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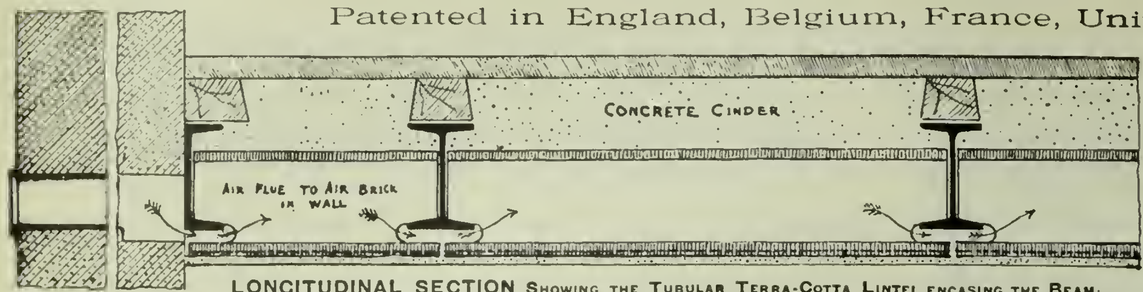
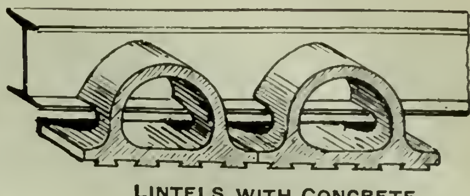
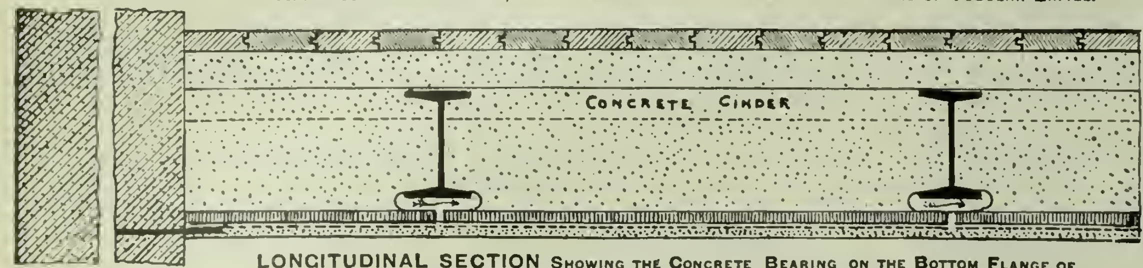


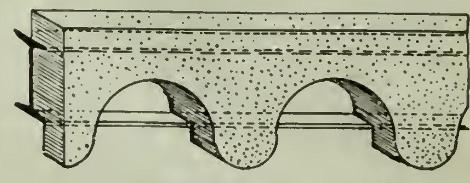
LONGITUDINAL SECTION SHOWING THE TUBULAR TERRA-COTTA LINTEL ENCASING THE BEAM; THE AIR PASSAGE UNDER BEAM, AND THE ADMISSION OF COLD AIR INTO THE END OF TUBULAR LINTEL.



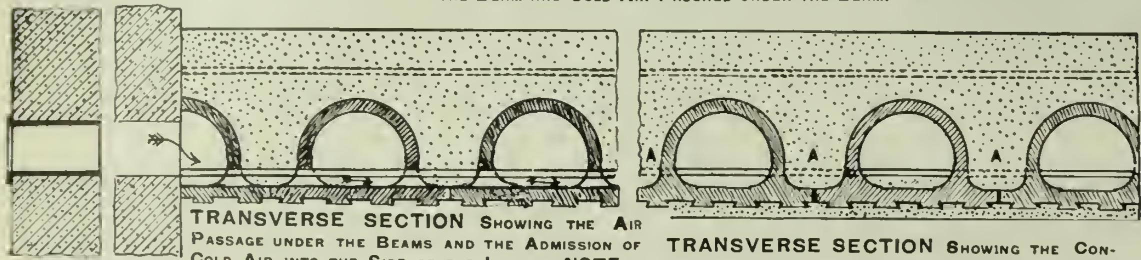
LINTELS WITH CONCRETE REMOVED.



LONGITUDINAL SECTION SHOWING THE CONCRETE BEARING ON THE BOTTOM FLANGE OF THE BEAM AND COLD AIR PASSAGE UNDER THE BEAM.

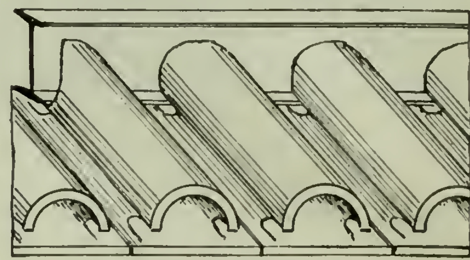


CONCRETE WITH LINTEL REMOVED.



TRANSVERSE SECTION SHOWING THE AIR PASSAGE UNDER THE BEAMS AND THE ADMISSION OF COLD AIR INTO THE SIDE OF THE LINTEL. NOTE.— ONLY TWO AIR BRICKS ARE ABSOLUTELY NECESSARY IN EACH ROOM TO OBTAIN A THOROUGH DRAUGHT UNDER THE BEAMS, AND THEY MAY BOTH BE IN THE SAME WALL.

TRANSVERSE SECTION SHOWING THE CONCRETE BEARING ON THE BOTTOM FLANGE OF THE BEAM A. NOTE.—THERE IS NO ROOM FOR THE CONCRETE TO WORK UNDER THE BEAMS AT A. OTHERWISE THE AIR PASSAGE WOULD BE STOPPED.



LINTELS FIXED READY FOR CONCRETING.

SCALE IN FEET.

Table showing the Weight of Materials used in Constructing the Fawcett Ventilated Fireproofing System.

MATERIALS USED IN FLOOR.	Wt. of floor material per sq. ft. of surface, for various size beams. DEPTH IN INCHES.								MATERIALS USED IN FLOOR.
	4 in.	5 in.	6 in.	7 in.	8 in.	9 in.	10 in.	12 in.	
Steel Beams	3.7 lbs	5.1 lbs	6.9 lbs	8.9 lbs	10.5 lbs	12.2 lbs	15.5 lbs	19.1 lbs	Steel Beams
Lintels	15.0 ,,	15.0 ,,	15.0 ,,	15.0 ,,	15.0 ,,	15.0 ,,	15.0 ,,	15.0 ,,	Lintels
Concrete	26.0 ,,	32.5 ,,	39.0 ,,	45.5 ,,	52.0 ,,	58.5 ,,	65.0 ,,	78.0 ,,	Concrete
Wood Floor	3.5 ,,	3.5 ,,	3.5 ,,	3.5 ,,	3.5 ,,	3.5 ,,	3.5 ,,	3.5 ,,	Wood Floor
Plastering	7.0 ,,	7.0 ,,	7.0 ,,	7.0 ,,	7.0 ,,	7.0 ,,	7.0 ,,	7.0 ,,	Plastering
Total Dead Weight	52.2 ,,	63.1 ,,	71.4 ,,	79.9 ,,	88.0 ,,	96.2 ,,	106.0 ,,	122.6 ,,	Total Dead Weight

NOTE. The Dead Weight per sq. ft. of surface is calculated for Concrete 2 inches above top of Beams.

Table showing Size of Steel Beams used in the Construction of the Fawcett Ventilated Fireproofing System.

Live Load per Sq. Ft.	SPANS IN FEET. 10 Feet.		12 Feet.		14 Feet.		16 Feet.		18 Feet.		20 Feet.		22 Feet.		24 Feet.		26 Feet.		Live Load per Sq. Ft.
	Depth.	Weight per ft.	Depth.	Weight per ft.	Depth.	Weight per ft.	Depth.	Weight per ft.	Depth.	Weight per ft.	Depth.	Weight per ft.	Depth.	Weight per ft.	Depth.	Weight per ft.	Depth.	Weight per ft.	
100 lbs.	4 I	6.2	4 I	7.5	5 I	9.2	5 I	10.3	6 I	11.9	6 I	13.9	7 I	15.5	8 I	17.2	9 I	20.3	100 lbs.
150 lbs.	4 I	7.5	5 I	9.2	6 I	11.9	6 I	13.9	7 I	14.4	7 I	17.8	8 I	18.0	9 I	20.3	9 I	24.4	150 lbs.
200 lbs.	5 I	9.2	5 I	10.3	6 I	13.0	7 I	14.4	7 I	17.8	8 I	18.0	9 I	20.3	10 I	25.5	10 I	30.0	200 lbs.
250 lbs.	5 I	10.3	6 I	11.9	7 I	14.4	7 I	15.5	8 I	17.2	9 I	20.3	9 I	24.4	10 I	30.0	10 I	33.1	250 lbs.
300 lbs.	5 I	11.9	6 I	13.0	7 I	15.5	8 I	17.2	9 I	20.3	9 I	25.1	10 I	30.0	12 I	30.6	12 I	32.0	300 lbs.

NOTE.— The above sizes of beams are for the finished floor including concrete 2 inches above top of beams, yellow pine flooring, and plastered ceiling.

WE ALSO FURNISH TERRA-COTTA PARTITIONS, ROOF BLOCKS, FURRING, GIRDER, COLUMN, AND PIPE COVERING.

ADVANTAGES OF OUR SYSTEM.

The Only System that provides an Absolutely Scientific Safeguard against Fire.

Adopted by Architects and Engineers on Account of

1. Fireproof Quality.
2. Sanitary Value.
3. Lightness.
4. Strength.
5. Ease and Quickness of Construction.
6. Cheapness.

In these 6 Main Advantages The Fawcett Ventilated Fireproof Floor Excels all Other.

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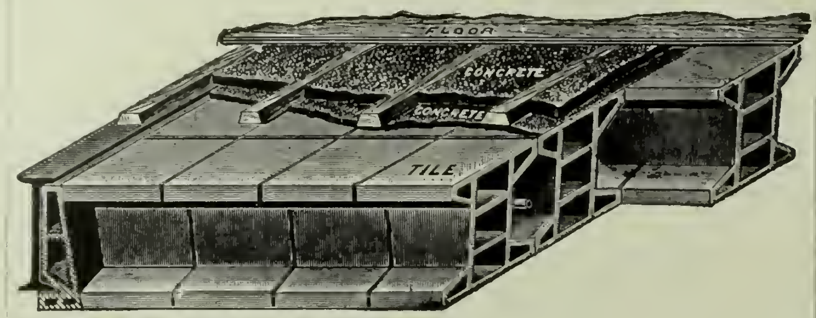
Floor Arches,
Partitions,
Furring,
Roofing, Etc.



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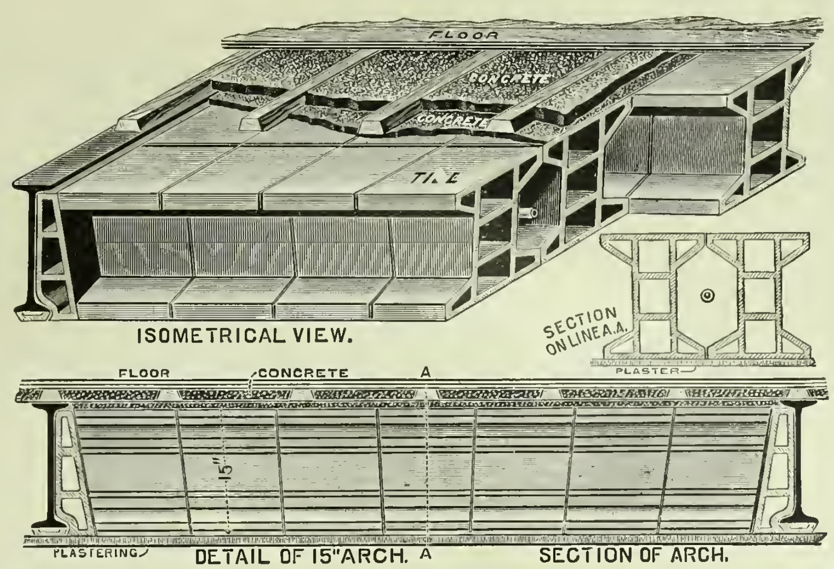

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VOLVME VI JULY 1897 No. 7

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.

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SOME LESSONS OF THE PITTSBURGH FIRE.

THE great value of the fire that occurred in Pittsburgh on the 3d of May as an object lesson to all who are interested in the reduction of fire losses in buildings has been attested by the extended notices and discussions that have appeared in the architectural and technical journals. Some of the technical journals sent special representatives to investigate it, who gave more or less correct accounts, according to the authorities they consulted. THE BRICKBUILDER was the only journal that sent an acknowledged expert in fire-proof construction to make an unprejudiced report on it, which appeared, fully illustrated, in the June number. It was the only report that correctly described and illustrated the several methods of construction used in the buildings. It was demonstrated that the two buildings most severely tested were fire-proofed with systems depending on the use of burned clay, and the material of each differed from that of the other. It was shown that the integrity of each building was assured by its fire-proof interior construction, and that the only parts carried down in one of them, involving a large and easily preventable loss, were destroyed through ignorance or carelessness in locating and supporting a huge water tank, and not through any failure of the fire-proofing system employed. Had this not occurred, there is no doubt but that all of the brick walls, and the steel work of the floors, roofs, ceilings, girders, and columns of both buildings would have been preserved. The value of fire-proofing with burned clay was demonstrated to the extent that while it might not in every case save itself, it can preserve from loss that which it is put to preserve.

This fire seems to have brought to the attention of underwriters, what is no surprise to any intelligent architect, the fact that if a building does not collapse the fire has a freer way through the goods contained in it. It is only a question of rates on goods with them, and does not concern us. If a building is undivided by partitions, they must necessarily put a higher rate on the goods; but the greatest demonstration has been made in the Jas. Horne Department Store, that, even though undivided by partitions, the building itself can stand the fire. They ought to be convinced of a matter in which some of them have doubts that fire-proof buildings, well constructed, can take care of themselves under all contingencies, and they now have some data for estimating what the greatest percentage of loss on such buildings can be. The Horne Office Building is one which best demonstrates the risk in the average of modern fire-proof building, and it had two dangerous elements, the exterior exposure and the open light court.

The first lesson to architects and owners, no less than to underwriters, is, that if you put a closed tank, in the form of a steel boiler, on the top of a building, even though it be placed there to furnish a supply of water to extinguish incipient fires, you are handling a very dangerous thing. The most improved systems for operating water elevators make it unnecessary to put a closed tank on the top of a building. Tanks in such places are necessary only where the automatic sprinkling system is used, and they can always be open tanks, built of wood, and supported so that they will tip over in case of fire and then do some good. There is no necessity for large tanks for ordinary water service, where pumps may be used constantly, or with automatic attachments. Another valuable precaution in fire-proof buildings, which has been used in some, would be to place a strong grill of steel over every elevator, sufficient to arrest the fall of the shieves and their supporting beams — which have to be exposed.

THE value of subdividing buildings by partitions needs no demonstration; but this can be done according to a system, and should be part of the original plan of the building. With a slight variation from what is considered the most convenient plan, any building can be provided with effective vertical fire barriers, and often buildings can be divided into sections without impairing the convenience of their plans. Forty years ago the printing house of Harper & Brothers, in New York, was built without an interior stairway or elevator, these being placed in towers in a court. There are two modern fire-proof buildings in this country which are built on a fire-proof plan. They are those of the American Bank Note Engraving Company, at New York, and Gore's Fire-proof Hotel, in Chicago. Both are built with a long court in the center, and with stairways and elevators so separated, being placed at both ends of the court, that they do not need fire escapes. In these buildings one half is the fire escape for the other half.

With regard to the details of fire-proofing with burned clay, we always have many things to learn as well as many reasons for congratulation in the present instance. Clay fire-proofing has to perform two offices; one is construction or work, and the other is protection. Protection is also sometimes combined with construction. Floors, ceilings, and roofs are constructions. It has been demonstrated that a flat, hollow arch, two cells deep, will support a floor and stop fire even when the bottom cell is broken. It has also been demonstrated that a beam covered by a one-cell hollow block will be protected when the outside shell of that block falls off. It has been shown that a semi-porous tile, when used for a continuous flat arch ceiling, will not be flaked off on the bottom, but that it may if used around a beam, two sides being exposed. It has been shown that in hard, hollow blocks of many cells the exterior shell is likely to be broken under any circumstances. The advantage is with the semi-porous tile, but the disadvantage is with the shape required for the projection of beams. The whole demonstration is that the continuous ceiling is the safest, especially when semi-porous tiles are used. There are some kinds of porous terra-cotta that will stand any fire-and-water test; but there is a difference whether the material is hollow or solid. In many cases it is best to use it solid, depending on the non-conduction of the material itself.

THE covering of the heavy steel built-up girders of the Horne Department Store was effective, and yet it was not by any means put on in a workmanlike manner. Large flat tiles of hard fire-clay were cramped to the bottoms of the girder, with steel cramps, and the sides were covered by 4 in. partition blocks resting on the flange. Great risk was taken in leaving the cramps exposed. They must have been raised to a white heat, and could not have sustained much weight; but it seems that each was able to keep its tile in place, the weight being, probably, not more than 4 lbs. to each cramp. The best methods for covering girders heretofore used have been with U shaped blocks of porous terra-cotta, extending far enough below the girder to support a soffit tile. Such blocks are firmly held in place by the mortar with which they are filled in setting, and partition tiles built on them to cover the sides of the girders add to their stability.

There are, unfortunately, too many Z bar columns in other buildings covered as were those in the Horne Department Store. It cannot be said that these columns were fire-proofed at all; 2 in. hollow partitions were simply built around them, and left to themselves. This would have been a compliance with the building laws of any city that compels all columns to be covered with "fire-proof material," providing for "two air spaces of at least 1 in."; and it demonstrates how defective such laws are. The contingencies that surround iron columns in any building are many, and have been the subject of experiments and inventions of experts for twenty years; but there is surely one principle that should be observed in fire-proofing columns, and that is that the material should be *fastened to the steel column*.

The 4 in. semi-porous hollow partition tiles used in the Horne Office Building were effective wherever they were set, so that they could stand alone, but most of them were cracked because they were *built on wooden strips*. The tiles did not crack in the walls, and were only broken by their fall. In Plate 10, in the June BRICKBUILDER, is seen the result of using a wooden framework when the door is combined with hall partition sashwood. This could be avoided by using channel bar steel frames in such cases. These might be warpled somewhat, but would keep the partitions in place.

These criticisms are offered in good part, with the hope that they may be of some benefit to those concerned in the fire-proofing of buildings with burned clay. They show that the buildings in question are not the best that have been done. We have seen that buildings as a whole can be saved by fire-proofing; but the fire-proofer cannot only protect constructions of steel, but preserve his own work, if he studies and profits by experience. It is his interest to demonstrate that the saving from the loss by fire shall commence with his own materials and workmanship, and unquestionably this is possible with burned clay properly used. He has nothing to do with what comes after him, and is not expected to insure the goods placed in a building. He cannot always do as he wants to, and the architect may ask him to put his work where he knows it will not stay; but our architects can also profit by experience, and will not fail to heed the lessons of the hour. The model for a *fire-proof building* should be, as Mr. Reed says, a good stove that can be used many times, and not requiring a new lining every time that it is fired up.

THE report of S. Albert Reed, Ph. D., Manager of the Tariff Association of New York, on the Pittsburgh fire, published in *Engineering Record*, is a very interesting and truthful statement, full of valuable suggestions to underwriters that will doubtless be heeded. We may therefore expect to see in the near future such an adjustment of rates as will tend to exert a corrective influence upon some of the neglected details of fire-proof buildings. We are glad to see that Mr. Reed agrees with our expert in nearly every particular. He differs, however, in his theory of the direct cause of the falling of the water tank in the Horne Department Store. He gives great stress to the fact that the roof beams supporting the ⊥ irons and book tiles were not fire-proofed, and that the upper ends of the Z bar columns of the sixth story passing through the blind attic were not covered with tile. This was undoubtedly a case of neglect, yet the blind attic was cut off by tile bulkheads around the skylight. He thinks that these fell out, and that the weakness of the roof let down the tank, the roof falling first. This supposes that the tank rested on the roof, which no ordinary constructor would allow. As the roof did not fall around the light shaft where the tile bulkhead fell out, it must be presumed that the bulkheads of the elevators and light shaft were dislodged by the shock of the tank falling through the roof. The suspended ceiling proved to be sufficient to stop the fire everywhere else and saved three fifths of the roof. Hence it would have been a barrier to protect all the uncovered steel under the roof if the tank had not fallen. It was undoubtedly the fire that rushed out over the elevators and stairway that weakened the supports of the tank, whatever they were.

Mr. Reed has a higher opinion of the column and girder covering used than Mr. Wight. The following sentences from his report show its drift: —

"The skeleton as it stands is not out of line or plumb. Except for the fatal omission of protection to roof supports the skeleton protection of this building was an unusually good piece of work, and it did its task successfully and well, mainly because it was good and thorough. It is important to state that such good column and girder protection is the exception in the Metropolitan District of New York."

"The question of skeleton protection I consider as settled by this fire. With good protection the skeleton may absolutely be relied upon to stand even a conflagration."

ILLUSTRATED ADVERTISEMENTS.

IN the advertisement of Fiske, Homes & Co., page vii, is illustrated a new design for a fireplace mantel by J. A. Schweinfurth, architect. This company has recently had prepared, by several well-known architects, a series of designs for fireplace mantels in brick and terra-cotta, that are of unusual merit in the matter of design and construction, and it is their purpose to show a different style in each issue of THE BRICKBUILDER.

In the advertisement of R. Guastavino, page xvi, is shown a view of the test recently conducted under the supervision of the Engineering Department, city of Boston, of a section of Guastavino floor in the new building at 270 Congress Street, Boston.

The terra-cotta entrance to the Union Trust Building, St. Louis, Louis H. Sullivan, architect, is shown in the advertisement of the Winkle Terra-Cotta Company, page xi.

A very decorative terra-cotta capital, designed by Hoppin & Kohen, architects, is illustrated in the advertisement of the New Jersey Terra-Cotta Company, page viii.

In the advertisement of the Bolles Sliding and Revolving Sash Company, page xl, is illustrated the new American Baptist Publishing Building at Philadelphia, Penn., Hales & Ballinger, architects.

The new public school building at Dobbs Ferry, New York, C. Powell Karr, architect, is illustrated in the advertisement of Charles T. Harris, Lessee, Celadon Terra-Cotta Company, page xxviii.

A residence in brick and terra-cotta, by Green & Wicks, architects, is published in connection with the advertisement of the Harbison & Walker Company on page xxx.

On page 160 the Philadelphia & Boston Face Brick Company illustrate another of their series of handsomely designed brick mantels.

TERRA-COTTA PANEL.
Executed by the New York Architectural Terra-Cotta Company.

WE have received the "National Electrical Code," printed by the National Board of Fire Underwriters, the preparation of which is the result of the united efforts of the various electrical, insurance, architectural, and allied interests which have, through a national conference composed of delegates from nine of the leading architectural, engineering, and insurance societies, presented these rules for adoption by the various governing boards throughout the country. The effort to systematize and regulate the constantly changing practise in regard to electrical wiring is highly commendable, and the results embodied in this code represent the state of the science at the present time. Probably no branch of building industry has expanded so extensively within the last few years as has electrical science, and the rapidity of its growth has repeatedly outdistanced the municipal regulations so that it has several times happened that what was considered first-class work at one time would not be tolerated three years later. The effort to have things right which is manifested by this code certainly deserves every encouragement.

ARCHITECTS' AND BUILDERS' DIRECTORIES.

WE have had sent to our table two recently published directories of architects and builders, one embracing the State of Connecticut, and published by the Record Publishing Company, of New Haven, Conn., and the other embracing the State of Wisconsin, and published by the Builders' and Traders' Exchange, of Milwaukee. This latter work is made especially interesting by the incorporation into its make-up of many pages devoted to the consideration of questions which arise in connection with the building business, such as Mechanics' Lien Laws, Rules and Conditions for Estimating Work, Hints to Contractors, Information for Masons, Laws relating to Buildings, Plumbing, Sewerage and Sanitary Laws, and other matter of value to architects, builders, and contractors, the whole work having been compiled by W. H. McElroy, Manager of the Exchange.

Brick versus Wood. I.

BY R. CLIPSTON STURGIS.

IN the following articles I propose to treat briefly, first, the advantages of brick over wood; second, the adaptability of brick to all circumstances of climate and all classes of buildings; and third, a consideration of the means for promoting the more general use of brick.

In this article, then, I will consider the durability, economy, and beauty of brick as compared with wood. For one who understands the possibilities of brickwork, it is difficult to see why it is so often passed over as a building material and wood chosen instead. It can be only ignorance which will lead to such a result. There seems to be a prevalent idea that brick is very well in the cities, where, indeed, one must use it, but that wood is the right and proper material for suburban or country houses.

This is, indeed, a natural position to be taken by a primitive people, or a people who are painfully and with labor settling a new country. With them the timber which surrounds them, and which must be cleared to permit tillage of the soil, does, indeed, present itself as the natural material of which to build. Such a people were we when this country was first settled, and as, perforce, we then built of wood, gradually we evolved from the new surroundings and the necessities of wood construction a style quite essentially our own — the classic of the Renaissance reproduced in wood.

ST. ALBAN'S ABBEY.

But we were not a primitive people even then, and we do not now live in a primitive country; wood is no longer the natural material which comes first to hand. Neither our spruce nor our pine grows now at our door. Even for a country house in Berkshire, or Mt. Desert, the material for a wooden house will largely come from far.

The wooden colonial house of New England was beautiful in its own way, and was a natural and lovely outgrowth of necessity, but the brick colonial house is quite as beautiful in itself and much more in keeping with our life and civilization. The brick house to-day, as the wood in primitive times, is the fitting and proper house. It is more durable; it is — partly because of its durability — more economical, and admits of a wider range in things beautiful,

BROWN & DURRELL BUILDING, BOSTON.
Winslow & Wetherell, Architects.

because a permanent material has in itself elements of beauty which a perishable material can never have.

For the three reasons of durability, economy, and beauty, we should certainly think twice when we are planning to build before we accept wood as the best material for our house.

First, brick is more durable than wood. It will stand dampness; it will stand heat. A brick, although more or less porous, is not injured by being exposed to damp. Even the severe test of alternate wet and freezing will not disintegrate brick (as it will many kinds of stone).

It is true that dampness must not be allowed to penetrate a wall to the inside, but precautions which will prevent this are so simple as to make the disadvantages of this hardly worth considering.

Nor is it subject to destruction by fire. It has come to perfection in the heat of the kiln, and is better adapted than any other material to stand the test of extreme heat and sudden cooling with water. Few stones will bear this. And if stone hardly bears comparison with brick on these two points, how much less does wood, which rots when exposed to damp and burns when exposed to fire. Wood will rot from damp; it will rot from lack of air. It will burn. It is not as good a non-conducting partition, even when in perfect preservation, as a vaulted brick wall. It has no permanency. Everything tends to wipe away from remembrance all memorials of an age of wood.

Where are all the fine old colonial houses of Boston, which once were its glory? Gone! Some to make way for modern buildings; more fallen in decay and in the lap of devouring flames. What an indescribable loss it is to us that so many of our buildings, historic now, and ever becoming more so, are so often mere frame buildings, subject to decay, an easy prey to fire. The pity of it! For we cannot help it now.

We may be thankful that the walls of Independence Hall, and of the Old State House of Massachusetts, and of Faneuil Hall, are of brick; and it would have been well to-day if the ornament and outside finish of those buildings had also been of imperishable material, instead of wood.

It is not, however, because men think wood especially durable that it is so often advocated. The general plea is economy. Now, a material which is perishable must be very cheap indeed if it is economical in the long run as compared with its more durable substitute. A suit of clothes which with three months' wear is faded and worn must be cheap indeed to be as economical as one which will wear as many years and yet hold its color and its texture.

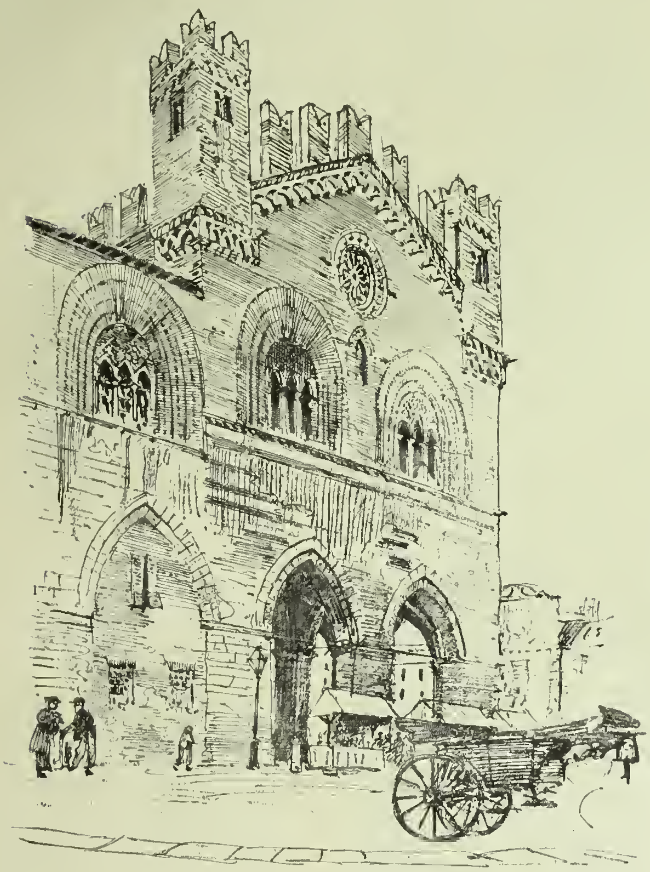
In the case in point the wood building is not by any means sufficiently cheap to bear comparison with its durable brick counterpart. For the saving lies wholly in the outside walls, that is, those that are above grade. The foundations for an ordinary house, for example, would be the same in either case, and the cost of the outside walls is, after all, not such a very large portion of the total cost. The foundations, the inside carpentry, floors, stairs, doors, windows, and finish, the plastering and plumbing, are not affected by the material of the outside walls, and the painting and heating, if affected at all, are in the direction of a reduction for the brick-walled house. It is on the walls only that the cost comes, and on these it might make a difference of eighteen or twenty dollars for every hundred square feet of wall. One can easily calculate what this would amount to on any given house. On one of tolerable size and cost it would probably be not more than five per cent. of the total cost.

And as an offset to this, one has a yearly saving in repairs and insurance, — this on the hard cash side; and then the comfort — not to be reckoned in dollars and cents, but worth dollars and cents notwithstanding — of feeling that one is well housed in a house that will endure, that protects you from winter's cold and summer's sun — as the wood will not — and that will outlive your day and perchance cover your children's children, and yet, again, their children. There is something in that not to be overlooked and yet difficult to reckon: that love for the old homestead which comes only through long years

HOUSES, BEDFORD PARK, LONDON.
R. N. Shaw, Architect.

of possession, which, in turn, breeds love for one's own town, for one's own State, for one's own country — the best and purest patriotism, which has its roots deep down in the home.

It remains only to show that brick is essentially more beautiful



PALAZZO COMUNALE, PIACENZA.

than wood, and then, I think, we shall have a fairly strong case for the brick house.

This is, of course, the hardest point to really prove; indeed, we might call it impossible of proof, for even those most competent to judge might differ. I will therefore only say why it seems to me that brick is a more beautiful building material than wood.

First, then, because after it has got the stamp from man's hand which shows it to be man's handiwork, and therefore fit and suitable for his needs, thereafter it is never touched again by aught but Nature's hand, which softens its rough or its too fine edges, covers it with bloom and beauty, and makes it year by year more lovely, until even in its decay and ruin (generally wrought by man) it is lovely yet. Look at the ruins of the Roman baths, Tattershall Castle, or that grand old tower of St. Albans. There are ruins which are beautiful, and good old stalwart brickwork, lovely in its age.

Now you cannot leave woodwork alone and yet have it preserve its usefulness. If left to weather and to be treated by Nature's hand, it does, indeed, become lovely. What more lovely in color and texture than a weather-stained board or shingle, or a water-washed or worn plank? But it is no longer fit for work. It is either not sound, or not tight, or not strong. No! we must protect our wood from the weather and keep it with oil or white lead, or else be constantly renewing it. Our house, then, always looks spic and span — nice enough in its way — or else shabby and disreputable.

It is the old story, our house is best when new; it doesn't improve with age; it must be constantly renewed to keep its value. But our brick house is worst when new, and grows yearly better and better. That is the kind of investment that I like, and that is one reason why I find it more beautiful.

The second reason is that it is a material which allows, and indeed demands, that its construction shall show. The wooden skeleton, the frame, is covered and protected, outside to keep out the weather, inside to cover its ugliness; but the brick-builder glories in his brick, and he finds in the necessary constructional bonding a chance for beautifying his wall, in his arches again an opportunity, in the vaults again another, and he need not be ashamed to show his brick wall inside. On this side of the case the constructional beauties of brick as a material might go on indefinitely. I trust I have said enough to at least set others thinking, even if I have not carried conviction.

As illustrations I would refer to Westover, in Virginia, a familiar but always lovely example of the best sort of colonial work. The tower of St. Albans (a sketch of which is given), dating back to 1200, now flanked by Gothic nave and nineteenth century additions which look almost trivial beside this massive old tower. The town hall of Piacenza, in brick and terra-cotta, and the apse of the church of the Frari in Venice, which has previously appeared in THE BRICKBUILDER, as examples of the ornate and the simple brickwork of Italy; and as similar contrasting examples in modern work, McKim's elaborate façade of the Century Club and Wetherell's quiet warehouse for Brown & Durrell, both excellent examples, and hard to beat in their way; and, finally, some very modest English work,

CENTURY CLUB, NEW YORK CITY.
McKim, Mead & White, Architects.

the lovely old Emanuel Hospital, at Westminster, now, I believe, swept away for modern improvements, and one of Norman Shaw's little houses in Bedford Park, a suburb of London, which owes nearly all its interest to what Shaw has done for it.

IT would be difficult to give stronger evidence of the intrinsic effect of a good colored material than is afforded by the fact that designs so really ignorant in their architectural detail as most of the buildings of the time of William III. and Queen Anne should, nevertheless, have a certain charm for us, solely derived from the beautiful color of the bricks with which they are built. — *Street.*

Architectural Terra-Cotta.

BY THOMAS CUSACK.

(*Continued.*)

THE advantage of jointing terra-cotta into reasonably large blocks received passing notice in the concluding paragraph of last article: but what constitutes a block of reasonable size is a question that was not, and, indeed, cannot be stated in the abstract. Within extreme limits, the size would depend upon its shape, the character of the work, and the situation it has to occupy when it reaches the building. One block contains, say, 240 cu. ins., another over 28 cu. ft., yet in both cases the size has been determined by the foregoing circumstances, without reference to the fact that one is but a two-hundredth part of the other, weighing 10 and 2,000 lbs. respectively. We have recently seen some excellent blocks of the latter size made and burned with complete success. These, we admit, were exceptionally large, but they served to prove what it is possible to do in this direction under favorable conditions as to shape, and in situations where large blocks are really necessary. Some manufacturers err in their indiscriminate advocacy of small blocks, forgetting that there are other things besides size to be considered. As it is always the poor workman who quarrels with his tools, so it is the poor terra-cotta maker who resorts to inordinately small blocks as a desperate remedy for ills that are otherwise, and at times, easily preventable. Degenerate types of the human family show a tendency to get back to barbarism, as an escape from the duties of advanced civilization. In a similar way do those who get behind in the well-contested race of architectural clay-working fall back upon less exacting forms, until they reach their level in the primitive simplicity of a brick. In the face of all that may be said to the contrary, we repeat that to joint work into needlessly small pieces is *not* the alpha and omega of architectural terra-cotta making.

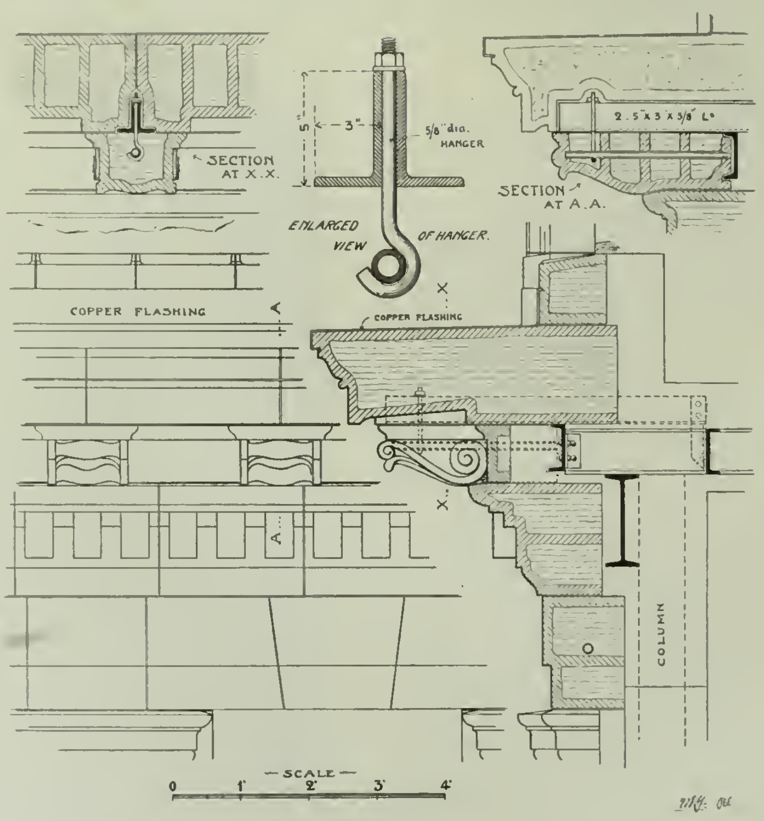


FIG. 26.

The actual size of a block in cubic inches has no meaning unless accompanied by the qualifying conditions that have just been referred to. Its relative proportions, and whether it could be molded on the widest dimension, as distinguished from the end or side, are among the technical things that an experienced terra-cotta maker would want to know before venturing an opinion. There is no formula by which even an approximate size may be fixed that would hold good in all cases. The nearest approach to one may, perhaps, be embodied in the following proposition. Let it be laid down as an abiding desideratum: First. That the block shall not crack in drying, and, having been burned at a high temperature, that it remains sound on all sides. Second. That its lines be practically true (they need not be mathematically so), its surfaces free from warping, and its shape as correct as the plaster model from which the mold was made. Third. That the maximum variation from exact size required shall not exceed one eighth of an inch in a block of, say, 3 ft., the same ratio being maintained in those of smaller dimensions. We would then say, let the rule be to make blocks *as large as practicable, subject to the foregoing conditions.*

It will be observed, however, that this rule is somewhat elastic for the size of our block, if not altogether an unknown, is, as yet, an extremely variable quantity. So it is, and so it must remain. Just what would be considered a practicable size might, in a measure, depend upon the color that had been selected, clays of different colors being more or less stable, and more or less tractable in their behavior. Account would likewise have to be taken of the plant and appliances to hand for drying and handling the blocks after they had been turned out of the mold. But these and other things being precisely equal, most of all would depend upon the skill, experience, forethought, and unceasing watchfulness of the man (or men) under whose direction the work is made. In like manner, but in a lesser degree, an important item towards success or failure must be charged to the account of care*ful* or care*less* handling. This would apply to every man through whose hands the blocks had to pass, from pressers to kiln setters. Thus does the actual result rest directly, and almost entirely, on an individual and distinctly personal basis. The form, finish, and degree of mechanical excellence in every block reflects the personnel of the men engaged in its production.

Let it be understood, once and for all, that in this department of terra-cotta making there is little, if any, room for automatic machinery. The only mechanism available for work of this kind is the head and hands — perchance the heart — of an individual man, or number of men. Not only does it represent the individual effort of mind and body acting upon matter, but every block of it becomes intensely human in all the excellencies or defects of its manipulation. As one man differs from another in intellect, training, and force of will, so does his work differ in accuracy, finish, and reliability. What is true of individuals is equally true of organized bodies; and the quality of their work in the aggregate will carry with it the indelible impress of their organization, as well as of their individuality. This is why the work of particular firms may be recognized in most cases by its unerring ear-marks. Whether viewed in a spirit of comparison or of contrast, the observant critic finds little difficulty in tracing its origin, or in forming a fairly accurate estimate of the men entrusted with the making of it.

Most of these observations apply to the making of terra-cotta in general; but some of them have a significant bearing on the matter now in hand, which has to do with the construction of heavy cornices. In work of this kind large blocks, though, perhaps, not always absolutely necessary, often become of vital importance. The extra size required is, in a measure, compensated by the nature of the situation; and it in turn makes the conditions of manufacture less exacting, therefore more favorable to the production of large pieces. The reasons why this is so were given with sufficient detail in connection with Figs. 23 and 24. But in Fig. 26, where we have a cornice of much greater weight and projection to deal with, the same considerations hold good. The projection in this case is 3 ft. 6 ins., with 1 ft. inside the wall line. The modillions are spaced, some on 2 ft. 10 in., and some on 3 ft. 2 in., centers; and as the spacing determines the length of the pieces, their dimensions averaged 4 ft. 6 ins. by 3 ft. by 1 ft. 5½ ins., which is equal to 19 cu. ft., and would weigh about 1,200 lbs.

It may not be out of place to mention that these blocks were used on the new Astoria Hotel, 34th Street and Fifth Avenue, New York City (Fig. 27), where one hundred and fifty of them were required for the cornice at the twelfth story. Not one of these blocks being in any way defective when taken from the kiln, the original number was shipped, and set in the building without misadventure. For one of them see Fig. 28. Several mitres — some of them being both internal and external — of still greater size were made at the same time with equal success. Their dimensions were 5 ft. 1 in. by 3 ft. 11 ins. by 1 ft. 5½ ins., and the weight close upon a ton. Even with these, the limit as to size did not appear in sight, if we except the door into kiln, which was only large enough to receive them without any room to spare. These blocks, be it observed, conformed to the conditions just laid down as the governing factor; whether it be in the absence of cracks, trueness of line, or accuracy of shape.

FIG. 27. ASTORIA HOTEL, 34TH STREET AND FIFTH AVENUE, NEW YORK CITY.
H. J. Hardenbergh, Architect.

We now turn to the scheme of construction which, having been approved by the architect, and accepted by the engineers, was carried out exactly as shown in Fig. 26. The chief advantage in the use of two L's instead of an inverted tee is that it allows the hangers by which the modillions are secured to pass up between them. This furnishes a ready means of adjusting the modillions to line, by giving a few turns to the tension nut. The cantilevers so formed are thus made to act in a dual capacity; in suspending the weight of the work below, and supporting the much greater weight of that which rests on top of them. The strength of the modillions is greatly increased by the pipe — or, better still, bar of iron — that is passed through them before the chambers have been filled with concrete. The ends, being shaped to fit into the 8 in. continuous channel, makes them less dependent upon the hangers, which, however, it is well to have in case of accidents. This channel is bracketed to the outer end of floor beams, and acts as a fulcrum to the cantilevers, the ends of which are similarly secured to short pieces of channel introduced *between* the floor beams. The whole weight is in this way transmitted to the 16 in. I beam on which the floors rest, and it is really part of the structural framing between the columns.

FIG. 28.

We would call attention to the metal covering on the top surface, which we consider a wise precaution. It is not that a single block of this cornice really needs protection on its own account; unprotected it would certainly outlast the copper. The vulnerable point in all work of this kind is not necessarily inherent in the blocks, but in the joints between them. The mortar or cement is liable to wear out; and the repointing, which should be done every five years, is usually neglected altogether. This allows the water to gain access to the iron, and when that occurs, we fear it is then only a question of,— how long before it perishes?

BRICK PORCHES AND FENCES.

IT is remarkable what very ornate porches may be constructed by a judicious selection of brick. We have seen entrances to mansions built entirely of this material that far outweigh in grandeur and cheerfulness the ponderous stone columns that would appear to be indispensable to the building of many of our country mansions. In fact we have seen a red brick porch added to an old farmhouse built of stone, that, far from looking incongruous, was a decided attraction.

For fences there is nothing better than bricks. Pretty well any quality of brick can be used, and it is the only form of fence that age does not wither nor time decay. Where wood fences are used there is always the rotting of the foundations to contend with, and much necessary painting or tarring to be done to the superstructure. Architects do not sufficiently know what lasting walls can be made by cast-off bricks, and what added charm is given to a house when lichen and creeper have added their finishing touches.— *The British Brickbuilder.*

WITH this issue, the continuation of Choisy's "The Art of Building among the Romans" is resumed. This work will now be published in successive numbers until completion, requiring probably four.

The Art of Building among the Romans.

Translated from the French of Auguste Choisy by Arthur J. Dillon.

CHAPTER III.

CONSTRUCTION IN WOOD.

GENERAL REMARKS ON THE METHODS IN USE AMONG THE ROMANS.

(Continued.)

IN these modern works, the squared timbers are frequently superseded by round ones, and the cleats by withes or cords. This elementary method of fastening was also much used by the Romans; or, at least, this may be deduced from the text where Vitruvius describes how ceilings imitating vaults should be constructed by means of poles firmly bound with slender stalks of flexible wood; and this is also brought out in the description the same author gives of the construction of caissons used in laying concrete under water.[1]

Of ancient wooden bridges there are really but two examples; the bridge over the Danube, built by Trajan at the time of his expedition against the Dacians, and the bridge over the Rhine, built by Cæsar, to facilitate the incursions of the Roman armies into Germany.

The bridge across the Rhine has been so often reconstructed, according to Cæsar's description, that to attempt still another restitution of it would be but to add one more disputable hypothesis to those which so many illustrious architects have vainly attempted. L. B. Alberti, Palladio, Scammozzi, have tried to interpret the text, and their efforts have only served to show the difficulties of the question; all agree that the platform rested on beams whose ends were fastened between two piles; but their agreement stops here. As soon as it is a question of the details of the structures, of that method of assemblage which, according to the expression of Cæsar, was strengthened by the effort of the current, one finds as many opinions as there are translators. It is sufficient to mention these numerous attempts; all seem very imperfect, but it is much easier to perceive their imperfections than to correct their errors.

As for the bridge over the Danube, the difficulties of its restoration are of an entirely different nature; for here it is a question of interpreting a strictly conventional view, which is almost as vague as the representations of the monuments in the landscapes of Pompeii, and which recalls only by a few characteristic traits the aspect of a Roman bridge.[2] Figure 95 gives the most important details shown on the bas-relief of Trajan's Column.[3]

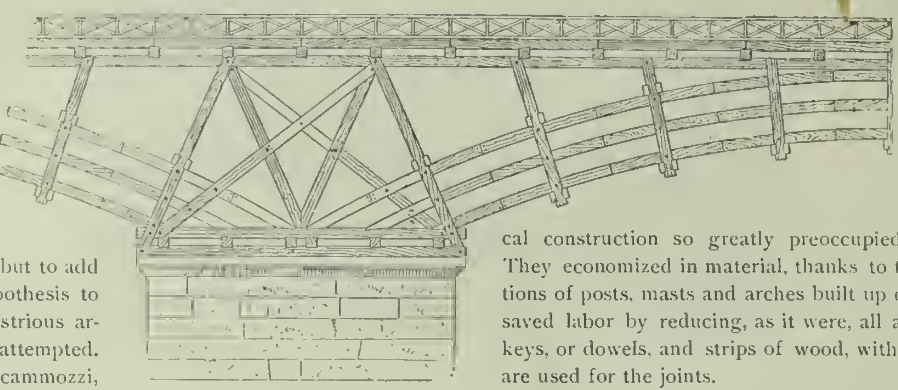


FIG. 95.

[1] Caissons of beams fastened with withes (Vitr., Lib. V., cap. 12.).

Imitations of vaults made by means of curved panels of wood with ligatures, keys, and plastering (Vitr., Lib. VII., cap. 3. Cf. Pall., de re rust., Lib. I., cap. 13; Vitr. compend., cap. 21).

[2] Many critics have even thought, through faith in Dion Cassius (Epit., Lib. LXVIII., 13), that the bridge shown on Trajan's Column is in no way a representation of that over the Danube; the latter, according to them, was entirely of stone. But this is a question of no interest to us; it suffices that the bridge shown on the column is a Roman type of bridge. Nevertheless, we may note that in representing the Danube bridge to be of wood, the bas-relief agrees with an engraving of a medal in the National Library, where are to be seen the three distinct arches as well as the ties that bind them together; the medal shows these ties vertical, while in the bas-relief they converge, and this is the only noticeable difference between the two figures.

[3] The tinted parts in Fig. 95 are those shown in the bas-relief; the restorations are shown in outline only.

Three concentric arches form the active part of a truss; these arches are bound together by ties that extend up to the level of the platform, holding the string pieces and supporting the flooring. Above the piers, the platform is carried on trestles. Such is the bridge reduced to its essential parts. As to the accessory pieces, cross-braces or others, the maker of the bas-relief has left us in ignorance; this omission is permissible in a figure meant only to fix the place of an event; but it is to be regretted that it leaves so large a field open to conjecture. The arches, in the bas-relief, have no abutment, and it is difficult to understand the cross-bracing between the trestles; I have prolonged the arches to their meeting with the piers, and have considered the cross-brace between the trestles as continued to the level of the platform. These were, it seemed to me, the least changes that could be made in order to make the bas-relief of Trajan's column practicable; and everywhere else I have conformed to the model. The bas-relief leaves the question of the material of the arches entirely unanswered. It is clear, however, that these large pieces were built up of small beams; it can even be said that their construction recalls that of the corner posts of the towers of attack previously described. It was Apollodorus that described them, and it is Apollodorus who is thought to be the architect of the Bridge of Trajan.[4] But here positive evidence begins to become scarce, and to go into a more extended discussion would only lead to hypotheses which seem at the best useless.

