exposed to the air is found in a want of proper preparation of the materials, particularly in the lack of sufficient grinding together of the chalk and clay to insure the complete silification of the lime during the process of calcination.

He also found that the best brands of German Portland cement which had withstood the action of water for several years became soft on exposure to air.

He says, also, that "air especially attacks sharply (hard) burnt cements, which imbibe a great deal of carbonic acid, and the decay in water is caused by an excess of matters which undergo an increase in volume by oxidation and imbibing of water."

What, then, can justly be claimed as an advance in the art of cement fabrication since the days of Smeaton, one hundred and forty years ago?

We have managed how to make a cement which will set hard in much less time now than then, but at the expense of endurance and this is, practically, all that has been learned.

The cement world of to-day is wrought to a high pitch in the matter of high short-time tests. The pendulum has swung in that direction without let or hindrance. But it will start on its return as soon as sufficient time has elapsed to prove beyond question that a cement may test too high, that all tests above the medium are developed at the expense of endurance.

And so there are those living to-day who will witness the passing of the high-test craze, and who will smile when they read of the conditions surrounding the testing of cements during the latter half of the nineteenth century.

The Masons' Department.

STRAINS IN ARCHES. I.

BY JOSEPH MARSHALL.

IN order to sustain any load over a void, between two supports, we have only four means available: (*a*) the lintel; (*b*) the arch; (*c*) the suspension cord or arc; and (*d*) the cantilever. In the lintel we have two forces in the same body — compression and tension. The relative areas of the body composing the lintel which are subject to these opposite forces at any one time, or in any one instance, must depend upon the nature of the material of which the lintel is composed and upon the force of the load borne. As a result we have what we call the *transverse strain*, which is only the offspring of the two opposing forces of compression and tension, both in operation at the same time in different parts of the same mass. It follows, therefore, that the highest efficiency is obtained from a lintel when the molecules of the matter of which it is composed possess a high degree of cohesion among themselves, and a high degree of resistance to compression. From these two qualities result *rigidity*. The lintel then derives its usefulness from this quality of rigidity.

The arch, on the contrary, has all its parts in a state of compression, and, therefore, only one kind of strain in operation in the masses of which it is composed. But because it is composed of several masses whose relations of cohesion to each other depend mainly on the gravity of their individual masses, there necessarily exists in the arch, as a construction, a high degree of pliability. So that while the lintel is wholly in transverse strain the arch is wholly in compression. But accompanying the arch and inseparable from it, as a construction, is this dangerous quality of pliability. While the office of the arch and lintel are the same, the manners of discharging the functions are different — their physical properties, and the effects produced upon their respective supports, are different. The lintel discharges all the force of the load borne, vertically upon its supports, and exercises no disturbing influence in a lateral direction. The arch conveys the whole force of the load borne to its supports, but at the same time exerts a lateral pressure tending to disturb their verticity, although not always in the same direction, yet, as generally used, tending to drive them apart.

It is of no importance, in considering their relative properties, whether an arch be perfectly horizontal, or a lintel be of any degree of curvature which an arch might exhibit, the physical properties of each remain quite unchanged. It is quite conceivable that a lintel might be made of a semicircular or other curved form to span a void and rest on two distant supports, yet while it may look like an arch and fulfil the office of an arch, it would still be nothing more than a curved lintel. On the other hand, an arch could be built so as to present horizontal boundary lines at top and bottom (as lintels usually do), but if it were composed of more than two distinct pieces which, by their collective relations and gravity, retain their position in place, *it is an arch*, although it may *seem* to be a lintel.

An arch, then, is definable as: An assemblage of not less than three pieces of any firm material so arranged in position that by their contact with each other, and their inherent gravity, they retain their relations of place and position so as to form a continuous structural way impending a sub-transverse void, and having support at its extremities only.

It is not necessary that such a structure should present to view in any part or particular a curvilineal form — such characteristic being incidental to convenience only.

In order to the better understanding of what we may say later, we will here divide arches into their natural classification.

All arches, of whatever form, are comprehended in two classes.

In three articles which will be published in consecutive numbers of THE BRICKBUILDER, Mr. Marshall, who has made an exhaustive study of the subject will give briefly his theory regarding the "Thrusts and Strains in Arches."— EDS.]

First, all arches springing from horizontal planes. Second, all arches springing from inclined planes.

In each of these classes there are four distinct varieties : —

First Class. *a*. Arches springing from horizontal planes the arcs of which are described from one center, and which attain their apex or maximum altitude (the highest point of the intrados) at a point vertically over the center of the arc. See Fig. 1.

b. Arches springing from horizontal planes, the arcs of which are described from two or more centers, and which attain their apex at a point to be determined by the intersection of their arcs. See Fig. 2.