These few examples, some borrowed from modern construction, will, I believe, help by analogy to a conception of the temporary framing, the scaffolding and centering whose economical construction so greatly preoccupied the Roman builders. They economized in material, thanks to their ingenious combinations of posts, masts and arches built up of small pieces, and they saved labor by reducing, as it were, all assembling to that where keys, or dowels, and strips of wood, withes and ligatures of rope are used for the joints.

Furthermore, whatever may have been the character of its applications, whether temporary or permanent, the art of framing was subject, to the same extent as the other branches of architecture, to the entirely local influences of resource and of traditions.[5]

Roman Egypt, as well as the Egypt of the Pharaohs, seems to have been devoted to the use, for building timber, of long stems, interlaced or held together by bonds of rushes (Strab., ed. Cas., p. 768 and 822).

Africa, at the time of Sallust, had an entirely distinct type of roofing, which recalled in appearance the hull of an overturned vessel, and which seemed the result of the effort to avoid the effects of the winds of the desert (Sall., Jug., cap. 18).

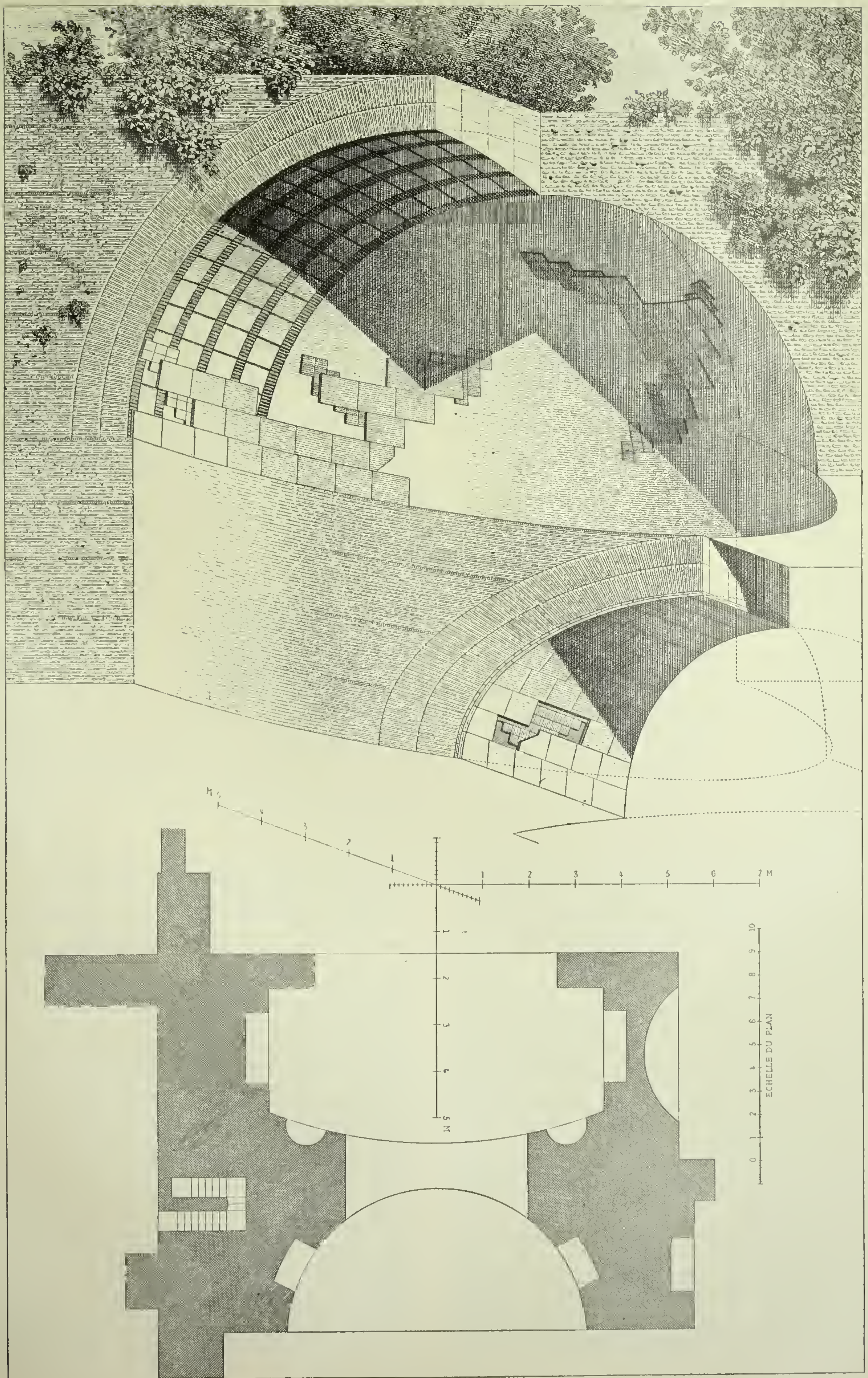
In Colchis, and without doubt in Arcadia, it was the use of round pieces, such as those used in the cottages in the Alps to-day, that regulated the entire system of framing (Pausan., Arcad., cap. 10; Vitr., Lib. II., cap. 1).

In Lycia the wooden buildings, made of panels interrupted at frequent intervals by strings of strong horizontal pieces, and covered by roofs of saplings, seemed to hold a middle place between the ordinary buildings and those with solid walls of horizontal trunks of Cholchis (see for the sculptures showing these constructions, the works of MM. Texier and Fellows).

In the Orient, at the extreme limits, or even beyond the frontiers, of the Empire, we find that the chief characteristic was the use of forked posts, from which came that type of the bifurcated columns that are so numerous in the ruins of Persepolis.

[4] Procop., de Adif., Lib. IV., cap. 6.

[5] I am indebted to M. Viollet-le-Duc for having called my attention to these local characteristics of ancient framing.



THERMES DE CARACALLA.
PLATE XII. THE ART OF BUILDING AMONG THE ROMANS.

Finally we come, in the midst of the forests that covered the soil of Gaul, or the country of the Marcomans or of the Dacians, to the masses of tree trunks, piled up in layers, sometimes mixed with rough or hewn stone, forming entrenchments, piers of bridges, fortifications on the banks of rivers—all that series of strange structures whose spirit is shown us in "Cæsar's Commentaries" and in the bas-reliefs on the columns of Trajan and of Antonius, and whose tradition has been preserved in Switzerland down even to the present time. I must limit myself, however, to the mention only of this variety of forms and methods, as well as of the double influence of local customs and natural resources, which justifies it in our eyes, and which made it inevitable among the ancient peoples.

REVIEW OF THE METHODS OF ORGANIZATION OF BUILDING OPERATIONS.

We finish here the examination of the methods of Roman construction: we have studied them in turn in the monuments built of concrete, in those of cut stone, and, as far as possible, in those of wood; we have separated and presented individually each of the parts of an ancient edifice; it is now the time to bring these elements together, to show them put into practice, and to indicate, at least by one example, the spirit of organization that ruled the great enterprises of construction. The practical art of the ancients was not, in fact, a simple combination of methods united by a community of principles; along with and above individual methods, the Romans introduced certain ideas of sagacious discipline which stamped their great architectural enterprises with the mark of that order and regularity which their political genius gave to the whole administration of the Empire. In a word, the Roman art of building was a matter of organization, and it is under this new aspect that we must now consider it. The Coliseum seems the building whose analysis will throw the clearest light on the general principles, so we will describe it both in relation to the organization of the workyards and to the general progress of the work.

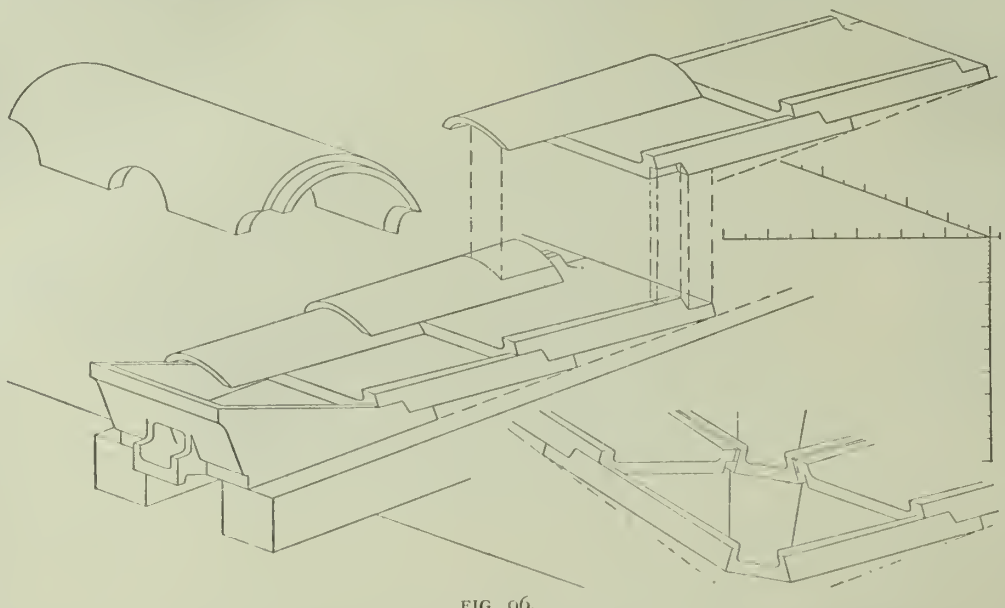


FIG. 96.

Plate XXII. gives a section along one of the radiating galleries of the Coliseum; the different tints show the different materials; the stones whose surface shows in a lighter tint against the more deeply colored background of the filling are blocks of travertine; the other stones are of a more common material, the compact volcanic tufa which, under the name of "peperin," is quarried at several points of the Roman Campagna.

The travertine is only employed, as can be seen, for the heads of the walls and for two intermediate piers — M and N — intended, without a doubt, to sustain heavy constructions, of which the idea was afterwards abandoned.

Without stopping to question what rôle the piers of travertine play, or were intended to play, in the edifice, we will note only their construction. Their courses bond, course for course, exactly with the courses of the filling. But this is not at all true for the heads of the walls, A and B. The courses of these pilaster-like heads run with the courses of the walls they terminate in the most incomplete, the most irregular, one might almost say, the most awkward manner. I show, in order to make the contrast more evident, the two cases of bonding; the first figure, Fig. 97, shows the imperfect bond between the heads and the walls; the other, Fig. 98, the regular bonding of the walls of tufa with the piers of travertine built in them.

At the first glance one is shocked by this so apparent incongruity; but closer examination finds in it an indication of one of those artifices of organization which the Romans introduced so happily into their great enterprises in order to simplify the progress and make it both surer and more orderly.

Evidently the disaccordance of the courses of the heads and the body of the wall cannot be justified by taking for its explanation only the difference of materials and the difficulty of quarrying the stone of Tivoli in blocks of the same height as the stone of Gabies or of Albano; the same difficulty would have existed in the bonding of the walls with piers such as M and N, which divided them. Yet, between the courses of the piers of travertine and of the walls of tufa, there can be seen (as we said above) none of those interruptions of continuity, none of those singular breaks; why then were they admitted, one might say purposely multiplied, in one case, and so carefully avoided and entirely proscribed in the other? The courses are not more regular in the heads than elsewhere, but their heights are different; only a few insignificant bond stones run into the filling of tufa; almost in every case these bonds cut the courses of the filling midway in their height, and chance only seems to have brought about the rare cases of accordance. Surely, the only hypothesis that can give a reason for these apparent anomalies is this — that the heads were built first of all; and afterwards the body of the walls, including the piers M and N, which strengthen it, was built.

This manner of proceeding is foreign to our customs, but its motives and advantages can be easily conceived. The pilasters A, B, C, once constructed about the entire perimeter, formed a sort of general plan in relief of the amphitheater whose utility can readily be perceived. We have here, in fact, an edifice whose plan is extremely complicated; the Coliseum comprised innumerable galleries and a great system of stairways and passages, hardly to be traced in the ruins, and much more difficult to distinguish in the midst of the disorder and confusion of the building operations. The builders were continually exposed to mistakes of all kinds when fixing the position and arrangement of so many diverse parts; and one can comprehend that the pilasters surmounted by arches, when built about the entire circumference, changing in form whenever the orientation or the shape of the stairways changed, would be of great assistance in limiting the field of errors and, as one might say, in rendering all doubt impossible in spite of the intermingling of the parts of the plan and of the multiplicity of its parts.

This separation of the work into distinct parts had another result not less important; it allowed it to be distributed among very distinct categories of workmen.

The pilasters A, B, C, and the arcades whose thrust they received, belonged to one class of workmen, to one series of operations;

the body of the walls to another; and in each the same operations were repeated without cessation. It was therefore possible to divide the workmen into two entirely distinct classes and to employ them according to their greater or less skilfulness or aptitude; it was, it may be said, an application of the ideas of modern industry on the division of labor. All the details, moreover, emphasize and explain this view.

In the lower story, the piers M and N bond with the filling; this because the piers and the filling differed only in the quality of the materials; the manner of building was the same, the care taken in the cutting was the same for both parts, and this entire portion of the edifice could be confided to the same workmen, hence a division such as that which existed between the walls and the heads had here no reason.

On the other hand, when the first floor level was reached, the cutting of the filling became less regular than that of the piers M and N. The courses of tufa were frequently interrupted; stones of all sizes were used and built in no regular determined order; here there was an occasion for a division of labor; and in fact, the bond between piers M and N and the filling was abandoned; the piers, up to this point cut with alternating long and short courses, suddenly became independent pillars, all of whose faces were vertical and continuous; the filling was butted up against these so that no bond whatever was obtained from the shape of the stones, as shown in Fig. 99.

If the architect thought this independence of parts justifiable when both piers and filling were built of cut stone, there was still greater justification for it when at the level of the second story he abandoned the use of cut stone in the filling and contented himself with rubble work with brick facing. Hence the piers of traverine — M and N — had in the entire height of the second story no bond with the walls; the faces of the piers were vertical, and the rubble was simply butted against them.

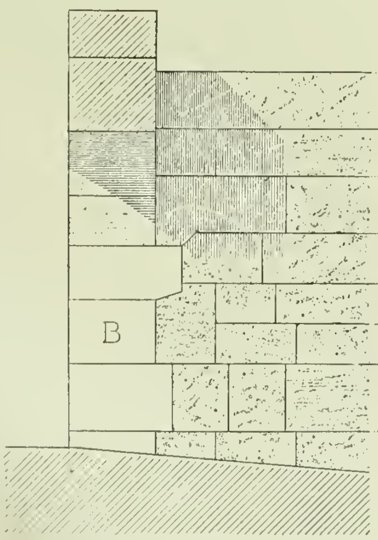


FIG. 97.

This example, moreover, is not the only one; the necessity of juxtaposing rubble walls and cut stone pilasters again arose in the parts of the radiating walls nearest to the arena; and in both cases there was the same solution of the same problem. The body of the wall at it slower parts, C–D, was of rubble with brick reveting; and here again all bonding between the walls and the cut stone pilasters terminating them was omitted. Instead of tieing into the rubble by alternate projecting and retreating courses, the sides of the pilasters were straight and smooth, and the different kinds of work joined, touched each other, but remained entirely independent.

These were the principal expedients in the construction of the Coliseum. In general, one should notice the great variation in the sizes of the stones. Throughout the edifice there is an entire lack of uniformity; while, on the other hand, other Roman buildings show, in unexpected contrast, a regularity of cutting that is not less systematic and curious; such, for instance, as in the case of the voussoirs of the bridge of Gard. In fact, however, there is here no anomaly, and the two contradictory systems show less a divergence of method than the concession made to the difficulty of quarrying uniform blocks from such stone as travertine. Through principle the Romans sought uniformity of size in their materials; and they desired to obtain it not only in their construction in stone, but also in their framing, especially in rapidly constructed works. Thus (as above) all the timbers for an attacking tower were of the same scantling, and all were cut from pieces either 16 or 9 ft. long; to adopt such a system was to accept waste, be it in the forest or the quarry, but at the same time it was to become free from one embarrassment by removing the bond between the lumber yard and quarry and the carpenter shop and cutting shed.

This separation which we have just noted between the various parts of a building becomes manifest in a still more striking manner if we pass from construction to ornament.

In the buildings of cut stone, the builders nearly always left the stones roughed out, and other workmen afterwards cut the ornament on them. Sometimes moldings, because of their importance, had to be cut in place, and then they were cut on stones independent of the body of construction and separately executed. Thus the Romans were careful not to cut the very salient molding (Fig. 100), that runs like an archivolt about the opening, on the voussoirs themselves; and, following the example of the Etruscans, they gave it its own ring of stones and cut it after it was put in place.

The same independence existed, as we have seen, between the wooden framing and the ornaments which decorated it; these latter for the most part being carved or painted pieces nailed on the beams of the framing or in the panels of the carpenter work.

But it was above all in the concrete structures that the separation between the construction and the ornament was most manifest. The Roman built; others then took up the work and assumed the task of embellishing it. They applied stucco, reveted it with marble, covered it with ornamentation, more or less beautiful, but which was exacted by no necessity of the construction, nor even announced by its disposition; do away with this envelope and the first conception will still exist in its prime integrity, so independent is the ornament of its background, of the structure of the edifice it decorates. And this is not a theoretical distinction; the division existed to such a marked extent that often the applied decoration covers and dissimulates facings whose elegant arrangement becomes superfluous when their surfaces cease to be visible. It is not rare to see the Romans thus complete their tasks as builders without preoccupying themselves about the final appearance of the edifice, and lay the small stones of the rubble or the bricks with an evident care on the surface of walls, which the decorator, who came after, was to cover with slabs of marble or coatings of precious materials. As examples of this I reproduce (Plate XV., Figs. 3 and 4) some wall surfaces of arcades taken from monuments where they were to be concealed by thick veneering or revetting as soon as they were completed. The first example comes from the ancient tower of Autun, known as the Temple of Janus; the second from the Mausoleum of Augustus. One feels impelled to say, at the sight of these carefully built surfaces, in which the Romans themselves had no profit, that they feared the proximate ruin of the rich covering, and, desirous of leaving a souvenir to posterity, thought, perhaps, of the time when their works would appear as they show themselves now, deprived of all applied ornament.

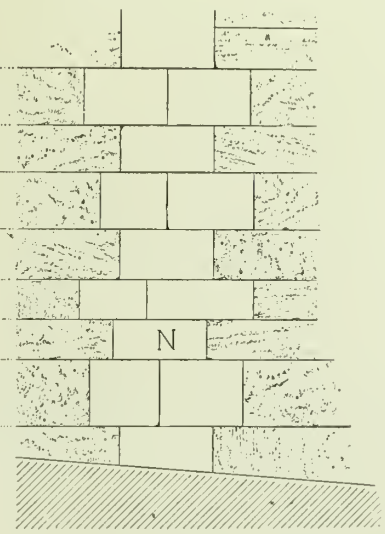


FIG. 98.

But I would prefer to see in this care of the wall surfaces an expression of an entirely practical idea, that of allowing the diverse corporations the greatest possible initiative; each thus had its part in the responsibility for the success of their common work, as each had its part in the choice of the means adopted. Each class of artisans remained, to a certain degree, the judge of the methods to be followed, and this privilege was used, as is known, by observing in the practice of the art certain traditional rules, which the organization of the workmen's corporations, perhaps somewhat narrow, made obligatory for all the individual members. The mason was not aware of what decoration would be applied to the walls; he constructed them according to certain admitted methods, and, whether they were to be covered by veneering or not, his methods were the same, the mass of the wall was built in the same manner, and the same care was given to the arrangement of the wall surfaces. Sometimes useless attention was given to work that was to be concealed by future decoration; but, on the whole, the uniformity introduced into the methods of work resulted in more rapid construction; and this was the main point in the eyes of the Roman architects. Under a social régime, when public monuments were often erected at the cost and by the orders of temporary magistrates,[1] rapidity was the first condition to be met, and the exigencies of decoration seemed hindrances from which it was useful to be free for the time being. Attention given to these matters during the preparation of the projects, and while carrying them out, would have involved inadmissible delay.

It is thus explainable why the Romans never accepted the system of construction of the Greeks except for temples, for façades of monuments or for buildings "*de luxe*," and of little importance. A system of architecture such as that of the Greeks, where the form is

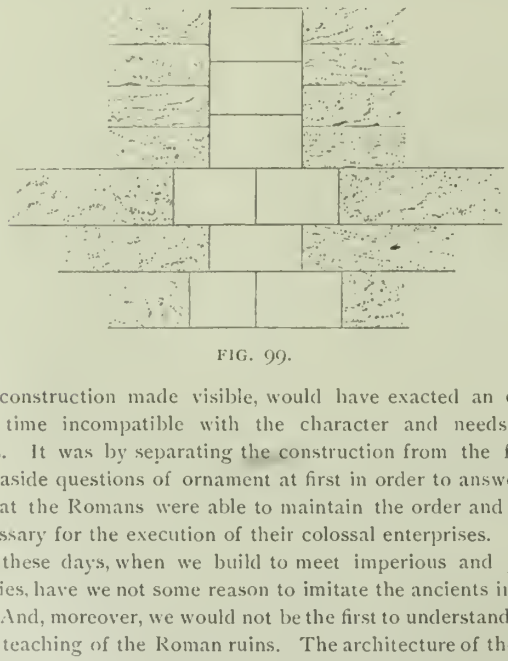


FIG. 99.

but the construction made visible, would have exacted an expenditure of time incompatible with the character and needs of the Romans. It was by separating the construction from the form, by putting aside questions of ornament at first in order to answer them later, that the Romans were able to maintain the order and simplicity necessary for the execution of their colossal enterprises.

In these days, when we build to meet imperious and pressing necessities, have we not some reason to imitate the ancients in this respect? And, moreover, we would not be the first to understand and follow this teaching of the Roman ruins. The architecture of the Italian Renaissance shows us continual and remarkable applications of it. The Roman idea of separating the decoration from the structure was never more in favor than in the sixteenth century in Italy. This can be seen, if need be, in the writings of that time (see, among others, Serlio, Liv. IV., p. 189, edit. of Venice). Still better, however, is it shown by the uncompleted edifices of that epoch, which are, for the greater part, rough masses of masonry, with recesses left for placing cornices and architraves, accessory ornamentaion which it was the custom to put in place afterwards. The architects of the Renaissance could have taken this practice directly from the ancients; bu there was no need of reviving the Roman tradition, for it had been followed in Italy, during all the middle ages; and the idea of separating the decoration from the structure is perhaps the one idea that ties the Italian architecture of the middle ages most closely to that of antiquity, and which distinguishes it the most clearly from the contemporary architecture of France.

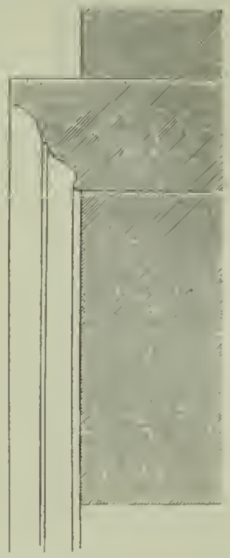


FIG. 100.

In France, during the middle ages, the structure and the form of the edifices were never treated separately; the stones always kept in the building, after they were set, the form given them in the stone yard; and it may be said that trimming and recutting in place were unknown in France from the twelfth to the fifteenth century.

On the contrary, in Italy during the same period, buildings were raised in masses of rude masonry, given, at the most, regular surfaces, where the architects afterwards incrusted the final ornament, or even placed entire façades. The façades of the cathedrals of Sienna, Orvieto, and Bologna are veneers thus placed, either over former façades or on walls prepared to receive a decorative revetment; and, without going to those celebrated edifices, it would perhaps be difficult to find a Gothic church in Pisa, Lucca, or even in the villages of Tuscany, where the decoration as a whole was done at the time of building. The enclosing walls of these buildings were sometimes built of rubble, with projecting bricks for ties, as can still be seen on the uncompleted façade of Bologna, by which were afterwards fastened the more or less richly ornamented outer walls. This reproduction of an ancient method in buildings whose general physiognomy resembles so little that of the Roman monuments affords one of the most curious examples of the variety of aspects that can be presented by the same idea, and of the apparent differences that can be manifested in the application of the same principle.

There are, however, few methods in the art of building that can be carried to their last expression with impunity. It is not for me to say what were the results produced by this separation on the architecture of the Italian Renaissance; but it must be acknowledged that this separation, so advantageous in rapidity and economy, had a regretable influence on the forms of ancient architecture. Becoming accustomed to consider decoration and structure separately, the Romans soon came to regard those things, between which they themselves had made the distinction, as being by their nature independent of each other; they then saw in the architecture of a building only a decorative dress, variable and in a certain degree arbitrary; the separation of the ornament and the construction gave too great freedom to fancy and to imitation, and contributed in precipitating the decadence of art among the Romans.

[1] This is clearly shown in numerous MSS in the collections of Roman law. In particular see Cod. Theod., Lib XV., tit. I., l. 19; Lib VI, tit. IV., l. 13, 29, 30. Cod. Justin. Lib. VIII., tit. XII., l. 5.

I will add that a large number of public edifices were built by the magistrates "*pro ludis*," that is, in place of the festivals or games they were obiiged to give to the people; thus the prodigality that was imposed on those who held public offices was turned to supplying useful work. But one can imagine what haste was necessary in erecting these magnificent presents when one thinks of the short term of office of the principal magistrates of the empire.

See Orelli, Inscrip., 3310, 2540 (?). Cod. Th., Lib. VI, tit. IV., l. 29

Fire-proofing Department.

ORIGIN AND HISTORY OF HOLLOW TILE FIRE-PROOF FLOOR CONSTRUCTION.

BY PETER B. WIGHT.

(*Concluded.*)

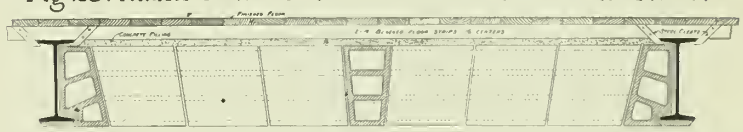
FACTORS OF SAFETY.

NOTE.— The following article was written and in type before the Pittsburg fire occurred and the article commenting on the same was written, and the author sees no reason for changing any of the opinions herein expressed.— P. B. W.

THERE may be a difference in opinion as to what factor of safety should be used for hollow-tile work when it serves any constructive purpose. The manufacturers have not generally taken it into consideration, and *as there have never been any accidents in completed buildings, due to failure in the hollow-tile floor arches,* there does not seem to be any reason for anxiety about it. In Mr. Hill's comments on the tests, published in THE BRICKBUILDER for February, 1895, and in the reports of other engineers, it seems to be taken for granted that the factor of safety is one tenth. At that rate there is not a side-pressure or end-pressure arch in any building used for business or warehouse purposes that is theoretically safe if all the tests are correct. The actual tests of side-pressure arches of the best make have thus far shown that they break at from 500 to 1,000 lbs. per superficial foot, while those for end-pressure arches run up to about 1,700 lbs. I maintain that, if in a number of tests on similar side-pressure experimental arches it should be shown that none of them fail at less than 500 lbs. per foot, it would be perfectly safe to use them where the loads do not exceed 400 lbs. per foot. I know by experience that the average work set in buildings is stronger than the average work in experimental arches, for I have made frequent tests in buildings after construction to demonstrate this. I made not only tests for dead weight on flat arches covered with sand, but for rolling loads and smashing weights on the same, after laying the floors (the wooden floors bearing on the arches), as long ago as 1884, in the Chicago Board of Trade. The rolling load was with a 4,000 lb. safe, which was not only rolled, but dropped on one side several inches. The smashing test was made with cases of dry goods weighing 400 lbs. each, some of which were thrown down from a height of 6 ft. These were 9 in. arches with a span of about 4½ ft. They were not injured in the least, though the wooden floor was badly splintered and broken. In the Natural Gas Company's building at Pittsburgh, 9 in. side pressure arches made by the Wight Fire-proofing Company, set in the building, were tested by the architect up to 1,000 lbs. per superficial foot, and the tests stopped there as he was satisfied with the guarantee. It is, therefore, clear that no such factor of safety has been considered necessary by the makers, as suggested by Mr. Hill. Every contractor knows that the severest tests his work is likely to be subjected to are the accidental ones that occur during the erection of a building. The first test he makes himself when he draws his centering at the earliest possible moment, and it is thus that he insures himself against any carelessness of his workmen. He knows that if there are any defects in the work they will then be developed, and that if any tiles have not been well bedded, they will either fall out or be subjected to the natural pressure of the arch, while before the centering is struck they lie like inert pieces of material on the boards. He knows that every day adds to the strength of the work through the hardening of the mortar, and that this goes on indefinitely.

He often finds clauses in the specification saying that the centering must remain three days, five days, or a week, before it is struck, and his best judgment is often brought in conflict with the architect, whose intentions are all right, but for all that he may be mistaken. Then, when other mechanics are allowed to run over the work, pile up their material or throw down their scaffolding upon it, another set of inevitable tests begins and continues until the building is completed. I have seen enameled bricks piled up solid 6 ft. high on flat arches that did not fail, and no one to protest but the hollow-tile man. I have seen 9 in. side-pressure arches without any webs, covered with 1 in. of Portland cement and 2 ins. of planking, used as a runway through a building, for teams bringing in material, and with safety. These are the tests the contractor is impressed with. Then he has a common-sense idea of what an arch should carry, which does not seem to have been suggested to the engineers. He examines the iron diagram to see what is the strength of the steel floor. It is easy for him to ascertain what would be the weight per foot necessary to deflect the beams to a permanent set, and when he finds that his arches will bear this load he knows that his work will be the last to break when the floor goes down. Anything stronger than this is a superfluity, and when an architect specifies any kind of work between the beams that costs more than enough to accomplish this he is guilty of wasting his client's money. It is strange that this should have been so little considered. And here comes in the question whether or not anything is gained by using end-pressure arches where the side-pressure arch will accomplish all that is required, unless there is any economy in them. On the latter point it is claimed that there is an economy of weight in some sections of tiles when used for the deeper arches. Thus far there has been found no economy in making the walls of hollow tiles less than ½ in. thick, and this is only possible with the best clays. Therefore, the walls of end-pressure tiles cannot be made any less in weight or expense unless the section is so changed as to reduce the average weight per superficial foot. This, I think, has been done with the tile used by the Pioneer Fire-proof Construction Company, of Chicago, and Henry Maurer & Sons, of New York, for illustrations of which the reader can be referred to the advertising columns of THE BRICKBUILDER. But no advantage in weight is possible where rectangular tiles are used. One of the best end-pressure arches of this kind is that of the Terra-cotta Lumber Company, of Chicago, whose illustration is here given (Fig. 23). This arch is made entirely of porous terra-cotta.

Fig 23. Illinois Terra-Cotta Lumber Co's End Pressure Arch.



The skew-backs and the keys are set longitudinal with the beams The intermediate tiles are used on the end-pressure system. In such an arch the material of the skew-backs and key should be thicker than the intermediate tiles, to make up, if possible, for the want of cross webs. The bearing sides are partially inert. But this system shows a better method of setting the skew-backs and putting in the key than if all the tiles were set transversely to the beams. It is a type of all end-pressure arches in which tiles of rectangular section are used, and it is easy to understand from the illustration the variation from it when all the tiles used are on the end-pressure system.

OBSERVATIONS ON THE USE OF HOLLOW-TILE ARCHES.

The end-pressure system has not entirely supplanted the older side-pressure system. It has its advantages when the ultimate weight to be carried on the floors is greater than 400 lbs. per superficial foot. In this I agree with Mr. Hill, and in the main with his conclusions in his paper of July, 1896, which I have no occasion here to repeat. As long as the ratio of effective height to length of span is maintained within one to eight, it is only a question of economy as to which to use. I do not think that the superior strength of the end-pressure arch is conducive to the reduction of the weight of floors for arches 10 ins. thick or less. Beyond this thickness, the weight of the end-pressure arch may be less than an effective side-pressure arch of the same depth. The cost of setting end-pressure arches is greater than for side-pressure arches.

The advantages of side-pressure arches are still maintained. First, by the greater ease with which they may be constructed, and the less chance of being weakened by inferior workmanship or defective tiles. Second, by the fact that there is a greater distribution of any concentrated load over a greater surface. Under the former may be comprised the more perfect bedding of the skew-back, and the possibility of driving in the key without losing the mortar, and under the latter may be mentioned the breaking of joints. In all side-pressure arches there is a considerable amount of inert material, but this is inevitable on account of the necessary process of manufacture.

The main defect in the end-pressure system is that the courses do not break joints. This has never yet been overcome, the only reliance being on the mortar joints and friction of surfaces, which depends upon the quality of mortar used. There is a way, however, to overcome this objection. Another is in the difficulty in making good joints between the voussoirs, involving always a great waste of mortar. The slight warping of the tiles in process of manufacture throws their abutting edges out of line, and on thin walled tiles this is of serious import. A much better joint can be had with porous than with hard tile, because the material is thicker, and for this reason the porous material is superior for end pressure arches. The greatest difficulty in getting a joint is at the key; for if it fits loose, the joint may run out before it sets, and if it is tight, the joint may be rubbed out in forcing it down. A good bed for a key can only be obtained by "slabbing" the ends of the interior voussoirs with thin pieces of tile before forcing down the key, having allowed for this in ordering the key. Another danger in arches where all the tiles are transverse to the beams is in the breaking off of the protecting bottom of the skew-back, or its cracking where it bears against the bottom flange of the beam; Mr. Hill's tests demonstrated this.

I agree with Mr. Hill that where the protection of the beam is by a projection from the skew-back on each side in any form of flat arch, it leads to defective construction and weakening of the arch. A separate soffit tile corrects this. My own form of soffit tile, which was the first ever used, passed around the flanges of the beam, and the skew-backs were bedded on this and the top of the flange and against web of the beam by one operation. (See Fig. 18, May BRICKBUILDER.) The abutting arches on both sides of the beam were also thrusting against the soffit tile. For this reason I have always maintained that in such constructions the effective depth of the arch was the whole depth of the tile, and this has always been borne out by comparisons between tests on experimental arches, where the soffit tile did not count for anything, and those set in buildings, which have always been in favor of the latter. In such cases two adjacent arches thrust against each other at the center of the soffit tile, the weight of the arch and floor being suspended from the lower flanges of the beam. I will therefore commend it to general use, as the invention is free for any one to use. Besides this, it has a greater advantage in setting. The soffit tiles are set dry on the centering, which when screwed up comes to a true line, while if the skew-backs run under the beams they are set before the centering is screwed up, and if screwed up before the mortar is hard, the bed of the tile on the beam flange is disturbed, and the arch is a defective one as soon as the centering is loosened.

A great improvement in the manufacture of hollow tiles was made after it became customary to make them in vertical sewer-pipe presses. This was first done for the Chicago and Western market, and soon after the example was followed by all the manufacturers in the Central States. Before this all the manufacturers in New Jersey used horizontal presses. The great advantage of the sewer-pipe press is its greater power, which by giving greater pressure to the wet clay makes it possible to reduce the walls, increase the strength, and consequently reduce the weight. This weight reduction was one of the first improvements that made it possible to erect high buildings on the compressible clay of Chicago, but has scarcely been recognized in the many treatises on high buildings that have appeared.

Notwithstanding many other ingenious and meritorious inventions for fire-resisting floor construction, many of which have the only merit of being incombustible, I believe that clay hollow-tile floor arches have come to stay for a long time yet, and that good burned clay will always be the best fire-proof building material. There will continue to be bad work of this kind, however, as long as architects are not discriminating in the quality of clay that enters into the material. Good concrete, which comes next in value, can only be used where bricks formerly were, and where the question of weight is not an important factor. There never will be any economy in using metal to reinforce tile construction, except to resist lateral thrusts, for the tiles can always do their work in compression. The only possible improvement I can see in floor construction with tiles may come when long tiles can be burned as cheaply as short ones, and can be used as lintels between beams. This was the dream of Mr. Scofield many years ago. I have always believed, and do so still, that in mechanics the flat hollow-tile arch with parallel top and bottom is nothing but a beam with confined ends, and that it makes little difference what direction the joints have, provided they are of good mortar and well compressed. There are very few scientific works that have given formulæ for constructions under these conditions. For the information of those who may be disposed to investigate farther, I will refer to a book entitled "Moseley's Mechanical Principles of Engineering and Architecture," with additions by D. H. Mahan, LL. D., published by the old firm of Wiley & Halsted, New York, 1856, pages 402 and 403.

With regard to the direction of the joints, I could never see any advantage in radial joints between voussoirs, which are so generally specified by architects, and which for that reason most manufacturers use. They complicate the work at every point from manufacture to setting, and increase the cost of the latter. In the Denver tests on side-pressure flat arches it is not generally known that as between two hard tile arches the one that broke at 651 lbs. per ft. had radial joints, and that which broke at 1,000 lbs. per ft. had parallel joints from skew-back to key. No record is made or comment given in Mr. Hill's reports of experiments, or, in fact, in any of the published tests, as to whether the arches were of one kind or another, but the illustrations show that the side-pressure tiles in Mr. Hill's tests had parallel joints.

An advantage of hollow tiles for floors which no other system seems likely to overcome is that at one operation it provides a ceiling and a floor, and in the shortest possible space of time. It is all dry in a few days, and does not hinder the rapid completion of the building and its delivery in good condition. It has another advantage in the fact that the arches can be made of any depth up to about 15 ins., and thus fill the whole space between the beams, reducing the concrete filling on top to a minimum, and thus reducing the weight of floors, and in some cases the cost of the work. For fire-proof qualities it requires no further commendation, though for this, as between good hard and good porous tile, I prefer the latter.

In this review of the condition of the art it is not intended to be implied that there are not other and meritorious systems of floor construction with burned clay that are of great value. The intention has been to confine the treatment of the subject to floor constructions in connection with steel beams. Already several systems have been in use which have greatly reduced the use of steel in fire-proof buildings, and they would be proper subjects for another treatise. But the present low price of steel has been such a strong argument for its continued use, that there does not seem any prospect of its ceasing to be the most favorable material to resist transverse strains for a long time to come.

Mortar and Concrete.

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

BY CLIFFORD RICHARDSON.

CEMENT.

The word from which we have derived our name cement was originally applied only to certain additions which were made to lime mortar to enable it to harden under water, such as the puzzolana used by the Romans and trass. Later this designation was used for all the binding materials which furnished a mortar which hardens under water and so has extended to our natural and Portland cements. To avoid confusion all these materials are now classed as Hydraulic Agents, Hydraulic Limes, Slag Cements, Natural Cements, and Portland Cements.

HYDRAULIC AGENTS.

Hydraulic agents do not possess the property of setting or forming a mortar by themselves but they offer silica and clay to the lime of ordinary mortar in a form which permits combination between the two, and a slow hardening. They are of both natural and artificial origin. The natural form is from volcanic sources, such as the puzzolana of Italy, and the trass of the Rhine Valley. We have no such deposits available in this country except in the far West. The artificial form includes slags, burnt clay and shale, ashes, silicate of soda, and, in fact, any inorganic material which contains clay and silica in the form soluble in acids, that is to say, available for combination with lime in the presence of water. There is a plenty of such material in this country but it is rarely, if ever, used, owing to the cheapness of our natural cements.

HYDRAULIC LIME.

We have already seen that, as the amount of impurities of a clayey nature increase in ordinary quicklime, it takes on hydraulic properties. As long as this amount is not too large to permit slaking, although slowly, the lime is known as being hydraulic.

Hydraulic limes have had extensive use in England early in the century but have never been of the same importance here, although they were imported from France and England before the days of the development of our natural cements. When used they are not distinguished from poor quicklimes, and, of course, are never substituted for the true cements in hydraulic work.

Hydraulic limes with but a small proportion of silicates, 5 to 15 per cent., harden under water in from eight to twenty days, but with larger amount in from one to four. There is no very sharp line between poor cements and hydraulic limes. They usually contain less than 20 per cent. of silica and silicates.

Dolomitic limestones, when burnt at a temperature sufficiently low to expel the carbonic acid from the magnesian carbonate, but not from the lime, have hydraulic properties.

Slag cements will be considered in another chapter.

NATURAL HYDRAULIC CEMENT.

Toward the end of the eighteenth century it was discovered in England that certain limestones, when burned, gave a lime which would not slake, but, when ground and mixed with water, furnished a mortar which would harden under water. A similar cement was also prepared from the septaria or concretions found in the London clay. An examination showed that the limestones and septaria which furnished such cements would not dissolve entirely in acids but left behind a residue of clay. It was evident, therefore, that to the presence of the clay the resulting cement owed its hydraulic properties. Such cements were largely prepared and took the place of hydraulic agents and hydraulic limes, and from their resemblance, in color and results to the mortar prepared with the former, were called Roman cements, a name never used in this country where we hear only of natural cements.

Extent of the Industry. — The importance of natural hydraulic cement in the United States is attributable to the wide extent of the deposits of hydraulic limestone which are suitable for its manufacture. Such stone is found, to a greater or less degree, in a majority of the States, especially along the mountains of the Atlantic States, and is well scattered through the country lying along the Great Lakes and in the West. Cement works are found to-day in New York, Pennsylvania, Maryland, Virginia, West Virginia, Georgia, Ohio, Illinois, Indiana, Kentucky, Wisconsin, Minnesota, Kansas, Texas, Utah, and New Mexico. According to the United States Geological Survey there were 68 plants in 1895 producing 7,741,077 barrels of natural cement, worth about $3,895,424. More than half of this was made in New York; 3,939,727 barrels, and about 1,703,000 in the Louisville district, the next producers in quantity being Pennsylvania, Wisconsin, Illinois, and the Maryland and Virginia district with about 600,000, 476,000, 490,000, and 242,000 barrels. Ulster County, N. Y., where the well-known Rosendale brands are burned, and where the first natural cement in this country was made, alone put over three millions of barrels on the market in 1895, valued at half of the entire product of the year. The United States exceeds all other countries of the world in the quantity of natural cement which it manufactures.

Hydraulic Limestones. — Natural cements can be made from limestones which have a very varied admixture of silica, clay, and magnesia, and considerable differences in physical properties. For each locality, where cement is manufactured, differences in composition will be found, as appears from the following analyses: —

COMPOSITION OF HYDRAULIC LIMESTONES USED FOR WELL-KNOWN BRANDS OF NATURAL CEMENTS.

ORIGINAL ANALYSES.

	1	2	3	4	5	6	7	8
	New York		Penn.		Maryland		Illinois	Kansas
	Rosendale	Akron	Lehigh Valley	Roundtop	Antietam	Cumberland & Potomac		Ft. Scott
Calcium Oxide CaO	25.80	19 93	29 94	35.76	23 72	25.54	32.85	35.00
Magnesium Oxide MgO	10.09	9.17	1.55	2.18	15.64	1.10	8.45	3.50
Carbonic Acid CO_2 and water . .	30.93	25.90	26.30	31.74	34.82	24 40	34.12	33.00
Silica SiO_2 . . .	21.41	33.80	27.77	19.81	15 97	28.72	17.01	21.80
Alumina Al_2O_3		3 96		7.35		12.28	3 35	3 70
	10.09		14.29		7.59			
Iron Oxide Fe_2O_3		.88		2 41		5 72	2.39	3.10
Sulphuric Acid SO_3	.66	.50	——	——	.71	1.53	1.81	——
Total Carbonates .	67.26	54.86	56.72	68.44	75.20	46.13	74.15	65.76
Insoluble in Acid .	29.21	35.01	40.15	27.25	20.15	47.72	22.06	23.95

	Carbonate of Lime	Carbonate of Magnesia	Total Carbonates	Alumina and Iron Oxides	Silica	Insoluble
Highest	63 75	32.84	75.20	17.50	33.80	47.72
Lowest	35 59	2.31	54.86	4.84	15.73	20.15

The most distinctive feature in the composition of hydraulic limestones, and one which enables them to be at once divided into two classes, is a marked difference in the amount of carbonate of magnesia which they contain. In the one class it is small, not exceeding 3 or 4 per cent; in the other from 15 to 35 per cent. is found. We have, therefore, two kinds of natural cements, lime and magnesian. With a few exceptions the hydraulic limestones of this country, used for making natural cement, are magnesian. In the Lehigh Valley the stone is not magnesian, and the same is the case in the upper Potomac Valley. Some of the deposits of the West are also nearly straight limestone. Considering their source the greater portion of natural cements, probably over 90 per cent., appear to be made from magnesian limestone. The rock from which the various Rosendale and Louisville cements are made, which alone make up a large part of our product, contains from 15 to 25 per cent. of magnesian carbonate.

The amount of the two carbonates in the limestones is very variable, reaching from 54 to 75 per cent. The silicates and silica may be present in larger or smaller amount, 20 to 47 per cent., and there are similar variations in the relation of silica to the bases, alumina and iron. In many cases there is much free silica with but a small amount of clay, as in the case of the limestone from Akron, N. Y.

The other and minor elements also show their peculiar but less important changes. In spite of these variations in composition natural cements are made from all these rocks.

Of course the properties of the resulting cements are very different.

VARIATION IN THE COMPOSITION OF ROCK IN ONE LOCALITY. — In addition to the variations in the composition of hydraulic limestone in different parts of the country a striking difference is also found in the strata in any one locality, or even in one quarry. There is generally no difficulty in distinguishing at a mere glance peculiarities of color and other physical properties which serve to mark the different strata and separate them. A chemical analysis is then required to determine the variations in composition or they may be tested by burning small amounts of the rock in an ordinary fire, crucible, or experimental kiln, or better, by both methods.

In case a chemical analysis is made it should be carried out according to the methods given in "Blair's Analyses of Iron and Steel," third edition.

In two cement rock quarries, one in Maryland and one in the West, strata are exposed which are typical of the variations in composition which have been mentioned.

COMPOSITION OF THE STRATA IN A WESTERN CEMENT QUARRY.

1. 4 ins. Limestone.
2. 6 ins. Limestone.
3. 20 ins. Bituminous shale.
4. 36 ins. Clay.
5. 48 ins. Cement rock.
6. 30 ins. Slate or shale.
7. 14 ins. Coal.
8. 30 ins. Clay, very hard.

	1	2	3	4	5	6	8
Loss on ignition. Carbonic acid, water and organic matter .	40.2	43.0	32.90	7.2	33.0	6.50	6.3
Lime, CaO . . .	48.0	50.1	.30	.5	35.0	6.70	.4
Magnesia, MgO .	2.0	2.8	2.39	2.0	3.5	2.57	1.08
Alumina, Al_2O_3 .	1.0	1.1	17.00	19.1	3.7	13.00	13.6
Iron oxide, Fe_2O_3 .	1.8	1.0	3.90	4.4	3.1	3.30	2.4
Silica, SiO_2 . . .	6.7	2.6	36.30	61.8	21.8	65.60	72.9
Insoluble in acid .	7.5	3.5			24.3		
Total carbonates .	89.9	93.6			69.9		

COMPOSITION OF FIVE STRATA OF CEMENT ROCK IN A MARYLAND CEMENT QUARRY.

No. 1. Top. Not in use, below the slates and pure limestones.
No. 2. Cement rock.
No. 3. Not in use.
No. 4. Cement rock.
No. 5. Not in use.

	1	2	3	4	5
Loss on ignition. Carbonic acid, water, and organic matter .	33.93	31.74	33.01	24.55	28.08
Lime, CaO	28.25	35.76	38.05	31.02	33.80
Magnesia, MgO	9.41	2.18	1.84	3.39	1.17
Alumina, Al_2O_3	5.25	7.33	5.58	4.17	5.43
Iron oxide, Fe_2O_3	7.07	2.41	3.88	8.29	2.40
Silica, SiO_2	15.71	19.81	16.7	26.52	24.62
Sulphuric acid, SO_3		.16		.19	
Insoluble in acid	28.13	29.66	26.05	29.10	33.51
Total carbonates	70.21	68.44	71.63	62.52	54.45
Magnesian carbonate . . .	19.76	4.58	3.86	7.12	2.46

It appears that the strata of hydraulic limestone may be associated with others of purer limestone, of slate or shale, and in the West of clay and of coal. The presence of strata of slate and the purer forms of limestone are common to almost all cement rock quarries, whereas the clay and coal are peculiar to the geological formations of the West. The Maryland quarry illustrates how great the variations in composition may be in five well-defined strata, all of which are of hydraulic character. The upper bed in this quarry holds nearly 20 per cent. of magnesian carbonate, while the rest are comparatively free from it. The total carbonates vary from 54 to 71 per cent. and the silica and silicates from 26 to 33 per cent., with corresponding variations in the per cent. of lime present. In other quarries an even more striking variety of rock is found as will appear later.

There is also one other variation in the composition of hydraulic limestone which must be noticed. In the same stratum, as it is worked or quarried over a large area, differences in composition are found, due to changes in the material laid down at the time of its formation or, to a less degree, by subsequent action of water. Such variations must be guarded against, but they are usually of minor importance in a good quarry.

With deposits of such a diversified nature it is apparent that the manufacture of natural cement can be based on no absolutely uniform practise. For each quarry and each stratum its own peculiar methods of working must be found.

CHARACTER OF LIMESTONE SUITABLE FOR NATURAL CEMENT. — The different strata of hydraulic limestones in any quarry are not, therefore, equally suited for making natural cement. Their availability for this purpose has been determined primarily by experiment. By comparison of the results so obtained with the chemical composition of the rocks it has been shown that this is dependent on the amount of silica and silicates which they contain, or their relative proportions, and on the per cent. of magnesia, with some regard also to that of the sulphur compounds and alkalies present. It is also important that the silica should be combined with alumina, that any silica present should not be too coarse grained to unite with lime at the temperature of burning and that the rock should be of great density so that the burning and the product may both be satisfactory.

There are, of course, other substances in such limestones which are of minor or no importance, such as manganese, phosphoric acid, barium, which are present to the extent of but fractions of a per cent. The essential constituents, however, whose relations are to be considered as involving the suitability of the rock for cement making, are silica, silicates, including the alumina and iron oxide, of which they are composed, the carbonates of lime and magnesia and at times of iron, and the alkalies and sulphur compounds. These substances can be divided into those soluble and those insoluble in acids, the former including the carbonates and the latter the silica or sand and the silicates. In a rough way a determination of the relative proportion in which these two classes of substances are present is sufficient to characterize a hydraulic limestone.

A more careful inquiry into the effect of the presence of a larger or smaller amount of each constitutent is necessary, however, in order to understand thoroughly what properties the cement derived from different limestones may be expected to have.

The two great classes of natural cements, distinguished by the presence and absence of magnesia, have, to begin with, entirely different characteristics. The magnesian cements, of which the Rosendale brands are typical representatives, do not heat on mixing with water. They set and acquire strength slowly, but eventually are as strong as the lime cements. They do not resist the action of frost well when first used, and if not carefully proportioned have a tendency to expand a year or more after use. The lime cements, unless carefully made, have a tendency, when made into mortar on the one hand, to heat when too rich in lime and on the other to blow when too rich in silicates or when overburned. They acquire their strength rapidly, having nearly twice as great a tensile strength at from one to twenty-eight days as the magnesian cements. They resist frost better than the latter, but at the age of a year they are often not superior, in fact are, at times, inferior, more crystalline and brittle with a tendency to deteriorate in strength. The perfectly proportioned and carefully made cements of this class are, however, the best natural cements in the world. The Round Top cement of the Potomac Valley is typical of the highest grade of the lime cements, as the numerous Rosendale brands are of the magnesian class.

The Masons' Department.

STRAINS IN ARCHES. II.

BY JOSEPH MARSHALL.

IN all arches of the first class, and in arches of the varieties of the second class, shown by Figs. 5 and 7, there are three distinct forces in operation, but in all other varieties of the second class there are only two. These forces we will, for convenience, name "The Thrust," "The Counterthrust," and "The Counterfort," and under all circumstances, in all classes and varieties of arches, the counterthrust and counterfort, singly or combined, must equal the thrust before the arched structure can be in equilibrio. Of course all these forces are the result of gravitation on the mass of the arch, its load, and its supports.

The thrust is that force which tends to drive apart the supporting piers; the counterthrust is that which tends to draw them nearer, and the counterfort is that which balances the difference between the other two.

If the thrust and counterthrust were of equal intensity — a rare occurrence — then the counterfort were unnecessary. It is then of importance to determine quickly and accurately the relations between the efforts of thrust and counterthrust, and to this purpose we now address ourselves.

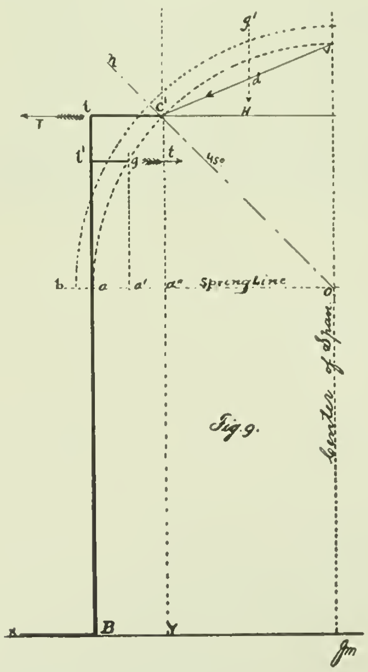
If thrust and counterthrust prevail in an arch — one opposing the other — at what point in the arch do the forces meet? For this must be a neutral point.

To this we answer: The neutral point will always be at the intersection of the arc of the arch by a line drawn at an angle of 45 degs. of elevation from the center, whence the arc is described, and this line and point we shall hereafter designate as the "Neutral" line or point.

It is evident that in a quadrant of a circle (which embraces 90 degs.) having one side parallel to the horizon, and the other perpendicular to it, the 45th deg. is midway between the vertical and horizontal, and that all parts below the 45th deg. stand more nearly vertical than horizontal, while all above that point are more nearly horizontal than vertical; hence, the weight of all parts below the neutral line will be discharged upon the piers with less tendency to disturb them than the weight of the parts above the neutral line, and moreover, the tendency to disturbance, which the arch below the neutral possesses, is exerted in the direction of the extension of that part of the arch, because in that direction it overhangs the gravity center of its support, thereby tending to draw with it in that direction the pier upon which it rests, while all that part of the arch above the neutral line, being suspended between the neutral and vertical lines, tends to force equally in both directions, but being opposed by an *equal* force on the opposite side of the vertical line (the force of the other half of the arch), its whole force is concentrated upon the neutral point, and being impelled by gravity, seeks the line of least resistance.

Referring now to Fig. 9, let us suppose that the vertical line from B to l possesses all the elements of a pier of brick 12 by 12 ins., except rigidity and sectional magnitude. Let the semi-circle in dotted lines from a to v represent the intrados boundary of an arch, the neutral line, o n from o (the center whence the arc is described), will intersect it at c', which is the neutral point. We have then the weight of that part of the arch c' to v, and whatever load this may carry, as constituting the thrust and impinging at c'. By the resistance which the lower part offers, the direction of the force is changed to that of least resistance, which would be the horizontal — c' to l — as indicated by the arrow T. Then l to B will become a lever which will be acted on at l by the thrust force; and if this thrust force in pounds be multiplied by the length in feet of the lever l B, the sum will indicate the pound force at B if not opposed by any other force. This would be the case if we consider c' to v as constituting a *segment* arch, having a half span o a'' mounted on a pier, the inner line of which coincides with the line c' Y. But in the example in hand, we have the arch a to c' overhanging its pier from a to a'', and having the mean of its force above the center of its overhanging distance, as g a', which tends to draw the pier in the direction of the arrow t. The pound force at g multiplied by the foot length of the lever l' B will, in its sum, represent the counterthrust at B. We must here remember that the pound force at g will, in its efficiency, be one half the weight of the arch from a to c' and the load it bears. The counterthrust force at B will always be less than the thrust force for this form of arch and *all* others, except pointed arches above the equilateral, *i. e.*, pointed arches, the radius of which is *greater* than the span.

When the counterthrust is less than the thrust, subtract the less from the greater, and the difference will be the excess of the thrust force at B — supposed to be the base of the supporting pier. This excess must be counterpoised in some way by the counterfort. To do this, we must provide a gravity force conceived to be acting upon horizontal arms rigidly attached to the lever l B, so that it becomes a bent lever. This gravity force is derived from the weight of *all* of the half arch, the weight of the supporting pier, and more weight if necessary. We will then divide the weight of the half arch and pier — taken in pounds — into the excess of the thrust force in pounds, and the quotient will be the length in feet of the lever B to X which would be necessary if no more weight were added to the counterpoise. The lever arm B to x,



having the weight concentrated at the end B, then becomes the counterfort and balances the thrust — always assuming the pier is sufficiently rigid to sustain the load.

For the counterpoising gravity, then, we have: weight of arch, weight of pier, and weight of counterfort. It will be observed that it does not matter whether the counterpoising weight be placed on the lever B x or the lever l c', except that the lever l c' is always limited by the arc of the arch, while the lever B x is considered unlimited as to length; also, the lever arm l c' will wholly disappear in arches of the second class, of the varieties shown by Figs. 6 and 8. In such arches, counterthrust is also absent. It is also evident that a part of the counterpoise may be applied to each of the lever arms B x and l c'.

To test the foregoing reasonings as well as to better demonstrate the procedure, let us suppose Fig. 9 to be at a scale of ⅛ in. to the foot. It will then represent one half an arch 42 ft. span, mounted on piers 30 ft. to the spring. For convenience we will suppose the arch and pier 1 ft. by 1 ft. sectional area, and weighing 120 lbs. to the cubic foot. Not pretending to extreme niceties, we measure the intrados of the arch *a* to *v* for length, and this we know to be 33 ft.; each lineal foot we will call a cubic foot. Now we know that there is 16½ cu. ft. above the neutral line, and 16½ cu. ft. below it. Then we have: —

Upper part of arch.		Lower part of arch.	
16½ cu. ft. × 120 lbs. =	1,980 lbs.	16½ cu. ft. × 120 lbs. =	1,980 lbs.
× lever *l B* in feet	44¾	÷ 2 (for half)	990
Thrust force at *B*	88,605 lbs.	× lever *l' B*	40¾
		Counterthrust at *B*	40,342

Hence, thrust	88,605 lbs.
Counterthrust	40,342 „
Excess thrust	48,263 „

This excess of thrust must be counterpoised, we will suppose, by the weight of the arch and pier, thus: —

Weight of arch	3,960 lbs.
„ „ pier	3,600 „

Excess of thrust lbs.

Total counterpoise w't. lbs. 7,560)48,263(6 ft.
45,360
2,903
× 12 for ins.
34,836(4½ ins.
30,240
$\frac{3,596}{7,560}$ about ½ in.

This would indicate that the lever arm from *B* to *x* would require to be 6 ft. 4½ ins. to just balance the forces of the arch if no more weight was anywhere added — the quality of rigidity in the lever arm *B x* being the agency through which the excess of thrust force is expended.

If the arm *B x* must be 6 ft. 4½ ins., what length must a similar lever be at the springing line of the arch? We have for that calculation the same weights for the two parts of the arch, but these weights operate through much shorter leverage. Then we have: —

Upper part of arch.		Lower part of arch.	
Weight	1,980 lbs.	Weight of arch	1,980 lbs.
× lever	14¾ ft.	÷ 2 (for half)	990
Thrust	29,205 lbs.	× lever	10¾
			10,642 lbs.

Excess of thrust 18,563 lbs.
÷ weight of half arch 3,960)15,840(4 ft.
2,723
12
32,676(8¼ ins.
31,680
$\frac{996}{3,960}$ = ¼

Thus, at the springing line we would require a pier (or lever arm) 4 ft. 8¼ ins. horizontal extension. This would seem to confirm our statement in the first chapter — that an arch could be overturned, even if the piers were absolutely immovable below the spring line; but the arches which may thus be destroyed are those only which exert a counterthrust, because it is only in this kind of arch that the thrust occurs above the springing line. Arches which have their springing line and point of thrust coincident upon their supporting piers may, indeed, fail, or be destroyed without final rupture of their piers, but only in a manner quite different from that pointed out above.

CRACKS IN TERRA-COTTA.

MANUFACTURERS of terra-cotta have a real grievance against builders and architects, on the score of the material not being properly dealt with by them. It would not be difficult to point to several large buildings in terra-cotta, the walls of which, especially in basements, are cracked from top to bottom. Speaking the other day to an architect who was very fond of terra-cotta, and had used it in many important buildings, we asked him why he did not now favor the material so much as formerly. His answer was not of the stereotyped kind relating to lateness of delivery and delays; but he indicated that he had been disappointed by the cracking of the material when subjected to much weight in heavy walls, though these cracks did not make their appearance until after the building had been up some time. No doubt many of the faults under such circumstances arise from settlement of the foundation; but we feel perfectly convinced that they would be far less prevalent and not be so noticeable if more attention were paid to setting and filling in building up the walls — and that is where the makers' chief grievance comes in. It seems to us that many of the large users regard terra-cotta for walls as a species of veneer; which does an injustice to the material. There are powerful reasons for not using terra-cotta in large solid blocks, on account of warping and twisting in burning and the like. And makers certainly have a right to insist on the filling being properly done, so as to render the blocks solid in the wall; it is not that the terra-cotta is at fault, but the builders. — *The British Brickbuilder.*

FRESH CEMENT, TO PAINT OVER.

A CONTRIBUTOR to *Painting and Decorating* recommends that the walls be washed with dilute sulphuric acid several days before painting. This will change the surplus caustic lime to sulphate of lime or gypsum. The acid should be about one half chamber acid and one half water, but if quick action is wanted 66 per cent. acid will answer. This should be repeated before painting, and a coat of raw linseed oil flowed on freely should be given for the first coat. While this cannot be always guaranteed as effectual for making the paint hold, it is the best method our correspondent has heard of for the purpose, and is worth trying when it is absolutely necessary to paint over fresh cement.— *Exchange.*

"POINTING."

AT this season of the year house fronts are commonly cleaned down, brickwork is "pointed," and with the assistance of paint the external aspect of the dwelling is changed. If people are silly enough to paint brickwork, let them do so; but there is more sense in "pointing it." What we desire to criticize in this "note" is the manner in which the pointing is done. The builder takes no trouble whatever over the bricks; he chips away the sharp, clean-cut edges, and scratches the mortar out. Then he fills up the holes made with mortar, and attempts to "restore" the sharp edges of the bricks by a compromise between a "trowel line" and a black streak. The chipped edges of the brick are hopelessly plastered over in the process, and never afterwards will the building front look like a good piece of brickwork. Whatever may be the excuses for pointing,— and they are many in populous, smoky districts,— there can be none for ruthlessly destroying the effect of a good piece of work. This morning we have just seen a really handsome brick front in process of mutilation in this fashion. The clipping and scraping having been duly carried out, a colored mortar — yellow, like the bricks — has been thrown in, and the clippings hidden by the leveling of the whole by the trowel. Then the inevitable "black streak" is performed, and the front looks as though it had been ruled into squares and irregular oblongs. And the "builder, decorator, and sanitary engineer" is so proud of his ghastly work that he has actually had the impudence to erect a board in the front garden giving his name and address! If "pointing" is to be done, let it be done carefully and reverently, and not as though the building were to form part of an ephemeral exhibition or raree-show.— *The British Brickbuilder.*

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

NEW YORK.— The quiet season has begun in New York as well as in most of the large cities, as chronicled in the daily press. It seems inevitable, at this time of year, that there should be a dearth of large operations in building projects. The rush, not as powerful as usual, ceased about May 1, and speculators and investors are quietly resting now until time to search for "new worlds to conquer." Preliminary sketches are now in progress for several important buildings designed to be ready for occupancy in '98, but most of the activity this summer will be in the preparation of plans for small buildings and residences. Some of the most important items of news follow.

TERRA-COTTA FIGURE, 10 FT. HIGH, ON GABLE, AMERICAN BAPTIST PUBLISHING SOCIETY BUILDING, PHILADELPHIA, PA.
Frank Miles Day & Bro., Architects.
Executed by the Conkling-Armstrong Terra-Cotta Company.

The disastrous fire on Ellis Island, which fortunately was confined to destruction of property only, will necessitate the entire rebuilding of the island, which has been used for many years as the landing place and headquarters for emigrants from foreign countries. The buildings have always been considered unsafe and unsubstantial, and although frequent complaints had been made to the authorities at Washington, nothing was done, until now some action is inevitable. The President has suggested that an appropriation of $600,000 be made, and Col. John L. Smithmeyer, of Washington, has been appointed Superintendent of Construction for the erection of the proposed buildings. The new buildings will be fire-proof, of brick or iron, and so constructed that the several parts can be cut off from each other by fire walls and steel doors.

Clinton & Russell, architects, are preparing plans for a fifteen-story brick and stone office building, to be built at Nos. 35 to 39 Broadway, for the Hemenway estate.

Ernest Flagg, architect, is preparing plans for a building to be erected on the north side of 36th Street, near Broadway.

James B. Baker, architect, is preparing plans for an office building to be erected corner of Fifth Avenue and 45th Street, for T. T. Tower.

W. J. Dilthey, architect, has completed plans for "The Renwick" store and loft building, which will cost $100,000. It will be located corner of University Place and 10th Street, and will be eight stories, all fire-proof.

Harney & Purdy, architects, are making sketches for a Hospital and Home for Colored People, to be erected on Concord and Wales Avenues, and to cost $100,000. It will be a four-story brick and stone building.

Lamb & Rich, architects, are preparing plans for a Baptist Church to be built corner Convent Avenue and 145th Street. Cost, $75,000.

C. P. H. Gilbert, architect, has planned an hotel, to cost $200,000, for the Imperial Realty Company. It will be a nine-story brick building.

TERRA-COTTA BELL TOWER, ST. JOHN'S CHURCH, JOHNSTOWN, PA.
Beezer Brothers, Architects.
Terra-cotta made by the Standard Terra-Cotta Company.

CHICAGO.— Building news continues to be depressing. A late issue of the Chicago *Economist* gives a column headed "Desperation of the Architects," in which the condition of the profession is declared to be worse than the general results of business stagnation. The evils of cutting prices is alluded to, and particular stress is laid on the disastrous competition between architects and their own draughtsmen, who work at night and have no office expenses. We may hope that some of the evils of the illegitimate practise of architecture will be done away with as a result of the law passed lately by the Illinois legislature. Under the provisions of this statute, any one who desires to practise architecture must

TERRA-COTTA CAPITAL, STEWART BUILDING, CHICAGO.
D. H. Burnham & Co., Architects.
Executed by the Northwestern Terra-Cotta Company.

VANDERGRIFT RESIDENCE, PITTSBURGH, PA.
Alden & Harlow, Architects.
Bricks manufactured by Harbison & Walker.

pass an examination and pay twenty-five dollars for his license, and an annual fee thereafter of five dollars. Established architects are not required to take the examination. Every individual member of a firm must take out a license. Record must be made in every county where an architect practises. The bill seems to have passed with little change from the form in which it was recommended by the Institute of Architects. A casual reading gives the impression that the clause which allows a contractor to be his own architect may afford a means of evading the law just where, for the sake of good architecture, it ought to be most effective.

The make-up of the examining board, the conditions for revocation of licenses, etc., are details of interest to the profession, which looks at the bad business, worse architecture, and some of the so-called members of the profession who bring disgrace upon it, and *hopes* that the new law will accomplish something.

The most important item this month is a ten-story office building, by Holabird & Roche, which is to be erected this summer at Clark and Harrison Streets, to cost $200,000. This location is at present the south side limit of high office buildings.

N. S. Patton, architect for the Board of Education, has several schools on hand.

S. S. Beman is taking bids on a hotel to be built in South Bend, Ind.

Plans have been completed by H. L. Ottenheimer for a four-story apartment building, to cost $100,000.

Bishop & Colcord have a $75,000 building of the same character under way.

Robert S. Smith has designed two important apartment buildings.

Among good residences may be named one at $75,000, designed by Richard E. Schmidt. Architect Fritz Foltz is designing one to cost $25,000.

BUFFALO.—Last month ended with far brighter prospects for the building trade than have been seen for a long time. On every hand seems to be the opinion that, with the settlement of the tariff, this city will begin, if not to boom, at any rate to be very busy.

There are several large buildings to be started very soon, chief among which may be cited the new building for the Buffalo Savings Bank. It is to be erected on the corner of Main and Huron Streets. The site cost $260,000. The building is to be built from designs obtained in competition. A week ago the following architects were invited to submit sketches: C. W. Eidlitz and R. W. Gibson, of New York, and Green & Wicks, A. Essenwein, Lansing & Belerl, Geo. Cary, E. A. Kent, Beebe & Son, Bethune & Fuchs, and C. K. Porter, of this city.

The committee announced that $250 would be paid to each competitor, and reserves the right to reject any and all plans, or adopt any which meets with their approval.

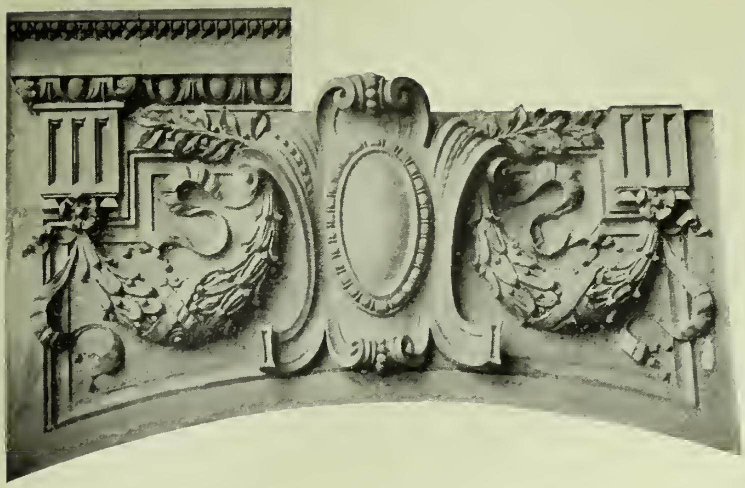
The New York architects have notified the secretary that they will not enter on such terms, but have sent a circular issued by a number of architects whereby they agree to prepare plans under conditions not approved of by the bank authorities.

No reply has yet been made, but the prospects are that the local architects only will compete. The building is to cost $300,000, and is to compare favorably with any buildings in the neighborhood. The directors wish to obtain one of the handsomest individual banking houses in the county.

The former owner of the property has bought from the Catholic Institute a block on Main Street and intends to build a fine structure there. As a consequence of this, the Catholic Institute intends to go on with their Institute on the corner of Main and Virginia Streets, and Messrs. Metzger & Greenfield have received the order for plans for the same. The idea is to have a building about 60 ft. high, three stories, with a frontage on Main of 98 ft., and to be built in the style of Italian Renaissance, with an imposing façade. Terra-cotta is expected to enter largely into the composition of both these buildings.

A large apartment house is to be built on Franklin Street, near

CHAPEL, WASHINGTON STREET, BOSTON.
Rotch & Tilden, Architects.



TERRA-COTTA WINDOW LINTEL, OSTERWEIS BUILDING, NEW HAVEN, CONN.
Brunner & Tryon, Architects.
Executed by New Jersey Terra-Cotta Company.

Allen. The plans have been drawn out of town and everything has been conducted with great secrecy, but the fact has leaked out. It is to be an elaborate structure, and is to far exceed in finish and convenience any building of the kind erected so far in this city.

There has been some little excitement over letting the contract for fire-proofing the new school No. 12. One of the fire-proofing companies using hollow brick complains that the specifications have been drawn to suit the Expanded Metal Fire-proofing Company, thereby preventing any other class of fire-proofing from having an equal chance to bid on the work. Nothing has been done in this case, but a proposition has been made to allow all fire-proofing companies to submit estimates for the ironwork necessary for their individual systems.

TERRA-COTTA PANEL, BUILDING WAVERLY PLACE AND GREENE STREETS, NEW YORK CITY.
Robert Maynicke, Architect.
Executed by Excelsior Terra-Cotta Company.

PITTSBURGH. — Some few new buildings are maturing on paper, among which is a new school building for the third ward, Allegheny, for which Architect F. C. Sauer is preparing the plans. It is to cost about $200,000.

The North Braddock School Board have decided to erect a new school building at a cost of $20,000.

Architects Shaw & Bailey are preparing plans for a three-story brick school-house for Warren, Penn., to cost about $30,000.

Architects Alden & Harlow have been selected to prepare plans for the new industrial school building for the second ward, Homestead, to be erected by Mr. C. M. Schwab, president of the Carnegie Steel Company. It will be two stories, of brick, and contain eight rooms, to cost $25,000.

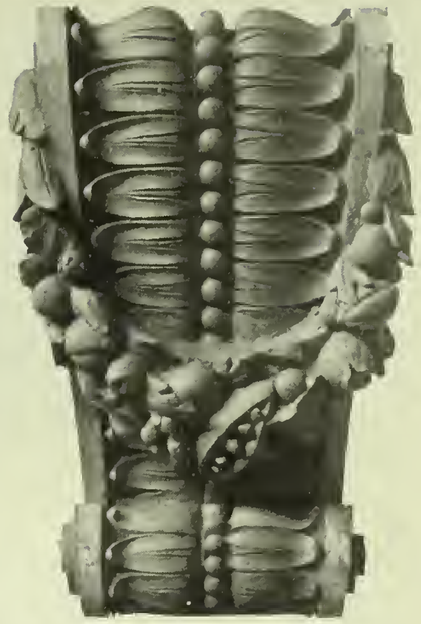
The same architects have prepared plans for a four-story brick warehouse to be erected on Liberty Street, for John Way, Jr.

Local architects have entered competitive designs for a new library building to be erected by Washington and Jefferson College, at Washington, Penn., at a cost of $60,000.

The Fifth Avenue Baptist congregation have accepted plans for a new $10,000 church on the site of the old chapel.

Architect J. P. Brennan has prepared plans for an industrial school for the St. Paul's Orphan Asylum, Tannehill Street, to be three stories, of brick, and to cost $15,000.

A new Casino will be erected here from plans prepared by Architect J. D. Allen, of Philadelphia, Penn., of steel construction and terra-cotta, to cost $150,000.



TERRA-COTTA KEY, BUILDING WAVERLY PLACE AND GREENE STREET, NEW YORK CITY.
Robert Maynicke, Architect.
Executed by Excelsior Terra-Cotta Company.

ROCHESTER. — Thus far there has been but one important building erected this year — the new extension to the wholesale warehouse of Sibley, Lindsay & Curr, which is about 75 by 150 ft., seven stories high, iron and steel construction, terra-cotta partitions, and floor arches, and cost about $75,000.

The massive foundations for the new Lehigh Valley Railroad Company's new depot are as yet uncompleted. The latter building, when finished, will be one of the handsomest structures in the city, and is the work of Architect J. Foster Warner, as is also the Sibley Building extension.

Architect George T. Otis is about to let contracts for the erection of a four-story building for the Young Women's Christian Asso-

TERRA-COTTA PIER CAP, 15TH STORY, ST. JAMES BUILDING, NEW YORK CITY.
Bruce Price, Architect.
Executed by the Perth Amboy Terra-Cotta Company.

ciation. Building will be about 60 by 85 ft., with a gymnasium wing 30 by 75 ft.; the latter will be fire-proof. Front will be of press-brick, furnished by the New York Hydraulic Press-Brick Company, and trimmed with Indiana limestone, or Vermont marble and terra-cotta; the building complete will cost about $35,000.

The Rochester Steam Laundry Company are erecting a new press-brick front to their four-story building on Court Street, from designs by Fay & Dryer. New York Hydraulic Press-Brick Company furnish the brick, and Excelsior Terra-Cotta Company the terra-cotta.

Architects Kelly & Headley are about to let contracts for the erection of the Wayne County (New York) Court House, which they recently won in competition. Building will be of press-brick trimmed with light-colored stone and terra-cotta.

Architect Claude F. Bragdon, of this city, has taken in a partner, Mr. J. Con Hillman, of Portland, Ore. Messrs. Bragdon & Hillman have prepared plans for a number of buildings to be erected at Despatch, N. Y., ranging in cost from $1,500 cottages to the $30,000 hotel, including a town hall, church, and railway station, the latter being completed and the hotel started; all are of brick and in "colonial style."

BRICK AND TERRA-COTTA FIREPLACE MANTELS.

THERE are no materials which can be used in interior finish about the chimney corner to better effect than brick or terra-cotta, which, when skilfully chosen and arranged, produces soft, harmonious effects not obtainable in any other way.

Architects who have had large experience in the use of such material have learned, however, that the production of special designs is attended not only with such great cost as to be often prohibitive, but that the burning to order of special terra-cotta to the uniform color, size, and nicety required for interior decoration, particularly in the so-called "fire-flashed" colors, is a difficult undertaking, and results in frequent failures, delays, and disappointments.

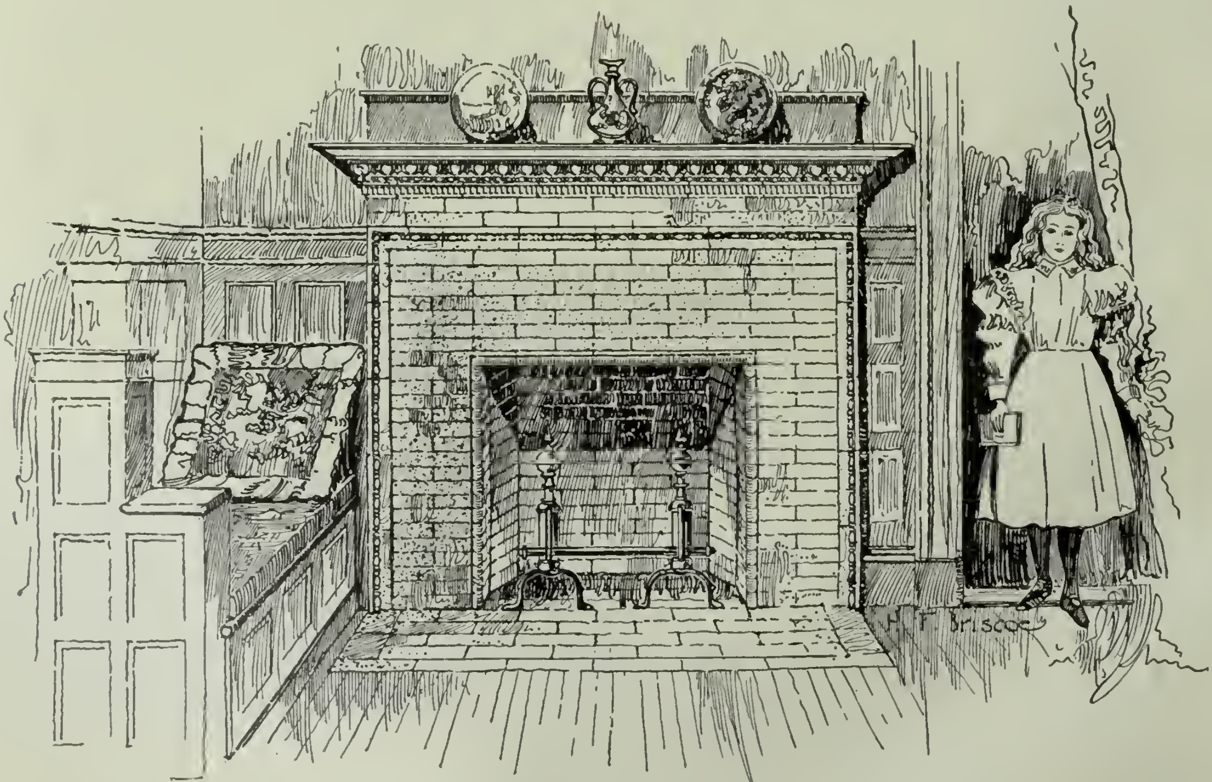
TERRA-COTTA FRIEZE, AMERICAN BAPTIST PUBLISHING SOCIETY BUILDING, PHILADELPHIA.
Frank Miles Day & Brother, Architects.
Executed by Conkling-Armstrong Terra-Cotta Company.

Any concern, therefore, that can offer a line of fireplaces in brick or terra-cotta, producing all the artistic effects of special designs, with the low cost and certainty of delivery attending stock patterns, will certainly make a most valuable contribution to the resources of our architects, and will greatly widen their present scope in the interior finishing of their buildings.

Fiske, Homes & Co., of Boston, have undertaken this task, and how well they have succeeded will be seen from the accompanying cut of one of their smaller designs, by the full-page advertisement shown elsewhere, and the series of drawings which they propose to illustrate in our pages during the coming year.

In their mantels they have adopted a somewhat novel method of handling the ornamentation, which is largely in terra-cotta form instead of molded bricks, thereby producing an artistic style not otherwise obtainable.

They have employed competent designers to first lay out the



BRICK AND TERRA-COTTA FIREPLACE MANTEL.
Designed by J. H. Ritchie. Del. by H. F. Briscoe. Modeled by Tito Conti.
Manufactured by Fiske, Homes & Co.

mantels without reference to the detail of the manufacture, giving them full scope to proportion and arrange them for the production of the finest architectural effects. The modeling has been done entirely by hand in the best classical style, while the pressing of stiff-tempered clay in smooth metal dies gives a nicety of finish much superior to the usual terra-cotta work made in plaster of Paris molds.

The terra-cotta work is all made in standard-sized interchangeable pieces.

In burning these pieces in the kilns, a variety of shades is obtained which are culled with great care, thus enabling an entire mantel to be furnished of a uniform color. This result cannot be accomplished in any other way, particularly in fire-flashed material.

A feature of great importance, which we hope will be appreciated and utilized by architects, is the opportunity afforded them of making designs to suit their own individual tastes as regards the choice and arrangement of ornamentation, by bringing together in any desired combination the standard interchangeable pieces which Fiske, Homes & Co. are now prepared to furnish. This method will give practically all the desirable features of special designs, but with the moderate cost and certainty of delivery already mentioned.

We illustrate above one of their low cost yet artistic designs in which the facing is made of 8 by 1½ in. bricks with beaded jambs, with a delicate bead and reel border, and the cornice of a skilfully modeled egg and dart and dentil design; a wood shelf and back-board are used to give a smooth and finished effect.

This design can be furnished in a variety of colors, and any width of opening from 28 to 48 ins. (varying by 4 in. intervals), the other dimensions being in proper proportion. By this flexibility of dimensions, which can be obtained only by the method adopted in these mantels, the requirements of any particular case can be suited.

OF INTEREST TO ARCHITECT AND MANUFACTURER.

MR. J. PARKER FISKE was admitted to the firm of Fiske, Homes & Co., Boston, on July 1, 1897.

WALDO BROTHERS have received the contract for furnishing the ornamental terra-cotta for Highland Spring Brewery, Boston.

NEGOTIATIONS have been closed whereby Meeker, Carter, Booraem & Co. will, in the future, handle the Brooklyn business of O. D. Person, of New York.

SIMPSON BROTHERS, Boston, are using Alsen German Portland Cement for platform work at new Newton stations, buying of Waldo Brothers, New England agents.

THE F. D. Cummer & Son Company, of Cleveland, Ohio, reports the sale of one of its celebrated dryers to be shipped to St. Petersburgh, Russia, and three to Antwerp, Belgium.

WALDO BROTHERS are supplying the Atlas brand of American Portland Cement for foundation work for Converse Building, Milk Street, and White Building, Boylston Street, Boston, Winslow & Wetherell, architects, and L. P. Soule & Son, builders.

THE American Enameled Brick and Tile Company has closed contract with the board of trustees of the Ohio State University for about fifty thousand enameled brick for use in Townshend Hall Building, of Ohio State University, Columbus, Ohio.

MEEKER, CARTER, BOORAEM & CO., of New York City, have opened a branch office in the Arbuckle Building, Brooklyn. In addition to a full line of burnt clay materials of foreign and domestic manufacture, they will carry common bricks, lime, cement, etc. One of the principal reasons for opening this office is to push the sale of paving bricks, manufactured by the Eastern Paving Brick Company. This branch of their business will be in charge of Mr. Paul E. O'Brien.

THE Tiffany Enameled Brick Company, Chicago, have closed the following contracts for their brick: Cataract Construction Company Power House, Niagara Falls, McKim, Mead & White, architects; Cook County Hospital, Chicago, Warren H. Milner, architect; Hecker Mausoleum, Detroit, McKim, Mead & White, architects; schoolhouse, No. 18, Buffalo, Aug. C. Esenwein, architect; stable for Mrs. Nearings, Toledo, Ohio, E. O. Falles, architect; Vocke Building, Napoleon, Ohio, E. O. Falles, architect.

THE New Jersey Terra-cotta Company is making the terra-cotta for office building, 115 Wall Street, New York City, Jardine, Kent & Jardine, architects; office building, 830 Broadway, New York City, Cleverdon & Putzel, architects; High School, Concord, Mass., Chapman, Frazer & Blinn, architects; apartment houses, St. Nicholas Avenue, New York City, Henry Anderson, architect; apartment houses, 146–150 Eighth Avenue, New York City, Thomas R. Jackson, architect; apartment house, Monroe & Hamilton Streets, New York City, Louis F. Heinicke, architect.

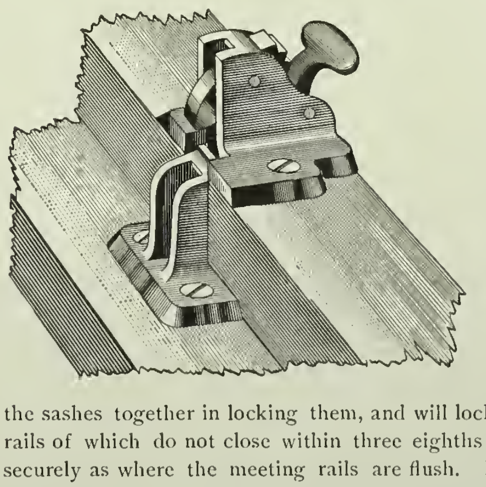
THE GRUEBY FAIENCE COMPANY, 164 Devonshire Street, Boston, has been reorganized and incorporated under the laws of Massachusetts; W. H. Grueby, W. H. Graves, and Geo. P. Kendrick, directors.

Their reproductions of the old Moorish tiles in the dull, soft colors of the originals are attracting a good deal of attention, and Moorish designs and colors are already finding a place in modern baths and smoking rooms.

The brilliant effect of the Grueby faience in a plain white surface can best be seen in a recently completed station of the Boston Subway. This smooth, clean material cannot fail to find favor wherever cleanliness and the absence of the germ of disease is of prime necessity — in hospitals, laboratories, baths, schools, and all public works.

A PRETTY booklet has come to our notice illustrating the Pancoast ventilators, made by the Pancoast Ventilator Company, 316 Bourse Building, Philadelphia, Penn. It is invaluable for use in offices, sitting rooms, bedrooms, smoking rooms, railroad cars, street cars, churches, court rooms, schoolrooms, public halls, hospitals, etc. The advantages of the ventilator are, efficiency, neatness, durability, and perfection. This firm guarantees to exhaust as many cubic feet of air per minute as any other storm-proof ventilator made. The Pancoast building and chimney ventilators are said to be one of the best ventilators on the market, and are guaranteed to give entire satisfaction. They are made in all sizes of galvanized iron or copper. There are several testimonials contained in this book from people who have used these ventilators, and who praise them very highly. Write the manufacturers for a catalogue.

THE GALE AUTOMATIC SAFETY SASH LOCK, herewith illustrated, commends itself at once on inspection as being simple and durable (having no springs), and positive in its automatic locking of any window equipped with it on shutting the same, as the sash cannot be closed without the lock fastening the window. This lock does not interfere with the free movement of either sash, and cannot cut or mar the woodwork, even if carelessly used. The lock draws the sashes together in locking them, and will lock those, the meeting rails of which do not close within three eighths of an inch, just as securely as where the meeting rails are flush. If the upper or outside sash has dropped or sagged, the lock will force it up to the head of the frame, and when locked holds the sashes absolutely rigid, and



prevents rattling. A unique feature of the lock is that, in the event of one not closing the lower or inside sash entirely, the window is locked, as the lock fastens at three distinct points. The lifting of the lever or knob releases the lock, and the window unlocks as the sash is raised. For further information regarding this device parties may correspond with Rufus E. Eggleston, 576 Mutual Life Building, Philadelphia, Penn.

We are in receipt of the following communication from Mr. T. W. Carmichael. inventor and manufacturer of the Carmichael Clay Steamer:—

I beg to call your attention to the great success of my clay steamer by handing you herewith a copy of a letter received from one of my latest customers. This party was in doubt about ever being able to make good pressed brick with his clay, but the steamer did not run longer than five minutes in his presence before he said he was satisfied.

GREEN BAY, WIS., May 22, 1897.

T. W. CARMICHAEL, ESQ., WELLSBURG, W. VA.

My dear Sir:— I am now satisfied our clay will make excellent Dry Press Brick. Your steamer has set us right, and I am now making press brick nf the best quality.

If you want a recommendation, write out anything you want and I will sign it.

Respectfully yours,

THE WM. FINNEGAN BRICK COMPANY,

WM. FINNEGAN.

Remember. my steamer is sold on a guaranty. It is my machine until it does work properly. I make it a point to set or start the steamer myself, thus avoiding delay and experimenting. It can in most cases be set at night, so no time is lost.

The following are among my customers for this season:—

James McNeen, La Junta, Colorado.
The Washington Brick & Terra-Cotta Company, Washington, D. C.
Chisholm, Boyd & White Company, Chicago, Ill.
Alumina Shale Brick Company, Bradford, Penn.
Standard Brick Company, McKeesport, Penn.
Alumina Shale Brick Company, Bradford, Penn., second order.
Wm. Finnegan Brick Company, Green Bay, Wis.
Nicholls & Mathews, Wellsburg, W. Va.
Empire Press Brick Company, Denton, Texas.
N. W. Ballentyne, New Cumberland, W. Va.
Gladding, McBean Company, San Francisco, Cal.
Camden Clay Company, Spillman, W. Va.

My claim that "No dry press brick plant is complete without the Carmichael Clay Steamer" receives a practical endorsement in the above list.

TREASURY DEPARTMENT, Office Supervising Architect, Washington, D. C., July 8, 1897. SEALED PROPOSALS will be received at this office until 2 o'clock P. M. on the tenth day of August, 1897, and opened immediately thereafter, for all the labor and materials required for the erection and completion (except heating apparatus, vault doors, and tower clock), of the United States Post-Office, etc., building at Paterson, N. J., in accordance with the drawings and specification, copies of which may be had at this office or the office of the superintendent, at Paterson, N. J. Each bid must be accompanied by a certified check for a sum not less than two per cent. of the amount of the proposal. The right is reserved to reject any or all bids, and to waive any defect or informality in any bid, should it be deemed in the interest of the Government to do so. All proposals received after the time stated for opening will be returned to the bidders. CHAS. E. KEMPER, Acting Supervising Architect.

WATERPROOFING BRICKS.

To those who are tired of applying two or three coats of linseed oil to their brick walls every two or three years, and to those who would like to avoid the expense which this triennial application entails,

CABOT'S BRICK PRESERVATIVE

is recommended as an article that will waterproof brickwork thoroughly with one coat (or with the most porous bricks, two coats,) at a less cost per coat than oil, and which the test of time has proved to be permanent. It is an indestructible, insoluble compound which never requires renewal. A preventive of the white efflorescence.

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See sample stairway at our office, showing its application to wood, marble, and iron, with and without illumination.

Send for illustrated pamphlet, sample, and estimates.

The American Mason Safety Tread Co.,
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As all parts are galvanized, this bead can be used with artificial plasters as well as with lime mortar.

The corner, when finished, presents a smooth, rounded surface for paper or decoration.

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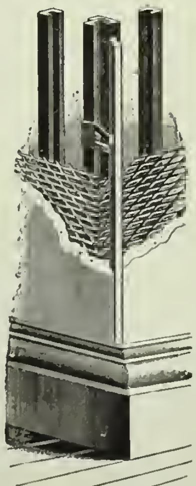
This Bead consists of a rod of Steel held rigidly at any required distance from the corner to be protected.

Different forms of clip enable this bead to be used as readily on the corners of brick and terra-cotta partition walls and of fireproof construction as on wood studding.

One hundred clips are sent with each hundred feet of rod, although they need not be placed in ordinary cases closer than 18 or 20 ins. With the clip for brick or terracotta walls, eight-penny wall nails are furnished.



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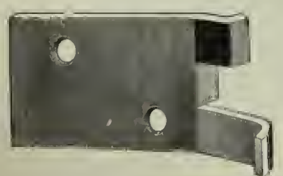
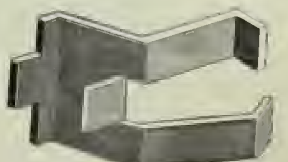


CLIP FOR WOOD.

CLIP FOR BRICK.



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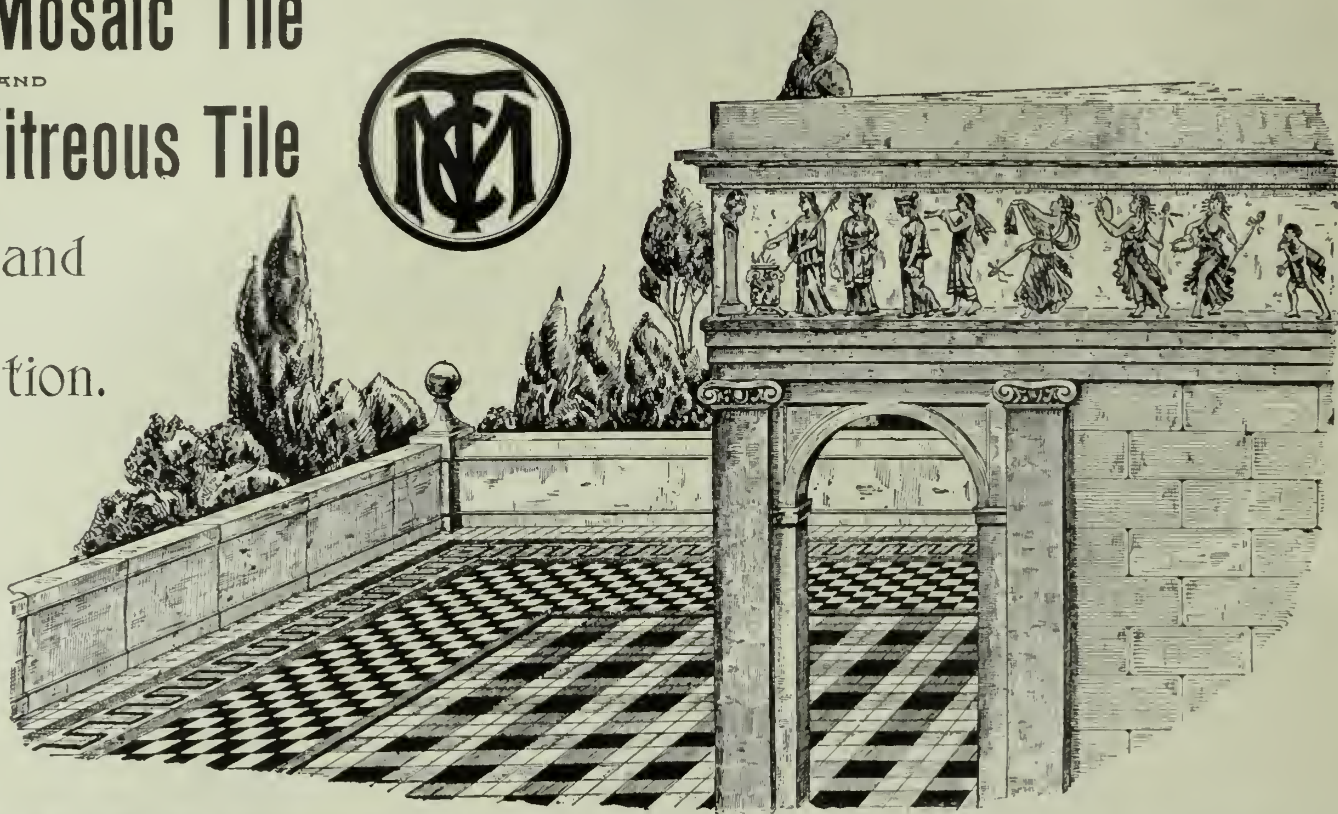

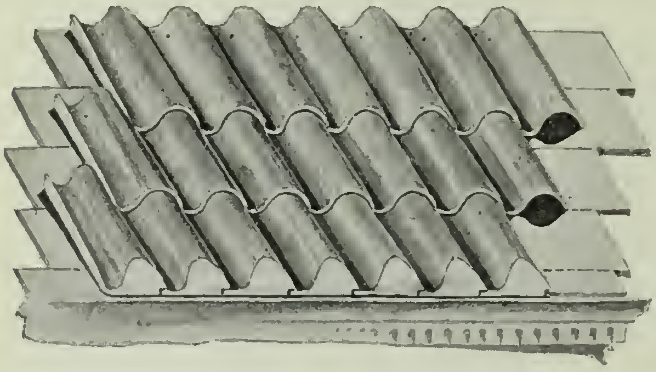

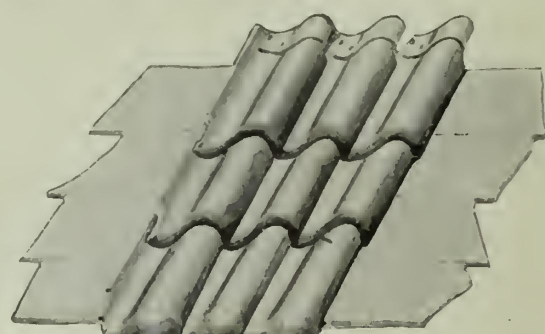

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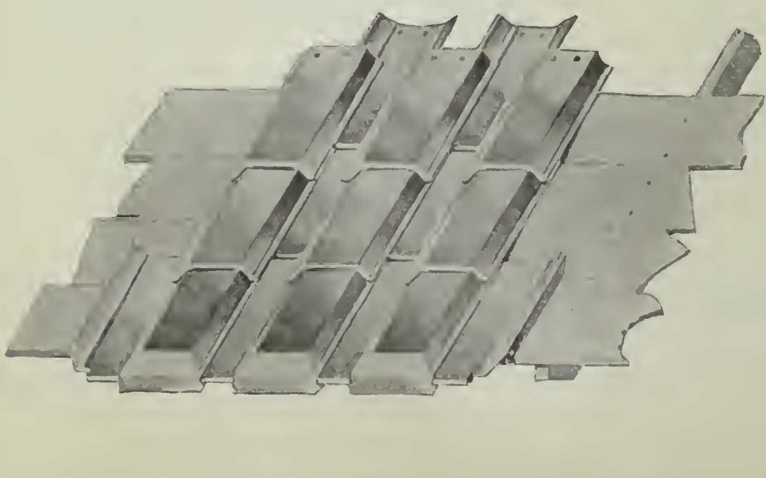

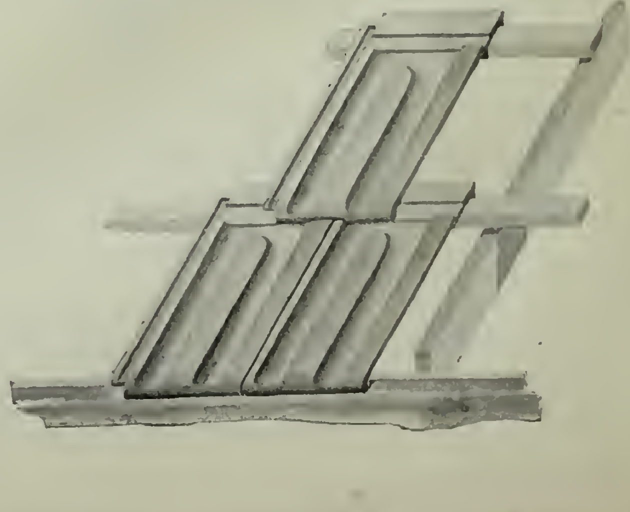


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VOLVME VI AUG. 1897 No. 8

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.