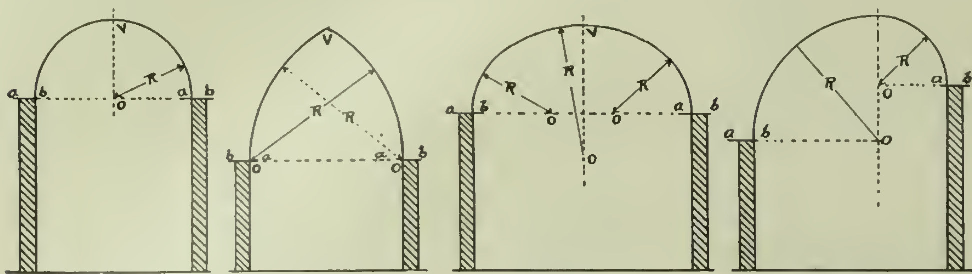


Fig. 1. *Fig. 2.* *Fig. 3.* *Fig. 4.*

a b horizontal planes ; *o* centers of arcs ; *r* radius ; *v* apex or highest point of intrados.

c. Arches springing from horizontal planes, the arcs of which are described from three or more centers, only two of which are located on the horizontal line from which the arches spring, and which attain their apex vertically over the center of the span. See Fig. 3.

d. Arches, springing from horizontal planes, the arcs of which are described from two centers in the same vertical line, and which attain their apex at a point in the same vertical line in which their centers occur. See Fig. 4.

Second Class. *a*. Arches, the arcs of which are described from one center, springing from inclined planes, situated below the point where a line drawn at an angle of 45 degs. of elevation from the center of the arc would intersect that arc, and which attain their apex at a point vertically above the center of the arc. See Fig 5.

b. Arches, the arcs of which are described from one center, springing from inclined planes, situated at or above the point where a line drawn at an angle of 45 degs. of elevation from the center of the arc would intersect the inner line of the supporting pier, and which attain their apex at a point vertically over the center of the arc. See Fig. 6.

c. Arches, the arcs of which are described from two or more centers, and which spring from inclined planes, situated below the point where a line, drawn at an angle of 45 degs. from the centers of the arcs, would cut the arc, from whose center it is drawn, and which attain their apex at the point where the arcs intersect. See Fig. 7.

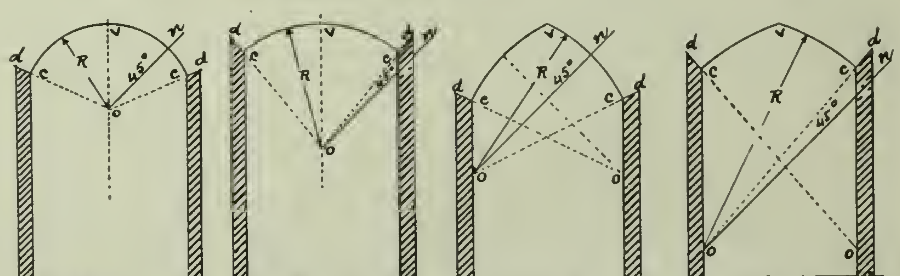


Fig. 5. *Fig. 6.* *Fig. 7* *Fig. 8.* *Jm*

d c inclined planes; *o* centers of arcs; *r* radius of arcs; *v* apex or highest point of intrados; *o n* the line drawn at an angle of 45 degs. elevation from the center of the arc to intersect the arc or the inner line of supporting pier, as may be.

d. Arches, the arcs of which are described from two or more centers, and which spring from inclined planes, situated above the point where lines, drawn at an angle of 45 degs. of elevation from the centers of the arcs, would intersect the inner lines of the supporting piers, and which attain their apex at the point where their arcs intersect. See Fig. 8.

Each class and variety has inherent elements of action peculiar to itself, but all are comprehended under one unchanging law.

It has been usual, we believe, to consider that all arches begin to exercise their *thrust* force at the *springing line*, and we believe most commentators on the arch take this for granted, and begin by assuming this premise to be correct. But from our investigations we are led to believe that this assumption is erroneous as a general law, but quite correct under certain circumstances. Hence, it is at best but misleading. Some forms of arches, although bound together at the springing line by sufficient force to prevent spreading of the supports *below* the spring line, could, nevertheless, be quite completely overthrown *above* the spring line by placing sufficient load at or about the crown. It is true that the force required to accomplish this result would be much greater than if the same arch was mounted on piers of greater or less height, and the reasons, therefore, we shall endeavor to present in future chapters.

In all our means of spanning voids, considering each contrivance as a whole, there seems to be no real difference in the manner of applying forces to resist gravity — tension and compression being the two forms of its application to matter. Indeed, it is exceedingly doubtful if force can be otherwise applied to matter.

We have observed that in the lintel one part was in compression while the other was in tension. This is equally true of an arched structure, *i. e.*, the arch and its piers, though not true of the arch itself. All parts of the *arch* are in compression, but the resistance of the piers is the equivalent of tension; indeed, it is the *evidence* of tension. A truss, no matter how elaborate, is only a constructed lintel, which has, like the monolithic lintel, its tension and compression within itself, differing from the arch, which has its compression within itself and its tension in its piers. The suspension cord is the reverse of an arch, being all in tension, but demanding the complement of compression from its supports. A cantilever is an arrangement of three trusses, or lintels (supplemented with gravity counterpoise), so arranged that two of them have their tension parts uppermost, and in opposite position from the third.

FROM THE BENCH.