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WHEN the use of terra-cotta was revived in England, some thirty years ago, it was then looked upon in the light of an innovation, rather than the re-introduction of a very old building material. Stone and brick, used separately or in combination, had become traditional and time honored in a land of invincible conservatism, whose people — whatever their views as to the first part of the proverb — "meddle not with him that is given to change." Notwithstanding this, terra-cotta was able to maintain a foothold, and of recent years its use has become general. Its durability is conceded, its utility no longer seriously questioned, while its susceptibility to various methods of treatment has been shown to exceed in many ways that of any rival material. These are qualities that appeal strongly to the sentiment, as well as to the business instinct of men who build not merely for their own but for succeeding generations. This, in a general way, is the secret of its growing demand in England, and, to some extent, the reason that underlies its popularity in America.

The estimation in which it is held in the two countries, however, differs considerably. That difference will, we think, be found to coincide with certain phases of national character (on which it is not at this moment necessary to enlarge), as well as with the relative climatic conditions. On this latter point, at least, comparison need not be odious, and may be made instructive. If, for example, bountiful nature has given us our full share of sunshine, there is no reason why we should not make the most of her gift. If, on the other hand, she has given England a moist atmosphere, with abundant supply of soft coal — therefore a comparatively gloomy outlook — its inhabitants do well to accept the situation without murmur or querulous complaint. They, however, have done and are doing more than this. Taking a leaf out of nature's own book, thay have sought to adapt themselves to their inexorable environment. With them terra-cotta has, to a great extent, superseded stone, but is *not* a substitute for, nor is it regarded as an imitation of stone. When chosen, it is by preference and in its own right; not merely on the score of economy, but in view of its greater permanence and, above all, because of its smoke-resisting properties. Hence, it is not used promiscuously on the cheaper classes of property, but usually on work of a very important character. It is almost invariably finished smooth, that it may offer less encouragement for soot to lodge on the surface. For a similar reason it is fired hard, and has a close, vitreous face, so that dirt may not penetrate the pores, causing lasting discoloration.

With us we fear it must be confessed that terra-cotta is often made to change places with stone solely from considerations of cost, or as a compromise, perhaps, between stone and cast iron. How often have we seen it placed in competition with galvanized iron, in which, alas, the cheapness of the latter, acting upon the cupidity of a sordid speculator, gained for it a preference otherwise inexplicable.

In most of the Eastern States, and wherever anthracite coal is the ordinary fuel, the smoke nuisance is not so serious. There is no telling what the future has reserved for us, even in this particular. It may be, as has been remarked metaphorically, that when our chimney has smoked as long as theirs the soot will be just as plentiful. The use of soft coal is certainly on the increase, and the air in all large cities is less free from the products of combustion than formerly. For the present, however, we can afford to stipple or scratch the face of terra-cotta, and sometimes go the length of tooling it "in imitation of stone."

A TOOLED surface cannot be claimed as a logical or natural treatment for a material of plastic origin, and one which, until finished and laid out to dry, is still susceptible to the lightest touch. The stiff mechanical regularity of six or eight cut work is in keeping with the rigid unyielding nature of stone. These cuts tell the story of its manipulation, from the time a large block leaves the quarry until the hewn stones are set in the building. Each cut represents a distinct blow of a mason's mallet on the steel tool by which the cut has been made. It suggests to the mind how stones have been shaped by a persistent use of these tools from time immemorial. We are aware that most of this work is now done by automatic machinery, producing a monotonous regularity, the imitation of which is all the more objectionable. But why attempt to imitate the surface texture of a hewn block in one that has been pressed into shape in a mold? In order to do so the mold has to be specially prepared, the required corrugations of six or eight to the inch being scratched in reverse by means of a steel templet. This, we understand, is the usual method; but whether it is merely the outcome of a conventionality of long standing, or done with deliberate, therefore dishonest, intent, the practice is equally anomalous, and should not be encouraged.

A similar but much more agreeable effect may be produced by the use of a toothed scraper, used directly on the face of each block shortly after it is taken from the mold. The toothing of the scraper may vary from eight to the inch, for work near the eye, to four to the inch on heavy work used on the upper stories of very high buildings.

When the tooling is done in the mold, every block coming from it is an exact duplicate, except in the case of blanks and otherwise defective impressions, which are not easy for the finisher to rectify. On the other hand, when done with the scraper no two pieces are exactly alike, though from the same mold and finished by the same man. These variations, and the slightly undulating movement resulting from hand finish, are among the things that invest the work with a higher degree of artistic merit. At all events, there is much to be said in favor of this method as against the one frequently adopted. Work that has been treated in that way has an added charm which cannot be expected from a series of stereotyped impressions needlessly deprived of all life and individuality.

SOCIETY, ASSOCIATION, AND CLUB NEWS.

THE Thirty-first Annual Convention of the American Institute of Architects will be held at Detroit, Mich., on Wednesday, Thursday, and Friday, Sept. 29, 30, and 31, 1897.

The full details of the program will be announced in a future circular. Papers will be submitted from Prof. C. Francis Osborne, F. A. I. A., of Cornell University; Mr. Henry Van Brunt, F. A. I. A., of Kansas City, and Mr. Cass Gilbert, F. A. I. A., of St. Paul, Minn., on Architectural Education, and its bearing on membership in the Institute. From Mr. Clipston Sturgis, F. A. I. A., of Boston, on Church Architecture, and Mr. H. Rutgers Marshall, F. A. I. A., of New York, on Architectural Truth.

The committee, to which was referred amendments to the Constitution and By-Laws, will report many and radical changes in the hope that they will be adopted, and that they will be so complete and harmonious as to preclude the necessity of changes for a long time to come.

Arrangements will probably be made for a reduction of railroad rates to one fare and a third for the round trip, but this can only be secured by a full attendance at the convention.

The president has appointed Mr. H. Langford Warren, Frank Miles Day, and the secretary of the Institute, committee on the part of the Institute, and the Michigan Chapter has appointed Mr. James Rogers, Jr., Henry J. Meier, Richard E. Raseman, and Frank C. Baldwin, the local committee of arrangements.

The local committee report that arrangements have been made with the Cadillac for headquarters for the Institute. Rooms and board may be had at the Cadillac for $3.00 and $3.50 per day.

THE Eighth Annual Convention of the National Association of Building Inspectors will be held in Detroit, Sept. 14, 15, 16, 17, 1897. The association was formed in June, 1890, for the express purpose of gathering and disseminating practical and useful knowledge, relating to the safe construction of buildings, introduction, and enforcement of the best methods obtainable of building laws.

The suggestions that will come up for consideration are of great variety and interest, among them being: —

Uniformity of safe loads for building floors. Adoption of a system of uniform definitions in building laws. Uniformity of tests of steel construction, and best methods of safeguarding the same against fire. Safe means of ingress and egress. Elevator inspection. Boiler inspection. Ventilation. Sanitation. Plumbing inspection. Gas fixtures inspection. Appointment of building inspectors. Best methods of enforcing building laws. Electric wiring in buildings, etc.

The headquarters of the association will be at the Russell House.

THE charter applied for by the T Square Club, the leading architectural organization of Pennsylvania, and one of the foremost in the country, has just been granted in the courts of Philadelphia, and the club is therefore duly incorporated under the laws of the State of Pennsylvania.

Although but now entering upon its corporate existence, this club has been an energetic organization and a moving factor in the field of its profession for the past fourteen years, having been organized in 1883. The following well-known architects were the founders: Walter Cope, John Stewardson, Wilson Eyre, Jr., R. G. Kennedy, Lindley Johnson, Arthur Truscott, George Paxson, Charles L. Hillman, Clement Remington, Frank Price, Louis C. Baker, and Mr. Carlton.

The purposes of the club, as set forth in the charter and in its constitution, are: "To promote the study and practise of architecture and the kindred arts, to afford its members opportunities for friendly competition in design, and to further the appreciation of architecture by the public." The subscribers to the charter, who constitute the present officers of the club, all of whom are well-known Philadelphia architects or draughtsmen, are: David Knickerbacker Boyd, president; Edgar V. Seeler, vice-president; George B. Page, secretary; Horace H. Burrell, treasurer; Walter Cope, Louis C. Hickman, and Charles Z. Klauder, executive committee, and Adin B. Lacey, Percy Ash, and Charles E. Oelschlager, house committee.

The T Square Club has made its influence felt in various municipal and national affairs, has passed important resolutions on progressive local and other matters, and last fall conducted the Architectural Exhibition in connection with the regular exhibition of painting and sculpture at the Pennsylvania Academy of the Fine Arts. This exhibition was one of the most successful ever held there or elsewhere, being the first in America to contain so many thoroughly representative contributions from foreign architects.

This fall will again see an architectural exhibition, held by this club, which, it is intended, shall surpass any previous one, both in the number and the interest of the exhibits. Representatives of the club are now in England and France, securing the best drawings, and a number of exhibits are promised from other countries.

The Club has also sent Mr. Albert Kelsey to represent it at the International Congress of Architects, to be held in Brussels, Belgium, in the latter part of this August.

PLATE ILLUSTRATIONS.

PLATE 65. A brick residence at Madison, N. J., Clinton & Russell, architects. A half-tone illustration made from a photograph of the building will be found on another page of this number.

Plate 66. Mr. Goodhue's splendid drawing of the church of St. Andrew by the Sea, Edgartown, Mass., Cram, Wentworth & Goodhue, architects. It is constructed entirely of brick, the interior being also finished in the same material. The main floor is of concrete, and in every respect the construction is of the most durable quality. The ceiling is of spruce, stained dark brown, and the finish and furniture of oak, the same color. The windows are filled with cathedral glass, in wide, heavy leads. The roof is covered with green slates. In spite of the nature of the construction, the cost of the entire building, including heating, furniture, pews, etc., will be $15,000, practically the sum that the same structure would have cost had it been built of wood. This church is the result of an attempt to build a small structure for a country parish, solid in construction, and with a certain degree of architectural effect, for a very limited amount of money.

Plates 67 and 68. An office building for the Proctor estate, Boston, Winslow & Wetherell, architects. The exterior of the building, with the exception of granite foundations, is entirely of terra-cotta ashlar. The results obtained in the designing and construction of this building are particularly successful, and as an example of the adaptation of the Spanish Renaissance to a modern building is very satisfactory. By the use of terra-cotta, the varied and elaborate ornamentation is carried out at a reasonably small cost when compared with carved stone.

Plates 69 and 70. Detail drawings of the building for the Proctor Estate.

Plates 70 and 72. Public bath houses at Crescent Beach, Mass., Stickney & Austin, architects.

The building is 80 ft. long and 75 ft. deep. On either side of the building are large yards containing commodious dressing rooms, to be used in connection with sea bathing. Connected with the building in the rear are two low, wooden sheds for the storage of bicycles. The yards are enclosed by the brick wall and the walls of the administration building, and by the bicycle sheds in the rear.

The monotony of the wall is relieved by the use of red and black brick placed alternately. Numerous entrances connect the main building with the yards.

The accommodations for the care of bicycles are beyond criticism. One may ride to the bath-house on his machine, and for five cents have it cared for. While in the bicycle sheds the machines are placed in racks that cannot injure the bicycles. There are enough racks provided to care for 1,225 machines at one time.

A small but complete hospital is connected with the establishment. A half-drowned bather, or any one suffering from accident, or overcome by illness, will receive prompt treatment in this room, which is on the lower floor of the building. Stretchers, an operating table, splints, a complete set of surgical instruments, and all other implements usually found in hospitals are here.

Near the hospital, and hidden from general observation, is a detention room, that will be used as a temporary prison for disorderly persons.

The laundry occupies the greater part of the upper story of the building. This laundry has a floor space of 80 by 70 ft. It is floored with asphalt, and the floor is guttered so that the water from the machines and condensation of steam is carried off into the drains.

Two gigantic washing machines are capable of washing five hundred suits at one time. After the suits have been washed they are put in two wringers, and all the water taken from them. They then go into large drying rooms, where the temperature is 210 degs. Fahr., and are dried within ten minutes. The suits then pass through the hands of an examiner, whose business it is to find rents in them, if there are any to be found.

Upon entering the building, the visitor finds himself in a large rotunda, very high studded, and finished artistically. The floor is of the finest asphalt. In this room hard wood railings guide the patrons along counters, at which they are to be served with keys, suits, etc. The men pass to the right and the women to the left. Behind these counters the large room for the storage of bathing suits is located, and is so arranged that suits of any size can be taken instantly from racks holding more than one thousand garments.

A person desiring to hire a suit and room first buys a ticket.

After securing a ticket, the patron passes along the counter to where the suits and keys of the rooms are given out. Then he passes a registering turnstile and goes into a small room, where he deposits his valuables. The system devised for the care of valuables is interesting and safe.

The valuables are placed in a large envelope by the patron himself, who then writes his name across the back of the sealed envelope. He is given a check that will secure the return of his valuables when he leaves his room after his bath. He receives his valuables from a room on the lower floor, directly below the apartment where he left them. They have been sent down on an elevator, and await him there. He is required to write his name on a book kept for that purpose, and thus he furnishes a positive identification of his envelope and a receipt for the goods.

After the customer has deposited his valuables he passes out into the yard containing the dressing rooms. The men's yard is much the larger, and contains 602 rooms. The women's yard contains 400 rooms. The dressing rooms are arranged on two tiers, or stories, and are planned so that the corridors on the basement story are open to the sky as well as those on the upper tier. The bath-houses in these yards are roofed with gravel and tar. They average 4 ft. by 6 ft. on the lower tier, and 4 ft. by 4½ ft. in the upper story. Only one person is allowed in a room, except where small children are accompanied by parents or guardians. Each room contains a good plate glass mirror, and each bather is furnished with a large Turkish towel.

When prepared to go into the water the bathers reach the beach through subways or passages that go under the boulevard and the shelter that is in front of the bath-house. This is one of the greatest features of the whole establishment, and will be welcomed by those who do not care to go through a crowd of loungers while in bathing costume.

The care for the comfort of the bathers continues even after they have left the subway, for long runs of asphalt have been constructed so as to reach far toward the water's edge, thus relieving the barefooted bather from the pain of walking over the pebbles near the crest of the beach.

After leaving the water, entrance to the bath-house is gained by the same subways, and here the bathers find shower and foot-baths ready for their use.

ILLUSTRATED ADVERTISEMENTS.

IN the advertisement of Fiske, Homes & Co., page vii, is illustrated another of their new and handsome designs of brick and terra-cotta fireplace mantels. The mantel is designed by H. B. Ball, architect, and rendered by H. F. Briscoe.

The Excelsior Terra-Cotta Company illustrate in their advertisement, page iv, a series of terra-cotta details used in the new building, corner Waverly Place and Greene Streets, New York City. R. Maynicke, architect.

EXECUTED BY THE NEW YORK ARCHITECTURAL TERRA-COTTA COMPANY.
J. E. Sperry, Architect, Baltimore, Md.

The new bank building, Montogue Street, Brooklyn, Wm. H. Beers, architect, is shown in the advertisement of the New Jersey Terra-Cotta Company, page viii.

A residence at Alleghany, Penn., Longfellow, Alden & Harlow, architects, is shown in the advertisement of Harbison & Walker, page xxv.

Another residence at Chicago, of which A. F. Hussander is the architect, is illustrated in the advertisement of Charles T. Harris, Lessee Celedon Terra-Cotta Company, page xxix.

Three views of a half-timbered and stone residence, Renwick, Aspinwall & Owen, architects, are shown in the advertisement of the Gilbreth Seam Face Granite Company, page xxxviii.

Brick versus Wood. II.

BY R. CLIPSTON STURGIS.

IN my previous article I have considered the advisability of using brick in preference to wood on account of its durability, economy, and beauty. I want now to show how wide has been the use of brick, and with what admirable results it has been used for all sorts of places and for all classes of buildings.

In the city one naturally expects to find brick; compared with other fire-resisting materials it is cheap, and has, therefore, every reason to commend its use. It is, indeed, somewhat curious, under these circumstances, to find anything else used for mercantile or business buildings, for it is cheap, easily obtained, quickly laid, and, above all, the most fire-proof of all materials.

WORTHINGTON BUILDING, STATE STREET, BOSTON.
Fehmer & Page, Architects.

There seems, however, a general feeling that stone, however common, even if it be mere split granite, is finer or more imposing than brick; and one has recently seen the incongruity of a fine building, open on four sides, faced on the two important sides with plain, dressed granite, without relief or ornament (unless a metal cornice may count for such), and red brick on the two other sides, equally exposed to view, and yet deemed less important.

An harmonious whole of good brick would certainly have been better, and probably cheaper.

The illustration of the Worthington Building, State Street, Boston, is a good example of simple yet dignified brick in an office building.

That it is not unsuited for a city house, even one of some dignity and cost, is, I think, fairly well shown by the Lyman House, on Beacon Street, and the charming houses on the Bay State Road, Boston, by Wheelwright, and by Little and Browne.

As soon as one gets outside of the fire limits, however, one finds brick discarded for houses, though the fact that even here it is sometimes used for buildings of more importance shows that it is looked upon as a material superior to wood.

The fear of expense, which I tried to show groundless in my last article, is, doubtless, still the chief cause for our wretched wooden suburbs. If only people would realize how inexpensive, how neat, and how compact is a suburb nicely laid out with brick houses, perhaps they would be led to at least try the experiment of a brick house for themselves. I have shown in an illustration of the first article a few cottages in Bedford Park, a London suburb. They were built by Norman Shaw, and were, I believe, inexpensive houses; and for good cheap cottages I would refer the reader to some of the facts and figures about the brick cottages built on some public land by the city of Birmingham, and forming a paying investment when rented at eight pounds a year.

CHARLESGATE STABLES, BOSTON.
Peabody & Stearns, Architects.

I am sorry to say that I cannot illustrate many good examples of cheap brick suburban houses in this country, because there are so few. The brick blocks which have here and there crept out from the city are mere city blocks, generally poor ones at that, misplaced, but the one illustration I have (a house in Newton) is a good one, and I hope may be productive of more like it.

If the ordinary householder is prejudiced against a brick house in the suburbs, his face is rigidly set against it in the country. Here it is not only the argument about expense, but also the plea as to the appropriateness of wood in the country. For myself, I can see the appropriateness if it is a really wooded country and the timber is at hand, just as stone becomes appropriate if one lives by a quarry: but otherwise I see no reason why brick is not far more appropriate, for if you anywhere want a permanent, dry, warm house, it is in the

LOWER SCHOOL AT ST. PAUL'S, CONCORD, N. H.
Henry Vaughn, Architect.

country, where you are exposed on all four sides to wind, and rain, and sun. If anywhere you want a house wall on which you can grow vines without tearing them down every few years to paint, it is in

RESIDENCE, BAY STATE ROAD, BOSTON.
Little & Brown, Architects.

the country. If anywhere you want a wall which requires little care or repair, it is in the country, where mechanics are not always convenient or competent. Brick seems to me, then, appropriate for city, for suburb, for country; and if appropriate for these various localities, it is also appropriate for the various classes of buildings, for houses, as we have said, and also for churches, public buildings, warehouses, and barns.

In churches we can point to many beautiful examples. There are the churches and towers of Rome; the Frari in Venice. There are many interesting massive towers of the Lowlands (Flemish and Dutch) which have been illustrated in a previous article in THE BRICKBUILDER. Here and there a good bit in England. Some old, like St. Albans tower. Some new, like Holy Trinity, Sloane Square, (Sedding's) — and as a modern following of Italian ways, the Judson Memorial Church on Washington Square, New York, the work, I think, of one of that gifted firm who have done so much for American architecture. These are no mean examples to show that brick has its place in church architecture.

HOUSE AT NEWTON, MASS.
E. H. Benton, Architect.

To pass from church to public buildings, one might call to mind Shaw's Scotland Yard in London, or our own modest little Independence Hall, and one might add innumerable town halls in Holland, and the St. James Palace in London. There are not, however, many important examples among large public buildings; much yet remains for brick to do in that field.

If schools come under the head of public buildings, we can point to numberless examples: Vaughn's Lower School at St. Paul's, and Wheelwright's well-known work for the city of Boston, buildings very different in their style and yet each charming in its way. Vaughn's work has little or no attempt at ornament, very quiet and refined, distinctly English in its whole feeling, looking thoroughly suited for its purpose, and most naturally English, for to England we must look for precedent in such schools; and Wheelwright's work, of ornamental brick, Italian in character, yet distinctly scholastic. Red brick is not wholly to be commended for interiors, and the halls and large rooms of Vaughn's school, which show dark-red walls,— red jointed, too,— are somber and forbidding, hardly a cheerful atmosphere for study. There are very many excellent examples of good brick-work in this class, but there is plenty of room for improvement and for a more general use of brick.

Under warehouses we can include the familiar great Cloth Hall

RESIDENCES, BAY STATE ROAD, BOSTON.
Wheelwright & Haven, Architects.

at Ypres; and the Waag at Amsterdam, and innumerable good buildings in our larger cities, of which the storage warehouse is a specially apt example, for we here have a building of considerable merit, and yet hardly a single opening to give opportunity to the architect. And we might in this class include that delightful brick and stone stable and carriage storehouse which Mr. Peabody built in Boston. And finally, in England we find real barns here and there, and plenty of stables of good honest brick, which speaks of certain assurance of permanency, and gives us a comfortable feeling that the owner expects to work and live long, tilling the soil and garnering his hay and corn. These buildings show brick in an attractive light from every point of view, — economical for the investor to build, a good risk for the insurance companies, and a beautiful building to delight the artist. And we see that there is most excellent precedent for the use of brick, in city and country, for houses and churches, for public and private buildings.

Architectural Terra-Cotta.

BY THOMAS CUSACK.

(Continued.)

THE Chamber of Commerce Building, Rochester, N. Y., designed by Messrs. Nolan, Nolan & Stern, of that city, affords an excellent example of terra-cotta architecture, in which that material is used consistently, in combination with brick, from sidewalk to corona. The first and mezzanine stories are, perforce, an expanse of plate glass, admitting of nothing save a series of piers, windows and doorways, of which, however, the most has been made. On the story above, with its rusticated piers and two horizontal courses, entirely of terra-cotta, considerable elaboration has been bestowed; at the same time the idea of homogeneity, so much needed at this point, is happily preserved. The succeeding eight stories are exact duplicates, and in this the exterior proclaims the nature and purpose of the interior with admirable candor. In the twelfth story, which is also wholly in terra-cotta, the laws of perspective, and the effect of foreshortening have been studied to some account. Figs. 29 and 30 will show that the embellishments have been carried out on a scale that is legible from the street, and not, as too often happens, reserved for the delectation of the feathered tribe.

This building has already been briefly referred to in connection with banded columns, of which it has two very good ones at the principal entrance. The business at present in hand is primarily one of cornice construction, and of that, too, it affords a typical example that may now be described, and made the subject of adequate illustration.

This cornice is 8 ft. 9 ins. high, and, having a total projection of 5 ft. from wall line to nose of lion's head, requires a well-devised scheme of structural support. The one that was adopted is shown in detail at Fig. 31. To the Z bar columns that extend up through the piers is bracketed, horizontally, a 10 in. I beam. This acts as the fulcrum to a series of 6 in. I beams that project over each modillion, the opposite end of which is attached to roof beams by means of a stirrup. These cantilevers, in addition to the weight that rests on top of them, are strong enough to support the modillions also. This they are made to do by the application of two ¾ in. hangers, which, taking hold of a short bar inserted in the modillion, pass up through a plate laid across the cantilever, and are then tightened up to required tension. The dental course, and the panels between modillions have each a hole into which a rod is passed, and from it they are anchored back through the wall.

The modillions are spaced on 3 ft., 8 in. centers, which, all things considered, rendered it inadvisable to make the soffit blocks in a single piece. They are therefore jointed into three, for greater convenience of handling and of setting, as well as in the making. This allows the two side pieces to be fitted into the flanges, and bedded down on each side of the cantilever. The center piece, to which the coffer panel is attached, is then dropped in as a key, and the whole course is thus made immovable. A hole is provided in blocks forming cima, into which short pieces of round iron are inserted, and from those they are secured by diagonal braces at intervals, riveted to the 6 in. I beams, as indicated in section. In view of subsequent criticism and comment on the deterioration of iron and steel, when used in a similar way, let it be noted that the top surface of this cornice like the one given in last example, is also covered with copper.

FIG. 29. CHAMBER OF COMMERCE BUILDING, ROCHESTER, N. Y.
Nolan, Nolan & Stern, Architects.

Among recent communications on the subject of cornice construction, there is one from Mr. J. E. Sperry, of Baltimore, that calls for special notice. In it he reaffirms the superiority of cast iron as distinguished from rolled sections. As for steel, he doubts the propriety of using it at all, in situations where it is likely to suffer from rust, adding: "I should hesitate to use structural steel, except in the inside of a building where it was not liable to be assailed by dampness. In cornice work, though the steel is in a measure protected by terra-cotta, it would not be entirely free from atmospheric influences, which would in the course of time cause disintegration not likely to occur in the case of cast iron."

Mr. Sperry is probably right in discriminating between iron and steel sections, and in giving the preference to the former of these two materials. The introduction of steel for structural purposes has been so recent that there has not been time for a conclusive test of its comparative durability. Its flexibility, as well as its stiffness, is allowed to be much greater than those of iron, but we think it is generally conceded among engineers that it should not be subjected to varying

FIG. 30. TWELFTH STORY CHAMBER OF COMMERCE BUILDING, ROCHESTER, N. Y.

degrees of dampness, from wet to dry, and in situations where it cannot be repainted. We have noticed a marked deterioration in the case of corrugated roofing plates, even when galvanized, and though steel is now the more generally used of the two for that purpose, its popularity is probably owing to its relative cheapness, and not to anything that can be said in favor of its durability. The laminæ in the texture of steel is more pronounced than in that of iron, and the scaling off that follows as a result of, oxidation appears to be correspondingly rapid and destructive in its action.

In the case of cast iron, however, it must be remembered that it, too, has defects of another and far more treacherous kind, which it is difficult to detect, and impossible to guard against even under the most rigid supervision. Sand-holes and blow-holes frequently occur in ordinary castings, but they are usually concealed by a convenient coat of paint, for which most foundrymen evince an easily understood predilection. It is for this reason that cast iron has been abandoned in bridge building, and is now superseded in all structural work where the load is eccentric and the strain as variable as the wind pressure.

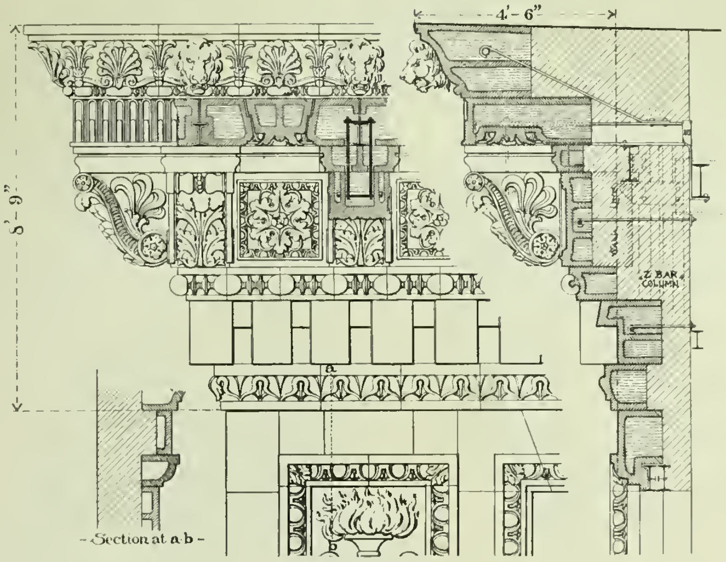


FIG. 31.

The foregoing objections to the use of rolled iron are valid up to a certain point, but by no means vital. We have already urged, as a sufficient set-off, the advisability of having all hangers, anchors, and cantilevers galvanized. This is now being done on several buildings in course of erection, one of which is in Baltimore, and for it we are pleased to know that Mr. Sperry is the architect. The new Delmonico Building on Fifth Avenue and 44th Street, New York, is another, and on it Mr. J. B. Lord has insisted that all special ironwork coming into contact with the terra-cotta be galvanized. When this is done there is no room for hesitation in the use of wrought iron, and no reason to doubt the permanent security of a properly constructed terra-cotta cornice, with it as the chief auxiliary support.

As a further step in the right direction, attention has likewise been directed to the importance of keeping water from entering the joints. This, however, is one of the things so frequently neglected that it may be well to reiterate the warning, and at the same time to indicate some of the ways in which the desired end may be attained.

A covering of copper, on all surfaces having a wide projection, is one very effectual method; but a fatal error is often made in the provision for fastening down the outer edge. Instead of turning the metal clear over the nose, as at A (Fig. 32), or providing a roll and quirk some distance back, as at B, architects sometimes call for a raggle to be sunk into the top surface, as at C. This latter plan may appear all right on paper; it may also satisfy a draughtsman who looks upon his drawing, not as a means to an end, but as an end in itself. In practise, however, it is a most objectionable method, and is liable to promote some of the things it had been intended to prevent. When the edge of the copper has been inserted in this groove, the metal worker drives in, at intervals, lead plugs to hold it down; if lead is not at hand, he contents himself with wedges of wood, which serve his turn as well. The mason then fills up what is left of the raggle with mortar or cement, which remains until after the job has been cleaned down. If well done, this may remain for a year or two longer, but it cannot be regarded as permanent. When it wears out — as sooner or later it is bound to do — this channel gets filled with water, which soaks into the blocks, and expands every time the temperature falls below freezing point. The nose, which has been weakened by the groove in the first instance, is then liable to break off, and whether it be from the third or from the twenty-third story, when it falls the consequences are equally disquieting. In work of a light color an architect may not want the copper to show on top member of cornice. In that case he has the alternative method at B, to which there can be no reasonable objection, and by adopting it he escapes all risk of a disaster such as he invites by making a groove along the wash.

Where a copper covering is not provided, the joints may be rendered perfectly secure in the way shown at D, Fig. 32. A dovetail rebate is molded in the ends of the blocks, as drawn in section at X. X. Vertical channels are likewise made to receive grout, which is poured in from the top, after the course has been set to line. The dovetail cavity so formed is then filled flush with granolithic; or a good brand of cement gauged with an equal quantity of clean, sharp sand may be used. A filling of this kind cannot work out, and the size of the body is a guarantee against its cracking or scaling off. Several important cornices, with the particulars of which the writer is acquainted, have had the joints protected in this manner, and in every instance with good results.

One of these was set about six years ago, and we can say, from a critical inspection made at the date of writing, that the joints are still in perfect condition, though nothing whatever in the way of pointing has been done during that interval. Let the blocks receive a hard metallic glaze (on the wash only), and let them be fired to the point of vitrifaction; no other covering will then be necessary, and a cornice so constructed will continue intact as long as the building remains in existence.

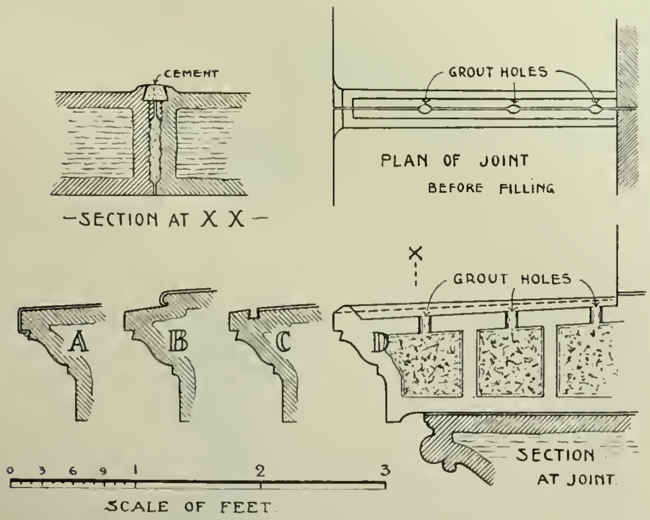


FIG. 32.

Continued.

The Art of Building among the Romans.

Translated from the French of Auguste Choisy by Arthur J. Dillon.

CHAPTER III.

PART III.

HISTORICAL ESSAY ON THE ART OF BUILDING AMONG THE ROMANS.

CHAPTER I.

FORMATION AND DECLINE OF LOCAL METHODS.

LOCAL SCHOOLS.

IT happens that in demonstrating the methods of the Roman art the examples cited in support of the same idea have been taken from different countries, and even sometimes from different epochs. It may be asked if the Roman art had such unity that it is possible to thus compare monuments of so many different provinces and centuries; the question is answered in part by the uniformity of the results of such a comparison. But let us be careful, however, of exaggerating this uniformity; it existed, it was possible, only in the principles, and excluded neither the progress that comes from the long practise of the same methods, nor those slight variations which arise in any system of construction in the process of adaptation to different climates. Construction had its local schools; it escaped neither the influence of foreign examples nor the vicissitudes of the internal condition of Rome. Tuscan when Rome was still one of the cities of Etruria, it took bit by bit the imprint of the Hellenic spirit, when brought into contact with Grecian civilization; and its originality lay less in creating new types than in grouping those already existing into a new system. We have indicated, in speaking of cut-stone construction, some of the ideas taken from Greece and Etruria; in order to mark these more clearly, and to decide the circumstances which brought foreign methods into use among the Romans, it would be necessary to enter into the field of conjecture, and to study the art of building in connection with the political relations of Rome. We will not attempt this difficult research; leaving aside the period when the Romans were satisfied in imitating the models of Etruria or of Greece, we will take as a starting point the time when they initiated the only methods that are strictly their own, those of concrete construction.

The appearance of concrete vaults in the Roman monuments must be placed at the last years before the Christian era. No doubt long trials had prepared for this important innovation, but no certain trace of them can be found either in ruins or in books. Vitruvius himself, writing but a few years before the laying of the foundation of the Baths of Agrippa, does not seem to suspect the great part that concrete vaults are about to play. The art of which he treats was at the point of entire transformation, yet nothing authorizes us to conclude that Vitruvius foresaw this change: so rapid was the progress of concrete construction, so sudden and unexpected was this revolution of Roman architecture.

What causes, then, determined this brusque revolution in the art under the government of Agrippa? Several come so naturally to mind that it is sufficient to mention them; public wealth had increased suddenly after a period of internal commotion and foreign war; thanks to an interval of calm, the new methods were applied on a grand scale for the first time, and had an opportunity of bold development; Agrippa saw in the embellishment of Rome a means of making its people forget their ancient political life, and put himself at the head of the movement; under his administration Rome was filled with edifices consecrated to the pleasures and festivals of the Romans; the ancient city was soon too small to contain all of them, and it became necessary to infringe even on the Field of Mars. It is, I think, in this double influence of customs and politics that the causes of the sudden advance in the art of building at the commencement of the imperial rule must be sought. Methods were henceforward definitely fixed, and the art of building, once systematized, remained stationary at its highest point of perfection for a period of more than three and one half centuries.

This fact, remarkable in itself, becomes of great interest when it is considered that it was during the decline of all the arts that the traditions of good construction were preserved without alteration—and also without progress. Even the causes that affected architecture seem to have had little or no influence on the art of building; ornament and construction had become almost entirely independent; and hence their development or decadence was according to different or even contrary laws. Under the Antonines construction was the same as under the Cæsars, although architecture was visibly modified in the intervening century. At the end of the third century architecture was in full decadence, while the art of building, still flourishing, produced the Baths of Diocletian. After Diocletian, art still degenerated; and, by a curious coincidence, the architects who could do no better than strip a monument of Trajan to ornament an arch of Constantine were the contemporaries of the daring builders who covered the naves of the Basilica of Maxentius with those magnificent vaults whose ruins still amaze us by their solidity and grandeur.[1] Never had the art of decoration and the art of building offered a stranger and more striking contrast. The discord was at its height, but it was also approaching its end; and under the reign of Constantine, the art of building fell to that degree of abasement which architecture had long before reached.

The fall was as brusque as the progress had been rapid; it was but scarcely announced by a few monuments built without due care, such as the circus of Maxentius, near the Appian Way; and at the side of these mediocre productions, practical architecture did not cease to show by its *chefs-d'œuvres* that the old traditions were still maintained. But suddenly this prodigious fecundity was exhausted, and the art of building reverted, as it were, to the point where it had started four centuries before. Its progress had been in the development of vaults, its decline was marked by their almost absolute abandonment. First the traditional methods were used timidly; the monuments of St. Constance and of St. Helen, at the gates of Rome, show the characteristics of this first period; and perhaps we must put at the same date the curious monument called Minerva Medica, where the vacillating and awkward use of the classic methods clearly marks the moment of hesitancy that precedes the centuries of decadence. Vaults — spherical vaults among them — did not cease to be used in sepulchral or religious monuments, but they disappeared almost completely from the great civil buildings. The Christian basilicas of the fourth and fifth century had no vaults, except such as are represented by the arches that spring from column to column; all the rest was roofed with wooden framing. Two centuries went by during which vaults, used only in buildings of little importance, ceased to dominate the general system of construction, to reappear again at the time of the Byzantine Renaissance, but under an entirely new form. The old tradition was definitely broken at Rome,[2] and the rapidity of the changes that took place seems to indicate a cause as violent as it was sudden.

In fact, between the time of Diocletian and the last years of the reign of Constantine, a revolution took place whose influence on the history of Roman construction was not less than its influence on the history of the Roman empire. Rome ceased to be the capital of the Roman world; and the art was transformed the day that Rome, losing its political preponderance, ceded to Byzantium the inheritance of its ancient privileges. The immense buildings of the new capital immediately absorbed the resources of the empire, and the date of its foundation (330) marks the epoch when the sudden and profound

[1] For the actual date of this building, called the Basilica of Constantine, see W. A. Becker, Handbuch der römischen Alterthümer, Part I., pp. 438 et seq.

[2] In some provinces the rupture of the old traditions was less sudden; thus, in the northern part of Gaul, construction was carried on, under Julian, on a scale that recalls that of ancient Rome. The Baths of Paris can with some reason be placed at this date; and their superiority over contemporary edifices in Rome is incontestable.

PANTHEON D'AGRIPPA.
PLATE XIII. THE ART OF BUILDING AMONG THE ROMANS.

1. Villa Hadriana. 2. Aqueduc Pres St. Jean de Latran.
PLATE XIV. THE ART OF BUILDING AMONG THE ROMANS.

transformation of Roman construction, whose principal characteristics we have shown, took place. This explanation must not be thought a pure conjecture. We have the proof of its truth in the singular demand which Constantine made on the pretorian prefect, ruler of both Italy and Africa, to supplement the exhausted resources of Italy: "Architectis quam plurimus opus est, sed quia non sunt . . . " such is the beginning of the first constitution of Constantine on the immunities of artisans (Cod. Theod., Lib. XIII., it. VI., l. 1). This constitution is dated 334, four years after the foundation of Constantinople. It was impossible to formulate more clearly, in an official act, the causes of the decline of architecture in the fourth century. Constantine established schools to save the remains of the ancient art; he founded institutes for the benefit of the young Romans who would agree to devote themselves to the study of architecture; but the efforts were fruitless; new demands had arisen, to meet which it was necessary to do no less than to create an entire system of entirely new methods. Another capital of the world could not be planned with that luxury of material and immovable solidity which we so admire in ancient Rome, when arms were lacking, when means of subjection had to continually be increased in order to obtain sufficient corvees, when even directors of the works were missing. Lighter construction, sacrificing solidity to the demands of endless necessities, was sought; and the venerable practises of the Roman art partially disappeared in the course of this change; the old equilibrium of the working classes was overthrown, and the tradition that had lasted from Augustus to Constantine was suddenly discontinued.

At the same time that the buildings of Constantinople were draining the resources of the empire, the magistrates of the provinces were, in their turn, endeavoring to transform their own residences; and the taste for building increased everywhere just when the means of satisfying it were becoming more and more insufficient. It became necessary to arrest this fad by the constitutions that are repeated, as one might say, on every page of the Code,[1] whose number is in itself an indication of their failure to accomplish their purpose. It was in vain that the emperors prohibited the erection of new public buildings before the completion of those already commenced; it was in vain that they tried to limit the number of these useless works by depriving the magistrates of the honor of placing their names on them; it was in vain that they imposed the onerous duty of assuring their complete achievement on those who commenced them: for fashion, stronger than imperial commands, immeasurably multiplied these senseless enterprises; and the lack of resources, day by day more marked, continually put the builders further from the good traditions of the ancient school. A small number of the monuments of this epoch have lasted until the present time; they are the basilicas, whose duration was prolonged by the pious care of the Christians; but the majority of the buildings of Constantinople had to be rebuilt by the Byzantine emperors. The historian Zosimus even affirms that several collapsed under the reign of Constantine, so hastily had they been constructed. This author, a thorough pagan, is open to the accusation of partiality when he speaks of Constantine, his government, or his religion; his animus can be perceived even in the expressions he uses in speaking of the monuments built by Constantine;[2] nevertheless, his testimony at least shows that the buildings were short lived; and their anticipated ruin seems due to that lack of resources of which the memory has been transmitted to us by the imperial constitutions.

Such was, to sum up, the history of concrete construction; a singular history, whose phases do not seem to follow, as do those of other histories, a law of general continuity. The great decadence of the fourth century was brought about, like the great rise of the last century before our era, without a transition whose monuments might make it possible to retrace its course.

It is no part of our program to study the Roman art such as it became after this last transformation. We have been compelled to limit ourselves to what it was during the long period that commenced during the last years of the republic, and ended at the epoch of the barbarian invasions. Let us now give a glance at the variations that were made in the methods in the different parts of the Roman world.

LOCAL SCHOOLS.

THE ROMAN ART AND THE MUNICIPAL SYSTEM OF THE EMPIRE.

When the Romans invented the system of concrete construction, they certainly created the most suitable instrument for making the methods of the art of building uniform. When they had learned how to erect their colossal vaults, with no other workmen than unskilled laborers, with no material but shapeless stones and mortar, they seemed to have obtained a mode of construction that was destined to become universal. By means of their colonies and legions they pushed the new methods to the farthest limits of the empire. At every point to which the domination of Rome extended, they improvised entire cities, recalling by their general traits the aspect of the metropolis; and these cities became in turn so many centers whence Roman architecture radiated with Roman habits and customs. Thus all tended toward uniformity. Nowhere, however, did the art succeed in acclimating itself without losing some of the characteristics that had marked it at its origin; it was, on the contrary, divided into a series of schools, whose clearly distinct methods reflected by their diversity the infinite variety of local resources and traditions. I could, to show these differences, limit myself to instances of construction properly so called alone, but the shades of difference are still more clearly manifest when the forms of architecture are considered. Compare the monuments of Rome with those of Roman Egypt, and on one side will be found the architecture that is regarded as the official style of the empire; on the other, a collection of types and proportions so similar to as to be mistakable for the art of the time of the Ptolomies; it is known, for instance, that the porticoes of Denderah and Esneh do not date from before the Roman epoch.

In Greece, as well, the Romans conformed to the traditions of the ancient national art. The frontispiece, known as the Entrance to the Agora, is a curious monument of this Grecian school of the empire; a school, without doubt, degenerate, but still essentially Greek, whose works are rude imitations of the ancient Hellenic art, but which borrow nothing from the forms of the contemporary art of Rome.

If other examples of this local architecture which departs from the ordinary types of ancient architecture in Italy are desired, they can be found in the monuments raised in Central Syria during the first centuries of the Christian era. All the edifices of Hauran, in which an ingenious theory finds the origin of the French architecture of the middle ages, are much more like the monuments of France of the twelfth century, both in structure and decoration, than like the edifices of Rome, Egypt, or Athens; a new and striking manifestation of the national traditions that divided Roman art at all periods of its history.

The cities of the western coast and of the southern part of Italy, Pompeii among others, retained their Grecian physiognomy under the empire; in the territory of ancient Etruria, the national tradition gave the edifices, even those of after the conquest, the seal of masculine simplicity so strongly marked in the Roman ruins at Perugia.

We also had our architecture of the period of the Emperors;

[1] Here are some of them: —

1st. Prohibition against undertaking new buildings before finishing those already commenced.

Code Theod., Lib. XV., tit. I., l. 3, 11, 15, 16, 17, 21, 27, 29, 37.

Code Justin., Lib. VIII., tit. XII., l. 22.

2d. Prohibition against magistrates who have not themselves assumed the cost of public buildings, inscribing their names thereon in place of that of the prince.

Code Theod., Lib. XV., tit. I., l. 31.

Code Justin., Lib. VIII., tit. XII, l 10.

3d. Obligation imposed on magistrates who commence buildings of public utility without authorization from the prince, to assure the completion at their own expense.

Code Theod., Lib. XV., tit. I., l. 28, 31.

[2] *Εις οικοδομιας δε πλειστας ανοφελεις τα δαμσια χραματα δαπανουν, τινα κατεσκευαςεν, α μικρον θὐστεραν διελυετω, βε βαιδ δια τᾶν επειζιν ον γενομενα* (*Zos. hist., Lib. II.*, cap. xxxii.).

and the characteristics of that elegant school of Gaul, evident in the ruins of St. Remy, of Orange and of St. Chamas, are such true expressions of the kind of genius that is properly our own, that they are rediscovered intact in the edifices of our Renaissance.

Thus it was that the forms of architecture differed in the different provinces. There was the same diversity in the practical methods; Vitruvius affirms this when, treating of the manner of building cut-stone walls (Lib. II., cap. 8), he makes a clear distinction between the customs of the Grecian and Roman builders. Independently of his testimony, however, sufficient proof of this can be found in the monuments themselves. Often, in fact, we have had to call attention to certain types of construction, and particularly to types of vaults, that were centered about such and such a country, where they were in a certain measure limited and perpetuated, without spreading abroad or ever reaching the character of general types; these are so many indications of the distinct traditions, of the local variations.

For example, the vaults of juxtaposed arches seem to have been special to a very limited region of which the aqueduct of Gardes is the center; in this country the unbonded vaults abound, — their use is to a certain degree the rule, — while elsewhere but a few isolated and imperfect examples can be found, and that with difficulty.

The same observation can be made of the system of ribs supporting horizontal slabs by means of tympanums. The only examples known to me belong in two provinces, both almost Greek — Southern Gaul and Syria; in Syria the importance of the system is comparable only to that of the pointed arches of the western buildings in the middle ages.

The hypogea of the north and center of France, whose style and stonework we have already characterized, are also monuments of a special form of construction. (Pl. XVIII. and XIX.) At their aspect one is struck by the originality of the conception that distinguishes them both from the other Roman monuments and from the works posterior to the barbaric invasions. The rampant vaults of echeloned arches, the barrel vaults centered on temporary walls, the use of the keyed groined vaults that the other schools sought to avoid, the evidently systematic use of stone of small size in a country rich in large material, are all unusual circumstances that place these monuments in a well-defined group, where are announced the tendencies of our medieval architecture, and whose memory or example had influence at the rebirth of French art at the end of the Roman period.

These few examples, all taken from monuments of cut stone, indicate, for the present, the nature and importance of the differences that separated the contemporary schools; if, to complete the review of ancient methods, we go back to our descriptions of concrete vaults, divergences of the same order, or even more strongly marked, will be found.

Even the network of brick, which was used with such skill and success in Rome that one is tempted to think it an essential element of the art of building, even these never came into general use. It expressed the spirit of Roman construction better than any other thing, but on the whole it amounted only to a local practice, and becomes rarer and rarer as one goes away from Rome. It is only necessary to go from Rome to Pompeii in order to see a notable change in this respect; the armature in the form of a network is replaced by degrees by a continuous thick layer of tufa, covering the centering and supporting the vault.

Toward the north, in Verona, we will find vaults with armatures like those of Pompeii, except that rounded pebbles replace the tufa used where the soil is entirely formed of volcanic debris. And when the Alps are crossed, even the idea of an armature disappears; or else, by a curious reversal of rôles, the armature of converging strata increases in importance to the point of becoming by itself the vault, while the masses of concrete in horizontal layers are no more than a covering, a backing, or, in a word, an accessory; the functions of the parts are inverted.