Liability of Assignee of Building Contract.—Where an assignment of a building contract as collateral security for a loan required the assignee to pay all moneys received on the contract to the assignee, and the assignee to apply them to the payment of claims arising under the contract, the assignee was not liable for the payment of such claims beyond the amounts so received.— *Supreme Court, Penn.*

Contractor May Have Fraudulent Conveyance Set Aside.— A contractor having a mechanic's lien may sue to set aside as fraudulent a conveyance of the premises by the owner. His standing, said the court, is not that merely of a general creditor, who must first obtain a lien on the property of the debtor by the recovery of a judgment and issue of execution. His lien is perfect on complying with the requirement of the statute, and it is a specific lien on the particular property, similar in all respects to a mortgage.— *Supreme Court, N. Y.*

Recent Brick and Terra-Cotta Work in American Cities, and Manufacturers' Department.

NEW YORK.— The most interesting event during the past month was the signing of the Greater New York charter by Governor Black.

A few facts regarding the extent of Greater New York may be of interest to our readers. The new city will cover 359.75 square miles. Its population will be 3,200,000. Length, 35 miles. Width, 19 miles at widest point.

There will be 167,000 buildings, of which 130,000 are residences.

During the past month the prospectus of the preliminary competition for the New York Public Library has been published. As announced recently in THE BRICKBUILDER, this building is to be a large and important one, and will be the home of the Astor, Lenox, and Tilden Libraries. $2,500,000 has been appropriated. Unfortunately the conditions of the competition are so unsatisfactory that very few of the leading architects will compete. Just now the New York architects are making a bold stand to have competitions properly conducted. It is a noble and worthy effort, and cannot be too highly commended.

ST. JAMES BUILDING, 26TH STREET AND BROADWAY, NEW YORK CITY.
Bruce Price, Architect.
The four hundred thousand red face brick used in the four exterior walls of this building were made by the Fuller Brick and Slate Company, Pine Grove Furnace, Pa., and supplied through their New York representatives, H. F. Mayland & Co.

Barnard College has been presented with $140,000 by Mrs. Joseph M. Fiske, to be devoted to a dormitory building.

The designing of the new Hall of Records has been entrusted to J. R. Thomas, who received first prize in the late City Hall competition.

Preparations for the new Chamber of Commerce are being made rapidly. $300,000 has been subscribed towards the building fund. The building will cost about $1,000,000.

CAP TO COLUMN, ENTRANCE BOHEMIAN CLUB, NEW YORK CITY.
Made by Excelsior Terra-Cotta Company.

Plans have been filed for an addition to the American Museum. of Natural History, to cost $500,000. Cady, Berg & See are the architects.

Little & Brown, of Boston, have planned a $100,000 house for Mr. E. W. Bliss, to be built on 61st Street, East.

F. A. Minuth has plans for the new $80,000 church for St. Paul's Lutheran Association, 22d Street and Eighth Avenue.

Plans have been filed for seven four-story and basement brick and stone dwellings on Riverside drive and 80th Street. Cost, $180,000. Clarence True, architect.

William R. Grace has purchased four lots on the north side of 60th Street near Amsterdam Avenue, as a site for the Grace Institute, for the instruction of young women, in practical arts and business.

Renwick, Aspinwall & Owen have prepared plans for a $100,000 country residence for Mr. Frederick Potter, at Sing Sing on the Hudson. It will be 60 by 150 ft., built of brick and terra-cotta.

Plans have been filed for a fifteen-story office building, 9 to 13 Maiden Lane, for Mr. Frank Gill. R. S. Townsend, architect.

C. P. H. Gilbert has planned a $200,000 hotel for R. N. Rafalsky, on 45th Street near Sixth Avenue, to be used as bachelor apartments.

Babb, Cook & Willard have planned a printing office for the New York Life Insurance Company, to be built corner of Elm and Leonard Streets. Cost, $150,000.

An addition to St. Vincent's Hospital, West 11th Street, near

CAP TO PILASTER, FOURTEENTH STORY, ST. JAMES BUILDING, NEW YORK CITY.
Bruce Price, Architect.
Made by Perth Amboy Terra-Cotta Company.

TERRA-COTTA ARCH, FIFTEENTH STORY, ST. JAMES BUILDING, NEW YORK CITY.
Bruce Price, Architect.
Made by the Perth Amboy Terra-Cotta Company.

Greenwich Avenue, will be built at a cost of $300,000. Schickel & Ditmars, architects.

Mr. J. T. Tower has bought the property 50 by 100 ft. corner of Fifth Avenue and 45th Street, for $410,000. He intends to erect a ten-story office and studio building.

The Metropolitan Street Railway Company intend to erect a car and power house at 146th Street and Lenox Avenue, at a cost of $200,000. A. V. Porter, architect.

PHILADELPHIA. — There seems to be a steady improvement in the building trades, and we are told that there have been more projects figured upon within the last three months than in any similar time since the depression reached this city.

Prominent amongst the projects now being put forth we may mention the Parkside Apartment House, which will be built on the corner of Parkside Avenue, 40th Street and Girard Avenue, a location unexcelled for a building of its kind. It will be of light bricks, stone, and terra cotta, seven and a half stories high, and the three fronts will be 90 ft., 29 ft., and 75 ft. respectively. The style will be French Renaissance, the lobby and main entrance in the style of Louis XVI., and the reception room Moorish; there will be a restaurant on the top floor, and a roof garden above. Architect Angus S. Wade has the work in charge.

Architects D. H. Burnham & Co., of Chicago, Ill., have completed the drawings for the $2,000,000 office building which the Land Title & Trust Company of this city expect to erect at the corner of Broad and Chestnut Streets. The site has been cleared of the buildings which formerly occupied it, and estimates upon the work are being made. The building will be 75 by 100 ft., fifteen stories high, the first and second of granite, and the others of buff brick and terra-cotta. It is intended to be the best equipped and most thoroughly modern office building in the city.

An apartment house will also be erected at 16th and Spruce Streets, by Mr. A. H. Mershon, from plans made by architect Thomas Bennett. This will also be thoroughly up to date, and of brick and terra-cotta.

There will be an addition built to the infirmary at Girard College. It will be three stories and basement, and conform to the present building. It will be 75 by 154 ft., and contain mortuary room, disinfecting room, swimming pool, and large wards.

The first award of the John Stewardson memorial scholarship in architecture was made on Monday last to H. L. Duhring, Jr., a graduate of the School of Architecture of the University of Pennsylvania. The problem was a city church in the style of the Renaissance. Mr. Duhring's design was adjudged as of especial merit. Charles Z. Klauder and Oscar M. Hokanson were awarded equal honorable mentions. The first prize gives to Mr. Duhring the use of $1,000 to be expended in travel and study in Europe, under the direction of the trustees of the fund. The judges were Prof. Wm. R. Ware, of Columbia College, G. L. Heins, and John Galen Howard, all prominent architects of New York.

BUFFALO. — Activity in the architectural and building lines in general is becoming now a little more pronounced. One noticeable feature is that few good buildings of the residence class are in progress, but chiefly flats and tenement buildings of low cost, which tends to prove that business has not improved to the extent anticipated.

Amongst the more prominent buildings nearing completion may be mentioned the eight-story apartment house, "The Lenox," on North Street near Delaware Avenue. Lovering & Whalen, architects.

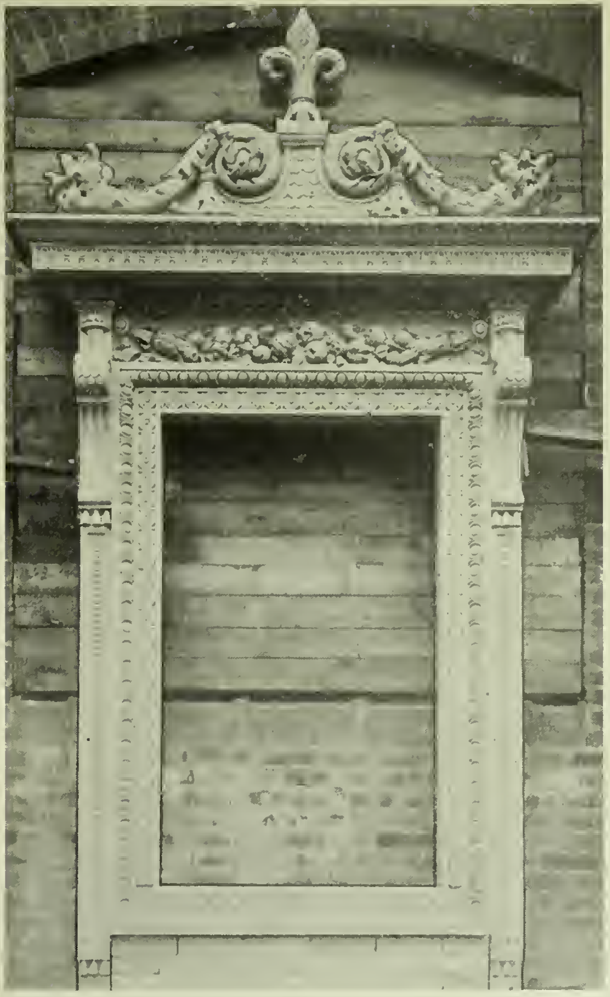
The entire cost of the building was about $400,000.

The John Otto & Son's five-story, fire-proof store and office building on Main Street. This building, with a frontage of 110 ft., has a first story of granite, and the entire superstructure of light buff terra-cotta, manufactured by the Northwestern Terra-Cotta Company, of Chicago; the four-story business block on Main Street, near Huron Street, erected by the Evans Estate; this building is of steel construction, fire-proof, and has a very ornate front composed entirely of white terra-cotta, supplied by the above-named firm. E. A. Kent is the architect for both these buildings.