Such were, in a special division of the art of building, and in a restricted portion of the empire, the variety of aspects presented by the methods of construction. Looked at from a more general point of view, antique art offers this same diversity of aspects in all its branches. If the types of sculpture, of Roman ceramics, of provincial medals, or even of the mosaics found in different parts of the empire, are reviewed, everywhere the mark of local schools will be found with the same clearness; everywhere a certain base of common principles will show the impulse emanating from Rome. But everywhere, under this apparent uniformity, attentive examination will discover shades without number, or even contrasts, in accordance with the entirely distinct municipal life of the ancient cities. Each city had its own architectural traditions, as it had its civil institutions, its customs, and its cult. Roman art was essentially municipal; this was its first, its principal characteristic. Let us then think of it in its innumerable forms, not trying to lend it a fixedness of methods incompatible with the incessantly changing conventions and necessities. Transplanted to diverse soils, it was subjected to inevitable influences; it transformed itself in order to spread over all the regions of the empire; its methods were classed by species; its types were consecrated by time, and each colony, each municipality, had in its corporations of artisans, depositaries of the traditions of local practice; and, as we will see, the Roman respect for the customs and freedoms of these labor associations contributed to rendering the distinctions between the different schools sharper and more durable.

(*Continued.*)

FIRE-PROOF BUILDINGS.

A PROPOSED change in the building law of Boston which has occasioned some discussion is that which requires that apartment houses of four or more suites shall be of first-class construction — that is, shall be built, both in their exterior and interior, of non-combustible materials. The objection that has been raised to this is that it is pushing the fire-proof theory to an unwarrantable length; but, it may be that those who look upon the question from this standpoint do so in ignorance of certain important considerations. In the first place, the cost of fire-proof construction has undergone in the last few years an enormous contraction. Some of the best builders assert that the difference in cost between fire-proof construction and ordinary construction is no more than between 10 and 20 per cent., and with the passage of the tariff bill and the increase that has been made in building timber, it is not impossible that the cost of first-class construction will be little, if any, greater than that of ordinary construction. A fire-proof building thus constructed, when once put up, has a durability which is worth, on account of the saving in depreciation, all of the added expense. In the matter of insurance, a decided reduction in rates can be obtained, and owners and occupants can have a sense of security which insurance either against fire, life, or accident will not altogether give to them. A still further fact is that this form of construction is what is required in practically all of the cities and towns of continental Europe, with the exception, perhaps, of Russia. Not only is it necessary in these places to build apartment houses and other large structures in this way, but the ordinary dwelling house is a fire-proof building. The result of this general adoption of correct methods of construction is seen in the almost entire absence of large losses by fire. Thus, in Berlin, which is a city about the size of New York, there are each year about the same number of alarms of fire as in the latter metropolis, say, between 3,500 and 4,000, or ten alarms a day. But although New York has a large and wonderfully well equipped fire department, and Berlin a relatively small and seemingly poorly equipped defensive service, the fire losses in Berlin are not much larger on the average than those met with in such cities as Lawrence or Haverhill, while the losses in New York city, where this thorough system of fire-proof construction does not obtain, is each year from twenty to thirty times as great as it is in Berlin. The time has come to make a step forward in construction, and hence we trust that the suggestion of the building commissioner in the matter referred to will be favorably considered by the Legislature.— *Boston Herald.*

Fire-proofing Department.

DETAILS OF FIRE-PROOF CONSTRUCTION WITH BURNED CLAY.

BY PETER B. WIGHT.

COLUMN PROTECTION.

THE work of the fire-proofing experts in connection with columns, pillars, or posts is confined to the protection of iron or steel, and forms no part of the construction of a building. An exception to this can be found in the first tier of seventy-two columns forming the arcade of the United States Pension Building, at Washington, which are built of drums of fire-brick, with a 5 in. hole in the center. Wooden posts are supposed to take care of themselves, which is largely the case where hard oak is used. When disasters by fire, caused by the breaking of iron columns, became frequent and noticeable, a great cry was raised by the underwriters, experts, and some professional firemen that nothing was safe in any building except a large wooden post which would not snap off or bend, but would stand as long as enough of it remained to carry its load. It was long before this time that other investigators had called attention to the danger of iron columns in a fire, and had suggested the proper remedy. The most prominent authority to demand the use of wood in superseding cast iron was the late Captain Shaw, of the London Fire Brigade, and what he said was taken up and echoed all through our own country. Yet, years before he published his first book, Wm. Stratford Hogg, an Englishman, had, in 1862, taken out a patent for protecting iron columns from fire by building circular bricks around them and leaving an air space between. But he received no encouragement, and there is no record of his patent having been used.

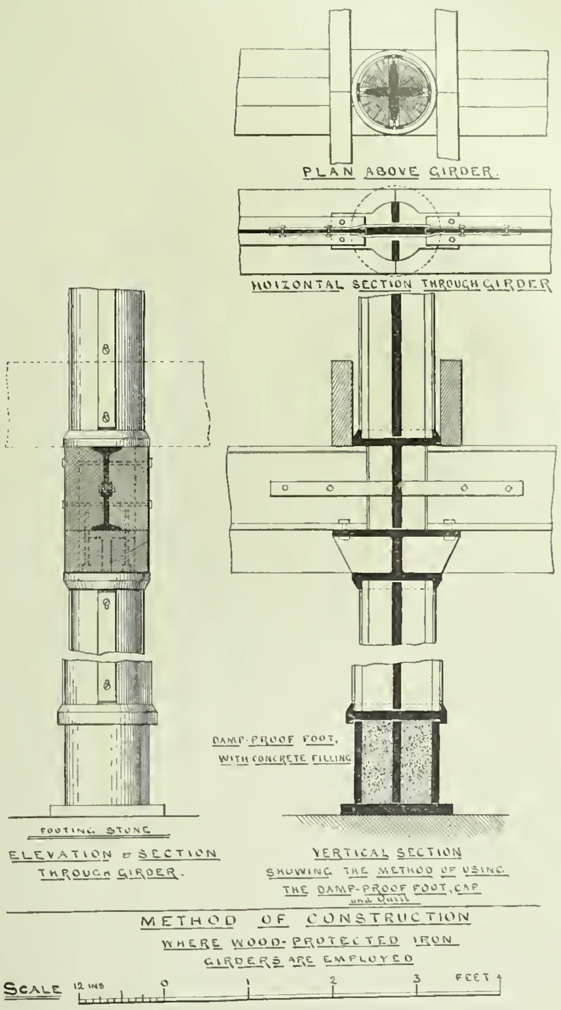


FIG. 1.

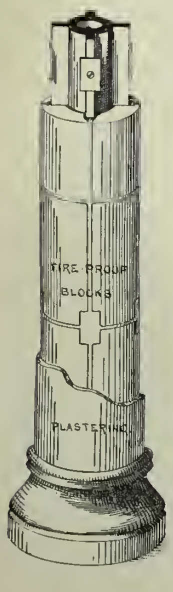


FIG. 2.

The result of this agitation was that in many buildings oak posts were used where it would have been better to employ iron protected by Hogg's method. This agitation led the writer to invent and patent, in 1873, a method of protecting cast iron by making the columns with four or more flanges, instead of in a cylindrical form, and securing gores of hard oak between them, depending upon the slow combustion of the surface of the wood, and its non-conducting properties when burning; for as a fact oak is a non-conductor of heat when one side is in combustion. The method was demonstrated by a comparative test with two unprotected iron columns in 1873. But while it attracted considerable attention, more on account of its novelty than its usefulness, the system was never put into use. It was not economical in the section of the iron used; yet no other form of casting could be employed that would admit of the application of the oak in a good form for protection. Fig. 1 shows how it was proposed to use this system, and its application to iron girders.

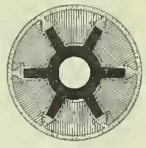


FIG. 3.

As porous terra-cotta was demonstrated to be a practicable article of manufacture in 1874, it was substituted for wood gores, and used for the first time with cast-iron cores of cruciform section in the Chicago Club, on Monroe Street, opposite the Palmer House in Chicago, now the Columbus Club. In these columns, of which there are four, the terra-cotta blocks project one inch beyond the flanges of the iron columns, and they are secured to the iron, not only by the cement, but by wrought-iron plates, 2½ ins. square countersunk into the tiles and screwed down to the edges of the flanges. The columns admitted of a plaster finish, and the ornamental capitals were of terra-cotta. Similar fire-proof columns were soon after used in the Milwaukee Board of Trade Building, some of which had six flanges in the iron cores. Five flange Phœnix wrought-iron columns were also used in the same building, and similarly fire-proofed.

The next improvement in columns that were expected to finish twelve or more inches in diameter was to make the cast-iron cores in the form of a cylinder, with four or more projecting flanges of about 1½ ins. projection. This was found to require only a slight excess of metal over cylindrical castings of the same strength. The terra-cotta sections were made about 2½ ins. in thickness, and were secured to the iron by the same method as that used in the club house. These columns were used on a large scale in the retail store built by the late D. M. Ferry, on Woodward Avenue, Detroit, in 1879, and were used from that time up to about 1888, in such a large number of buildings that a computation then made showed that there were upwards of 40,000 lineal feet of columns thus fire-proofed. Fig. 2 is an illustration of one of these columns, and Fig. 3, a plan of one having six flanges as used in the First National Bank, Chicago. In 1884, this system came into extensive use as an application to the Phœnix wrought-iron columns. These are the same in practical shape as the cast-iron cores that had been used. Instead of screwing the countersunk plates into the edges of the flanges, cast plates were made with two hooks, which would fit over the rivet heads in any part. As the blocks were built up in place, a course of plates was hooked onto the rivet heads at about every two feet in height, and then built in with the next course of blocks. In this way all the Phœnix columns of the Mutual Life Insurance Building, on Nassau Street, in New York, were covered, most of them being six-flange columns. Fig. 4 is an illustration of the usual method applied to Phœnix columns, and Fig. 5 shows a special method applied to two columns in the Chicago Board of Trade. It was not uncommon, also,

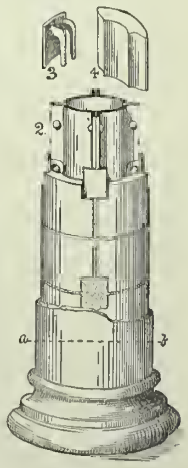


FIG. 4.

where it was desired to give square cast-iron posts a round finish, to make the blocks flat on the inside, and curved on the outside for this purpose. The countersunk plates were secured by screws to the outer angles of the castings, using them as if they were flanges. In the same way square cores were covered to finish square with chamfered angles (see Fig. 6), and even round columns were covered with porous terra-cotta blocks, so as to make them finish in a square form. For this purpose, and for the fire-proofing of cylindrical cast-iron cores that were not provided with vertical flanges, the castings were tapped with holes into which small, round studs were screwed, and the countersunk plates used to secure the fire-proof blocks were screwed into these studs (see Fig. 7).

FIG. 5.

This system was based on the idea that no fire-proof material can be depended upon to hold itself in position, and that cement is only subsidiary to mechanical fastenings. It did not allow any fire-proof covering of an iron column to bulge off by vertical expansion, because it depended upon the individual fastening of the porous terra-cotta blocks to the iron core. This proved to be effective in every case in which it was tested. When the Grannis Block was burned in Chicago no attempt had been made to make it fire-proof in any particular, except that the cast-iron columns were covered as here described. But columns that had fallen down in the ruins were taken out with all their fire-proofing attached.

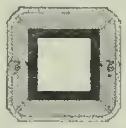


FIG. 6.


FIG. 7.

The engineers attached to the office of the supervising architect of the Treasury Department decided to fire-proof the columns of all buildings between 1880 and 1890. But they refused to allow them to be cast with flanges, and only allowed about 1½ ins. of thickness for the terra-cotta fire-proofing. As they would not permit the columns to be drilled, the fire-proofing had to be secured with bands. To put these on the outside, or to wire the blocks on, which the specifications allowed, would have exposed these fastenings to fire. Those which were done by the Wight Fire-proofing Company were covered with blocks having grooved edges. As each course was set, a hoop of iron was bent around the column, hooked together at the ends, and dropped into this groove. Then the next course was set with the grooved edge down, and thus the iron bands were incorporated with the tiles and cement, and protected from heat on the exterior. In this way the cast-iron columns of at least thirty government buildings were fire-proofed. Fig. 8 is an illustration of the method, and Fig. 9 a plan of one of these columns.

This is somewhat like writing up ancient history; for every one of the processes above mentioned has been out of use for from six to nine years. It is perhaps needless to add that they are the methods used for a long time by the company of which the writer was the originator, and which went out of business six years ago. The reasons for this are two. They are such as are not called for in the specifications, and sometimes more expensive than those in present use. It is part of its history that the Wight Fire-proofing Company, in the later years of its existence, followed in many cases the methods of its rivals in covering iron columns, for the simple reason that these were all that were called for and demanded in architects' specifications, or paid for by the owners. This was even the case in some of the largest government buildings. What seemed to become the standard system of fire-proofing columns at that time consisted of a flangeless unglazed hard drain tile, scored in two places so that it would split in two, and then set up around the column so as to break joints. In some cases the architect or superintendent would demand that they be tied on with wires, which was generally done when it was ordered, because it cost next to nothing, and it was not worth while to kick. An illustration of one of these is here given. (Fig. 10.) In other cases it has been customary to cover Z bar, or other kinds of built steel columns, with hollow blocks of hard, hollow tile, built as a wall around them and without fastenings, as was the case in the Horne Department Store at Pittsburgh, recently burned, and described in the June BRICKBUILDER. A few architects have required that the Z bar columns shall have their hollows filled in with pieces of tile before the exterior covering is put on. In other words, they think that the hollow tile covering is better when it is *stuck on* as well as built up. Such are the methods now generally used where tiles are employed, and hard or porous tiles are used indifferently according to whether the lowest bidder is a "hard" or "porous" manufacturer.

FIG. 8.


FIG. 9.

FIG. 10.


FIG. 11.

There is some food for reflection after reading the opinions of some of the most successful architects of New York and Boston, on the general character of our fire-proofing, in THE BRICKBUILDER for January and February. In the course of all of those interviews, which are characterized by very just criticisms of many of the shortcomings of the makers and users of clay fire-proofing materials, no suggestion was made of the necessity of *securing* the fire-proofing to the iron or steel by mechanical means. Those who referred to column fire-proofing only suggested increasing its thickness, and one said that it should be "at least" 4 ins. in thickness. Another suggested filling the columns solid with cement on the inside, and putting metal lathing and plastering on the outside. Mr. Carrère showed the most perfect knowledge of the defects and necessities of the fire-proofing art as practised in Eastern cities; but his only suggestions about column covering were that they should be heavier, interlocking, or that they should be doubled. The building law of Chicago, which was last amended so that it should cover also the use of plastic coverings with metal lathing, requires that there shall be two air spaces around all columns. THE BRICKBUILDER has already pointed out that the defective method, as in the Horne Department Store at Pittsburgh, which *by some good chance* left the columns intact though it fell off promiscuously, is admissible under its provisions.

So we find that in the present state of the art neither the laws nor the practise of the leading architects, nor the methods advertised by manufacturers or contractors,[1]

FIG. 12.

[1] The writer has looked in vain through the published catalogues of the present manufacturers of fire-proofing materials of clay for illustrations, or descriptions of methods for protecting iron or steel columns from fire, which provide for fastening the protection to the column, with the earnest hope to be able to do them justice, but has found none. Most of the illustrations given in them are unauthorized copies of some of the shapes that have been described in this paper, without the fastenings. Of those

are calculated to insure the safety of this most vulnerable feature of modern fire-proof buildings. We have traced a brief outline of the art as it has been practised,—necessarily brief, for very much more could be said on the subject. It does not show that the case is hopeless. It only demonstrates that we have much to learn that seems to have been forgotten. To sum up, it must be recognized that some method is better than others, and the best should be used. It is an unfortunate fact that the element of cheapness has been the main cause of depreciation, no less than the indifference of the architects. This is not to say that the effective fire-proofing of columns is a very expensive operation. On the contrary, there is very little difference in cost between good methods and bad ones, and this difference would hardly be noticed in the aggregate cost of a large and expensively finished fire-proof building, if attention is given to this detail at the proper time.

FIG. 13.

The writer was led into the field of fire-proof construction by his study of the best methods for protecting iron columns from fire. His first and every effort was to avoid any unnecessary additions to the diameters of columns. We have now become accustomed to these additions, and architects even propose to increase them. He found that porous terra-cotta was the best material for the purpose, because, on account of its own non-conducting properties, it did not require a hollow space. He also found by experiment and practise that a thickness of 2½ ins. of this material was sufficient under any circumstances, and that wherever it could be used it need not project beyond any flange more than 1 in. He became convinced that any fire-proofing material was liable to be forced away from the column by its own *lateral expansion in the direction of the length of the column*, and that it must be fastened directly to the column by mechanical means, countersunk for their own protection. These are the fundamental conditions of column fire-proofing, no matter how applied. They make it possible to save much space and yet get the best results. They are applicable to every form of vertical support now in use, and in applying them the best fire-proofing material ever made, porous terra-cotta, should always be used. The use of porous, and not semi-porous, material is recommended for inert or protecting material when used solid, while the semi-porous terra-cotta is recommended when used in the hollow form.

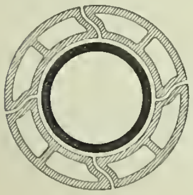


FIG. 14.

In making these suggestions much has been said that looks like advertising, and it must be added by way of explanation that all patents covering these methods have expired, and there is no monopoly of these ideas. THE BRICKBUILDER in publishing them is only doing missionary work in a cause which it is endeavoring to serve. We do not claim to be infallible, nor is the admission that there is always room for improvement a confession of the weakness of a cause. In this case it shows that the use of clay in the erection of fire-proof buildings is always capable of a higher development in the hands of those who are seeking for the best results.

OF all known fire-proofing materials, it has been unquestionably proven that burnt clay is the most effective for the prevention of the spread of fire. Where it has shown failure, faulty methods of application have been the cause. This is a matter that we may expect to see satisfactorily handled in the near future, as never before has it received the intelligent study that is being given it at present.

that appear to have merit and originality, the illustrations Figs. 11 and 12 show a plan and general view of one method of the Pioneer Fire-proof Construction Company, of Chicago, in which hollow tiles are held together *around* the column with cramps. Fig. 13 shows the method of the Illinois Terra-Cotta Lumber Company for protecting the Lorimer steel columns, and Fig. 14 shows the same method for cast-iron cylindrical columns. There is no description of these, but it has been noticed in practise that the blocks are built in courses breaking joints. Nearly every maker in the country makes for the Z bar columns either the ordinary partition tiles or hollow blocks similar to those used in the Horne Department Store and illustrated in BRICKBUILDER for June.

Mortar and Concrete.

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

BY CLIFFORD RICHARDSON.

THE MANUFACTURE OF NATURAL CEMENT.

FROM the preceding pages it is apparent that in the establishment of the natural cement industry at any point, a thorough study of the chemical composition and physical properties of the available rocks is necessary, in order to determine upon the selection of suitable material for the purpose and the rejection of that which is unsatisfactory. The proper manner of mixing and burning strata of different composition must be decided upon, and the economic considerations affecting the quarrying of different strata, depending on their dip and overburden, must, of course, not be neglected.

The following are the most important points to be considered in connection with the examination of hydraulic limestones:—

CHARACTER OF THE ROCK. The general appearance and nature of the various strata in any quarry of cement rock, their color, grain, and hardness, are usually somewhat different, and sufficient to distinguish and identify them. An examination in the laboratory, even with limited facilities, will then reveal definite physical and chemical properties which will enable one to determine the availability of the stone for the manufacture of cement.

PHYSICAL PROPERTIES. It is of the first importance that the rock should be dense. A light rock will not burn well or grind to a cement of suitable volume, weight, or density. The specific gravity determined at 78 degs. Fahr. should not be below 2.70, and should preferably be 2.8 or higher. Some hydraulic limestones have a specific gravity of only 2.65, and are inferior, while, where weathering has taken place, it may be even less. The best rock is always obtained after a quarry has been so far worked as to have reached beyond all weathered material and alteration products. Where the dip is sharp, this condition is soon arrived at; but when there is little dip, all strata must be rejected which are near enough the surface to have been weathered or acted upon by water.

In the Rosendale series of cement rocks the following densities at 78 degs. Fahr. were found for stone, all from deep levels, but at different depths.

Nearest Surface.		
	Light rock,	2.830
	Dark rock,	2.849
Medium.		
	Light rock,	2.815
	Dark rock,	2.841
Deepest.		
	Light rock,	2.827
	Dark rock,	2.845

At these depths below ground there is little difference in the density of the rocks obtained, all being very heavy and typical of the best quality.

The Fort Scott, Kansas, rock, on the other hand, which is nearer the surface, has a density of only 2.730; that at Round Top, Maryland, 2.731; while that of the hydraulic limestone of Illinois is no greater than 2.667, and of course does not produce as dense a cement.

The state of aggregation is as important as the density of a cement rock. The mixture of clay, sand, and carbonates should be thorough, and one in which the constituents were deposited in the form of an impalpable powder. Where the sand is coarse, the clay in lumps, or the carbonates in pockets without admixture of silicates, the rock is unsuited for cement burning. Mere inspection will usually reveal the uniformity of the rock, while the size of the particles can be determined by dissolving a weighed fragment, without pulverizing, in acid, and determining the size and amount of the insoluble particles of sand remaining undissolved by means of fine sieves. As an example may be mentioned a magnesian limestone from a Virginia cement quarry, which might have made a fair cement were it not for the coarse nature of the stone. The residue of clay and sand, insoluble in acid, consisted of 9.5 per cent. of particles too large to pass an ordinary 100 mesh cement sieve. It was, therefore, necessary to reject this stratum in working the quarry.

In the Rosendale rocks the following residues were found in the cement rocks at various levels : —

		Per cent. of Residue on Sieve.		
Nearest Surface.		200 mesh.	100 mesh.	50 mesh.
	Light rock,	2.9		
	Dark rock,	0.0		
Medium.				
	Light rock,	0.0		
	Dark rock,	0.0		
Deepest.				
	Light rock,	0.6	0.6	0.4
	Dark rock,	1.2	0.5	0.3

On treatment with acids these rocks retained their original shape, but could then be broken down by a rubber pestle or the fingers, revealing, in one case, some firm silicious veins which were quite resistent. Under the microscope the fine residue has the appearance of kaolin.

Where it is necessary to use a coarse rock, the burning must be slow and prolonged, in order to bring about as much combination between the lime and silica as possible; otherwise, the finished product is merely one of quicklime and but partially combined silicates.

CHEMICAL COMPOSITIONS.

CARBONATES OF LIME AND MAGNESIA. The amount of carbonates in a hydraulic limestone cannot exceed 75 per cent. and produce a good cement, and, in most cases, they should preferably be less than 70 per cent. Where several strata are taken from one quarry it is possible to use a small proportion of rock richer in carbonates, but this is undesirable on account of the difficulty of properly burning the richer limestone. The average composition of a mixture of rocks under such circumstances cannot exceed 70 per cent. without the production of an inferior or hot cement. With 75 per cent. of carbonate of lime the proportion for Portland cement is reached, and a different system of burning is necessary. The material from which Portland cement is made will, however, give a rock cement when lightly burned, but one that is very quick setting.

Hydraulic limestones, which are free from magnesia, probably make the best cements when properly proportioned. They must, however, contain sufficient clay. Such a stone has the composition given for the No. 2 rock of the Maryland quarry where the total carbonates are 68.44 per cent., including only 4.58 per cent. of carbonate of magnesia, while the silica and clay amount to 29.66 per cent. Rock of this description is rarely found. Where the latter constituents are deficient cement from such a rock is very quick and hot, especially when the rock contains more silicious sand than clay.

MAGNESIA. As has been already shown, the majority of the hydraulic limestones in use in the United States are magnesian, the amount of magnesian carbonate varying from 39 per cent. to little enough for the stone to be considered as a straight lime rock. In any single rock or mixture the carbonate of magnesia should not exceed 30 per cent., and should be preferably not more than 25. From a stone with more than the latter, the cement produced has a tendency to expand slowly with age, especially when deficient in clay. This is illustrated by a Western New York rock, having 37.0 per cent. of magnesian carbonate, and less than 11 per cent. of silica and silicates, which yields a cement which expands in concrete to a very large degree for many months or even years after use.

The Rosendale cements, owing to their density and composition, are the highest type of this class of cements. The rock they are made from contains only about 20 per cent. of magnesian carbonate, with 30 per cent. of clay.

SILICA AND SILICATES. The amount of silica and silicates in hydraulic limestones is, of course, inversely proportional to that of the carbonates they contain. When rich in carbonates they are poor in silica and silicates, and the reverse. As it is to the presence of these substances that the limestones owe their hydraulic properties, the amount which they contain is of the greatest importance. It is also of quite as much importance that the silica should be largely, if not entirely, in combination with alumina as clay, and not in the free state as mere sand. This is determined by the amount of alumina and iron in the stone, which serves as an index of the possible clay present. For example, in a stone from Akron, N. Y., and one of the Rosendale series, the analyses previously given show 35 and 29 per cent. of substance insoluble in acid; but an examination of the amount of alumina and iron present reveals the fact that there can be but little clay in the Akron stone, while there is an abundance in the Rosendale, one having only 4.84 per cent. of alumina and iron while the other has 10 per cent. The Rosendale rock, in consequence, makes a very superior cement, while the Akron shows the peculiarities of a cement deficient in clay and too rich in magnesia. In fact, a deficiency in clay is more serious in a magnesian than in a lime cement, as under such circumstances there is very apt to be serious expansion of the cement after use.

Cement rock deficient in clay yields cements which heat and set too quickly. On the other hand, too much clay in a hydraulic limestone is as bad as too little. Cement made from such rock will blow or expand, when immersed in water, especially when carelessly burned. Clay may also contain too much iron oxide and insufficient alumina, in this case yielding a weak cement.

SULPHATES AND SULPHUR. Sulphur occurs in limestone as sulphate of lime and as pyrites or iron sulphide. These substances are rarely present in sufficient amount to affect the quality of cements. Sulphates are sometimes reduced in burning, combining with some of the iron oxide to produce the green color now and then seen in briquettes of natural cement. Two per cent. of sulphur in its compounds is a large amount for a cement rock to hold.

ALKALIES. Potash and soda are sometimes found to a considerable amount, between 1 and 2 per cent., in the silicates of hydraulic limestones. Unless they are present in more than the usual traces they have no effect on the cement. In excess they make the rock fusible in the kiln, in consequence of which such material is rejected or must be burned slowly at low temperatures. As far as is known, they do not injure the quality of the cement. The amount present in various well-known cements is as follows : —

ALKALIES IN HYDRAULIC CEMENTS.

Milwaukee	Cement,	K_2O	.87%
"	"	Na_2O	1.64
Ft. Scott	"	K_2O	.70
"	"	Na_2O	1.33
Akron, Star	"	K_2O	1.39
" "	"	Na_2O	.23
Akron, Obelisk	"	K_2O	1.60
" "	"	Na_2O	.52

Buffalo	Cement.	K_2O	1.44
"	"	Na_2O	.41
Rosendale	"	K_2O	
"	"	Na_2O	
Round Top	"	K_2O	
" "	"	Na_2O	

It will be noticed that in some cases potash is in excess, in others soda. This is due to the kind of feldspar from which the clay in the cement rock originated.

MINOR CONSTITUENTS. All limestones contain small portions, fractions of a per cent., of other elements besides those mentioned, such as barium, strontium, manganese, phosphoric acid, chlorine, and other widely diffused substances, but they have little or no influence on the suitability of the rocks for cement making, and may be neglected unless their amount is more than a trace.

CRUDE TESTS OF ROCK.

Where it is impossible to obtain complete chemical analyses and determinations of the physical properties, such as have been mentioned, a fair idea of the peculiarities and deficiencies of any hydraulic limestone may be obtained to supplement burning tests in the experimental kiln, or muffle, from an estimation of the loss on ignition. This corresponds to the amount of carbonates, and inversely to the per cent. of substances, insoluble in acid, present. From such a determination, especially when the appearance of the residue is examined critically with the object of learning its character, an approximate conclusion can be drawn as to the value of a stone or the cause of its inferiority.

In the simplest way an ordinary coal fire, in which pieces of the rock are buried and burned for varying lengths of time, will furnish much valuable information.

APPLICATION OF THE RESULTS OF ANALYSES TO PRACTISE.

As illustrations of the application of the information obtained from the physical and chemical examination of cement rocks to their selection and use in cement making the following cases in actual practise will serve.

QUARRY OF MAGNESIAN HYDRAULIC LIMESTONE.

Some years ago a new quarry of magnesian cement rock was opened in Maryland, which contained a large number of distinct strata which were available for making cement. I was requested, with due consideration for economical working, to select, after a chemical and physical examination, the best strata for use in making a high-grade natural cement.

The strata which were submitted were eleven in number, mostly of light color, and all, with one exception, quite uniform in character, but readily distinguished by their appearance. The results of the laboratory examination were as follows: —

ANALYSES OF MAGNESIUM LIMESTONE, MARYLAND CEMENT COMPANY.

No.	1	2	3	4	5	6	7	8	9 Light	9 Dark	10	11
Loss on ignition	36.56	29.50	41.95	34.82	31.09	39.65	28.55	33.23	37.34	39.64	30.94	38.95
Silica	14.61	23.99	6.68	15.97	21.45	9.89	33.06	20.47	15.01	9.06	19.70	8.01
Alumina and Iron Insol.	3.83	5.60	2.03	4.54	4.01	2.77	3.26	5.09	3.22	4.84	4.84	2.63
" " " Sol.	2.49	4.17	1.58	3.05	2.86	2.73	3.26	2.67	5.22	2.51	5.09	1.59
Lime	25.25	20.16	31.59	23.72	23.87	28.63	20.33	26.20	25.85	27.88	20.25	39.77
Magnesia	16.18	13.33	15.81	15.64	12.98	15.15	10.26	11.59	18.84	15.67	15.23	7,43
Sulphur as SO_3	.78	1.29	trace	.71	.22	.34	.82	.58	trace	.38	.34	.44
Calcium carbonate	45.09	36.01	56.42	42.36	42.63	51.13	36.31	46.79	46.17	49.79	36.16	71.03
Magnesium carbonate	33.98	27.99	33.20	32.84	27.26	31.82	21.55	24.34	39.56	32.91	31.98	15.60
Total	79.07	64.00	89.62	75.20	69.89	82.05	57.86	71.13	85.73	82.70	68.14	86.63
	Poor		Bad	Poor		Bad						
Silica, etc., coarser than 100 mesh screen	9.51	6.92	1.29	.04	.00	4.84	.32	1.31	.32	.00	2.02	.33

The rocks of the different strata in this quarry are distinguished in a general way by the rather low percentage of alumina and iron, and consequently of clay. The insoluble portion in many cases is largely silica, and rather coarse grained, as may be seen from the determinations of its size.

Stratum No. 1 was recommended for rejection, as it contained 9.5 per cent. of sand coarser than would pass the ordinary screen of 100 meshes to the inch. This rock was also too rich in carbonates, and would have given, under the best handling, an inferior cement, as magnesian cements deficient in clay are not constant in volume after use.

Stratum No. 2 had an excellent chemical composition but physically was too coarse, and, lying among inferior strata, it would naturally be neglected for economical reasons.

Stratum No. 3 was rejected because quite deficient in clay and silica.

Stratum No. 4 was characterized as a poor rock which might be used if necessary, but was not recommended, being deficient in clay.

Stratum No. 5 was marked as being a slight improvement over No. 4 owing to the smaller amount of carbonates it contained, although deficient in clay.

Stratum No. 6 was too rich in carbonates and too low in alumina or clay to be used for hydraulic cement.

Stratum No. 7 proved the most silicious of the series, although it contained little clay. With care in burning it could be used, as the silica was present in a state of fine division. It is, however, not an entirely satisfactory rock.

Stratum No. 8 proved a good stone for this quarry.

Stratum No. 9, in both its forms, light and dark, was, besides having great lack of uniformity, too rich in carbonates and deficient in insoluble matter. By itself this stratum would prove a poor one.

Stratum No. 10 was an excellent one, and was recommended for use.

Stratum No. 11 appeared at a glance to be insufficiently hydraulic, and was excluded.

Of all these strata, for one or more reasons, only those numbered 5, 8, and 10 were considered to be fairly good rock, if burned by themselves. The possibility, however, of mixing the cement made from the different strata permits the faults of one to correct those of another to a certain extent. The stratum No. 7 was, therefore, included, and such a mixture served very well. Cement so prepared analyzed as follows: —

Loss on ignition	8.29
Uncombined silica	16.30
Silica combined	13.50
Alumina and iron oxide	11.04
Lime	33.36
Magnesia	15.58
Sulphuric acid	.40
Alkalies	1.50

The proportions of silica, clay, and carbonates are satisfactory in this mixture, and gave a good cement which, it would seem, might perhaps have been improved by some further slow burning, as too much of the silica was in the uncombined form. As a matter of fact, however, rock from this quarry in practise had to be burned lightly and with great care to obtain the best results, and for this reason considerable silica was left uncombined. The cement has proved, after long use, to be a satisfactory and permanent one, although probably not one of the best.

QUARRY OF MAGNESIAN FREE CEMENT ROCK.

In another Maryland quarry, where the rock was as nearly free from magnesian carbonate as ever happens, an opportunity occurred for a study of the variations in composition of a large number of strata, and of the suitability of this kind of hydraulic limestone for cement making. The strata had a dip of nearly 90 degs., and, being exposed along the face of a high cliff, were, in consequence, very accessible.

The rocks, fifteen in number, had the following composition and furnished, when burned by themselves, experimental cements which set and tested as given.

COMPOSITION OF THE STRATA OF ROCK AND TESTS OF THE CEMENT BURNED THEREFROM IN A MARYLAND QUARRY, MAY–JUNE, 1892.

No.	1	2	3	4	5
Silica	28.08	20.40	28.72	26.36	16.38
Alumina	12.58	12.42	12.28	10.88	8.42
Iron	5.00	4.86	5.22	5.50	2.86
Calcium carbonate	45.86	57.93	43.82	48.75	62.56
Magnesium carbonate	2.18	2.98	2.31	2.85	5.76
Total carbonate	46.04	60.91	46.13	51.60	68.32
Total aluminum and iron oxide	17.58	17.28	17.50	16.38	11.28
Sulphur	.00	1.18	1.53	1.73	.67
Total silica and silicates	45.66	44.68	46.22	37.24	27.66
Set initial	30 ft.	10 ft.	65 ft.	7 ft.	26 ft.
Tensile strength.					
1 day neat	36	83	64	60	64
7 " "	64	212	252	190	218
28 " "	152	275	252	276	307
3 months.					
7 days 2 parts quartz	46	122	184	168	127
28 "	110	250	210	206	233

	6	7	8	9	10
Silica	21.94	9.92	12.12	21.78	29.22
Alumina	7.96	3.38	2.36	5.57	11.48
Iron oxide	3.78	2.22	3.78	3.82	3.52
Calcium carbonate	60.75	81.52	51.82	61.40	44.57
Magnesium carbonate	2.01	1.07	23.39	3.15	3.86
Total carbonate	62.76	83.49	75.21	64.55	48.43
Alumina and iron oxide	11.74	5.60	6.14	9.39	15.00
Sulphur	.34	.11	.00	1.10	.78
Total silica and silicates	33.68	15.52	18.26	31.17	44.22
Set initial	32 ft.			48 ft.	14 ft.
Tensile strength.					
1 day neat	61			48	54
7 " "	218			220	225
28 " "	210			262	220
3 months.					
7 days, 2 parts quartz	152			187	165
28 "	240			239	268

No.	11	12	13	14	15
Silica	16.82	18.50	35.38	8.78	42.94
Alumina	5.46	6.34	13.46	2.70	12.62
Iron	3.66	4.28	4.28	2.62	5.92
Calcium carbonate	69.54	43.03	33.61	80.39	25.56
Magnesium carbonate	2.69	16.00	7.56	4.02	8.35
Total carbonate	72.23	59.03	41.17	84.41	33.91
Total aluminum and iron oxide	9.12	10.62	17.74	5.32	18.54
Sulphur	.80	.35	.82	.64	.17
Total silica and silicates	25.94	39.12	53.12	14.10	61.48
Set initial	4 ft.	14 ft.			
Tensile strength.					
1 day neat	128	62			
7 " "	250	138			
28 " "	266	300			
7 days, 2 parts quartz	233	80			
28 "	285	190			

These hydraulic limestones are very typical of cement rock which is free from magnesia. They show quite as marked variations in composition as those of any quarry that has been examined, having from 84 to 34 per cent. of carbonates containing from 23 to 2 per cent. of carbonate of magnesia, with from 61 to 14 per cent. of silica, alumina, and iron oxide, and from 1.73 to 0 per cent. of sulphur as sulphates. Physically the rocks were of very fine texture, as only one, No. 5, left particles too coarse to pass a sieve of 100 meshes to the linear inch on solution in acid, in this respect being very different from those of the magnesian quarry previously described. Of all the rocks it is at once evident that Nos. 7, 8, 13, 14, and 15 must be rejected, 7, 8, and 14 on account of their excess of carbonates and deficiency in clay, and Nos. 13 and 15 for the opposite reason. Stratum No. 8 would, however, furnish a cement of the Western New York class.

Of the other strata, cements were burned in an experimental kiln and tested, with the results given. The remarkable fact that good, natural hydraulic cement could be made from rock of such very varied composition is very striking.

The group of strata 1, 2, 3, and 4 are all very high in alumina and iron, consequently of clay. Nos. 2 and 4 are in addition the highest of these in lime, and consequently yield the quickest setting cements. No. 3, having the least lime, is the slowest setting. With the high percentage of clay which these limestones hold their burning must be conducted carefully, or blowing cement would result.

Strata 5, 6, and 9 are lower in clay and higher in lime than those preceding, and furnish slower and more satisfactory cements. No. 10 resembles the highly clayed rocks 1 to 4. No. 11 is so rich in lime and poor in clay as to make a fiery cement, and No. 13 is, as we have mentioned, rejected on account of its magnesia.

We found, then, in this quarry two particular classes of rock, one highly clayed, the other much less so. This fact and the economy of working the strata led to the decision to burn the strata 2, 3, and 4, as one lead in the quarry, in one set of kilns, and numbers 9 and 11 as another lead in another set of kilns, mixing the burned rock before grinding. If an increased output was desired, it was suggested that Nos. 5 and 6 be added in the second series, or No. 12 omitted and these used in its place.

With these suggestions as a guide the works were established, and a high-grade cement made after some experimenting as to the best manner of burning.

The physical properties of the cements made from the different rocks of this quarry are instructive. The high lime and low-clayed rock, No. 11, made a cement which gave the greatest immediate returns, both in quickness of set and in tensile strength, of any of the strata. It must be noticed, however, that, having acquired this strength quickly, there was little or no increase at a later period. This is very characteristic of such cement.

The magnesia rock, No. 12, gained in strength slowly, as all magnesia cements do, but would in the end have probably exceeded many of the others. As it was, it surpassed in neat strength all but one at 28 days. If used for the manufacture of cement, it would probably have to be burned in a different way from the other strata, to obtain the best results.

Strata Nos. 1 and 4, which are nearly identical in composition, yielded cement of quite different quality, No. 1 being the weakest of all that were burned. This can only be attributed to a difference in the manner of burning. It is probable that No. 1 was either under or overburned.

The cements from the other strata were much alike in tensile strength.

The Masons' Department.

STRAINS IN ARCHES. III.

BY JOSEPH MARSHALL.

IF we now apply to the method pointed out in the foregoing chapters the test of the "resolution of forces," we will have a fair comparison, and may judge whether the foregoing methods are sufficiently approximate in their results to be considered worthy of adoption in practise.

Referring to Fig. 10, which is drawn to a scale of ⅛ in. to the foot (reduced one half in reproduction), we have the heavy line B to *a* indicating the pier supporting an arch indicated by the heavy lined arc *a* to *v*, which is intersected at *c'* by the neutral line *o n* drawn at 45 degs. elevation.

Assuming that the arch is 1 ft. by 1 ft. sectional area, and that the weight of that part of the arch above the neutral line is (in even hundreds) 2,000 lbs., and that part below the neutral line also 2,000 lbs., we have the diagonal line *c'v* indicating a force of 2,000 lbs. in the direction towards *c'*. Resolving this into two equivalent forces,—one acting horizontally, the other vertically, — we have the parallelogram *c'* H *v w*, which in their magnitude and direction are equal to *c' v*. If *c' w* with its indicated force acted from *c'* towards *w*, and *c'* H also with its indicated force acted towards H, they would conjointly exactly balance the 2,000 lbs. indicated of *c' v*.

Then for the force and direction of the lower part of the arch we have the parallelogram *c' a' a l* with the diagonal *l a'* indicating a magnitude of 2,000 lbs. force, with its equivalents *l a* vertically and *l c'* horizontally. The forces indicated by the horizontal lines *l c'* and *c'* H act in opposite directions and in the same straight line, and, therefore, are to each other as the algebraical differences of their magnitudes. If they were of equal magnitude they would exactly balance each other. But they are not equal in magnitude, and hence one must be greater than the other — *c'* H, indicating the thrust, is the greater, and *l c'*, indicating the counterthrust, the lesser. Beyond establishing the relations and magnitude of the forces in the arch the employment of the parallelogram of force is useless, because the excess of force, whatever it may be or in whatever direction acting, acts upon the pier at *l* and in manner to convert the pier into a lever of the length *l B*. Having discovered the difference in magnitude between the thrust and counterthrust, and knowing the length of the lever *l B*, nothing remains but to proceed with the numerical calculation as in Chapter II. The diagonal line *c' v* being charged with representing 2,000 lbs. force, and choosing the scale of one eighth of an inch for 125 lbs. (convenience dictating),

we have *c'* to H equal to	14¾	eighths, and
from *l* to *c'* equal to	6¼	eighths.
Subtracting, we have	8½	eighths thrust
× 125 lbs. to each eighth	125	
Gives excess of thrust at *l*	1062½ lbs.	
× by length in feet of lever *l B*	44¾	
Excess of thrust force at *B*	47547 lbs.	
This must be counterpoised by:		
÷ weight of half arch	4000 lbs.	
plus weight of pier, 30 ft. by 121¼ lbs. weight per cubic feet	3637	
Total counterpoise weight in pounds	7637)45822(6 ft.	
	1725	
	×12 for ins.	
	20700 (2 ins.	
	15274	
	5426/7637 = ¾ nearly.	

Or 6 ft. 2¾ ins., nearly, for the length of the bent arm of the lever from B towards *x*. In our numerical calculation in Chapter II. we found the requirement at this point to be 6 ft. 4½ ins., or 1¾ ins. more than by the present calculation.

It is now expedient that we inquire into the necessary length of the lever arm at *a*, the springing line of the arch.

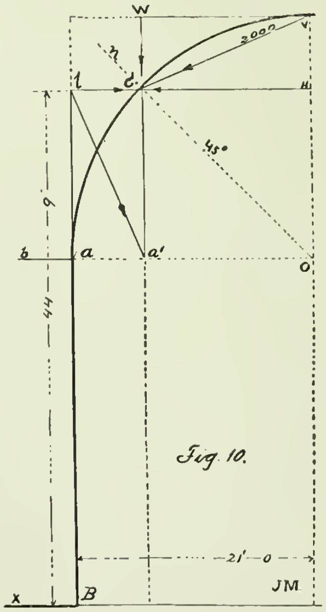
We have, of course, the same excess of thrust force indicated above, but the counterpoise weight is reduced to the weight of the half arch only, and the length of lever is only from *l* to *a*, 14¾ ft.

Hence we have: —

Excess of thrust at *l*	1062½ lbs.
× length of lever *l* to *a* in feet	14¾ ft.
Thrust force at *a* (omitting notice of fraction)	15672 lbs.
÷ weight of half arch in pounds	4000)12000(3 ft.
	3672
	× 12 for ins.
	44064 (11 ins.
	44000

or the bent arm of the lever *l a* extending towards *b* is shown to be required to be 3 ft. 11 ins.,— the fraction is worthless.

In numerical calculation in Chapter II., this arm is shown to be 4 ft. 3¼ ins.; there is then a difference between the two results of 1¾ ins. for the arch when mounted on piers 30 ft. high, and 9¼ ins. when the arch rests on its springing. The question will at once arise why this difference — even small as it is—why does it appear?



In answer we will say that in the method shown by Chapter II., the fixing of the length of the lever through which the counterthrust force operates is somewhat arbitrary, as is also the counterthrust force itself. But, although arbitrary, convenience is served by it and the degree of accuracy quite sufficient for practical use. Limited space herein forbids more extensive explanation and observations upon this very important subject,— conditions which may in the future be otherwise removed, — but it is necessary here to observe, as a cautionary advice, that the dimensions of pier required to support a given arch are not safely ascertained by drawing a straight from the indicated requirement at the nether base of the pier, as at *x*, to the indicated requirement at the spring line of the arch, as at *b*. The exterior boundary line of such a pier would be invariably *convex* outwardly. The manner of ascertaining the proper degree of convexity in any required pier is to divide the height of the pier into any desirable number of parts — equal or unequal — and to consider the lines of division as so many different bases, and find the extent of the horizontal arm for each base separately, then trace the line of curvature between the indicated points. It is not necessary that the permanent face of the pier shall remain possessed of this curvature, but only that such curve be regarded as a cautionary signal to the designer, perhaps disappearing when the final dimensions are reduced to consonance, with the judgment and intentions of the designer.

Before closing this communication we beg to be permitted one remark concerning something like advice, given to us by so many authorities commenting on arches as structural factors. I mean the importance which seems to be attached to the "depth of the keystone." From this, some pleasant fictions seem to have been romanticated as to the size of the voussoirs or archstones. Those authors, quoting from arches which, it seems, have been structurally successful, have laid down quite lengthy tables of the depths of keystones, and we are expected to take this advice as a fish might take a bait and swallow it. If the structure, based on this advice, is a success, we congratulate ourselves; if it fails, we, in part, excuse ourselves on the score of precedent, and partly because of the alleged "dishonesty of the contractor," the "incapacity of the workmen," "treachery of the foundation," or some other ingenious fabrication.

The relation of keystones to voussoirs, or archstones, is this: They must not be of less depth than their next neighbor archstones, or such masses as may be employed to serve as archstones. If we take this view of it, there still remains importuning us for an answer the question, What should be the depth of the arch blocks, and how shall we determine this for any required instance?

We should approach the reply in this way: —

1. The weight the arch is to bear (the weight of its own mass included) as compared with the resistence to crushing which the material of which the arch is built possesses: in the same manner as the crushing strength of a vertical pier or wall is considered and determined; for, after all, an arch is only a wall or pier built more or less parallel to the horizon, instead of perpendicular to it.

2. By considering convenience as regards the conventionally or accidentally fixed masses of materials of which some arches are, and others may be built, such as brick, rough stones from the quarry, building tile, etc., etc., and then allowing reasonably for defections in materials and workmanship, — and "there are others."

By far the greatest number of arches are built stronger than the demands of their position are ever likely to require, and this because we do not care to reduce materials to exact dimensions that we may know to be necessary. We take such as we find ready to hand which will serve. This is true particularly of all arches of little span and bearing little weight.

It is only when we have the shaping of the material, both as to dimension and form, subject to our judgment and order that the question seriously presents itself, How much *must* we have? or, How little can we with safety employ? Then the suggestion 1 above becomes pertinent.

But in any event the *strength* of the arch is not ascertainable from a made-for-stock "keystone." It is better to make the keystone to suit the arch requirements; *i. e.*, if a "keystone" is at all permissible as an especially honored or conspicuous member of the brotherhood composing the arch. Of course we find the center and highest part of an arch a most tempting (because of precedent) place on which to hang the conceits we call "ornaments" or "decoration," and for this reason we often go a great way around to mask our purpose.

And when it happens that our purposes are a long time masked, superstition, like a spider, weaves many fantastic webs around them, so as finally to effectually conceal the underlying motive or render a correct interpretation almost impossible. For these reasons we wander sometimes long amid a labyrinth of uncertainties, making pursuit after many will-o'-the-wisps, but not readily finding our way out.

Another curious quandary we often find uneasily brooding. In form of question it is: WHAT RISE SHOULD AN ARCH HAVE? The popular mind is full of the idea that an arch, to be "strong," must have relatively great height above the tops of its piers. But this, like many other popular ideas, is a fallacy. But the arch with a great rise above its springing is more easily destroyed than a popular fallacy.

The least *rise* an arch has, when its supports are competent, the stronger the structure will be. Then the question propounded above must of necessity change its form and become, What is the least rise sufficient for full structural efficiency in an arch?

We would answer that the least rise must not be less than the equivalent of *compression* under the greatest weight to be borne.

Taking it for granted that some curve may be traced through component parts of an arch, it follows that the arc is longer than a straight from one extremity of the arc to the other. It is self-evident that the longer line would not pass through the space occupied by the shorter one. Therefore the arch could not drop through the void it spans. But if by any means the length of the arc be shortened to a length less than the straight line between its extremities, then it will readily drop into the void. This, it seems to us, is the whole essence of the philosophy involved in the relation between the rise and span of an arch.

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

NEW YORK. — A state of midsummer quietness seems to be prevalent in this city, but it is no more than should be expected, and is not an alarming condition of affairs. On the contrary, the outlook for the coming fall and winter is very bright, and even the architects, who are not busy now, seem to be sanguine as to the future and what it will bring forth. There seems to be no reason why this city should not share in the good times which are sure to follow, with the tariff law settled and confidence restored.

The coming election for the first mayor of Greater New York will undoubtedly cause considerable excitement, and possibly some interference with business; but this will be counteracted by the feeling everywhere prevalent that the city will be benefited ultimately by consolidation.

Among the items of new work which have been reported are: —

A five-story brick and stone tenement at Nos. 104 to 106 Second Street, for Mrs. Van Alen, of Newport, R. I. Clinton & Russell are the architects.