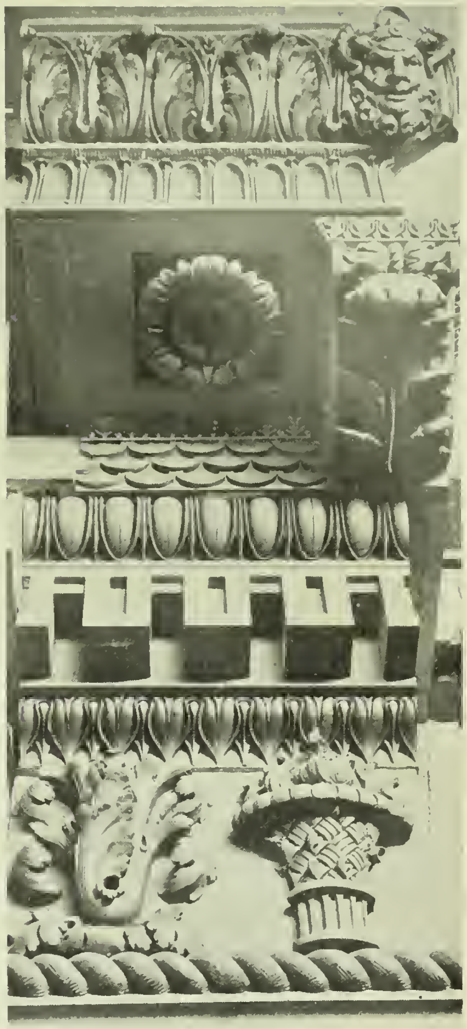
Amongst projected buildings may be mentioned the $50,000 "Welcome Hall," to be erected on Seneca Street by the First Presbyterian Church, and to be used as a place of recreation and reformation of the lower classes of all creeds. Green & Wicks are the architects.

The same firm is preparing drawings for the new ten-story, fire-proof office building to be erected by the trustees of Syracuse University, at Syracuse, at an expenditure of $451,000; also the new brick residence and stable,

TERRA-COTTA DETAIL, OFFICE BUILDING, FIFTH AVENUE, NEW YORK.
Albert Wagner, Architect.
Made by White Brick and Terra-Cotta Company.



THIRD STORY WINDOW, VAN RENSSELAER HOUSES, ALBANY, N. Y.
Marcus T. Reynolds, Architect.
Made by New York Architectural Terra-Cotta Company.



MAIN CORNICE, VAN RENSSELAER HOUSES, ALBANY, N. Y.
Marcus T. Reynolds, Architect.
Made by the New York Architectural Terra-Cotta Company.

designed in a most severe style of Elizabethan architecture, at the corner of Delaware Avenue and Ferry Street, for John Glenny.

The Historical Society has finally decided to erect their new building in the Delaware Park, near the lake, at an outlay of $50,000, but as yet no architect has been selected; in fact, it has not been decided whether or not it will be put up to open competition.

The erection of an enormous convention hall by this city has been authorized by both houses, and the sum of $400,000 appropriated, but no site has yet been selected, although the idea of using the present Chippewa Market site, and having the hall built over the market, is meeting with much favor. When the ideas of the public are finally crystallized, competitive designs are to be asked for.

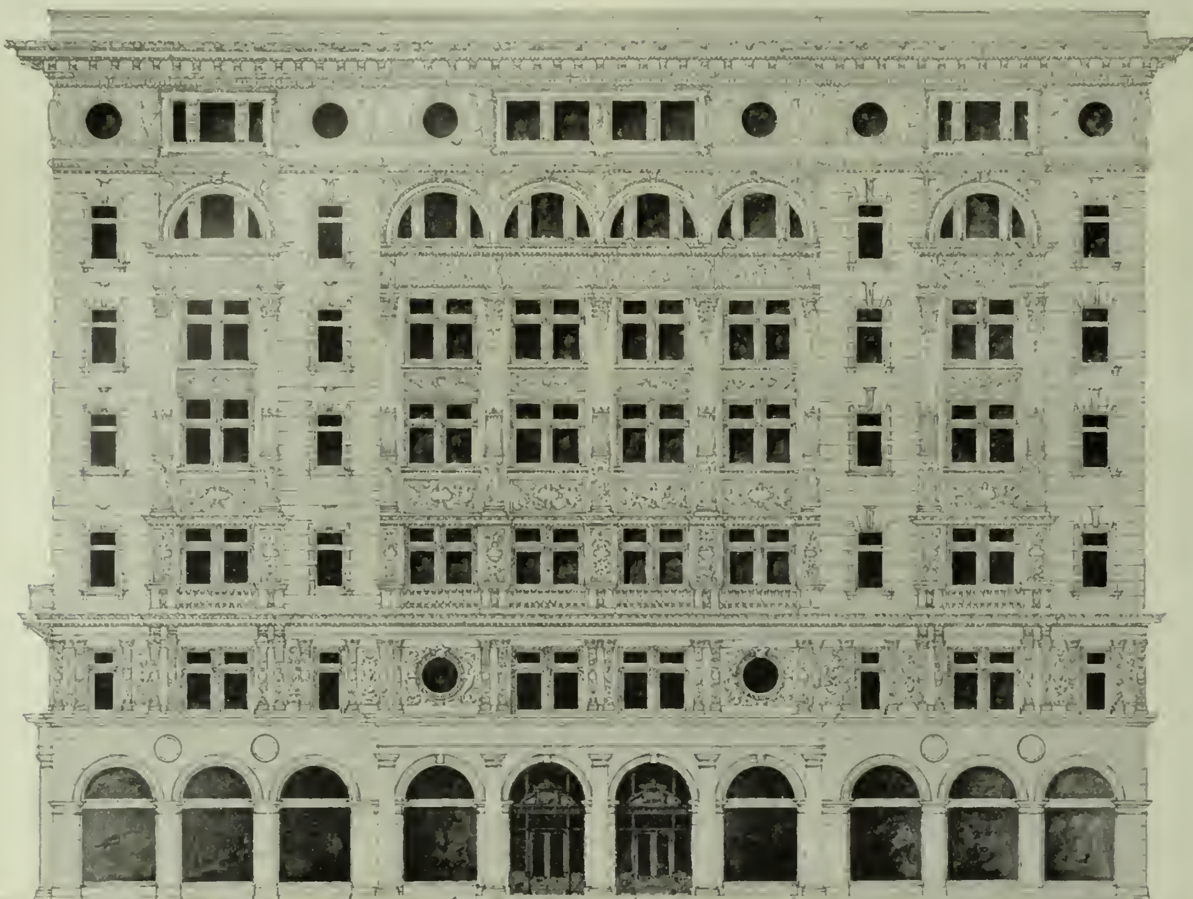
The contract for the new shops of the Merchants' Dispatch Company at Penfield, N. Y., has been let to J. L. Stewart & Co., for $118,215.

SECOND STORY WINDOW, VAN RENSSELAER HOUSES, ALBANY, N. Y.
Marcus T. Reynolds, Architect.
Made by the New York Architectural Terra-Cotta Company.

The new East Side High School, also four new public schools, are almost ready for use, and are to be formally opened after the summer recess. Two of the schools have been built of fire-proof construction, and since it has been found that the cost did not exceed that of the non-fire-proof ones, the intention is that all new buildings used for school purposes shall be built as nearly fire-proof as possible.

PITTSBURG. Building projects are on the increase, and several very good buildings are under way, among them being the new Horne Store Building, to be erected on the site of the burnt building, from plans by architects Peabody & Stearns, to be steel and fire-proof construction. The Horne Office Building, which was also destroyed by the fire, will be rebuilt from plans by architects Struthers & Hannah, successors of the late W. S. Fraser. The same firm are also preparing plans for a five-story building for Mrs. McCullough, to be erected opposite this building, but facing on Liberty Street, to be of brick and terra-cotta. The Jenkins Building, in which the fire originated, will be rebuilt from plans prepared by architects Topp & Craig. It is to be six stories, and of steel construction, to cost $150,000. The same firm are preparing plans for a brick hotel, to be erected at Ebensburg, Penn., for G. B. Denny, Esq. Architects Alden & Harlow are preparing plans for the West End branch of the Carnegie Library. Architects Geo. Orth & Bros. are preparing plans for a large brick warehouse for Harry Darlington, to be erected on Seventh Avenue. The B. P. O. E. of Allegheny are contemplating the erection of a club house, to cost $25,000. Architect S. T. McClarren has prepared plans for a sixteen-room schoolhouse for the sixteenth ward, to cost about $75,000. Architect J. E. Campbell has prepared plans for a six-story hotel building at Greensburg, Penn., for Jno. Keck, Esq., to cost $40,000. City architect H. S. Bair is preparing plans for No. 27 Engine House, to be two stories, brick and stone.

The "Colonial," which is designed for bachelor apartments, has just been completed. Messrs. Barnett, Haynes & Barnett were the architects. The building occupies the site of the old J. E. Kaime residence, and into which the old residence has been incorporated.



PROPOSED BUILDING FOR THE CURTIS PUBLISHING COMPANY, SIXTH AND WALNUT STREETS, PHILADELPHIA, PA.
MacCollin & Fast, Architects.

ST. LOUIS.— There is less work in the architects' offices at the present time than at any previous time within a number of years, not excepting during the panic of 1893. The report of the Commissioner of Buildings shows permits taken out for improvements aggregate more than for the corresponding time last year, but it consists mostly of alteration and small residences or cheap flats, which are innocent of ever having been in an architect's office.

Architect August Brinke has prepared plans for an apartment building 150 by 215 ft., to cost $125,000, and for a bakery to be located on Grand Avenue, to cost $200,000, for the Weile, Boettlers Bakery Company.

Architect H. E. Roach has prepared plans for an apartment building for Mr. E. B. Woolfe, to cost $500,000.

TERRA-COTTA DETAIL, HORTICULTURAL HALL, PHILADELPHIA.
Frank Miles Day & Brother, Architects.
Made by the Conkling-Armstrong Terra-Cotta Company.

DETROIT. — Architect Gustav A. Mueller has completed plans and let the contracts for the erection of a handsome five-story store for Ernst Kern, retail dry goods dealer, to be erected at the southeast corner of Woodward and Gratiot Avenues. It will have a frontage of 36 ft. 8 ins. on the former avenue, and 100 ft. on the latter. The exterior will be of buff pressed brick, with trimmings of Ohio buff sandstone and terra-cotta. It will cost $35,000.

Architects Malcomson & Higginbotham are preparing plans for a $30,000 residence for Edward Ford, Wyandotte, Mich., to be of pressed brick, terra-cotta, and buff sandstone. Also completed plans for additions to two public school buildings for the Board of Education, Detroit, to be of brick, and cost respectively $20,000 and $10,000. Also completed plans for a two-story pressed brick residence for Dr. Reuben H. Osborne, to be built on Ledyard Street, to cost $10,000.