An office building to cost $125,000, designed by C. P. H. Gilbert, architect, will be erected on the northeast corner of Broadway

TERRA-COTTA DETAIL, BUILDING FOR THE EVANS ESTATE, BUFFALO, N. Y.
E. A. Kent, Architect.
Executed by the Northwestern Terra-Cotta Company.

and Maiden Lane. It is interesting as showing the enormous value of real estate in this locality to note that this lot 30 by 50 ft., with the old five-story building which is now on it, was sold for $245,000.

R. Maynicke, architect, has planned a $250,000 office building to be erected on Broadway for Henry Korn.

McKim, Mead & White, architects, are making extensive alterations to the residence of ex-Secretary of the navy, Wm. C. Whitney. It is said that the alterations will cost $150,000.

Mr. Oliver H. P. Belmont has purchased a lot on the southeast corner of Fifth Avenue and 77th Street, for which he paid $150,000. The lot is 27 by 120 ft. Mr. Belmont intends to erect a handsome residence, but plans have not yet been prepared.

A. M. Welch, architect, has filed plans for one three-story and three two-story brick and stone stables and dwellings on 77th Street. Cost, $60,000.

H. J. Hardenburgh, architect, has drawn plans for a hotel to be erected at 54 and 58 Third Avenue. Cost, $400,000.

Dehli & Howard, architects, have planned an academy of music for the Apollo Club, of Brooklyn, to cost $600,000. The site has not yet been selected.

Buchman & Diesler, architects, have completed plans for a twelve-story store and loft building, to be erected on Broadway, between Prince and Houston Streets, and to cost $800,000.

CHICAGO.— Bids on anything in the building line can be obtained at remarkably low figures. Contractors who formerly awaited invitations are now soliciting opportunities to figure. There is, however, a brighter feeling, and building is on the increase, though the increase is slow. As the political economist would term it, the improvement is a conservative, healthy one.

RESIDENCE AT MADISON, N. J.
Clinton & Russell, Architects.

We repeat ourselves, as the facts are doing, when we say that the greatest part of the building activity is in small flat buildings, which can be seen springing up even in the outlying districts of Chicago. The greater number of these cost from $7,000 to $12,000 or $15,000. One, costing $35,000, may head the column of building news, while $75,000 to $100,000 figures often get extended description.

Alterations of stores and commercial buildings have been referred to as an important feature of building operations in this city this year. The remodeling of one hotel is just being completed, and that of three more well-known hostelries will soon be under way, under the direction respectively of Jenney & Mundie, Wilson & Marshall, and W. W. Boyington & Co.

Holabird & Roche have let contracts for a commercial building, seven stories high, to be erected near the new public library.

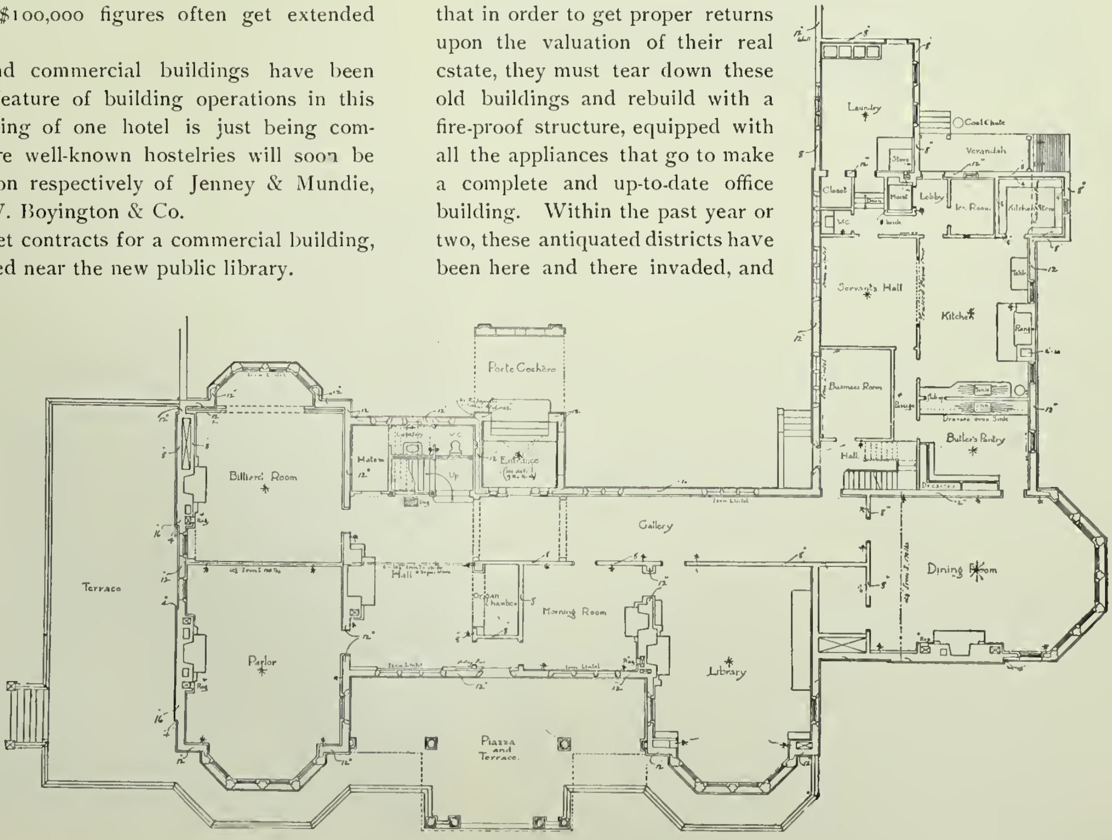
The one building project which interests the general public in Chicago is the Post-Office Building. The old one did finally disappear, and now the site is a desert waste — a lonely looking excavation a block square, surrounded by a dense business population. A contract has just been let, however, to McArthur Brothers, some $235,000 in amount for foundation work, and they will begin soon to drive piles.

The old post-office had continuous foundations of heavy concrete so well built that they had to be blasted out. They rested on a bog, however, and the unequal loading caused serious trouble. The foundations of the new building are not to be of the isolated type, but, like those of the public library, where the consulting engineer was the same, Mr. Sooy Smith, will be piles. They are to be of Norway pine, and the contract requires that they be driven to bed rock 103 ft. below the street level.

Some two hundred thousand, more or less, Chicago bicyclers are beginning to pay their $1 each for license tags, in pursuance of a recent ordinance. The architects have not as yet begun to pay their $50 apiece for their license tags, in accordance with the new State law.

The Pioneer Fire-proof Construction Company lately lost one of their factories by fire. This may have been a satirical joke on the part of the little red devils, but we are pleased to know that the company's business will not be seriously interfered with.

BOSTON.—While there is not a great deal in sight at the present time in the way of new building operations, yet there is every reason to believe that Boston is on the eve of a very active period in this respect. Real estate owners are beginning to feel the demand on the part of their tenants for better accommodations, and the old-time buildings are fast being vacated because of the decided preference given to modern structures by the majority of business men renting offices. It is doubtful if any of the other large cities have as large a proportion of antiquated buildings located on valuable business sites as has Boston. The commercial heart of the city is largely made up of just such structures, varying in age from forty years upward. It is now becoming evident to the owners of such property that in order to get proper returns upon the valuation of their real estate, they must tear down these old buildings and rebuild with a fire-proof structure, equipped with all the appliances that go to make a complete and up-to-date office building. Within the past year or two, these antiquated districts have been here and there invaded, and



FIRST FLOOR PLAN, RESIDENCE AT MADISON, N. J.
Clinton & Russell, Architects.

modern buildings of attractive appearance have been, or are now being erected, which, by force of contrast, make the old structures less desirable than ever. The effect of this will, we believe, be soon evinced by a general rebuilding of these localities, especially now that the improvement in business conditions warrants investors in going ahead with enterprises of this nature.

RESIDENCE, WOODLAWN AVE., COLUMBUS, OHIO.
H. A. Linthwaite, Architect.
Built of Gray Roman Brick, manufactured by the Columbus Brick & Terra-Cotta Company.

The erection of the South Union Terminal Station along the lines of Summer and Federal Streets greatly increases the valuation of property in that section, and, to some extent at least, will alter the character of business on the streets mentioned, and also in the immediate neighborhood of the station. Owners of real estate on the line of Summer Street anticipate that their properties will become valuable sites for retail establishments, and should this prove true, it will cause, within the next few years, a general rebuilding of that street.

Work on the station itself is rapidly progressing, and notwithstanding the many unforeseen obstacles encountered, the contractors are already ahead of their contract. Superintendent Clark states that they will doubtless begin to lay front brick on the main building at the Summer Street corner by the middle of September. Unless something unforeseen occurs, there is little doubt but that the station will be ready for occupancy by the fall of 1898.

Among the new buildings, either now under process of construction, or on which work will be shortly begun, may be mentioned the following: —

The Jeweller's Exchange (office and retail store building) situated at the corner of Bromfield and Washington Streets, Winslow & Wetherell, architects; Fuller Construction Company, of Chicago, contractors; to be constructed of brick and terra-cotta. The Russia Building (mercantile), Atlantic Avenue and Congress Streets, Peabody & Stearns, architects; C. Everett Clark, contractor; to be constructed of brick. Converse Building (office building), Pearl and Milk Streets, Winslow & Wetherell, architects; L. P. Soule & Son, contractors; to be constructed of brick and terra-cotta. Paul Revere School Building, Peabody & Stearns, architects; W. S. Sampson & Son, contractors; to be constructed of mottled brick and gray terra-cotta. Bath-house for the city of Boston, Peabody & Stearns, architects, James Fagan, contractor; to be constructed of mottled brick and gray terra-cotta. Brookline Real Estate Trust Building (a $250,000 fire-proof apartment hotel) at Brookline, Winslow & Wetherell, architects; T. S. Robbins, Worcester, Mass., contractor; to be constructed of brick and terra-cotta. St. John Parish Church, East Boston, Martin & Hall, architects, Providence, R. I.; W. L. Clark & Co., contractors; to be constructed of brick and terra-cotta. Cambridge Savings Bank Building, Cambridge, Mass., C. H. Blackall, architect; Norcross & Cleveland, contractors; to be constructed of brick and terra-cotta. Puffer Building (mercantile), Harrison Avenue and Essex Street, Rand & Taylor, Kendall & Stevens, architects; to be constructed of terra-cotta and limestone. Solid terra-cotta front above the second story. Masonic Temple, Boylston and Tremont Streets, Loring & Phipps, architects. Fire-proof building; to be constructed of brick. $200,000 apartment hotel, Brookline, Mass., E. D. Ryerson, architect; to be constructed of brick and stone. $630,000 apartment block, Back Bay, Henry E. Grieger and John Addison, architects, Chicago; to be constructed of brick and terra-cotta. Residence for Earnest W. Bowditch, at Milton, Mass., architects, McKim, Mead & White; C. Everett Clark, contractor; to be constructed of brick. $150,000 dormitory, Cambridge, Mass., Coolidge & Wright, architects; to be constructed of brick; fire-proof building. $120,000 apartment hotel, Back Bay, Charles E. Park, architect; to be constructed of brick. $60,000 schoolhouse, Somerville, Mass., Aaron H. Gould, architect; to be constructed of brick. $130,000 apartment hotel, Back Bay, H. B. Ball, architect; to be constructed of brick. $500,000 office building, corner Somerset and Beacon Streets, Boston; Congregational Publishing Club, owners: Shepley, Rutan & Coolidge, architects; to be constructed of stone. New brewery for the Puritan Brewing Company, Charlestown, Mass., Hettinger & Hartman, archi-

BRICK AND TERRA-COTTA RESIDENCE, PITTSBURG, PA.
Beezer Bros., Architects.

tects; Mack Brothers, of Salem, contractors; to be constructed of red brick. $150,000 addition to the Insane Hospital, at Worcester, Mass., Fuller, Delano & Frost, architects, Worcester; to be constructed of

CARTOUCHE PANEL, NEW YORK AND NEW JERSEY TELEPHONE BUILDING, BROOKLYN, NEW YORK.
R. L. Daus, Architect.
Executed by the Perth Amboy Terra-Cotta Company.

brick and stone. $30,000 church, Exeter, N. H., Cram, Wentworth & Goodhue, architects. Revere town hall, Revere, Mass., Greenleaf & Cobb, architects; W. L. Clark & Co., contractors; to be constructed of red brick and gray terra-cotta.

ST. LOUIS. — The report of the Commissioner of Public Buildings for the last month shows an increase in the number of permits issued, and also for a better class of buildings. This, for one of the dullest months in the year, affords considerable encouragement, and the feeling seems quite general that there will be a steady improvement in business throughout the year.

The most important happening in this part of the architectural world of late, perhaps, has been the competition for the St. Louis Club. A short time ago the club, becoming dissatisfied with their present location at 29th and Locust Streets, which is a most interesting piece of Romanesque work, by Peabody & Stearns, selected a site on Lindell Boulevard, which extends through to Olive Street.

Architects Eames & Young, M. P. McArdle, and Shepley, Rutan & Coolidge, of this city, and Arthur J. Dillon, of New York, were invited to submit plans, and Mr. Dillon's plans were selected. The design is in the French Renaissance, two story and attic high. On Olive Street an entrance and gate lodge will add to the attractiveness of the surroundings. Some comment has been made concerning the action of the committee in selecting Mr. Dillon's plans, as 'tis said the instructions were that the building should be designed in the Italian Renaissance, but it seems by the employment of the French style, and the placing of the banquet hall in the high roof, the architect was enabled to get the required amount of space with a very much reduced cubic area, which, doubtless, influenced the committee very materially in their decision. The building is expected to cost between $125,000 and $150,000.

During the past three years quite a number of schemes have been in contemplation for the improvement of the northeast corner of Olive and Sixth Streets, which have taken more or less definite form, but eventually fell through, and the last proposition, which was to build a sixteen-story office building, and for which a permit was taken out before the ordinance, limiting the height of buildings, went into effect, seems to have shared the fate of all others after the old buildings had been partially wrecked.

Shepley, Rutan & Coolidge are preparing plans for a nine-story fire-proof building, to be built on the southeast corner of St. Charles

TERRA-COTTA PANEL, RESIDENCE, BROAD STREET, PHILADELPHIA, PA.
Hazelhurst & Huckel, Architects.
Executed by the Conkling, Armstrong Terra-Cotta Company.

and Tenth Streets, for the Imperial Lighting Company. The lower floors are to be used for the machinery, and the upper floors for offices.

PITTSBURG.— Activity in the building line has been very brisk the past month, and much more work is looked for in the near future. Most of the new work is in the East End, consisting mainly of first-class residences and several good churches. Architect W. A. Thomas is preparing plans for a fifteen-room buff brick colonial residence on Fifth and Shady Avenues, also a twelve-room brick dwelling on Rebecca Street, for Mrs. R. Davis.

Architect E. B. Milligan is preparing plans for two brick dwellings in the East End for Reed B. Coyle, Esq., one a fifteen and the other an eleven-room building; also two brick dwellings for Dr. Connell, at Oakland.

Architect E. M. Butz is preparing plans for a $20,000 colonial dwelling on Wightman Street, for Colonel Robinson.

Architect T. D. Evans has prepared plans for four brick dwellings, to be erected on Elgin near Highland Avenue, for Jno. Fite, Esq.

Architects Alden & Harlow have closed the contract for the erection of a two-story brick resi-

TERRA-COTTA DETAIL, OFFICE BUILDING, WALL STREET, NEW YORK CITY.
Jardine, Kent & Jardine, Architects.
Executed by the New Jersey Terra-Cotta Company.

dence for J. C. Jennings, Esq., Fifth Avenue and Lilac Street, to cost $20,000.

Architects Struthers & Hannah are preparing plans for a brick military drill hall for Grove City College.

Architects Rutan & Russell have prepared plans for a warehouse for the Hayes estate, to be erected on Liberty Street.

Architect Charles Bickel is preparing plans for a five-story apartment building.

Architect L. H. Raisig is preparing plans for a row of store and apartment buildings, to be erected at Homestead, for Dr. McCaslin, of that place.

IMPOST CAP, ENTRANCE BOHEMIAN CLUB, NEW YORK CITY.
Julius Franke, Architect.
Executed by the Excelsior Terra-Cotta Company.

A NEW SIDEWALK LIGHT.

A DESIGN for a new sidewalk vault light has been gotten out by the American Mason Safety Tread Company, whose non-slipping specialty has now become so well known among architects. The new light, of which a cut is given in the advertising columns of THE BRICKBUILDER, page xxxvi, this month, seems to be, in many of its features, an advance over any now in use. In the first place, its surface is protected by strips of lead under the Mason patent against the possibility of becoming slippery, a very distinct improvement, when the cost and annoyance of the iron pegs usually used is considered, and that in a busy place they wear so rapidly that they require to be renewed frequently. The lead strips are sufficiently near together to furnish absolute security against slipping, and experience has shown that even rain or light snow does not neutralize this advantage. The largest lighting area consistent with strength is given, and to secure the glasses against breakage by the action of frost, they are set with a special lead cement. It is the purpose of the company to furnish the best and safest light possible to be made, and the enterprise will surely enlist the interest of architects, who have long been conscious of the imperfections of the light now used. The company will send a full-size blue print on application.

WITH THE BUSY.

T. W. CARMICHAEL claims to have invented a clay screen which has two or three times the capacity of any screen on the market.

TERRA-COTTA DETAIL, BANK BUILDING, DOYLESTOWN, PA.
Baker & Dallett, Architects.
Executed by the Conkling, Armstrong Terra-Cotta Company.

O. W. PETERSON & Co., Boston, Mass., are furnishing the brick on the Robinson Street School, Dorchester, Mass., A. Warren Gould, architect; also on the Registry of Deeds Building, Cambridge, Mass., Olin W. Cutter, architect.

CHAMBERS BROTHERS COMPANY, Philadelphia, report a very gratifying interest in their exhibit of brick-making machinery on the part of visitors to the Tennessee Centennial, at Nashville, and state that they have already pocketed some orders as an indirect result of this exhibit.

T. W. CARMICHAEL, Wellsburg, W. Va., has shipped the fourteenth clay steamer for this season. The last shipment was to Christiania, Norway, in response to an order by cablegram.

RUFUS E. EGGLESTON, Philadelphia, has just closed a contract for the furnishing of the Gale Automatic Sash Locks and the Bolles Revolving Windows in the new building for the Bell Telephone Company of that city, 11th and Filbert Streets; Charles McCaul, builder.

CELADON ROOFING TILES, Charles T. Harris, lessee, have been specified for the following: —

Residence for T. B. Crary, Binghamton, N. Y. Residence for G. W. Griswold, Hornellsville, N. Y. Home for the I. O. O. F., Springfield, O., Yost & Packard, architects.

BEST BROTHERS' Keene's cement (for which Fiske, Homes & Co., Boston, are exclusive agents) has been specified for over fifty apartment houses, business blocks, and residences now being erected, and about one hundred having been plastered either wholly or partially with it during the past eighteen months.

THE new Houghton & Dutton building on Tremont Street and Pemberton Square, Boston, is being supplied with white mottled brick, manufactured at Fiske, Homes & Co.'s factory, South Boston. The architectural terra-cotta and the fire-proofing, and the lime and cement are also being furnished by them.

CONTRACTS have been closed for placing the Bolles Sliding and Revolving Sash in Dr. Kelly's Hospital, and an office building, corner Lexington and Davis Streets, Baltimore, also in a large residence in Hagerstown. The warehouse of George Blome & Son will be fully equipped with these improved sashes within the next month.

THE ZANESVILLE MOSAIC TILE COMPANY, of Zanesville, Ohio, are furnishing, through their Boston agents, O. W. Peterson & Co., the tiles for the apartment house of A. Bilafsky, on Beacon Street. The tiles will be used in twenty-four bathrooms, seventy-two fire-places, and in the main halls and vestibules.

THE PERTH AMBOY TERRA-COTTA COMPANY have recently closed the following contracts for architectural terra-cotta: —

Church and Clergy House, 88th Street, between First and Second Avenues, New York, N. Y., Messrs. Barney & Chapman, of New York City, architects. New York Telephone Building, 30, 32, and 34 Gold Street, New York, N. Y., Mr. Cyrus L. W. Eidlitz, of New York City, architect. Addition to Crotona Park Public Building, Crotona Park, N. Y., Mr. George B. Post, of New York City, architect.

The New Jersey Terra-Cotta Company, of New York, have secured through G. R. Twichell & Co., Boston, their New England agents, the contract to supply the terra-cotta on the Brewer Building, Worcester, Mass. George H. Clemence, architect, Worcester. Norcross & Cleveland, contractors, Boston. Terra-cotta to be of a salmon shade.

The Cummings Cement Company, with works of enormous capacity at Akron, N. Y., are running one quarter overtime, in an endeavor to keep pace with the rapidly increasing demand for its rock and Portland cements, the larger share of which is being used for street paving in Buffalo and other large cities in New York and Pennsylvania.

The Hydraulic Press Brick Company, St. Louis, have just secured a contract for over three hundred thousand enameled bricks for the interior of the Burlington depot at Omaha, Neb. They are also putting on the market a white face brick with a surface that is impervious, and when soiled can be cleaned with soap and water. The surface is not glazed.

The Excelsior Terra-Cotta Company, through their Boston representative, Charles Beacon, have closed the following contracts for architectural terra-cotta: Converse Building, Boston; Winslow & Wetherell, architects; L. P. Soule & Son, builders. Cambridge Savings Bank, Cambridge, Mass; C. H. Blackall, architect; Norcross & Cleveland, builders.

Messrs. Frank Sears, of New York, and Charles B. Sears, of Chicago, formerly managers of the business of the late James Brand, in association with Mr. Wm. S. Humbert, of Buffalo, N. Y., will continue in that long-established business, under the style of Sears, Humbert & Co., with offices in New York City, Buffalo, and Chicago. The new firm will continue the importation of the La Farge, Josson, and Burham Portland cements, and will, besides, represent the American Cement Company in the West.

The Powhatan Clay Manufacturing Company's bricks are now being used in the store and loft building at 39th Street and Fifth Avenue, business building at Forsyth and Hester Streets, flats at 143d Street and Seventh Avenue, interior of laundry of St. Joseph's Orphan Asylum, 401 E. 89th Street, all of New York City.

They have recently closed the contracts for the kindergarten at Rivington and Cannon Streets, flats on 117th Street, near Lenox Avenue, and the business building at 590 Broadway, New York City.

In all of the above the brick is their cream white.

The Eastern Hydraulic Press-Brick Company have recently furnished their iron-spot bricks for lining the interior of one of the handsomest churches in Rochester, N. Y.,— St. Paul's Episcopal. They are also just completing a contract for furnishing their gold-colored bricks for lining the interior of the St. Stephen's Episcopal Church, at Wilkesbarre, Penn. Those who have seen the effect pronounce it beautiful, and, as it is somewhat of a departure, it will be of interest to our readers, and should lead to an increased use of light-colored bricks for the interior of churches and other large public buildings.

Conkling, Armstrong Terra-Cotta Company, through their New England agent, Charles E. Willard, have secured the contract to supply the terra-cotta for Times Building, Hartford, Conn., George B. Rogers, architect; the St. Anne Church, Somerville, Mass., Keeley & Houghton, architects, Brooklyn, N. Y., S. Brennan & Co., contractors; the A. D. Puffer Building, 1651 Washington Street, Boston, A. H. Nelson, architect; the Paul Revere School, Boston, Peabody & Stearns, architects; the Revere Town Hall, Greenleaf & Cobb, architects; and the new building for the Puritan Brewing Company, Charlestown, Mass., Hettinger & Hartmann, architects.

Chicago Terra-Cotta Roofing and Siding Tile Company report the following buildings completed last month, on which their goods were used for roofing: —

Residence, Buffalo, N. Y., Swan & Faulkner, architects, French tile. Residence, Titusville, Pa., C. W. Terry, architect, Oil City, Pa., small Spanish. Residence, Calumet Avenue, Chicago, S. B. Eisendrath, architect, French tile. Apartment Building, Wright Street, Chicago, Anderson & Gelin, architects, French tile. Residence, Douglas Boulevard, Chicago, Burtar & Gassman, architects, small Spanish. Memorial Church, Wheeling, W. Va., Franzheim, Giesey & Faris, architects, Spanish. Residence, Key West, Fla., large Spanish tile. Residence, St. Louis, A. M. Baker, architect.

Mr. Ross F. Tucker, the Manager of the Manhattan Concrete Company, has been awarded the contract for completing the several splendid buildings at the University of Virginia, of which Messrs. McKim, Mead & White are the architects. The Manhattan Concrete Company has a large contract for elaborate ornamental concrete on these buildings. The Manhattan Concrete Company has just finished a large contract on the Mills Houses, Bleeker, Sullivan, and Thompson Streets, New York, Ernest Flagg, architect. The work covered under this contract consisted of all floors and roof, 149,000 sq. ft. These floors were built for the most part in cold weather last winter, without the loss of a single foot. All floors throughout were finished with "Granitoid" similar to that being put down by this company on Boston Common, but of finer texture. The basement areas are lighted by the Manhattan Vault Light, a very superior and excellent construction. The building as a whole is a fine example of what can be done with concrete when properly used.

Sayre & Fisher Company, through their Boston representative, Charles Bacon, have closed the following contracts for supplying bricks.

Revere Beach Bathing Establishment, Revere, Mass.; pink brick and enamel; Stickney & Austin, architects, W. T. Eaton, contractor.

Real Estate & Trust Company Building, Atlantic Ave., Boston, mottled brick (gray); Peabody & Stearns, architects, C. E. Clark & Whitney, contractors.

West End Power House, Cambridge, Mass., white enameled brick; W. E. Whidden & Co., contractors.

Converse Building, Milk Street, pink brick; Winslow & Wetherell, architects, L. P. Soule & Son, contractors.

Cambridge Savings Bank, Cambridge, gray brick; C. H. Blackall, architect, Norcross & Cleveland, contractors.

Apartment house, Brookline, mottled brick; C. E. Dark, architect, E. F. Staples, contractor.

White Building, Boylston Street, white enameled; Winslow & Wetherell, architects, L. P. Soule & Son, contractors.

Massachusetts Historical Society, Fenway, Boston; Wheelright & Haven, architects, L. D. Wolcutt & Son, contractors.

Messrs. Fiske, Homes & Co., Boston, report a satisfactory business in their brick specialties. The following schoolhouse buildings are being supplied: —

Springfield, Mass., high school, Hartwell, Richardson & Driver, architects. Melrose, Mass., high school, Tristram Griffin, architect. Cambridge, Mass., normal school, Hartwell, Richardson & Driver, architects. Marlboro, Mass., high school, C. E. Barnes & Co., architects. Hartford, Conn., grammar school, C. W. Brocklesby, architect. Gardner, Mass., grammar school, Barker & Nourse, architects. North Adams, Mass., grammar school. Newton, Mass., high school, Hartwell, Richardson & Driver, architects. All taking approximately 1,500,000 bricks.

Among the smaller orders booked are: —

Block of apartment houses, Blackwood Street, Boston; 40,000 bricks. Large apartment houses, Mountford Street, Boston; 75,000 bricks. Large apartment houses, Copeland and Warren Streets, Roxbury; 75,000 bricks. Apartment house, Forest Street and Mt. Pleasant Avenue, Roxbury; 25,000 bricks. Apartment house, Ruggles Street, Roxbury; 75,000 bricks. Block of apartment houses, Batavia Street, Boston; 60,000 bricks. Block of apartment houses, St. Germain Street, Boston; 55,000 bricks. Two business blocks, Haverhill, Mass., 25,000.

The Cleveland, O., *Leader*, says: —

"Vitrified shale clay glazed is being successfully used as cattle guards on the Cleveland, Canton & Southern Railroad. The new material being stable, durable, and inexpensive will likely be adopted universally, not immediately, but gradually. Railroad officials have found cattle guards made of wood or metal unsatisfactory, it is said, for several reasons. It has been found necessary to replace the old-fashioned protectors frequently, and careful watching is required to keep them in repair and in position.

"About a year ago the Cleveland, Canton & Southern Company experimented with the vitrified shale clay guards, and the success that has attended their use has induced the management to adopt them on all parts of the line. Railroad officers state that the new invention promises to supersede the systems now in use, many advantages being claimed for the glazed vitrified shale clay. It is said to be less expensive than wood, and to cost about a fifth what iron guards cost, a feature which is advantageous in these days of economical railroading. The guard is composed of short sections fastened together with iron rods if desirable, but this is not considered necessary. Being glazed they do not need painting, and rains and winds keep them clean. The manufacturers of the guards have decided not to build a factory, but to send dies to a brickyard near where the order goes, thus saving transportation charges. It is claimed that almost any brickyard can make them when furnished the dies. The manufacturers are Cleveland and Canton men."

These guards are made on the machines of The American Clay-Working Machinery Company, of Bucyrus.

TREASURY DEPARTMENT, Office Supervising Architect, Washington, D. C., July 8, 1897. SEALED PROPOSALS will be received at this office until 2 o'clock P. M. on the tenth day of August, 1897, and opened immediately thereafter, for all the labor and materials required for the erection and completion (except heating apparatus, vault doors, and tower clock), of the United States Post-Office, etc., building at Paterson, N. J., in accordance with the drawings and specification, copies of which may be had at this office or the office of the superintendent, at Paterson, N. J. Each bid must be accompanied by a certified check for a sum not less than two per cent. of the amount of the proposal. The right is reserved to reject any or all bids, and to waive any defect or informality in any bid, should it be deemed in the interest of the Government to do so. All proposals received after the time stated for opening will be returned to the bidders. CHAS. E. KEMPER, Acting Supervising Architect.

INDEX TO ADVERTISEMENTS.

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Is superior to any other Portland cement made. It is very finely ground, always uniform and reliable, and of such extraordinary strength that it will permit the addition of 25 per cent. more sand, etc., than other well-known Portland cements, and produce the most durable work. It is unalterable in volume and not liable to crack.

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It must be acknowledged that the author has carried out the work in a clear and systematic manner, and in addition to his own experiments has made use of the German work relating to the subject. The descriptions of clay masses and glazes are judicious and give in a few strokes a characteristic outline, so that the entire work must be considered very instructive. The reading matter of the book, which is free from bombast and is distinguished by solid knowledge of the subject matter, may be cordially commended. — *Chemiker Zeitung.*

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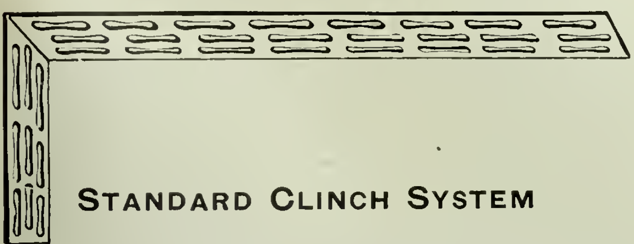

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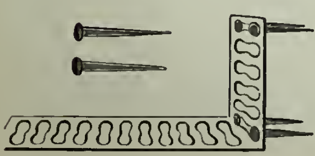

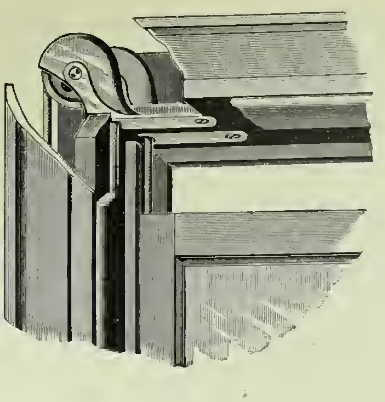

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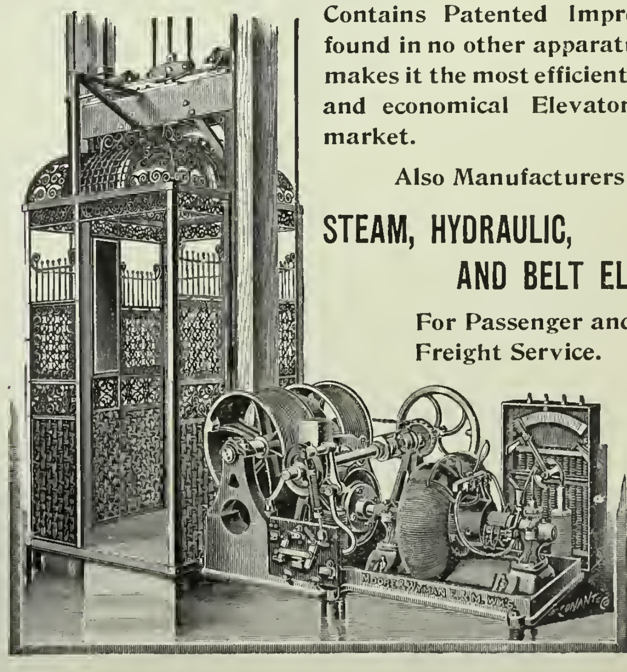

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VOLVME VI SEPT. 1897 No. 9

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.

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THE REASONABLE PRINCIPLES OF ARCHITECTURAL COMPETITION.

THERE are four issues of primary importance which must be considered in defining a good architectural competition. The first point is the legal validity of the contract between the competing architects and the owner. Second, the financial considerations of this contract. Third, the considerations other than those purely financial. Fourth, the clear subordination of either the cost to the accommodation, or the accommodation to the cost.

FIRST: THE COMPETITION AGREEMENT SHOULD BE A DOCUMENT VALID IN THE COURTS.

We recognize two distinct kinds of architectural competition: limited competitions, in which the owner invites a limited number of architects to compete; and open competitions, in which all architects are free to enter at their own option.

These two sorts of competition may be variously combined or modified; but whatever form a competition may take, the relation existing between competitors and owner is first, last, and always a *business* relation. Its purpose is an exchange of goods or services to the profit of both parties. It is not profitable to an owner if a competition results in furnishing him with a lot of plans of no real service to him, nor is it profitable to architects to run this part of their business at an average loss. *Only those forms of competition are profitable which rest upon a sound business basis, and which bring an equal benefit to both sides.* This being granted, it follows that these benefits should be legally assured to both parties to the contract.

Important competition agreements should be tentatively drawn and submitted to the inspection of legal council on both sides; and especially should architects refrain from accepting such agreements until the documents have received such scrutiny. This reform must be effected through the machinery of their professional organizations.

The competition agreement or contract cannot be valid unless, first, the parties issuing it are empowered by law to fulfil it in all respects; and second, unless it be so drawn as to leave no legal uncertainty as to its meaning. The more terse the document the better. The word "shall" should be regarded with the highest suspicion.

SECOND: THE FINANCIAL CONSIDERATIONS OF THE COMPETITION AGREEMENT.

If an architect conducts his office with reasonable economy, he should make as net profit about one half his gross receipts. The usual payment for services being 5 per cent. of the total cost of the building, any one piece of work would bring him on an average a profit of 2½ per cent. of its cost. When, therefore, the award of the commission to design and erect a certain building is the declared aim of a competition, this 2½ per cent. of its cost is the money prize for which architects compete.

Now, before architects can fix a price for their services for entering into competition, they must know whether this prize is assured to one of the competitors, or not. What is necessary is a definite statement which can be legally maintained one way or the other. In most cases where competitions are held the erection of a building has been definitely decided upon, and it is a very remote contingency that may prevent its erection. The only appreciable danger, therefore, in announcing the commission for the building as the prize of the competition is that no one of the competitors will prove a suitable person to design and erect it. This danger is absolutely avoided by having a limited competition to which only capable architects are invited; but, inasmuch as even with excellent competitors there is a remote possibility that something may cause the abandonment, or essential modification of the owner's intention, a mode of liquidating his indebtedness to the winning architect should be provided in the competition contract, and this, of course, would be the payment to the winning architect of 2½ per cent. on the proposed cost of the building, the money equivalent of the commission.

If, then, a competition agreement guarantees the prize of the competition to be the award of the building or the payment of 2½ per cent. of its proposed cost, the architect has a definite business proposition upon which to base the price of his services. Whether this price be low or high will next depend largely upon the following considerations.

An architect's chance of winning a competition depends, first of all, upon his ability, and second, upon the number of contestants in the competition. Exceptional ability always has its premiums, and is exempt from ordinary rules; but the great majority which constitutes the average man must recognize their force and conform to them. They must obey the law of averages, or violate them at their own risk.

Now, suppose a competition to which five men are invited. By the law of averages each man has but one chance in five of winning that competition, and in a round of five such competitions he stands to lose four times and win once. As we found above, the net profit of a $300,000 building is 2½ per cent. on its cost, or, $7,500. This is clear gain. In competitions of five contestants for such a building each architect therefore stands to win $7,500, minus the loss to him of preparing four different sets of unused sketches. The normal value of each of these sets of sketches is 1 per cent., or $3,000, according to the schedule of the American Institute of Architects. Half of this amount is reckoned as the cost of the drawings, half as profit. *Profit, however, is only another name for the payment made to the architect for his own individual services.* The profit for a year represents what he personally earns in a year, just as the laborer's income is the sum of his total wages. If the laborer did his day's work and was denied payment for it, his case would be the same as that of the architect who made competition sketches and was paid only the "cost" of them. The architect loses as clearly in that case as the laborer when his day's wages are withheld.

Accordingly, if an architect, acting upon the suggestion of certain leading members of his profession in New York, decides that otherwise proper competitions may be accepted when payment of cost alone is made for sketches, he is then doing that work at the loss of his own individual wages, which, in the instance taken, amount to $1,500. His total losses in a round of five competitions would be four times $1,500, or $6,000. His total winning, the profit of the full commission for the building, would be $7,500. This, therefore, leaves him a saving of $1,500, *or one half of 1 per cent. on the cost of the building, as his entire profit on work which normally brings a profit of 4½ per cent.;* namely, four different sets of competition sketches at 1 per cent. each and one full commission at 5 per cent. This, clearly, is a very narrow margin of profit, yet it is sufficient to permit us technically to define a competition on this basis as profitable.

When, however, the number of contestants varies from that taken in the previous example, different results are found. In competitions of ten contestants the architect stands to lose nine times and win once. Computing as above, his losses in ten such competitions would be nine times $1,500, or $13,500, while his one winning brings him in but $7,500, making a total loss of $6,000 if he should enter ten such competitions.

Equally, when the move is in the other direction and the number of contestants is lessened, the architect stands to increase his margin of profit. In competitions of only two, where each contestant should win one effort in two, the loss would be only $1,500, to a gain of $7,500, leaving a profit of $6,000 on a round of two competitions.

The following is a summary of what each architect stands to win or lose in competitions comprising up to ten competitors for a $300,000 building, when the commission, or an equivalent payment, is guaranteed, and each competitor is paid one half of 1 per cent. as the cost of his competition sketches.

No. of competitors.	Each receives in one round of competitions.		Each loses in one round of competitions.		Difference between receipts and losses.		Number of competitions in one round.		Each stands to win or lose in each competition.
2	$7,500	minus	$1,500	equals	$6,000	divided by	2	equals	$3,000
3	7,500	"	3,000	"	4,500	"	3	"	1,500
4	7,500	"	4,500	"	3,000	"	4	"	750
5	7,500	"	6,000	"	1,500	"	5	"	300
6	7,500	"	7,500	"	0	"	6	"	0
7	7,500	"	9,000	"	—1,500	"	7	"	—214
8	7,500	"	10,500	"	—3,000	"	8	"	—375
9	7,500	"	12,000	"	—4,500	"	9	"	—500
10	7,500	"	13,500	"	—6,000	"	10	"	—600

The deductions from this investigation are of the greatest importance, and may be worked out by the owner and the architect as their interests impel them. Certainly it is very clear why it is the owner's interest to keep the number of contestants as small as possible, and to select only architects of the highest ability.

We are also prepared to understand why open competitions are not deemed profitable by architects; for if, as in the above example, a single limited competition of ten contestants with the award of the building guaranteed, and each competitor paid the cost of drawings, means an average loss of $600 to each of those who enter it, it is not reasonable to suppose that architects of standing and intelligence will enter competitions where the individual recompense is not assured at all, and where the number of contestants is entirely unlimited.

THIRD: CONSIDERATIONS OF THE COMPETITION AGREEMENT WHICH ARE OTHER THAN FINANCIAL.

All the advantage that an architect receives in entering into competition is not financial. Otherwise there would be no such discounting of the price of services as is now usual. His greatest inducement, after the financial one, is the ambition of every architect to erect important buildings. It makes a great difference, therefore, to an architect already in good practise, whether the erection of the building is assured or not. The chances of losing the building through the selection of one of the other competitors, when multiplied by the chances of the owner's withdrawing the building altogether, forms too great a hazard for him to consider in cases where the erection of the building is not guaranteed. Guaranteeing the erection of the building, therefore, presents an inducement over and above the merely monetary security it gives, and constitutes a consideration which owners cannot fail to regard.

Another consideration of the greatest importance is the assurance of just dealing between competitors. The knowledge of the owner's integrity and right of intention does not of itself offer this assurance. It is not the lack of right intentions that wrecks competitions, but the blunders of men unaccustomed to the task of directing them. Architectural competition is not at its best unless it is so conducted as to give free play to the contestants' spirit of emulation. In this respect it is like all sports which aim at the highest attainment of the individual. Such forms of emulative competition must be conducted under rules very different in nature from those which govern in the courts of law. The rules which govern the sports may often seem absurdly technical to the non-sportsman, yet they are evolved by long practise, and are essential to the moral health of the sports conducted under them, quite as much as the laws of our courts are essential to the social safety of the community; but the difference between them is a very essential one. The law of the courts obliges a plaintiff to prove his injury, as well as the facts alleged. The law of sports makes the fact and the injury identical. It is not necessary for a yacht to prove that she has been injured in a collision brought about through the fault of another boat to claim a foul and its penalty, nor need she show a loss if forced off her course improperly. The penalty attaches to the fact of interference, and the question of the amount of injury caused by that interference, or of intention, which forms so large an issue in the courts of law, is not considered. A blunder is a crime, and is punished as such.

Additional instances might be set forth at length, showing conclusively that in all those fields of competition where the highest perfection of individual attainment is sought, the law sanctioned by experience absolutely safeguards the interests of those who maintain the rules set down, and as absolutely condemns those who break them. The rules themselves thereby come to have an importance appreciated only by those who have watched their long application, and have learned their necessity. It matters not so much what the rules may be as that their integrity be maintained. Otherwise there is no assured freedom for any, and the best conditions to enthusiastic effort are lacking.

The rules which govern competitions should therefore be as few and as distinctly stated as possible, and the restraints imposed of a kind which leave free the best faculties of the competitor. The penalty for an infringement of these rules must be the instant, final, and unequivocal disbarment of the transgressor. These rules can only be drawn up by one who has devoted time and thought to the science of conducting architectural competitions.

Still another consideration valued by architects is the knowledge that their plans are to receive the judgment of one able to appreciate their finer shades of excellence, and a reasonable assurance that the opinion of such a judge will be an important factor in determining the award.

FOURTH: RELATIVE DEMANDS REGARDING COST AND ACCOMMODATIONS.

There is yet another most important consideration, which appears to have hitherto been very largely overlooked. We refer to the habit of stating in competition programs in an absolute way both the accommodations of the building, and its limit of cost. This arbitrary method defeats its own end. The architect is not omniscient, and cannot possibly arrive at any right estimate of what it will cost to meet the given conditions until his sketches are made, and the time for sending them in is close at hand. The competition cannot then be declared closed upon his representations and new instructions issued. It is too late. The drawings go in and disaster follows. All drawings are declared rejected because none fall within the limit of cost. Whose fault is it? It is hard to say.

Surely no architect should be so silly and no committee so fatuous as to believe that absolute statements of cost and absolute statements of accommodation, size, materials, etc., can be unchangeably determined before plans are made, *for it is precisely to determine the relation of these two things that the architect makes his drawings.*

If the cost must be absolutely limited, it will pay the owner to let the architects exercise their intelligence in adjusting his desires to his pocketbook; but if, as in most buildings, the accommodations demanded are in reality the essential thing, it is certainly enough to state with emphasis that economy in meeting these demands will form an important issue in determining the award.

ROBERT D. ANDREWS.

THE recent International Congress of Architects, which was held in connection with the Brussels Exposition during the past month, has awakened considerable interest on the part of architects in this country and abroad; and although America was represented by but four delegates, if we are properly informed, out of a total attendance of about three hundred, the eminence of those participating in the deliberations of the congress and the ideas which were developed in the discussions have combined to give it a peculiar value. It is to be hoped that these international congresses may become more frequent. No country can live to itself in art any more than in anything else, and in these days when architecture is so essentially a matter of convention, tradition, and concurrent practise, no one can afford to neglect an opportunity to compare his standards with those of other countries, nor to ignore the achievements of foreign architects. The object of this congress was avowedly to bring about a better understanding of the practise of architecture in the various countries and to awaken the public to a better appreciation of architecture, and although the duration was short, only five days, the program was a very full and complete one. The language of the congress was French. Great credit is due to the Société Centrale d'Architecture for the admirable manner in which the congress was organized, the cordial reception and careful consideration for the comfort and pleasures of the members of the congress, and to Mr. Dumortier for his strong and efficient management during the entire session. The congress was informally opened on Saturday, August 29, by the King of Belgium, in person, and the succeeding days were taken up with discussion of architectural topics in the mornings, and delightful excursions to surrounding points of architectural interest in the afternoon. Aside from the business transacted, the one thing which was most worthy of note was the individual character of the distinguished delegates and the high personal esteem with which they were held. There were present not only architects, but statesmen, three members of the Institute of France, one deputy, one member of the Italian parliament, and several French representatives, besides others in political and municipal affairs from many countries. That Leopold, King of the Belgians, should have come up from Ostend specially to open the congress is sufficient proof of the high esteem in which our profession is held in foreign countries.

It is to be hoped that the next congress of architects, which is to be held in connection with the International Exhibition in Paris, in 1900, may be more fully attended by our countrymen. The architectural efforts of America are hardly appreciated at all in Europe outside of England. While our architecture has not the past to boast of, which is so valuable a factor in European art, our progress during the past two decades has been along lines of which we have every reason to be proud, and in an international congress of this description our delegates ought to be able both to give and receive. We are indebted to Mr. G. O. Totten, Jr., the official delegate from the United States Government, for a very complete and interesting account of the congress.

IN this connection it is intensely gratifying in every respect to note the spirit which has accompanied the growth of the T Square Club at Philadelphia, which from being an association of young and extremely enthusiastic draughtsmen, has developed into one of the leading architectural bodies of the country, certainly being foremost in the enthusiasm which is so essential to continued interest in architecture as a profession. The club has repeatedly put itself on record in a most emphatic way as being keenly alive to its own possibilities and the general good of the profession, and its history ought to be an example to all the other clubs and architectural societies throughout the country as showing the lines in which club work can be carried along so as to profit not only the members themselves, but to form a tangible force in the advancement of art in general and architecture in particular. The T Square Club is full of live, energetic men, including among its members the best talent of the Quaker city, and by its action of sending a properly accredited delegate to the Brussels Congress of Architects, it has shown its appreciation of the position which a society of this kind can occupy in relation to its growth. We lack in this country very strongly what the French term *esprit de corps*, and architects are so constantly accused of professional jealousy, and unfortunately there is so often good reason for the charge, that we sincerely hope that the spirit of the T Square Club may spread beyond the borders of Philadelphia. Mr. Kelsey, the delegate of the club, gave a very felicitous address in which he summed up the position of the T Square Club as being pre-eminently one whose attitude was to seek and study, and every one who has had the pleasure of reading his words will feel that in this instance the profession as a whole, as well as the T Square Club, was honored by the Philadelphia delegate.

PERSONAL AND CLUB NEWS.

MESSRS. O. A. KLUMANN and Charles I. Thomas, Wilkes-Barre, Penn., have associated themselves under the firm name of Klumann & Thomas for the practise of architecture. Catalogues and samples desired.

THE Chicago Architectural Club had its first meeting after vacation, on Monday evening, September 13.

"How to Make the Most of the Club's Privileges this Coming Season" was the subject for discussion; many of the leading members offering valuable suggestions which will no doubt materialize as the season advances.

THE second annual exhibition of the Cleveland Architectural Club will be held in the New England Building, from Nov. 15 to Nov. 27, 1897.

Works will be received until Monday, November 1.

The exhibition will include:—

Architectural sketches, perspectives, and elevations in all renderings; photographs of executed work; landscape architecture; interior architecture and decoration; interior furnishings (samples and sketches); architectural and decorative metal work (wrought iron, bronze, and brass); carving and sculpture (wood, stone, metal, or plaster); advertisers' exhibit (the latest novelties and improvements for modern buildings).

All drawings for the exhibition must be framed or mounted.

The Cleveland Club will pay all charges for the collecting, shipping, and returning of contributed works.

AT the first regular meeting held by the St. Louis Architectural Club after the vacation season, a general discussion of the proposed work for the winter brought out many interesting features, and considerable interest was manifest. All committees were instructed to bring in full reports at the next meeting, including a special committee which was appointed to look into the advisability of the club publishing the revised building ordinance.

Messrs. Bailey & Enders were appointed a committee to procure a suitable case for the medal which was awarded the "T" Square Club of Philadelphia some time ago, for the best club exhibit.