Architects Spier & Rohns have prepared plans for a two and a half story pressed brick and stone residence for C. W. Althouse, to be built at the northwest corner of Woodward and Delaware Avenues. It will have tile roof, and cost $20,000. Also prepared plans for a two-story pressed brick parochial residence for the Roman Catholic parish of the Sacred Heart of St. Mary, to cost $10,000.

Architects John Scott & Co. have completed plans and awarded contracts for a three-story double residence for Jeremiah Dwyer, to be built at the northwest corner of Jefferson and St. Aubint Avenues. It will be of buff pressed brick trimmed with terra-cotta and buff sandstone, and cost $17,000.

Architect Edward C. Van Leyen has prepared plans for a two and a half story pressed brick residence for Charles L. Coffin, to be built on Medbury Avenue. It will have tile roof, and cost $10,000.

Architects Mortimer L. Smith & Son have completed plans for a $10,000 pressed brick double residence for Mrs. O. N. Brown, to be built on Warren Avenue.

Architects Baxter & Hill have plans for a two and a half story

TERRA-COTTA DETAIL, BRAZIER BUILDING, BOSTON.
Cass Gilbert, Architect.
Made by the Northwestern Terra-Cotta Company.

stone and pressed brick residence for Edwin Earle, to be built on the east side of Woodward Avenue, to cost $10,000.

Architect Albert E. French has prepared plans for a two and a half story pressed brick residence with cut stone trimmings for Justice H. L. Shellenburg, to be built on Forest Avenue, at a cost of $10,000.

PERSONAL AND CLUB NEWS.

Mr. L. D. Bayley has retired from the firm of Putnam & Bayley, architects, Northampton, Mass., and has formed a copartnership with Mr. Goodrich, of Hartford, Conn., under the firm name of Bayley & Goodrich. Mr. Putnam will continue the business of the old firm.

The Chicago Architectural Club held its last "Bohemian night" meeting before vacation, on Monday evening, June 7, in the club rooms. H. Y. von Holst, Adolph F. Bernhard, Chas. Eliot Birge were hosts. The club rooms will be open during vacation.

The regular monthly meeting of the St. Louis Architectural Club was held on Saturday evening, June 5. It was decided to discontinue the classes during the summer months excepting the water-color class, under the instructions of F. C. Dwyer.

The club's exhibition, which is purely local, consisting solely of the work of members of the club, opened on the same evening.

The monthly meetings, which are largely of a social character, will be in the way of excursions, etc., until the fall work commences. The first of these excursions will be to Belleville, Ill., to inspect the brickyards at that place.

ITEMS OF INTEREST AND VALUE.

The city of Worcester has contracted for Atlas brand American Portland cement for this season's supply.

Powhatan cream-white bricks will be used in the new Troy Bazaar Building, at Troy, N. Y.

Waldo Brothers have secured the cement contract for the city of Quincy, Mass., for this year, supplying them Hoffman, Rosendale, and Atlas brand of American Portland.

H. F. Mayland & Co. are the New York representatives of The Burlington Architectural Terra-Cotta Company, of Burlington, N. J.

The town of Melrose, Mass., has contracted with Waldo Brothers for their season's supply of cement, the brands being Hoffman, Rosendale, and Brooks, Shoobridge & Co. Portland.

The cement for the Southern Union Station has been awarded to Waldo Brothers by Norcross Brothers, Hoffman being the brand. This is the largest order for cement ever placed in Boston.

H. F. Mayland & Co., United Charities Building, are the New York representatives for Messrs. Oliphant & Pope, manufacturers of white and mottled front brick from plastic clay.

The Powhatan cream bricks which are being used for the front walls of the new Art Museum, Worcester, Mass., are supplied by Waldo Brothers.

The town of Milton, Mass., has contracted with Waldo Brothers for the furnishing of Brooks, Shoobridge & Co. Portland and Hoffman Rosendale cement for this year.

The contract for Portland cement to be used by the town of Wellesley, Mass., has been awarded to Brooks, Shoobridge & Co., Waldo Brothers being agents.

The American Enameled Brick and Tile Company have just closed a good-sized order with Messrs. Norcross Brothers for enameled brick for private stable of Mr. William K. Vanderbilt, at Hyde Park, N. Y.

The Philadelphia and Boston Face Brick Company have closed the following contracts: buff molded and arch brick for B. & M. Railroad Company station at Northampton, Mass.; gray molded brick for Pierce Building on Vernon Street, Boston; buff face and molded brick for Mayo Building, at Erie, Penn.

Charles T. Harris, Lessee, Celadon Terra-Cotta Company, will supply the roofing tiles for the following buildings: Mortuary

Chapel, Wildwood Cemetery, Williamsport, Penn., D. K. Dean, architect; station for Erie Railroad, at Jamestown, N. Y., G. E. Archer, architect; station for the Erie Railroad, at Paterson, N. J., G. E. Archer, architect; residence for C. W. Hoff, Chicago.