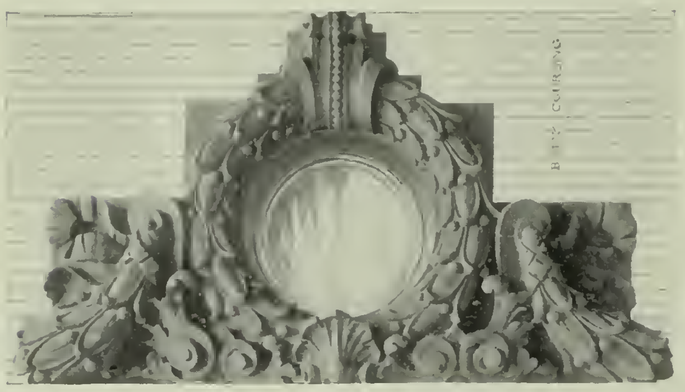
ILLUSTRATED ADVERTISEMENTS.

THE Excelsior Terra-Cotta Company illustrate, in their advertisement on page iv, the new Mechanics Bank Building, Brooklyn, N. Y.; George L. Morse, architect.

Fiske, Homes & Co. have illustrated on their advertising page (vii), number three of their new and especially prepared designs of brick and terra-cotta fireplace mantels.

On page viii, in the advertisement of the New Jersey Terra-cotta Company, is illustrated the new New Zealand Building, Broadway, New York City; Hoppin & Koen, architects.

A residence at Buffalo, N. Y., of which C. D. Swan was the



architect, is illustrated in the advertisement of the Harbison & Walker Company, on page xxv.

Two views of the Hall Memorial Chapel, Woodlawn, Chicago, W. A. Otis, architect, are shown in the advertisement of Charles T. Harris, Lessee, on page xxix.

The Gilbreth Seam-Face Granite Company, in their advertisement on page xxxviii, show a fireplace at Lenox, Mass., of which George T. Tilden was the architect.

PLATE ILLUSTRATIONS.

PLATES 73 and 74. Details of the upper stories of the Dun Building, now in course of erection on Broadway, corner of Reade Street, New York City; George Edward Harding & Gooch, architects.

The Broadway and Reade Street façades of this building are constructed of light brick and terra-cotta.

Plates 75 and 76. Details of the upper stories of the New Queen Insurance Company Building, Broadway, New York City; George Edward Harding & Gooch, architects. Like the Dun Building, this, too, is constructed of brick and terra cotta.

Plates 77, 78, 79, and 80. Dental Hall, University of Pennsylvania. The building, of which the exteriors and details only are given, is arranged in plan in two parallel parts connected by a staircase neck. The main portion is 50 ft. wide by 180 ft. long, the smaller wing is 48 by 85 ft.; these two are arranged on a central axis, and their difference in length accommodates itself to the lines of 33d Street and Locust Street, which intersect at an angle of about 50 degs. The larger building has its upper story devoted entirely to the operating room, in which are placed one hundred dental chairs. The back building contains an auditorium seating five hundred. The remainder of the floor space is given over to laboratories, examining rooms for patients, lecture rooms, students' assembly room, and quarters for the faculty and dean.

The structure is of slow-burning construction throughout with the exception of the roofs, where steel trusses are used. The heating is by steam and is supplemented by a special system of ventilation. Lighting throughout and power for operating the machinery of the laboratories is by electricity. These two are supplied from the main central heat and light station of the university. The exterior of the building is of brick laid in Flemish bond. The trimmings throughout are of terra-cotta, the roof of red tiles with cresting and lanterns of green copper.

THE legislature of Illinois having passed a law providing for the licensing of architects and the regulation of the practise of architecture, the governor has appointed the following named gentlemen to act on the Board of Examiners: Mr. Dankmar Adler, of Chicago, the president of the board; Mr. Peter B. Wight, of Chicago, the secretary; Mr. William Reeves, of Peoria; Prof. N. Clifford Ricker, of the University of Illinois; and Mr. William Zimmerman, of Chicago. The board has chosen a committee on examinations, consisting of the president, and secretary, and Mr. Reeves, and will soon be ready to enter upon the performance of its duties.

THE matter of licensing architects is receiving more or less serious consideration by the profession, and a committee of the institute has been appointed to investigate and report on the advisablity of adopting some such restriction. The most conservative opinion seems to be that the time has not yet arrived when such a plan could be carried out with sufficient thoroughness to be of any special value, either to the profession or the public. On the other hand, the fact remains that this matter is being agitated more or less by State and municipal governments, and that certain laws bearing on this question have been already passed in some places, which shows that within a comparatively short time the proposition must be met and settled in some way. Legislation affecting any profession should be controlled from within rather than from without, and while action may be temporarily deferred, the fact that certain restrictions, in many instances quite rigid, are now in force abroad shows plainly that some such measures are sure to be adopted sooner or later in this country, and also that it is important that the profession should keep the matter sufficiently well in hand to forestall any unreasonable action on the part of the law makers, who, when left to their own devices, are almost sure to impose some ill-considered and unjust measure. There appears to be a prejudice with some architects against the license idea, on the ground that it places them in an undignified and unprofessional position. But such objections can be easily disposed of by calling attention to the fact that both doctors and lawyers now practise under similar conditions to those under which it is proposed to place the architect.

AT a meeting of the Executive Committee of the T Square Club, held September 17, a series of resolutions was adopted condemning the action of the State Capitol Commission in violating their agreement with competing architects, and in disregarding the recommendation of their own experts and the warnings of the Governor. The sentiment of the club is clearly shown in the following resolutions:—

"*Resolved*, That the architectural profession, and the citizens of this Commonwealth, are warned that the evident intention of a majority of the Commission to select an architect without reference to the terms of the contract they have made is a public scandal which calls for immediate correction.

"*Resolved*, That this Club pledges itself to the distinguished and honorable Board of Experts to uphold them and the reputable element in the profession in their protest against the disgraceful action of the majority of the Commission."

Brick versus Wood. III.

BY R. CLIPSTON STURGIS.

IN the preceding articles I have touched upon the advisability of using brick from motives of economy and beauty, and its adaptability to all kinds of work and all localities. I wish now to take up, perhaps, the most important part of the subject. How can a better and more frequent use of brick be encouraged?

ENTRANCE COURT, COOMBE WARREN.
George Devey, Architect.

First, I think, by more diffused knowledge. People generally do not appreciate, what I have, perhaps lamely, tried to show, how beautiful and appropriate brick is. They should learn why wood should not be used for any building which lays claim to dignity or importance, even if it be but the dignity of that lowly place a home, because, being perishable, it does not, cannot fulfil the demands made on it by such a building.

Then, wood being set aside, they should learn that the material which, other things being equal, is nearest at hand and cheapest to use is in most cases the best. This material is generally brick; where stone is handier or cheaper, then use it.

Wood is justified only in two ways; either because it is the only material available, or because land must be cleared of timber, and it is the easiest and least wasteful to keep the saw-mill going and build your buildings with the by-product of cultivation. Both these circumstances belong to a phase of life which we have happily outlived, at all events where architecture, as an art, exists.

If wood is used under the force of circumstances, it must ever be looked upon as a temporary expedient. It is not to the advantage of the present owner and indweller to live within wooden walls, and it is certainly not to the advantage of those who will follow him. It is not only that it is using a perishable material for a permanent purpose, thus endangering one's own household and your neighbors', but that one is using as a building material that which has other and, in many ways, more important uses.

For furniture, cabinet work, and innumerable small wares wood is indispensable, no other material can well replace it in these fields, and these are the natural markets for wood when cut. It is equally, I might say even more, useful standing, for it alone preserves us both from drought and from flood.

The great forests at the head waters of our rivers hold the winter snows and release them gradually to keep full the rivers, and to thus irrigate and fertilize the lowlands. Once remove these forests, and the spring sends the snows down in one mighty rush, to flood the country, devastating the land, leaving ruin in its track and drought to follow.

It is to the shame of our intelligence that we are so slow to waken to the necessity of husbanding our wood. We refuse to reserve our still wooded tracks, and we invite, yes, urge, wholesale destruction by putting prohibitive tariff on timbers from other countries. The folly of such a course seems inconceivable. When our hills are denuded it will be too late.

Thus while we are gratifying a perverted taste and building of wood we are endangering our own safety and that of our neighbors, and at the same time encouraging an industry which is fattening on the life blood of the country, in injuring its agricultural productiveness. There is no possible merit in encouraging this industry, for the trade in building lumber is not one which benefits the community at large, but one where the profits, unwholesomely large, go into a very small number of pockets.

As to the quality; this, of course, varies with localities, and in many places they have no reason to be ashamed of their common brick; but there are many kilns which turn out irregular and uneven brick, with great variations in size as between the hard burned and the soft. For this there seems to be but little excuse.

As to uniformity; there is now no standard brick, and if backing and facing are different, you must trust to luck for a bond here and there where the courses run level. This lack of uniformity is still worse from the architectural point of view, for in any given brick building the drawings cannot be made accurate until the builder has been settled upon, and he in turn has decided upon and bought his brick. Then only can you tell how thick a two-brick wall is, or how long a pier of four stretchers, or whether you can manage to make eight headers fill the four-stretcher space — nor can you course off your façade and tell how many courses high are your window openings.

No one but an architect can realize how intensely perplexing and annoying this is.

A uniform brick — at least for all common brick — would obviate this, and the uniform brick, of whatever size, should at least comply with the requirement of two headers and a joint equaling a stretcher.

Then, as to the steadiness of the supply. Some of our kilns are summer affairs, and only then can brick be made.

This is particularly discouraging in the very places where I think brick building should be encouraged. In the cities one can always depend on the large brickmaking centers where machinery is used, and the work is carried on regardless of weather; but in the

GARDEN FRONT, COOMBE WARREN.
George Devey, Architect.

country one must depend on local supply unless freight rates are favorable.

This is a most uneconomical way of doing business. To have a large piece of land, with buildings and machinery standing idle and profitless for six months, is not the way to produce cheaply. Apart from the business aspect, it is annoying to an architect or builder to find that when he is ready for brick he can't get them from the kiln he prefers because they are sold out, and no more can be made until the spring opens; or, perhaps he has got the plain brick and wants a few bullnose, or other simple molded brick made from the same clay, and he can't get them, but must use face brick with his common brick, and spoil them both.

LUKE FIELD'S HOUSE, KENSINGTON.
R. N. Shaw, Architect.

But most important of all is it to get the cost brought down where brick can actually compete with wood, that is, the brick that must of necessity be used in the less expensive class of buildings; and this, I believe, is possible, and, in view of the certain rise in lumber, as our unfortunate forests are laid low, probable, too, and that at no very distant date.

A very common grade of brick, if they were of good proportion, would answer perfectly well for the cheaper class of buildings, and would be laid more quickly and to better advantage. The same would answer for backing, and would bond with the various superior bricks. One frequently meets with the absurdity of a higher price from a local kiln than the price, including freight, from a kiln two hundred miles away.

To sum up, I have tried to show how economical and beautiful the brick wall is, and how adapted it is to all situations, and have pointed out what seems to me the best methods of encouraging the use of brick; I can only hope that I may, at least, have opened up a line of thought among builders, architects, and brickmakers that may lead to action on this important subject.

MORLEY'S PLACE.
George Devey, Architect.

I am aware that I have treated the subject very cursorily, and also keenly aware that I am attempting to give suggestions in a trade which I have never learned; it is only on the principle of judging by their fruits that I have dared to judge at all; but of this one thing I feel certain, that we are using wood too much in our building, and that some day we shall pay dearly for it.

The illustrations in this article have no immediate connection with the text further than exemplifying some good things in brick.

Coombe Warren was built fifteen years or so ago by the late George Devey for Bertram Currie, Esq., and although somewhat heavy in detail, it is virile and interesting — more so than much of the over-ornamented Italian Renaissance which we see so much to-day.

Morley's place is also by Devey; it stands on the site of an old house, "Hall Place," and has the advantage of retaining the old garden. With the rapid growth of vines and shrubs, and England's moist and mellow touch, it looks to-day almost like an old house.

CHURCH FOR COLORED PEOPLE, BOSTON.

Luke Field's house, on Melbury Road, Kensington, is by Shaw, one of his most happy examples of the many houses for artists which he has built, so absolutely simple and homelike in appearance, and yet so distinctly fitted for its purpose.

The last illustration is a small church for colored people, built a few years ago in Boston.

Architectural Terra-Cotta.

BY THOMAS CUSACK.

(*Continued.*)

THE two Doric columns described in a preceding chapter were, we presume, introduced chiefly with the view of affording some visible means of support to the sub-cornice resting upon them. The word *visible* is used advisedly, for the invisible has been provided in the manner shown at Fig. 33. This occurs at the fourteenth story of Fig. 34, which is the Central Syndicate Building, Broadway and Pearl Street, New York. The member referred to spans a recess of some depth, and of two stories in height, which, in its turn, becomes a central feature of the frontage overlooking that famous thoroughfare. Just why the least flexible of the classical orders should have been chosen, in an effort to clothe and embellish an avowedly unsympathetic anatomy of steel, would, we suppose, admit of more than one explanation. On that point, however, we are not inclined, at this moment, to hazard a conjecture. Suffice it to say that the effort *has* been made, and that, too, under circumstances sufficiently exacting to exhaust the resources, if they did not tax the complaisance of most architects.

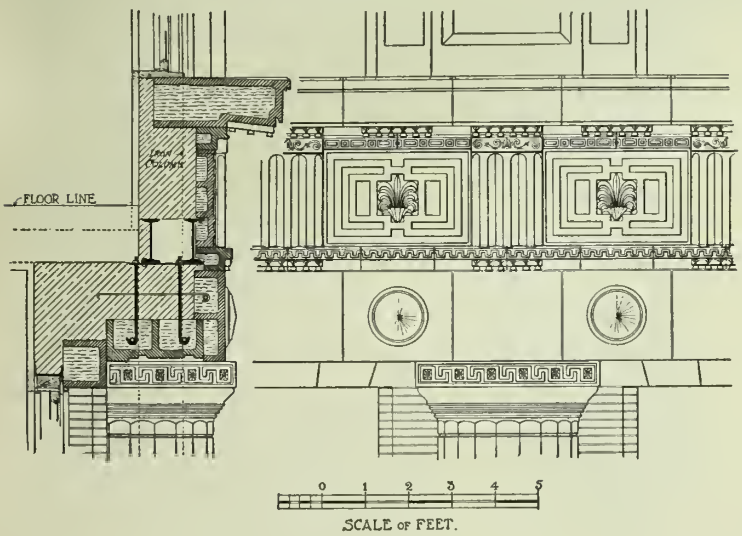


FIG. 33.

Our concern at present is chiefly with the cornice, and most of what is said applies to the upper stories of this building. In dealing with these, there may be a doubt as to whether the designer had any very definite object in view; but the doubt is a reasonable one, and of it he shall have full benefit. We shall, therefore, assume that it was his intention to create, at an altitude of 200 ft., an effect proportionate to that obtained in classical examples at about one fifth of that height. If he has fallen short of this ideal, no one will attribute his failure to a lack of ambition. It was certainly a lofty one, however hopeless of attainment. He has not, it will be observed, attempted to do this by a relative enlargement of all the moldings, but by a redistribution and repeated use of the orthodox members, arbitrarily assigned to new situations. Thus we have the architrave, frieze, and cornice of the Doric order combined; and, as a single member of 6 ft. 8 ins., it is made to serve as an enlarged architrave. What would ordinarily have been the frieze is utilized as the fifteenth story; the piers taking the place of triglyphs, and the windows becoming metopes, minus the ornament. On top of these comes the actual cornice, with a projection of 5 ft. 9 ins., making a total of some 20 ft. from soffit of architrave, or about one tenth of the entire height from grade level.

What the ancients of Athens, or their less scrupulous successors of Rome might have done, or left undone, in the face of such a problem has been discussed with avidity among architects. This subject would seem to possess a peculiar fascination, and being still an unsettled one, it has been rediscussed by the wise men among them, with special reference to this building. Nine months or so have elapsed since its completion, and up until date of writing they have not, so far as is known, agreed upon a verdict. The prevalent impression is that upon so remote a contingency it would be idle to speculate, at which status, the question may be allowed a long rest.

The Greek architects belonged to a classical era in the world's history, while it is our lot to live in an age of iron. They had their own problems, which they solved to their own satisfaction, and to the admiration of succeeding ages. Their talents found sufficient vent in the pursuit of subtle refinements, and when these reached the acme of human perfection "a deep sleep" fell upon them. Should they awake in this commercial age, the perplexities of the situation might worry them more than they appear to have done the up-to-date designer of this modern office building. He, we doubt not, consoles himself with the reflection that they have been a long while dead, and so are not likely to turn in their sarcophagi over this latest, though not least daring transposition of their exquisite detail.

In consideration of what has been said, we give a number of details, as drawn from the models, all of them giving an accurate representation of the work as executed. Most of these may be left to speak for themselves. In the main cornice (Fig. 38) certain peculiarities in the design made it necessary to devise a somewhat different method of construction from that shown in previous examples. This change is made imperative by the absence of modillions, which, among other things, served to conceal the inverted ⊥s, heretofore used as cantilevers. The whole of the soffit being now exposed, the iron supports must be inserted some distance from the surface. Instead of ⊥ sections we now find it expedient to use 5 in. 12 lb. I beams, for which an exact counterpart is molded in the ends of each block. These soffit blocks are made in one piece, with a hole in the center, into which the rosette is keyed at the time of setting. In the setting, too, of this cornice, different methods of procedure must be resorted to. Of these we know of but two that are practicable, and between them there is little room for choice.

If it be decided to space the cantilevers and make permanent riveted connections with the structural ironwork, that may be done before the walls have reached their full height. They must, in that case, be spaced accurately to the dimensions furnished by, or previously agreed to with the terra-cotta maker, who, meanwhile, has his work too far advanced to admit of material alteration. It may be that he has it made, perhaps fitted to these figures, and ready for shipping on demand. They should likewise extend at right angles to the building line, resting on an unyielding fulcrum, and be adjusted to perfect alignment. We have reason to know that these fundamental conditions do not always receive the attention that their importance demands. The drawings supplied for this purpose may be complete, and as perfect as it is possible to make them; it does not by any means follow that the erection of the work

FIG. 34.

will be equally so. The iron-workers, at least, have a stable material on which correct measurements may be made, and the holes punched, or, when necessary, drilled with mathematical exactness. This, of course, calls for reasonable care and consideration on their part;

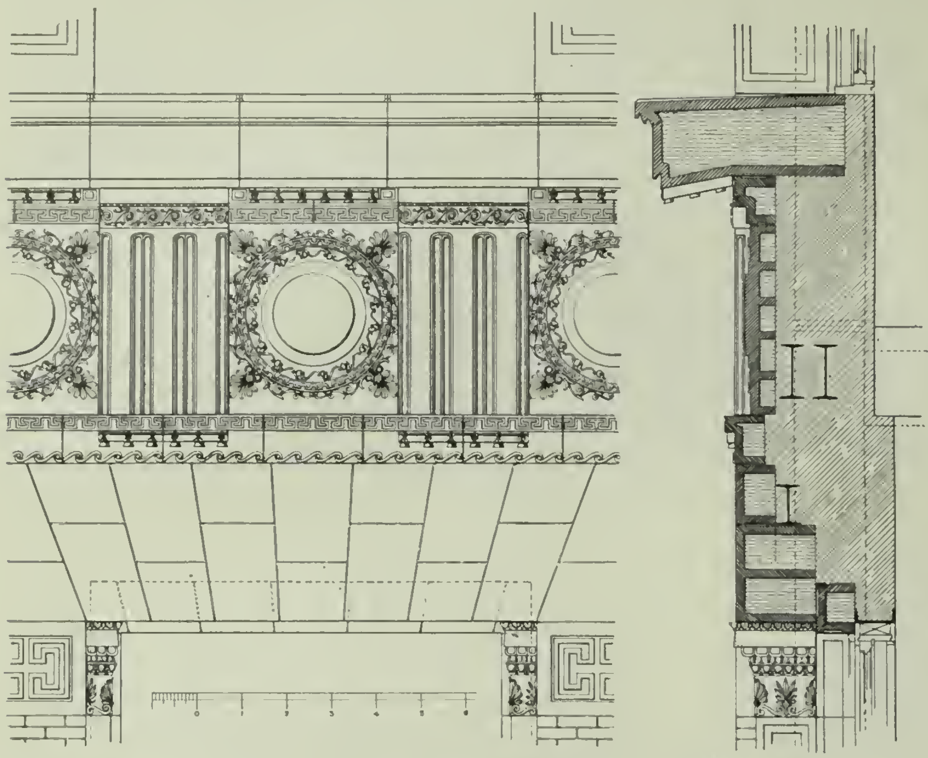


FIG. 35. CORNICE BETWEEN 4TH AND 5TH STORIES.

two qualities which they should be encouraged to cultivate. We are very far from saying that they are the only class of workmen to be met with on buildings who are wont to excuse themselves by the use of a well-worn "near enough" or "good enough." It is, nevertheless, a fact that they use these exploded maxims, and, what is worse, appear to act upon them far too frequently. A more rigid supervision is certainly required in such matters, and where other influences fail, the contracting engineer should be held to strict account by the architect. A few elementary lessons would not be amiss, as an aid to memory, the more salutary if of a pecuniary character, and taught him at his own expense.

Assuming, for the moment, that the ironworkers have done their part intelligently, the same thing will be expected from the men entrusted with the setting of the terra-cotta. Their first requisite is a scaffold of extra width, and, it may be added, of extra strength, in order that the blocks may swing clear of the cantilevers and then slide in between them. When this plan is adopted the chief drawback encountered is in getting sufficient mortar into the vertical joints. We fear there are cases where this difficulty was deemed a sufficient excuse for setting them dry. The terra-cotta manufacturer, however, can do much to invalidate this pretext by providing vertical grooves in the ends of the blocks. Into these, cement grout should be run; it will find its way down as far as the iron, for which it will be a preservative, at the same time filling most of the interstices.

The other, and perhaps better, plan is to have all the cantilevers fitted and marked for their respective places, but not fastened. As each block of terra-cotta is bedded in position it is followed simultaneously by a cantilever, which may be held in place temporarily by a bolt, to be replaced by the usual rivets as soon as convenient. This allows mortar of sufficient stiffness to be spread on each end of the block, which, when pushed together on the iron, leaves no unfilled crevices in the joint. But, whichever plan happens to be adopted, no extraordinary effort is presupposed, much less demanded, from anybody concerned. In addition to the skill which most workmen claim as their stock in trade, a reasonable amount of cooperation and helpfulness is all that is needed. This, if not expressly stipulated in every specification, is tacitly understood, and is the essence of every contract.

Beyond the points that have been suggested, there is but one criticism to make in connection with this cornice, and it, though the last, is not the least important. The lions' heads on the corona are much too plentiful. They are good enough things in themselves, but it will be seen how easy it is to have too much of a good thing. A head on every third block would have been ample, and in this respect our example of last month comes much nearer to the right disposition. Most of the moldings introduced into the soffit are too small, and, consequently, also too numerous. These small undercut members were put in at considerable expense to the manufacturer, and the most regrettable part of it is that when viewed from the street they represent nothing, unless it may be so much wasted effort. Ruskin was thinking prospectively as well as retrospectively when he wrote of things such as this being "fused together in nebulous aggregation." Fewer and bolder members, with sufficient cinctures to give relief, would, we think, have been a decided improvement, and these could have been had for the asking. The foregoing are faults for which no excuse can be offered, but if it be any satisfaction to those responsible for them, we will say that they are in what may be considered good company, architecturally. Such failings, if not common, are certainly not confined to this building. We know of cases in which the size of the members began to diminish in inverse ratio to their height in the building. The smallest leaf used by one eminent member of the profession was withheld from the entrance vestibule and reserved as an enrichment for coping on the parapet.

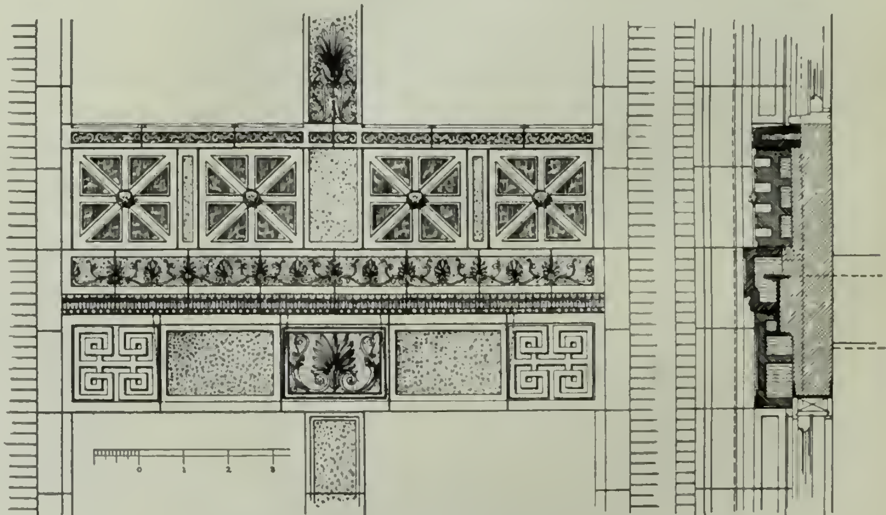


FIG. 36. TRANSOM IN WINDOWS BETWEEN 4TH AND 5TH STORIES.

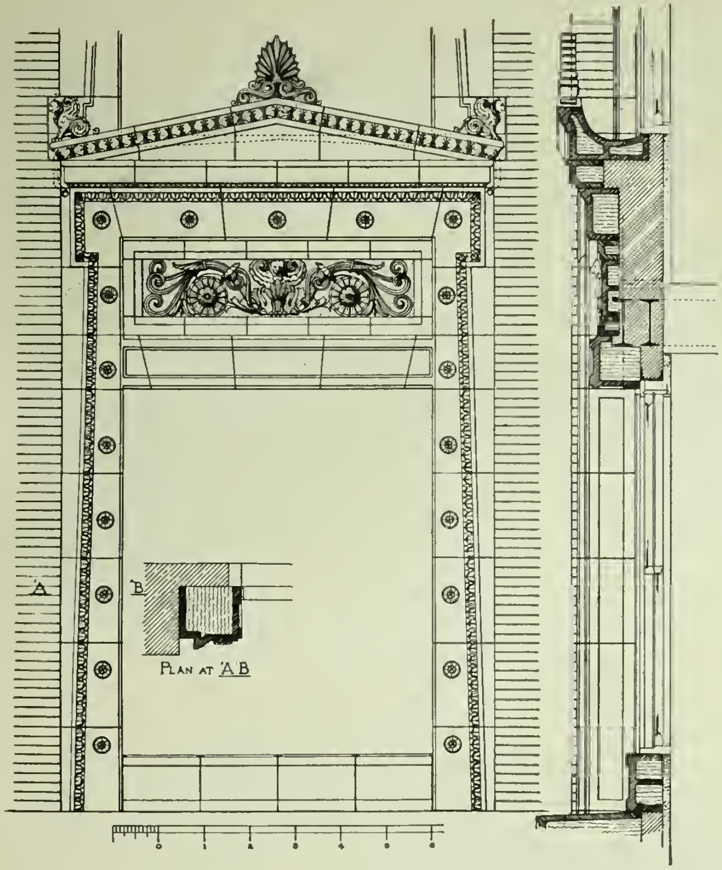


FIG. 37. WINDOWS IN 12TH STORY.

It is difficult to account for this well-nigh unaccountable tendency. One explanation may be found in the fact that the average draughtsman views his work at too short a range, viz., the drawing board. Let the physical eye follow the lines that are being made on paper, by all means, but let the mental vision soar to higher altitudes, and there picture the complete work *before the foundations have been dug*, proportioning each detail to what it should appear when placed at any given height in the building.

BRICK EFFLORESCENCE.

A GERMAN'S OPINION.

THE incrustation or efflorescence of bricks and brickwork through weathering formed the subject of an inaugural address by Professor Gunther at the University of Rostock, North Germany. Mineral incrustations on walls are mostly white or grayish, more rarely yellow or green — these latter being due to vanadium, a silvery brittle metal of rare occurrence. In appearance these incrustations vary, according to the solubility of the component salts, from floury or wooly powders to stalactitic masses; and they may result from various causes present either in the raw clay or introduced in the water employed in brickmaking, or from pyrites in the clay or fuel, or from the ash of the latter material; and the infiltration of soluble substances from the mortar, or combination of the alkalis in the latter with the gypsum in the bricks; or, finally, the absorption of nitrates from the soil and from the air of ammonia or sodium chlorate (near the sea) may give rise to incrustation. Incrustation may come either from the bricks or from the mortar. While incrustations of calcium carbonate do no harm beyond spoiling the appearance of the work, soluble alkali salts repeatedly dissolve and recrystallize in the cracks — ultimately producing disintegration. To prevent these incrustations, pyrites, and sulphates can either be removed by the slow process of seasoning the clay by prolonged exposure to the weather before making up into bricks, or by adding barium salts to the clay before burning, so as to produce the insoluble barium sulphate. Bricks should be very thoroughly burnt, since in this state they are less disposed to absorb the moisture necessary for the extraction of the soluble salts. — *The British Brickbuilder.*

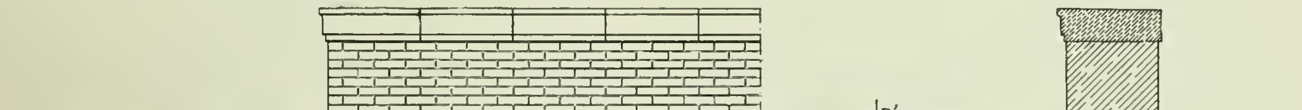


FIG. 38.

The Art of Building among the Romans.

Translated from the French of AUGUSTE CHOISY by Arthur J. Dillon.

PART III.

CHAPTER II.

THE ART OF BUILDING AND THE ORGANIZATION OF THE WORKING CLASSES.

I HAVE reviewed the principal epochs of the history of Roman construction, and the circumstances that attach it to the history of the empire. I now wish to go a step farther, and, without stopping over the exterior causes that in turn hastened or retarded the progress of the art of building, go back to the influences which the interior organization of society has in its methods. What part had free labor? What part had slavery? In what ways, from what parts of the people, were procured the thousands of workmen who built the monuments of Rome? In what way could their efforts be utilized, and what were the practical methods that were consequently preferable? All these questions are related to each other. The condition of the working classes is shown in the construction of the edifices as plainly as the Roman customs are shown in their plans; and the principal interest in the study of construction would be lacking if the account of the methods were separated from the account of the institutions that explain and justify them.[1]

One institution, among others, whose name constantly recurs in the Roman laws and inscriptions is that of the corporations or colleges of workmen; strange associations, the details of whose regulations, unfortunately, the ancients failed to transmit to us, and whose history must be sought by the difficult comparison of scattered documents. Sometimes a concession of privileges, sometimes a law on public taxes, gives us a trace of their immunities or their obligations; one inscription gives us a glimpse, in lists of titles as obscure as they are numerous, of a complex hierarchy established in each of the corporations; another inscription reveals, in fragmentary sentences, a series of statutes freely accepted by the corporations, regulating the relations of the different members. These are truly very incomplete documents, but in spite of the unfortunate vagueness of many of them, the general impression obtained from a review of the whole mass is of a certain clearness; and one fact of capital importance seems to be shown by this incomplete evidence; it is the existence of a working class, widely separated from the rest of Roman society, and placed, by an hierarchial organization and by a system of privileges and duties, in the hands of the emperors.

Moreover, this organization is of recent date. Before becoming an instrument of the centralized imperial power, the workingmen's corporations had a long struggle to obtain recognition of their existence and sanction of their franchises; a struggle which commenced with the first days of Rome, and which was prolonged with varying fortunes for a period of nearly eight centuries; for it was only under Hadrian that the corporations finally took a definite rank among the recognized institutions, and commenced to play that important part in the internal economy of the empire that was henceforward to be theirs.

The origin of the workingmen's corporations is confounded with that of the Roman state; perhaps their creation must even be placed among those numerous things borrowed from Etruria in that period of peaceful organization to which historians give the name of Numa. Afterwards, when the attention of the Romans was again turned to war, the institution, temporarily overthrown, rose in a new form; the corporations that were able to assist in military works, in the equipment of the armies, in the manufacture and the maneuvering of the engines of war, became the important ones, and when the people were classed by centuries, the power of these corporations was so great that by themselves they formed two centuries, voting in the *comitia* with the first class of Roman citizens. This privilege, to be sure, was enjoyed by a large number of corporations which we could not investigate without going beyond the natural limits of this study, but there are several of them in which we are particularly interested; among others, those who worked in metal and wood took rank in these half-military societies, which, according to the expression of Titus Livius, were soldiers by trade, though they did not bear arms.[2]

The example of these first corporations, the ever-increasing influence that they had in the Roman society greatly increased the tendency toward association among the working classes, and little by little all the trades of Rome were organized as corporations under regulations that made them similar in varying degrees to the corporations instituted by Numa and Tulla. Objectionable above all to the last Tarquins, and to the aristocratic government that followed the expulsion of those kings, the existence of these popular confederations was more than once in question;[3] but the spirit of association prevailed over the prohibitions of the patricians to such an extent that at the last years of the republic the whole of the workmen of Rome were formed into free societies, strongly constituted, and having, with or without the consent of the government, an organization that, to a certain degree, put them beyond the control of the central authority.

It would appear that the material advantages were rather the pretext than the real basis of these unions, and about the time of the civil commotions that preceded Augustus, the interests of the factions into which the Roman world was divided gave the workingmen's corporations one of the principal elements of their power. They were animated by a seditious spirit, and numerous revolts (in which the name of Clodius, it is said, was mixed) finally moved the Roman government to a distrust of the principles themselves of these institutions. Prohibited under the rule of Cicero, in spite of the support they had formerly given him, the corporations were reestablished by Clodius, who increased their number, admitted foreigners, and even slaves, and increased in them the unquiet spirit which forced Julius Cæsar to again suppress them.[4] Only a few exceptions were made, through respect of ancient traditions, or on account of regard for general needs. The fate of the corporations who took part in construction, whether they were comprised in the condemnation, or whether their ancient origin and the importance of their services placed them in the small number of corporations which, the documents say, were spared for the public good, is not known.

[1] Besides the original texts to which I refer, the following works can be consulted in relation to the questions which are the subject of this chapter:

Heineccius, De collegiis et corporibus opificum (a dissertation reproduced in the collection called Opusculorum variorum sylloge).

Serrigny, Droit public et administratif romain.

Th. Mommsen, De collegiis et sodaliciis Romanorum (Kiliæ, 1843).

Rabanais, Recherches sur les Dendrophores (Bordeaux, 1841).

Roth, De re municipali Romanorum libri II. (Stuttgart, 1801).

But kindly advice has assisted me more than these learned works, and I beg to acknowledge my gratitude to M. Egger for direction he gave to my researches.

[2] The original documents on the origin of these corporations are these: —

1st. Establishment of the corporations under Numa as peaceful organizations.

Plut., Numa, Cap. XV.

Plin., Hist. Nat., Lib. XXXIV., Cap. I.

2d. Transformation of many corporations into semi-military institutions, under Tulla.

Dinoys. Halic., Ant. rom., Lib. IV., Cap. XVII.

Tit. Liv., Lib. I., Cap. XLIII

3d. Persistence of distinctions in favor of the corporations who aided the armies.

Digest., Lib. I., tit. VI., l. 6 (taken from a treatise, "Militarum," written about the time of Commodins).

Among the concordant works on these documents, see the dissertation of Heineccius, "De orig. et jure coll. et corp. apud Rom.," and that of M. Mommsen, "De coll. et sodaliciis," p. 27, et seq.)

[3] Heineccius, "De orig. et jure coll.," Cap. I., § 9.

[4] Some of the documents on which these statements are founded are these: —

1st. Suppression of the corporations by Cicero.

Asconius, in Corneliana Ciceronis, edit. Orelli, p. 75.

(Cf. Cic., Pro domo, Cap. XXVIII.; and Q. Cic. De petitione consul., Cap. I.)

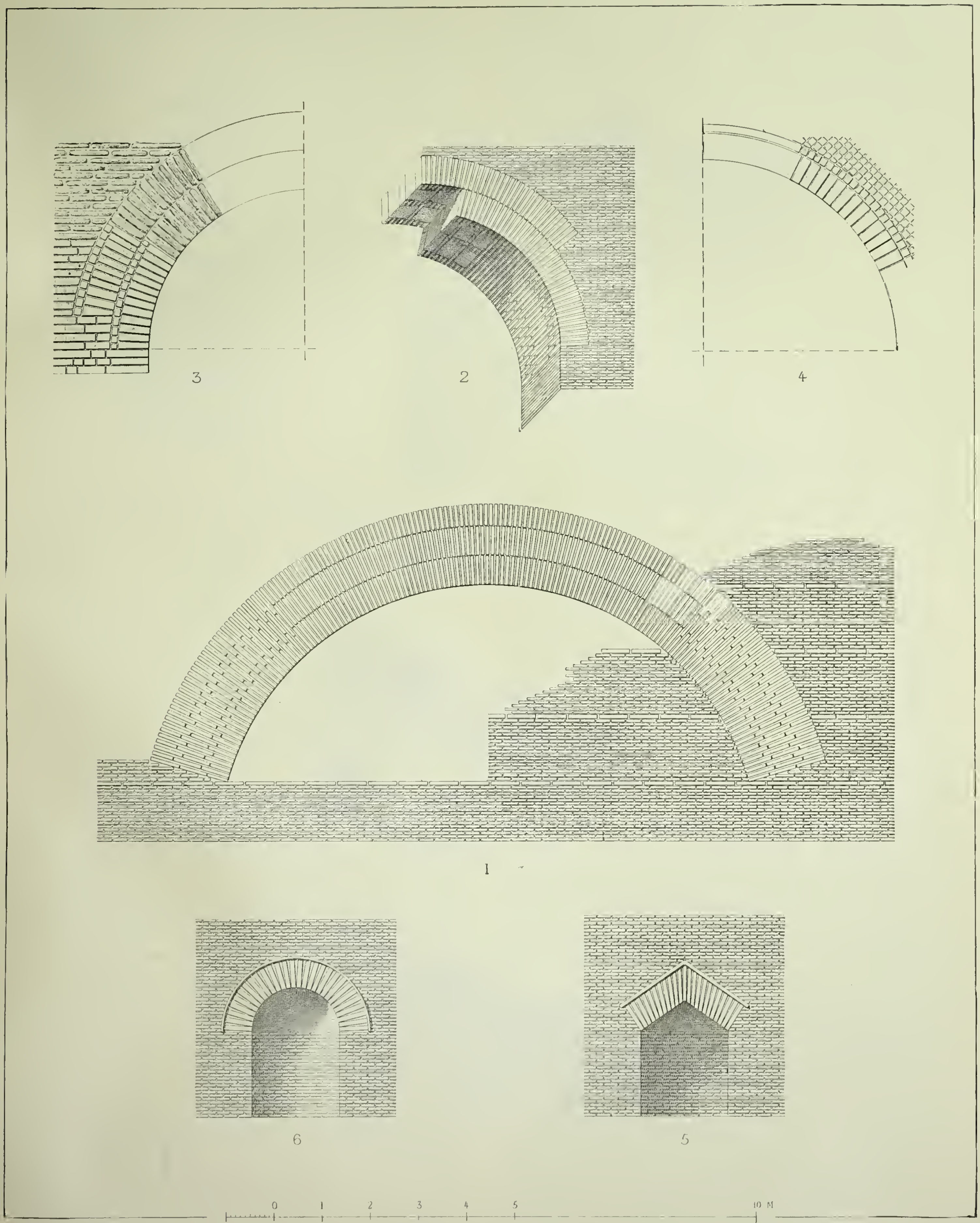
2d. Reestablishment by Clodius: —

Cic., in Pisonem, Cap. IV.

3d. Suppression by Julius Cæsar;

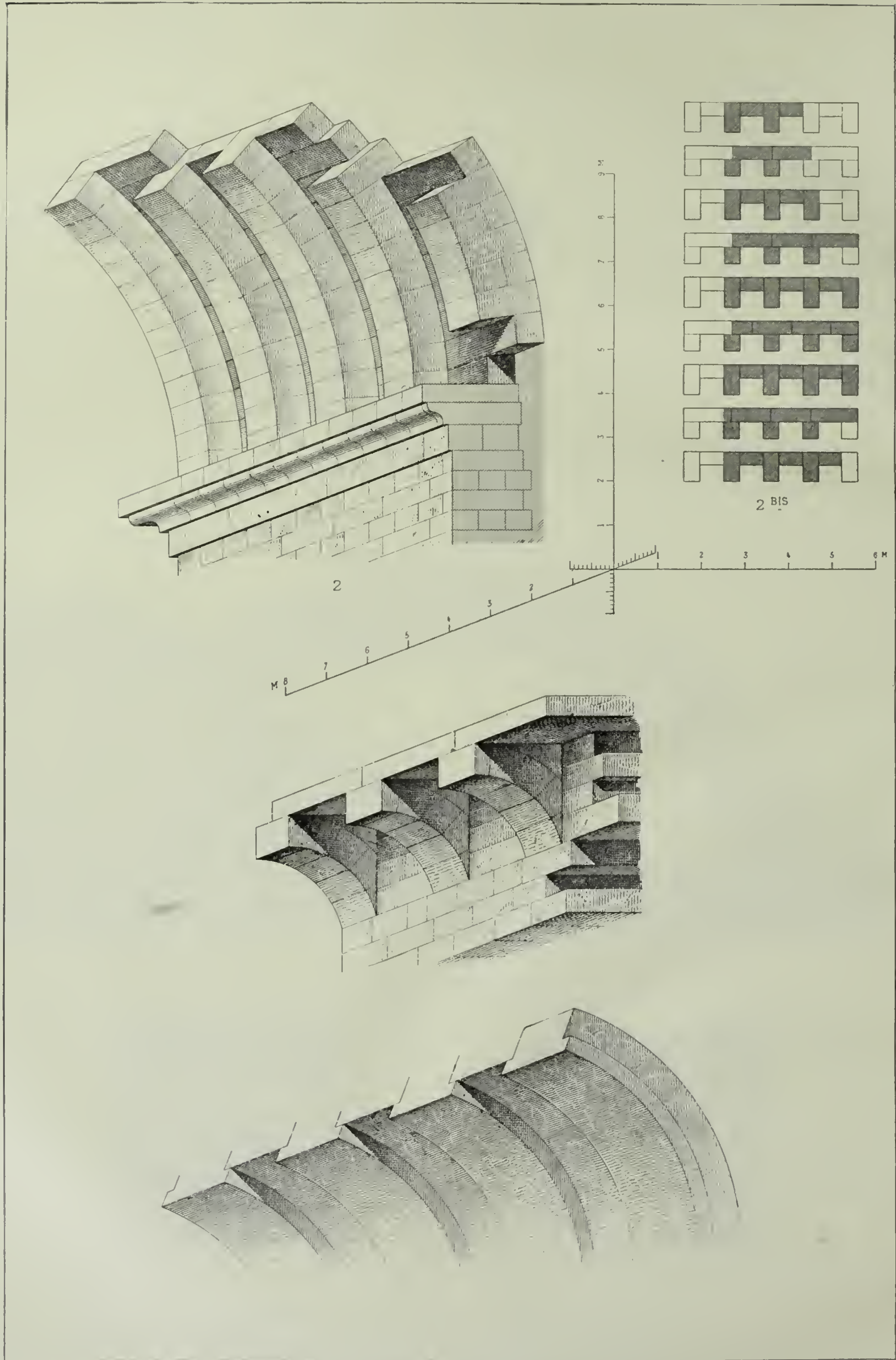
Suet., Jul., Cap. XLII.

(For the discussion of these documents see the memoir of M. Mommsen.)



1. Pantheon. 5–6. Taormine.

PLATE XV. THE ART OF BUILDING AMONG THE ROMANS.



1. Bains de Diane a Nimes. 2 and 2 Bis. Point de Narni.

PLATE XVI. THE ART OF BUILDING AMONG THE ROMANS.

However that may be, the frequency of the edicts published against the corporations during the period of a century shows what permanence the idea of association had. From Julius Cæsar to the Emperor Claudius, three successive edicts confirm in turn the first interdictions.[1] Finally renouncing the direct contest against a tendency that increased in proportion to the efforts opposed to it, the emperors, little by little, placed themselves at the head of the corporations, and in order to dominate them, they profited, it seems, by the religious character which was found, as well as the idea of association, and the partisan spirit was found in them.

Nero had himself made a priest of all the corporations tolerated in Rome,[2] and a great number of the corporations that had been overthrown were reconstituted under the open patronage and the somewhat perfidious protection of the pontifical power of the Cæsars. But the direction given to the workingmen's corporations by the supreme authority was not sufficient to stifle the fear of them for any long period. Trajan tried, but in vain, to revive the ancient interdictions; and during the first years of the second century there is the singular spectacle of a Roman emperor compelled to recognize in Rome the unions he is endeavoring to suppress in the provinces.[3]

Hadrian was the first to understand the fruitlessness of the effort to stop the movement. He abandoned both the idea of suppressing the corporations and that of transforming them into simply religious societies; they seemed to him to afford valuable resources for the execution of the great edifices he was planning; he saw in them a powerful instrument which he strove to put to profit in the interest of his vast enterprises. Henceforward the workingmen's corporations lost their primitive character of free associations and became official institutions of the State, a fundamental change which marked, for the greater part of the working classes, the point of departure of an entirely new régime, of a condition of affairs whose developments fill the long period that elapsed from Hadrian to Theodorus.[4]

The new condition imposed on the corporations of builders is indicated in a few historical texts, but it is most plainly marked in the regulation of Antoninus and his successors, while the definite form it took in the last period of the empire is shown in numerous texts preserved in the Theodosian Legislation. Aurelius Victor says (epit., cap. XIV.) that Hadrian has enrolled the building trades in cohorts, organized after the model of those of the armies. "Ad specimen legionum militarium, fabros, perpendiculatoris, architectos, genusque cunctum exstruendorum mucnium seu decorandum, in cohortis centuriaverat."[5]

This testimony is made clearer, though the well-defined, original form leaves no room for doubt, by regulations which may be attributed to the immediate successor of Hadrian. The jurisconsult Callistratus expresses himself thus, in summing up the measures taken by Antonine Pius in regard to the corporations: —

"To certain corporations . . . immunity is granted; these corporations are those to which admission is obtained by virtue of a trade, such as the corporation of smiths, and all those which have a similar origin, that is to say, which were established to give the aid necessary to enterprises of public utility. . . ." "Quibusdam collegiis vel corporibus quibus jus cœundi permissum est, immunitas tribuitur: Scilicet eis collegis vel corporibus in quibus artifici sui causaunus — quisque adsumitur: ut faborum corpus est, et si qua eamdem rationem originis habent, id est idcirco instituta sunt, ut necessariam operam publicis utilitatibus exhiberent," etc. (Digest., Lib., tit. VI., l. 5, 12).[6]

I thought I should give this curious document in its entirety, for it defines both the kind of servitude imposed on the corporations and the reasons for giving the privileges that were granted to them in return. The privileges enjoyed by the corporations were above all a recompense for the duties that weighed on them. The emperors had to recompense by indemnities the extremely onerous obligations that bound the members of a corporation to give their services in this manner whenever a public necessity demanded their assistance.

This was the fundamental idea on which the workingmen's corpo ations rested, but it will be of interest to go beyond this generality, and endeavor to fix the nature of the requisitions which their members were compelled to meet, the character of their immunities, and the principal points of their internal organization.

The servitude imposed on the corporations did not consist of the obligation of giving their work to the State gratuitously, but only of the obligation of giving it; it was an infringement of personal liberty, nothing more, but none the less a serious infringement when judged either by the importance of the compensation given for it, or by the severity of the penalties decreed against the members of corporations who should endeavor to escape the charges put on them by flight.[7]

It was no less a matter than that of placing one's self absolutely at the discretion of the State, of continually residing at the place where the corporation did its work, and of accepting as the price for these services whatever the State was pleased to grant. It was, as can be seen, essentially a dependent condition that has more than one point in common with that of the Roman colonists, or, better still, with that of those singular dignitaries of the last days of the empire, who, under the name of curials, were given honorary duties under ruinous conditions by the despotic emperors. Looked at from no matter what point of view, Roman society seems to have been based entirely on a system of servitude partially repaid by privileges.

But the members of the corporations were more fortunate in this respect than the classes to which we have just compared them, for the immunities granted to them in return for their heavy obligations were a less illusory compensation. Their privileges consisted in their absolute exemption from all public taxes, from all municipal duties, and from all extraordinary imposts; they were not subject to the corvée, nor to military service, and were entirely free from the burdensome impositions which, under an infinite variety of names, crushed the other classes of Roman society.[8]

Apart from these advantages, the workingmen's corporations received from the State a gift of lands whose revenue was included in the remuneration for their services. The lands comprised in these

[1] 1st. Under Julius Cæsar; Suet., Jul., Cap. XLII.
2d. Under Augustus; Suet, Aug., Cap. XXXII.
3d. Under Claudius; Dio. Cass., Lib. LX., Cap. VI.
(This last document seems also to indicate the commencement of tolerance on the part of the predecessor of Claudius.)

[2] Orelli, Inscript. lat., No. 764 (note); I have taken this from the paper of M. Belin de Launay in the Acts of the Acad. de Bordeaux, 1867, 1er tri.

[3] Prohibitions: Plin., epist., Lib. X., 42 and 43. Recognized corporations: Aurel. Vict, De Cæsarib, Cap. XIII.