Fiske, Homes & Co. have just completed two large orders for brick at Providence, — the State Normal School, Martin & Hall, architects, and the new railroad station, Stone, Carpenter & Wilson, architects; the former a light buff, and the latter a fire-flashed mottled brick. They are now supplying the Falston brick for the new Masonic Temple at Pawtucket. W. R. Walker & Son, architects.

An interesting piece of work is now being done for the new bath house at Revere Beach, Mass., by W. T. Eaton, in connection with the Murdock Parlor Grate Company. It consists of a sea wall and a considerable quantity of artificial stone work, both being made of Alsen German Portland cement and furnished by Waldo Brothers. We predict a large amount of this work will be done in the near future with Portland cement.

Meeker, Carter, Booraem & Co., New York City, have taken the agency of the Eastern Paving Brick Company, of Catskill, N. Y., and have in charge the paving of the streets of Patchogue, L. I. Mr. Paul O'Brien will have charge of this department. This company under its new management is making a high-class vitrified shale paving brick at the rate of 100,000 per day, and their water facilities and nearness to the Metropolitan district gives them a decided advantage in that market.

H. H. Meiers & Co.'s Puzzolan German Portland cement has been specified by Winslow & Wetherell, architects, for the White Building, on Boylston Street, the Converse Building, on Milk Street, and also for the office building on the corner of Kilby and Doane Streets, Boston. The cement is called for on account of its non-staining qualities as well as its high tensile strength, and all the brickwork in connection with the front will be laid with this cement. Waldo Brothers, Boston agents, will furnish it.

The Bolles Sliding and Revolving Sash has been specified for a large apartment house in Atlanta, a block of houses in Indianapolis, and for the new Court House for McDonough County, Georgia. Agencies have been established as follows: V. H. Kriegshaber, Atlanta, Ga.; F. Codman Ford, New Orleans, La.; A. L. Blair, Richmond, Va.; Harding & Whiteside, Louisville, Ky.; Wm. B. Roberts, Indianapolis, Ind.; Cyrus P. Finley, St. Louis, Mo.; George W. Laws & Co., St. Paul and Minneapolis, Minn.

A useful and very interesting book is "A Mint of Hints," just issued by the American Clay-Working Machinery Company, of Bucyrus, Ohio. The book is one of the prettiest ever sent out to brick and tile makers, is printed in brown and green ink, and is enclosed in a handsomely embossed cover. In this work is given a description of the Durant hollow building block, and matter showing its superiority as a building material. There is also shown a multitude of shapes and forms of all kinds of brick.

The Globe Fire-Proofing Company, of Philadelphia, have started their new and modern plant for the manufacture of fireproofing and brick, at Clayville, N. J. They are in the market with a beautiful line of tempered clay buff brick, and are manufacturing all kinds of flat and segmental arches, furring, partition, roof and ceiling blocks, girder and column covering. All these materials burn a beautiful buff, and are made of fire-clay. The main office is at 449 Philadelphia Bourse; Boston office, 443 Tremont Building; New York office, 412 Presbyterian Building, 156 Fifth Avenue.

THE copartnership heretofore existing between George R. Twichell and Alfred Yates, dealers in builders' supplies at 19 Federal Street, Boston, under the name and style of G. R. Twichell & Co., has been dissolved by mutual consent. The business in future will be carried on at the same location by George R. Twichell, under the same name and style, who will assume all liabilities, and receive all accounts payable to said late firm.

CHAMBERS BROTHERS COMPANY, of Philadelphia, have recently erected and started a plant for making hollow brick, on the yard of the C. P. Merwin Brick Company, at Berlin, Conn.

Their exhibit of brick-making machinery at the Tennessee Centennial, at Nashville, Tenn., where they have erected a building for their own use, and installed about $20,000 worth of machinery, is in operation and receiving a great deal of attention. This is one of the few machinery exhibits which was ready to go on the opening day. One characteristic feature of the Chambers machines is that when the engine starts the Chambers machine makes brick.

COLUMBUS BRICK AND TERRA-COTTA COMPANY, Columbus, Ohio, have recently secured the contracts to furnish the bricks on the following jobs: Spahr Building, Columbus, Ohio, D. H. Burnham & Co., architects; terra-cotta Roman brick to be used. High school at Urbana, Ohio, Yost & Packard, of Columbus, architects; light-gray standard brick. Townshend Hall, Ohio State University at Columbus, Peters, Burns & Pretzinger, architects: dark-gray standard bricks. Toledo High School, Toledo, Ohio, Bacon & Huber, architects: first story, dark-gray bricks; second story, buff. Henry Flesh residence at Piqua, Peters, Burns & Pretzinger, architects: gray Roman bricks. Residence, Geo. H. Partridge, Minneapolis, Minn., Long & Rees, architects: dark-buff Roman. Residence of Carl Hoster at Columbus, A. A. Linthwaite, architects: gray standard brick.

THE BURLINGTON ARCHITECTURAL TERRA-COTTA COMPANY have contracted for the following work: twelve houses, Broad Street and Erie Avenue, Philadelphia, H. E. Flower, architect; addition to the Hayes Mechanics' Home, Philadelphia, Kean & Mead, architects; new office building for the Prospect Brewing Company, Philadelphia, A. C. Wagner, architect.

INDEX TO ADVERTISEMENTS.