[4] It may be said in passing, that this change in the character of the corporations, which commenced by being tolerated and ended in being obligatory, explains a certain lack of agreement between the juridical documents in the Digest. Taking the oldest of these texts, those of Gaius, for example, the workingmen's corporations are almost invariably presented as tolerated associations (see in particular Dig., Lib. III., tit. IV., l. 1). On the contrary, taking the constitutions of the fourth and fifth centuries, they all imply a different character to the corporations, that of obligatory associations. The means of compulsion which are cited farther on belong to this period, and sufficiently mark the nature and importance of the transformation that was made.

[5] "He had enrolled as cohorts, according to the model of the military legions, the smiths, terracers, the architects, and all that group of artisans who build or decorate.

[6] This enunciation, taken from a jurisconsult of the second century, is enlarged upon, and made still clearer by Majorien, who shows us all the members of the corporations compelled to live in their own cities in order to work for the public benefit in turn (*alternis vicibus*) and at the request of the curiales (*pro curialium dispositione*): Nov. Theod., Lib. IV., tit. I. This is the text of the constitution: "De collegiatis vero illa servanda sunt, quæ præcedentium legum præcipit auctoritas. Quibus illud provisio nostræ serenitatis adjungit, ut collegiatas operas patriæ alternis vicibus pro curialium dispositione præbentibus, extra territorium civitatis suæ habitare non liceat."

[7] Novell. Maj., previously cited, is a sufficient proof of this (Nov. Maj., tit. I); furthermore, it may be confirmed by these works: —
Novell. Theod., Lib. I., tit. XXVI.
Cod. Theod., Lib. XIV., tit. II., l. 4. Lib. XIV., tit. VII., l. 1. Lib. VI., tit. XXX., l. 16.

[8] 1st. Exemption from military service. Novell. Theod., Lib. I., tit. XXVI.
2d. Exemption from municipal duties. This is at least probably established by Cod. Theod., Lib. XII., tit. I, where the two kinds of duties seem to be considered equivalent.
3d. Exemption from taxes or extraordinary imposts. Cod. Theod., Lib. XIV., tit. II., l. 2.
4th. Exemption of minors. Digest., Lib. XXVII., tit. I., l. 17, § 2.

donations, the *fundi dotales*, divided between the members of the corporations, became their individual property, transferable, like other possessions, by inheritance, and it was on account of the importance of the donation that the charges upon them were divided among the different members of the corporation. Each contributed to the service of the State in proportion to the part he held of these lands so heavily encumbered, and the obligations were transferred with the property itself.[1]

Several important consequences were brought about by this, for when the endowment passed from a member of a college to his children, the obligation of fulfilling the public duties would also be hereditary, and by this reasoning, which, in spite of its unfortunate results, was correct, it followed that the Romans found themselves compelled to attach the workingman to his corporation, and to perpetuate a servitude which took from the son of a Roman workingman the right to choose his mode of life, and to select his occupation according to his taste or his needs.

The natural solution would have been to give a choice between assuming the duties of the corporation or abandoning the endowment; and this did not escape the attention of the logical and penetrating minds of the Roman law makers. The terms of the law in this respect are precise, and contain, one might say, the entire theory of the servitude imposed on the workingmen's corporations. "Those who hold under any title whatever, property subject to the charges of corporations, whether they have obtained possession by purchase, gift, or in any other manner, must either take the charges on themselves in proportion to the value of the property or else must give up possession" (Cod. Theod., Lib. XIV., tit. IV., l. 8), and the law adds, this also covers "all the corporations that share in the privileges of the city of Rome."[2]

But it is to be feared that this law, which seems a safeguard of individual liberty, was only one of those speculative matters from which Roman legislation is not free: there is no doubt that in more than one case the strict deductions were put aside at the exigency of certain less favored corporations that had become, through long custom, necessary organs of the imperial administration. The emperors arrogated the right of placing citizens in the corporations on their own authority, and of transferring members of one corporation to another; and, above all, as though they feared a lack of members, forced membership in those corporations whose duties were the most burdensome was made a legal penalty.[3]

Thus, by means of a wisely tyrannical discipline the Roman government provided for the general necessities of public works and for the provisioning of the large cities. The workman or merchant of the Roman empire was not an independent citizen who worked according to his own will to supply his own daily needs; he was a functionary of the centralized government, receiving, in the form of revenue from an endowment, a regular salary, and bound to deliver, in exchange for this revenue, this salary, the result of his labor either to the State or to the municipality. The State, through its endowed employees, produced directly the provisions necessary for the support of the people (*pistores*, *suari*, etc.), undertook all transportation (*navicularii*, *vecturarii*, etc.), and built its monuments (*structoris*, *tignarii*, *fabri*, etc.); a strange system which wiped out private enterprise and competition, and which substituted for the spontaneous workings of industry, the machinery of an immense administrative hierarchy which commenced at the emperors and ended at the lowest workman of the large cities.

It can be seen that it would be a serious error to regard the services of the corporations as gratuitous; their endowments and their privileges were a first recompense, but they had also in many cases a further one which was regulated entirely by the importance of the services rendered. I found the proof of this in the curious constitutions that regulated the corporation that was bound to supply Rome with the lime necessary for its buildings, the "*calcis coctores*." Their pay, following a widespread custom of the empire, was not in money but in kind, an amphora of wine for three wagons of lime; the carters who transported the lime (also functionaries of the Roman administration) received an amphora of wine for every 2,900 lbs. of lime, not including the income from their endowed lands, and the produce of three hundred oxen given to their corporation (Cod. Theod., Lib. XIV., tit. VI., l. 1).

It seems, then, that the Roman society recognized the state of subjection which it imposed on the corporations by immunities or permanent gifts, and recompensed each service rendered by a special salary. These benefits, however, reasonable and seemingly equitable, were far from being sufficient to repay the services at their true value; they were, as the Code says, but consolations (*solatium*)[4] which served to lighten the heavy obligations. The State reserved the right of fixing the payments of the forced contractors of its works, and the amounts it paid were but a small recompense, and dissimulated but poorly the semi-slavery. The greater part of the expenses of the city were in reality borne by the corporations; and, to use the language that was used by an illustrious Roman citizen in a petition to the Emperor, "The ancient privileges were bought at a great price; their so-called immunities are paid for by perpetual slavery."[5]

(*Continued.*)

[1] Cod. Theod., Lib. XIV., tit. III., l. 7, 13, 19; tit. IV., l. 8.

The working of this system of donations and duties can be observed by reading the applications the Romans made of it to two of their principal corporations, the *naviculare* and the *pistores*; each of these applications, each of these monographs, as they may be called, is the subject of a special title in the Theodosian Code.

Taking the expressions of the Code exactly, two meanings may be given to the words *fundi dotales*. The donation to the corporations could be a complete abandonment of certain property to their members, or it could be simply the exemption from charges of land held by them. These two hypotheses, neither of which, moreover, excludes the other, carry the same consequences as far as the legal position of the collegiati and the character of their remuneration is concerned: whether the members of the corporations had the revenue of the donated lands as an indemnity, or whether the *fundi dotales* was simply the partial or complete exemption from all imposts entailed by the possession of such lands, the principal remains the same and the conclusions we are brought to remain true.

[2] "Hi vero qui prædia obnoxia corpori, vel ex empto, vel ex donato, vel ex quo libet titulo tenent, pro rata publicum munus agnoscant, aut possessionibus cedunt. Circa reliqua etiam corpora, quæ ad privilegia Urbis Romæ pertinere noscuntur, eadem præcepti nostri forma servetur."

[3] For the participation of citizens in the corporations, and the right of transferring the members of one corporation to another, see Symmach., Lib. X., ep. 58.

For the grade of the condemnation that placed free citizens in certain corporations whose duties were onerous, see Cod. Theod., Lib. IX., tit. XL., l. 5; Lib. XIV, 10, tit. III, l. 23, etc.

[4] Cod. Theod., Lib. XIV, tit. III, l. 19.

[5] Symmach., Lib. X., ep. 27: The "report" from which I took this citation forms one of the most interesting and most complete pictures the ancients have left us of the position and condition of the corporations of the workingmen of the Roman empire.

FREEZING TEST FOR BRICKS.

ONE of the most important features in structural materials of all kinds is their permanence under the influence of atmospheric influences. Of all these perhaps the one that exercises the greatest mechanical effect is frost, which tends to disintegrate bricks and stone by the expansion in the act of freezing of the water enclosed in the pores, with a consequent separation of particles or flakes when thawing ensues. Probably very few of your readers have ever thought of testing the permanency of their goods under such conditions; the winter time provides a seasonable opportunity, and there is no reason why every manufacturer should not, if we have frost enough, be able to ascertain to what extent his goods will stand frost. This can be determined by a very simple test, namely, by direct freezing. Let typical samples of the goods be chosen during frosty weather, and saturated with water, and then alternately frozen and thawed a dozen times or more. Now, if the samples to be tested are weighed dry, and the loss of weight by exfoliation determined also on the dry samples, the thing is accomplished. It would be possible to create a standard of permanency by counting a given percentage of loss as unity (this would have to be chosen arbitrarily) and then referring other percentages of loss to it. Thus might be created a scale of permanency, and when about to enter into a contract, this might be referred to just in the same way as the resistance to crushing strain is now quoted. — *British Brickbuilder.*

Fire-proofing Department.

DETAILS OF FIRE-PROOF CONSTRUCTION WITH BURNED CLAY.

BY PETER B. WIGHT.

PARTITIONS AND WALL FURRING.

HOLLOW-TILE building blocks were invented and patented in this country by the late George H. Johnson, about the year 1872, the purpose of the invention being to construct round or square grain bins in elevators; though numerous forms of rectangular hollow blocks had been made in France before that time. The feature of Mr. Johnson's invention was to cramp the blocks together with burned clay cramps, the blocks being set on end. Thus when the courses were set with broken joints the cramps were concealed. An added strength was thus given to grain bins which are subject to great lateral thrusts. But the invention was of doubtful utility and added to the expense of partition work when used in buildings. It was used for a considerable time by the company which continued Mr. Johnson's work in Chicago, but has since been abandoned. One of these partitions is shown in Fig. 1.

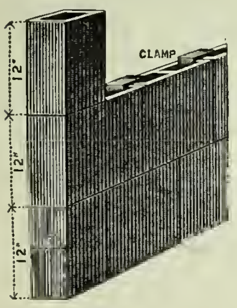


FIG. 1.

The first hollow block used for partitions in New York and the Eastern States in the early 70's was 4 by 6 by 12 ins. in size, with two longitudinal holes. The thickness of the clay was ⅝ in. for hard tile and ⅞ in. for porous tile. One of the latter is shown in Fig. 2. These were used for both 4 in. and 6 in. partitions, and are still the standard article of manufacture by some makers. But they make the partitions unnecessarily heavy, and are more expensive to set than larger and lighter blocks. The tiles for partitions made by Johnson were 10 by 10 ins. without any cross webs, and ¾ in. thick. In 1881 partition tiles were used at Chicago which were 12 by 12 ins., with one and two cross webs. They were only ½ in. thick and made of hard fire-clay. An illustration of these is given (Fig. 3). They were generally laid on the side, though, being square, they could be set on end, like the Johnson tile, which was frequently done, especially where the partition was very high or subjected to great weight, as in the surrounding of an elevator shaft. At angles they were always set on end. Greater care and a little more expense is required in setting partition tiles on the ends. This method is also the best when the partition is not to be plastered, as when they are set on the side it is impossible to fill all the vertical joints. This remark does not apply, however, to the 4 by 6 blocks, which are laid like large bricks, and have more surface at the ends to hold the mortar joint. They, however, show the holes at the angles of partitions which have to be filled with mortar. Hollow partition tiles may now be had for partitions 2, 3, 4, 5, 6, and 8 ins. thick, and 12 in. partitions may be had by setting 6 by 12 in. tiles on the flat side. This is a handy way to build light fire-proof vaults in buildings where there are sufficient foundations.

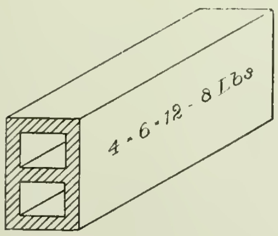
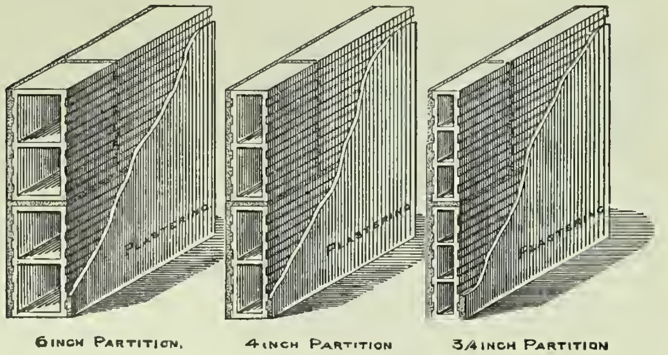


FIG. 2.

The thickness of partitions in practise is regulated by the heights of stories. A 3 in. partition can be safely built to 12 ft., a 4 in. to 16 ft., and a 6 in. to 20 ft. in height. I advise that these be the outside limits, as there is a possibility of careless workmanship that has escaped detection. I was once required by an architect to build the 3 in. partitions in a story 16 ft. high, he taking the responsibility. They were tested by severe shaking before the doors were put in or any plastering was done, and though very elastic we could not pull any of them down by hand, and they are



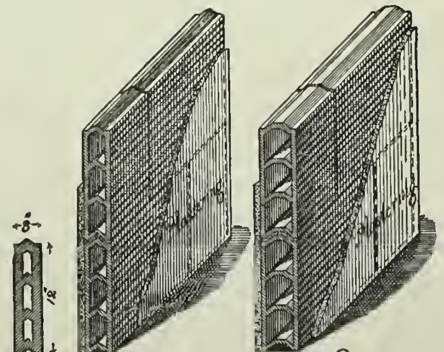
6 INCH PARTITION. 4 INCH PARTITION 3/4 INCH PARTITION
FIG. 3.

there to-day. The length of any one straight section of a partition is a more important element than its height, and judgment must be used in every case. I have built a 3 in. partition around two sides of an elevator shaft, 120 ft. high on girders in the cellar, the tiles being set on end; the weight at the bottom course was about 1,500 lbs. per lineal foot. This was only 94 lbs. per square inch of tile area.

It is customary in St. Paul and Minneapolis to build the partitions in office buildings, having stories 10½ ft. in the clear, with 2 in. porous tiles. The tiles are 8 by 12 ins. and abundantly strong when set in good mortar tempered with cement. When they want to cut out additional doors between rooms the carpenter does it with a saw. Two-inch partitions of hard hollow tiles have been recently built in Chicago. The same tiles are also used for wall furrings, and building out architectural shapes around columns, and boxing in pipes.

When book tiles were first used for roofs it was found that the same die would make a square partition tile which was very useful under certain circumstances. It was possible to give greater strength to long partitions without lateral supports by setting them on the side. The tiles, breaking joints, could be built up to a great length even without mortar. This led to making 4 in. book tiles for partitions. These have been used considerably in the Central States, but not at the East. An illustration is here given (Fig. 4). Another use was made of tiles of this section; wood blocks 1 in. thick were mill-worked to fit exactly between the joints of these tiles, and cut off to the length of the tiles. They were used only between tiles set in courses on end, wherever nailing was required. Thus, wherever there was to be wooden wainscoting, the first and fourth courses were set on end with wood blocks between which were as immovable as the tiles. These blocks should never be used in the joints when the tiles are set horizontally.

Two questions of importance are to be considered in setting partitions: the first is securing them to the walls and ceilings, and the second is the treatment of openings. The simplest and best way to secure partitions to brick walls is to drive large cut nails (not wire nails) into the joints of the brickwork on top of each course of tiles before setting the next course. The heads of the nails will then come between the courses. Cut nails are better in mortar or in porous tiles because they are of wedge shape. Nothing more than a few wooden wedges at the top is of any use. It is best to set partitions in the lower stories first and work upward. The weight of the partitions on each floor



Porous. 3inch Partition. 4 inch Partition.
FIG. 4.

will add to the deflection of the beams of that floor, and thus bring pressure on the partitions of the floor beneath; while, if the partitions on the upper floor are set first, the setting of the partitions of the floor beneath it will pull them away from the ceiling. In buildings with wooden joists no dependence can be had on securing tile partitions at the top. They will always settle down and show a crack at the ceiling line unless they are set on steel beams. It is best for fire-proofing purposes in every case to set partitions after the ceilings are brown coated.

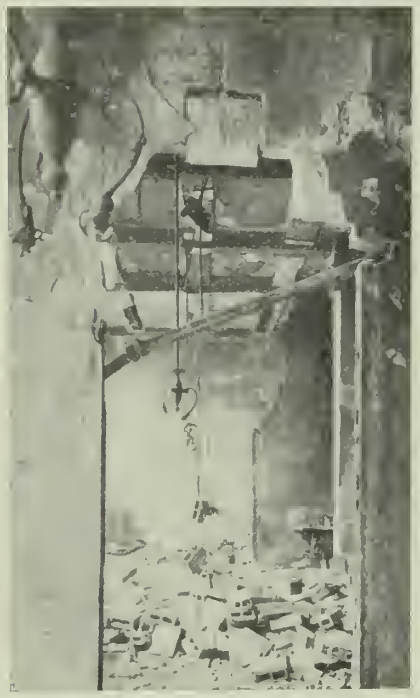


FIG. 5.

The greatest faults to be found in hollow-tile partitions are in the methods used for building doors and windows in them. First of all, the top of a door should always be covered with a flat end-pressure arch made of the partition material. As an example of how not to do this, see the half-tone from a photograph of a partition door in the Horne Office Building at Pittsburgh, taken after the fire in that building (Fig. 5). Here the tiles over the door have fallen down, while a natural arch has been formed by those that held their places. Where there are long rows of windows it is impossible to put in an arch. In such cases no expedient can be relied upon except to build a channel bar frame in each opening. It has been shown in repeated fires that all rough wooden frames are useless. If there must be finished wooden jambs, they should be screwed to steel jambs, but it would be better to hang all doors to steel jambs made of channels. The tiles can be built into them and their flanges will become grounds for the plasterer. An ornamental German steel rolled molding can be used to cover the joint. Where there are only occasional doors in the partitions and economy is desired, the rough wooden jambs can be secured in no better way than the simple one of driving two cut nails into their backs between the joints in the courses of tiles, and depending on the weight of the tiles on the projecting nail heads to hold the rough frames in place. These are better than angle cleats or anything else of the kind. No door studs should run to the ceiling. The tile partitions will always stand the racket if the door jambs are secured firmly to them. Experience has shown that no dependence can be placed in nails for securing anything to porous tiles, but wood screws are reliable.

Furring brick walls is a simple process that requires little comment. The best method is that shown in the illustration (Fig. 6). This shows porous terra-cotta plates 2 ins. thick and 12 ins. square.

(Continued.)

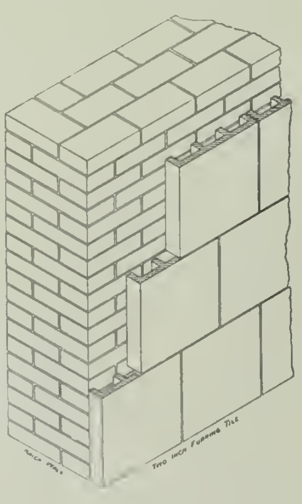


FIG. 6.

Mortar and Concrete.

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

BY CLIFFORD RICHARDSON.

THE ROSENDALE CEMENT INDUSTRY.

A GREAT anticlinal fold, extending along the valley of Roundout Creek from the Hudson River to the south and west for many miles, brings to the surface a series of cement rocks which is the source of the raw material for the great Rosendale cement industry; an industry which, as has been shown, supplies the Atlantic Coast with over three million barrels of cement a year, and which includes the mills of one company, alone able to turn out seven thousand barrels of cement a day.

The rock of suitable nature for cement making consists of two beds, one lighter in color than the other, which are separated by from 6 to 12 ft. of rock, not sufficiently argillaceous for making cement. The average thickness of the light rock is 11 ft., and the dark rock 21 ft. They are now quarried at a considerable depth below the surface, and obtained in a dense and unaltered condition. A collection of the rock from quarries, working at three different depths, made especially for the purpose in May, 1897, had the following composition: —

UPPER OR LIGHT STRATUM.

Density.	Nearest Surface.		Medium Depth.		Deepest.	
Coarser than 200 sieve	2.9		0.		.6	
Coarser than 100 sieve	2.3				.6	
Coarser than 50 sieve	1.7				.4	
Loss on ignition	38.00		36.90		37.72	
Insoluble in HCl	17.38		22.68		20.68	
Total Alumina and Iron Oxides	5.50		7.62		7.20	
Total Carbonates	80.80		72.70		75.80	
Carbonic Acid, Water, etc.	38.00		36.90		37.72	
Lime CaO, soluble	26.66		23.60		23.92	
Lime CaO, insoluble	trace		trace		trace	
Magnesia, soluble	15.00		13.70		15.06	
Magnesia, insoluble	.79		.88		.69	
Total		15.79		14.58		15.75
Alumina, soluble	1.04		1.88		.56	
Alumina, insoluble	2.94		3.80		3.52	
Total		3.98		5.68		4.08
Iron Oxide, soluble	1.52		1.20		1.96	
Iron Oxide, insoluble	40		.74		1.16	
Total		1.92		1.94		3.12
Silica	12.72		16.66		15.14	
Sulphuric Acid	.68		.13		.09	

LOWER OR DARK STRATUM.

Density.	Nearest Surface.		Medium Depth.		Deepest.	
Coarser than 200 sieve	0.		0.		1.2	
Coarser than 100 sieve					.5	
Coarser than 50 sieve					.3	
Loss on ignition	33.84		36.28		34.60	
Insoluble in HCl	16.62		22.90		25.06	
Total Alumina and Iron Oxide	8.14		11.00		7.78	
Total Carbonates	70.20		66.50		73.30	
Carbonic Acid, Water, etc.	33.84		36.28		34.60	
Lime CaO, soluble	22.00		22.17		22.01	
Lime CaO, insoluble	trace		trace		trace	
Magnesia, soluble	13.90		12.07		13.15	
Magnesia, insoluble	.83		.79		2.98	
Total		14.73		12.86		16.13
Alumina, soluble	1.12		3.92		2.58	
Alumina, insoluble	3.68		4.38		2.26	
Total		4.80		8.30		4.84
Iron Oxide, soluble	3.34		2.70		1.72	
Iron Oxide, insoluble	.92		.86		1.22	
Total		4.26		3.56		2.94
Silica	18.40		16.22		18.48	
Sulphuric Acid	.17		.25		trace	

The hydraulic limestones of the Rosendale cement formation are seen to be somewhat variable in different localities and at different depths of the quarries from the surface. The upper or lighter stratum or bed is richer in carbonates than the lower or darker one, and, of course, poorer in silicates and oxides of iron and alumina. The nearer to the surface the quarrying is done the greater the amount of carbonates in the lighter stone, and the smaller the amount of silicates. This surface stone seems to be the most inferior in use. It is, however, mixed with the rock from the deeper quarries, having the most silicates, so that a proper average composition is obtained. All the cement rock contains much magnesia, from 15.06 to 12.07 per cent., but, fortunately, the silica and alumina are not, as a whole, deficient in amount, so that none of the strata are rejected. They require careful combination and proper burning, however, and their composition being so variable should be frequently determined by analysis, as a control. The best cement produced from this rock may be regarded as the highest standard of what a natural cement should be.

BURNING OF NATURAL CEMENT.

Natural cement is burned in much the same way as lime. The kiln commonly used is the ordinary draw kiln, a structure of masonry lined with fire-brick, or an outer iron casing, or shell, enclosing a light brickwork the space between which and the fire-brick lining is filled in with sand or loam. These kilns are from 20 to 30 ft. high and from 8 to 12 ft. in diameter. They are arranged either singly, in pairs, or in banks, and have somewhat varied vertical sections. There is generally an increase in diameter from the top to a certain distance, and then a more or less gradual contraction to the throat, an opening at the bottom, or eye, through which the draught of the kiln is maintained and the burnt stone drawn.

The peculiar forms seen in practise are characteristic of the localities where they are used.

In some works flame kilns have been employed in which the combustion is carried on in furnaces outside of the main body, and the stone burned by the heat of the products of combustion. These kilns have no great application in the United States, as they require more fuel and more constant attention. Theoretically they are a much better form, as the finished cement is not mixed with the fuel ash, and the burning is more regular. The cement produced by them is found, however, not to be so much more satisfactory as to repay the extra cost.

Ordinary kilns hold enough stone to make from 300 to 600 barrels of cement of 300 lbs. each. They are charged with alternate layers of stone of suitable size, and coal. The size of the rock depends upon the ease with which it can be calcined, and the degree required for producing a good cement. It is at times uniform, or a certain proportion of finer material may also be added to prevent the too free burning of the kiln.

The proportions of fuel and stone vary very much. From one quarter to one eighth of the weight of the stone in coal is used.

The regulation of the temperature and time of burning is accomplished by varying the amount of coal, the size of the pieces of rock, the draught through the kiln, and the length of time between each drawing. The amount of coal and the draught are, of course, the principal factors in the burning. For hard burning more coal is used, for quick burning less, and more draught.

In burning the Rosendale cements there has been no change in the form of kiln since the early days of the industry. The old-fashioned draw or pot kiln is still in use, the eyes of two kilns opening into the same drawing pit, and the kilns being arranged in banks of six or more. The fuel is fine anthracite which is charged alternately with the rock, about 4 ins. of the former and 18 to 20 of the stone, which corresponds to about four and five tenths to five times more stone than coal in volume. Gilmore states that at the Ulster County cement works 3,500 lbs. of coal burns 30,000 lbs. of cement, which would be equivalent to over 40,000 lbs. of rock, and a proportion of over twelve times as much stone by weight as rock.

The kilns are drawn twice daily in the Rosendale district, beginning at 5 A. M., continuing until the rock gets hot, and again in the afternoon. At night the kilns are heaped up, and are burned down by morning. From 1 cu. yd. of rock nine barrels of cement are ground.

In the Potomac Valley and in the West bituminous coal is used in the same way. The custom there is to draw but twice a day, with the limestones free from magnesia, while at Fort Scott, Kan., small drawings are made every four hours. For each stone and each kind of fuel and form of the kiln the best proportions must be learned by experience, and it is not always possible to learn them from the manufacturers.

If the kilns are not properly charged and watched they may burn too quickly and freely, or, not having sufficient draught, the stone will be burned too little or unevenly, and the quality of the cement be inferior. Some rock, under careless regard of conditions, will be over and some underburned.

Finally, there is such a difference in the way various hydraulic limestones ought to be calcined that they should each properly be burned in separate kilns, where strata of different composition in the same quarry are in use, and the product then mixed in the most desirable proportions. Economy and carelessness, however, seldom permit of this refinement in practise.

TEMPERATURE OF BURNING.

What the suitable temperature and length of time of burning any particular stone may be depends on its composition as well as on its physical properties, density, and state of aggregation.

With a good stone, with medium percentages of clay, of fine grain and good density, a gentle and rather prolonged burning is best. The carbonic acid should be nearly, but certainly not entirely, removed from its combination as carbonates, yet no signs of sintering or clinker should appear.

When the insoluble part is more silicious than clayey, and especially when it is rather coarse, a very gentle and prolonged heat is the best to enable the lime to slowly combine with the silica.

When the insoluble matter is clay, and this is present at all in excess, a sharp, quick heat is found most desirable. The higher the amount of insoluble matter or silicates in a hydraulic limestone the more carefully it must be burned and the lower the heat must be. Rocks of this class, when overburned, are liable to crack and blow on setting.

When magnesia is present in large amount the rock can be burned in two ways, either below a red heat sufficiently to expel the carbonic acid from the magnesian carbonate, and to a smaller degree from the calcium carbonate, which gives a cement of considerable hydraulic activity; or it may be very strongly burned until the hydraulic activity of the magnesia is destroyed. The latter method is seldom or never followed in practise, as it is difficult to regulate and not universally applicable.

The smaller the amount of clay and silica in magnesian rocks the more moderate must the burning be, until finally a dolomite with no clay is reached, which, with light burning, will yield a mixture of magnesian oxide and carbonate of lime which has very considerable hydraulic activity.

Magnesian cements deficient in clay, which approach hydraulic limes, if not burned carefully, are, however, very apt to expand a long time after use.

In the Rosendale limestones of Ulster County, New York, a suitable amount of clay is found, and this, together with the density of the rock, gives the cements made from them their desirable properties, as distinguished from the Western New York cements, which are, most of them, scarcely more than hydraulic limes.

CHEMISTRY OF BURNING.

In the process of burning cement stone the rock, at a low temperature, is dried out. At about 750 degs. Fahr. it begins to lose carbonic acid, although a continued bright-red heat is necessary for the complete conversion of the carbonates to caustic lime and magnesia. A porous stone burns much more easily than a very dense one. The best hydraulic limestone requires, therefore, longer burning than the inferior material. The rate of burning also depends on the size of the fragments and upon the rapid removal of the carbonic acid from the kiln, as in ordinary lime burning. The amount of clay or silica in the stone has also an influence; the more of these substances present, the more difficult the burning.

When the carbonic acid has been driven off in part the free lime, at the high temperature, attacks the clay and silica, combining with them to form new compounds having hydraulic energy and rendering them soluble in acid, although previously insoluble. The heat, however, in the process of natural cement making is not great enough to bring about the combination of the entire amount of lime present with the silica and clay, as in the case of Portland cement. A certain amount remains uncombined, both free and as carbonates, and the silicates and aluminates are not as basic, lime and magnesia not being present in these compounds to their full capacity, as they are in the artificial cements, where as much lime is combined with the silica and alumina as is possible, to form very basic compounds.

Some free lime, and generally carbonates, are therefore present in natural cement, and are characteristic of it.

If too great a heat is used in burning, approaching that employed in the Portland cement manufacture, compounds are in most instances formed which have no hydraulic value unless the proportions of the various constituents in the stone are approximately those required for that class of highly burned artificial cements known as Portlands, when such a substance may be formed. In the presence of too much clay overburned natural cements contain very unstable compounds which, while they may at first set on addition of water, check later and fly to pieces.

When there is an excess of certain elements in limestone, such as alkalies or sulphates, these substances may enter into the reactions of the burning process and complicate it, as they have a tendency to form with ease compounds of ready fusibility. Rocks of such composition are unsuitable for use.

ILLUSTRATIONS OF RESULTS OF BURNING.

The peculiarities which have been mentioned may be illustrated by some particular cases.

No. 1. A Lime Cement. This cement when freshly made had the following composition : —

Loss on ignition, carbonic acid, and water,	10.27
Silica and silicates, not decomposed by burning.	9.80
Silica combined with lime in burning,	20.42
Alumina and iron oxide,	13.76
Lime,	39.54
Magnesia,	3.80

This cement, burned from a stone comparatively free from magnesia, as ready for use, loses only about 10 per cent. of its weight on ignition, consisting of water, with which the freshly burned stone was sprinkled to lengthen the time of setting, and of carbonic acid, which shows that the burning was thorough. The silicates have not, at the temperature employed, all been decomposed and become combined with lime, but very much the largest part has done so. There is an ample amount of alumina, all of which has been converted into compounds of hydraulic value in the kiln. This cement is an excellent example of this type of natural lime cements.

Tests for tensile strength gave the following results : —

Neat at	1 day	150
	7 days	440
	28 „	452
2 parts quartz	7 „	244
	28 „	276

It acquires strength rapidly in the test pieces in seven days, and would be found to increase slowly for one or two years thereafter. In actual use, with larger quantities of water in the mortar, it would of course attain its strength more slowly.

No. 2. A Blowing Magnesian Cement. This cement, when made into briquettes and immersed in water, checked and blew to pieces in a few days. The difficulty is revealed by the following results of an analysis : —

Loss on ignition, carbonic acid,	7.44
Silica and silicates, undecomposed,	17.09
Silica combined,	10.88
Alumina and iron oxide,	13.26
Lime,	38.69
Magnesia,	9.64
Sulphuric oxide,	.95

The burning, it appears, has been so conducted that, while carbonic acid had been largely driven off, the temperature was too low to permit of combination of the free lime with the silica, although unstable alumina compounds had been formed. The cement, therefore, blows. On reburning it, at a higher temperature, for a short time a normal magnesian cement was obtained. It contained then but 3.70 per cent. of carbonic acid, and but 4.70 per cent. of undecomposed silicates. This cement gained strength slowly but regularly, and, when properly burned, has been largely used in concrete with great success.

Tensile strength tests resulted as follows : —

Neat at	1 day	82
	7 days	102
	28 „	252
	3 months	340
	6 „	358
2 parts quartz	7 days	59
	28 „	120
	3 months	238
	6 „	288

No. 3. A Magnesian Cement Deficient in Clay. This cement gave very low results on testing for tensile strength for the first few days after mixing, but soon gained rapidly, expanding, however, very considerably at a greater age. Its composition was as follows : —

Loss on ignition,	6.00
Silica and silicates undecomposed,	4.48
Silica combined,	13.06
Alumina and iron oxide,	5.01
Lime,	41.79
Magnesia,	29.60

The cement is plainly deficient in silica and alumina and contains a very large amount of magnesia. It has been burned, apparently, quite hard, and is practically merely a dolomite cement which is weak at first, and afterwards, although attaining very considerable strength, expands. To obtain the best results with this cement it was, of course, necessary to burn it quite hard. The results of tests for tensile strength were as follows : —

Neat at	1 day	36
	7 days	230
	28 „	400
	6 months	Expands
2 parts quartz	7 days	130
	28 „	300
	6 months	Expands

This cement is used successfully for much work where the expansion in sand mortar does no damage, but it is hardly satisfactory to use such material.

HARDENING AND DETERIORATION OF LIME MORTAR.

BY H. K. LANDIS, E. M.

IT frequently happens that specifications are very rigorous in their requirements for the character of sand employed in mortars containing the best grade of lime, and very exacting in the proportion of sand to be used. This is probably due to the antiquated idea, held by some, that the sand actually combines with the lime and forms large proportions of silicate of lime. It is a fact that silicate of lime is formed in lime mortars, but not in quantities sufficient to make it the predominant factor in hardening of mortar. Petzholdt found two thirds of 1 per cent. of the quartz sand added to lime had combined with it in five weeks, while but one tenth that amount was found combined at the end of one week. In a wall one century old 2.1 per cent. of combined silica was found, while this was increased to 6.2 per cent. in a mortar three hundred years old, although the original lime contained but 0.11 per cent. combined silica. The hardening effect of this silicate of lime is, however, insignificant when compared with the total hardening of lime mortar, for after several years there will be but half a per cent. of silicate of lime in the mortar.

This silicate is not very stable because carbonic acid, a comparatively weak agent, displaces it. Moisture favors the formation of silicate of lime, so that its formation begins from the time the mortar is mixed, and is comparatively rapid until the lime mortar has dried ; then carbonic acid gas begins to act, and as numerous observations and analyses have shown, really displaces the silicate with carbonate, for scarcely a trace of silicate is found among the carbonate ; it, however, exists in the interior where the gas has not yet penetrated.

The mixture of sand with lime is thus not the necessary condition of hardening, for hard mortars can be obtained by mixing finely ground limestone or chalk with the lime. Its functions lie more particularly in making the mortar more porous, thus permitting easy access of carbonic acid gas in counteracting the effects of shrinkage, and in reducing the cost of mortar.

Sand should be free from earth, dust, clay, or iron rust in order to permit the close adhesion of lime to it; this action is mechanical. It should be angular, as the mortar is thus not so liable to fracture along a smooth plane, which is thus one of greater weakness; angular masses knit together and bind each other, and are also more elastic; the sharp edges of the silica sand do not form silicates to any noteworthy extent. The particles should be uniform in size and not too coarse, in order to avoid the occurrence of flat surfaces in the section of mortar which would be large enough to weaken the mortar itself, because the cohesion of lime for itself is greater than its adhesion to any large surface. Thus far a specification can reasonably go.

Not all mortars are equal setting; some become solid in a few days, while others will not be completely hardened in a century. When fresh mortar is exposed to the air it first loses part of its water, then begins to take up carbonic acid gas, which is given out by animals, and by vegetable combustion, and has its hydrate of lime changed to carbonate of lime. This absorption takes place gradually, from the surface inward, and usually does not begin until the mortar has set; it is found that the proportion of water in fresh mortar — about 50 per cent. — is strong enough to prevent the formation of carbonate of lime, and to prevent the absorption of gas. If we place fresh mortar in a glass tube and fill it with carbonic acid gas, the mortar will be unchanged after many days, and the quantity of gas absorbed will be insignificant, while the same mortar exposed an equal time in air will have absorbed considerable gas.

Suspend in a flask filled with carbonic acid gas samples of fresh mortar. At the end of a week it will be as moist as when put in, and will have absorbed less than 1 per cent. of its weight of gas. If, now, a dryer, such as strong sulphuric acid, is placed in the bottom of the flask, the same samples of mortar will absorb the carbonic acid gas in the flask at the rate of about 14 per cent. per day. A number of other experiments may be performed to show the same fact. If, however, we dry the mortar completely we obtain a very compact but very friable mass. Duquesnay says that in this state the mortar does not harden and absorbs no carbonic acid gas. A certain amount of moisture is thus necessary in the mortar.

The formation of carbonate of lime is favored by drying slowly after setting, and this also favors the cohesion of the hydrate, since the particles which solidify first are surrounded by a solution of lime which on drying leaves its lime on the outside of these particles and cements them together just as the grains of sand are cemented together in the formation of sandstone ; this cementing is the more complete as the drying is slower, and thus one can explain the extreme solidity of masonry of the middle ages, which now must be blasted in removing.

Gas penetrates smooth surfaces more slowly than rough ones; in fact, the character of the surface exposed to the air has a very strong influence. In a block of lime which was examined chemically at the end of a year, the depth to which carbonation had penetrated on a trowel-finished side, a rough-finished side, and a side which had been broken off, was in the proportion, respectively, of 3 to 7 to 14, half the surface of a cross section being unaffected. This would indicate that the usual method of smooth finishing joints is not the best.

Deterioration in mortars has numerous causes which depend upon both outside conditions and the character of the mortar itself. It is assumed that stone and sand shall be used, which will be unaffected by the ordinary agencies with which it comes in contact. Precautions are easy to observe in this regard, but when we come to lime it is not so easy to prevent alteration. Lime is soluble in water, and if exposed to a current will be taken up by the water quite rapidly. When the mortar has somewhat hardened in air and is then exposed to still water the effect is inappreciable, for the lime is protected by a superficial coat of carbonate, and not only resists the dissolving action of the water but attains to considerable hardness.

Nitrogenous matter, such as manure or urine, can produce nitrates of lime under certain conditions of moisture and temperature. This salt deposits as snow-white accretions on the stone or as a superficial layer on the mortar, and sometimes resemble flakes of snow. Such salts are used in the chemical industry ; their production should be discouraged, as they have a deteriorating effect on the masonry, making it liable to crumble.

Efflorescences of another kind often appear on the surface of the walls, such as sulphate of soda, carbonate of soda, chloride of sodium, carbonate of potash, and chloride of potassium, which contain the constituents of neither stone, brick, nor sand, and are hence attributed to the kind of lime used in the mortar. The presence of alkalies is explained by their existing in the original limestone before calcination, or that they are derived from wood and coal ashes which contain considerable quantities of alkalies; sometimes soil alkalies are brought in by surface waters and disperse through the walls, leaving a white deposit on the surface when they evaporate.

Ammoniacal fumes are given out by many industrial operations, as when tobacco waste is burned in fireplaces along with coal or coke; the latter furnish sulphurous vapors derived from the oxidation of iron pyrites in the coal, which combines at the top of the chimney with condensed water vapor and ammonia gases, forming sulphate of ammonia; this liquid in a short time causes the mortar to disappear entirely. The use of salty water for slaking lime or mixing mortar causes the formation of chloride of sodium and carbonate of soda (common salt and washing soda), which absorb moisture readily and tend to constantly keep the walls damp.

THE ELECTRIC CONDUCTIVITY OF CEMENTS AND BETONS.

IN a very interesting series of experiments made by Dr. Lindecka and described in the *Electrotechnische Zechschrift* a considerable amount of new information was brought to light.

He found that the electric resistance of a cubic foot of cement, when dry, was about 144 ohms, which fell to 43 ohms after 24 hours' immersion in water, while it rose to 820 ohms when exposed to a temperature of 212° Fahr.

Sand and gravel increase the electrical resistance one part of cement to seven of gravel in a block having a resistance of 18,000 ohms, which fell to 72 ohms when the blocks were wet, or rose to 2 megohms at 212° Fahr.

If we allow for concrete an average resistance of 1,670 ohms per cubic foot, one obtains an insulation resistance of about 1.2 ohms per thousand. In asphalt paving the loss of current through the asphalt is very small, so that where conductors are laid directly in the concrete they should be surrounded with asphalt cement. This cement is usually made, one half broken stone; gravel, free from clay or sand, 20 per cent.; asphalt, 12 per cent.; tar, 8, and mineral oil, 10 per cent. These figures are important, not only as showing how current may be saved, but also in pointing out the conditions under which cement insulation may become a dangerously good conductor.

The Masons' Department.

HOW SHALL THE VALUE OF EXTRA WORK BE DETERMINED?

THE most irritating and troublesome questions which the architect and contractor are called upon to consider are probably those of determining the value of extra work or work omitted. The zeal which the architect often displays in the interest of his client on the one hand, and on the other the pernicious habit of many contractors who take work at cost or below and depend on changes to make their profit, are perhaps equally responsible for the trouble which ensues. It takes comparatively little experience to absolutely prove that almost no building contract is carried to completion without more or less changes from the original scheme. And the alterations made from time to time, which affect the progress of the work, must of necessity be ordered without delay and in accordance with the terms of the contract. The natural result of this is that very little time is afforded the architect to verify the propositions of the contractor, and the necessary haste often tends to encourage arbitrary action. While most all building contracts at the present time provide for an appeal from the decision of the architect by either of the parties concerned, and the reference of such questions to three arbitrators, such a course is rarely taken. The complexity of the architect's duties makes it impossible for him to keep more than generally informed as to the value of the various work and materials which enter into the construction of a building, and he must, therefore, adopt one of two courses to obtain the information which is necessary for him to possess in order to fulfil his obligation to the client on one side and the builder on the other; the first is to arrive at a conclusion from personal observation and experience; the other is to obtain the desired knowledge from experts, that is to say, those who are engaged in the same sort of business in regard to which the question arises. Each of these courses have their own peculiar disadvantages. In the first instance, the architect is usually inclined to undervalue, for the simple reason that it is almost impossible for an outsider to appreciate the amount of detail which goes to make up the cost of labor and materials connected with any given piece of work. If, on the contrary, he seeks expert advice, what may be broadly defined as "professional courtesy" prevents his getting at the bottom facts, or else, for some reason, the person to whom the matter is referred takes the opportunity to even things up or pay off an old score by giving prices unreasonably low. The simple truth is that the position of the architect, when called upon to determine what is a fair value for the work of a contractor, is one which is extremely difficult to fill with any degree of satisfaction to both of the parties concerned. This fact has led some architects to insert a clause in their contracts making the architect the sole judge of the value of work and materials, with no appeal from his decision. This arbitrary method can hardly be defended as quite just or reasonable, but one is sometimes inclined to believe that even a solution as absolute as this is preferable to the discussions and irritations of a less severe method; for under this plan the matters can at least be settled promptly and once for all, which in some ways has an advantage over the usual manner which so often involves perhaps a greater loss in the way of delays than would be suffered by the arbitrary decision of the architect. There can be no question that, if some method could be devised by which the value of extras could be settled both promptly and fairly, the builders who figure to do work exactly as called for, and include in their original estimate a fair and reasonable profit, would be much more likely to be successful when in competition with those who pursue the opposite course. There are very few architects of standing who would not prefer to give their work to the former class, but the apparent saving by the acceptance of a low bid is usually too much of a temptation to the client, who cannot be made to realize the economy of a just discrimination until he has paid out much more than the original saving in overvalued extras and undervalued omissions.

The satisfactory solution of this problem seems at first thought a difficult matter, but in reality it probably presents no more serious complications than many other questions which have been met and settled. With the knowledge which both architects and contractors have on this subject, it is to be hoped that their organizations will realize the importance of instituting a reform in this direction.

CONTRACTOR.

EDITOR OF THE BRICKBUILDER.

Dear Sir: — May I trespass on your valuable space to ask for a bit of advice? I am erecting a building of which the first story is stone, and the upper stories of brick and terra-cotta. For constructive reasons the masonry should be laid up in cement, but I do not dare to risk the staining which cement is so apt to impart to the stonework. I have been advised to put a certain amount of sugar in lime mortar and use the mixture instead of cement, and I have been told that the addition of sugar to lime mortar will produce a species of cement which will set up very nearly as hard as if hydraulic cement were used. Is this true? Can you give me any idea as to the proportion of sugar to use? And whether there is any liability of the mortar staining the limestone? I was advised by the mason to cover the back of the stonework with asphalt, but I hesitate to do so, fearing that the oil in the asphalt would work through and stain the stone. Is there anything else which can be used to advantage to prevent the moisture of the cement from the brick backing working out through the stone?

Also, in regard to the terra-cotta, it is to be what is commonly designated as white terra-cotta. In the last building upon which I used this shade of terra-cotta I find that the surface of the material is stained somewhat, and though the building has been finished for over a year, the individual blocks are not of the same tone, and none of them have come back to the color they presented before the work was set in the building. The terra-cotta was laid up with mortar composed of lime, with a very small proportion, I think one sixth in bulk, of Rosendale cement. I am afraid to use cement in the new work. Why should the light terra-cotta stain, or, why should it not regain its original color when dried? I feel that facts of this sort are pretty vitally connected with the use of terra-cotta, and should be glad of any advice you could give me.

ARCHITECT.

IN regard to the staining of stonework, Lefarge cement, it is claimed, will not stain the stone at all, but any other cement which is on the market at present, with which we are familiar, is liable to produce discolorations. The value of sugar as a component of lime mortar is an unknown quantity to us. It has been used repeatedly, but we are unable to give any exact information as to the quantity necessary to produce the best results. The value of sugar as a component of lime mortar lies in the fact that sugar unites with a portion of the lime, forming saccharate of lime, which is considerably more soluble than the ordinary hydrate. Consequently, the resulting mixture will form a more intimate bond with the sand.

In regard to the staining of terra-cotta, it may come from one of several causes. We do not believe that cement can be trusted in any quantity in the mortar which is to be used for setting up light-colored terra-cotta. Even one sixth might produce permanent stains. Another cause of possible stains is due to the terra-cotta being improperly packed in soiled material. We know of one case where straw was used which had been taken from a stable where it had served as bedding for horses, and the owner of the building in question was for a long while at a loss to account for the vile yellowish stains which appeared on his terra-cotta. We believe, however, if pure lime mortar, the lime for which has been slacked at least three weeks before being used, is employed with clean, sharp white sand, and proper care is taken in the handling and setting, and nothing but pure water is used to clean off the surface of the terra-cotta, there will be no stains whatever on even the most delicate shades.

The use of iron ties is not advisable in connection with terra-cotta if extreme precautions are to be taken. Nothing better has so far been found than copper for this purpose, and if iron is used, even when thoroughly galvanized, it is liable to rust; and a very slight amount of oxide of iron is capable of producing serious stains in the terra-cotta.

It must be remembered that it is not enough to lay up the terra-cotta itself with mortar from which the cement is excluded, but the brick backing must equally be kept free from the disturbing influence, for it has been found that the staining qualities of the cement will penetrate through several courses of brick and affect the exterior surface of the terra-cotta. Furthermore, it is bad construction to lay up the backing of a wall with a different mortar than the front. The matrix ought to be the same in each case to insure equal shrinkage of the joints and to preserve the alignment of the wall.

We refer the questions of our correspondent to our readers, and would be glad to receive any information on the subject. EDS.

QUANTITY OF MORTAR REQUIRED FOR A THOUSAND BRICK.

A WRITER discussing in one of our exchanges the quantity of mortar necessary to lay 1,000 brick, states that this is a point on which knowledge is essential before one can properly estimate the cost of brickwork. He says that the proportion will vary with the size of the brick and with the thickness of the joints. With the standard size of brick, which are $8\frac{1}{4}$ by 4 by $2\frac{1}{4}$ ins., a cubic yard of masonry laid with $\frac{1}{2}$ to $\frac{5}{8}$ in. joints will require from .35 to .40 cu. yd. of mortar; or 1,000 bricks will require .80 to .90 cu. yd. If the joints are $\frac{1}{4}$ to $\frac{3}{8}$ in. thick, a cubic yard of brickwork will require from .25 to .30 cu. yd. of mortar; or 1,000 bricks will require from .45 to .55 cu. yd. If the joints are $\frac{1}{8}$ in., as for pressed brickwork, 1,000 bricks will require from .15 to .20 cu. yd. of mortar. It should not be difficult for an estimator to be able to tell exactly the cost of the matertals required to build up 1,000 bricks in a wall, having the cost of bricks, sand, and lime at hand, including hauling, with the above data before him. It is a little difficult to tell exactly how many bricks a man will lay in a day of nine hours, as conditions vary, and some men are much more expert than others; but if well supplied with materials, and no scaffolds to adjust, and a long wall to work on, 1,500 bricks would make a good average day's work. If, however, there are many openings to work around, and neat facing to do, from 900 to 1,100 will make a good day's work. In good ordinary street fronts from 700 to 900 may be counted, and in the finest street work, where there are numerous angles, doorways, or belting courses, from 150 to 250 may be considered a good day's work. In large works, or where walls are very thick, a good man will lay from 1,500 to 1,800 bricks, but this is rather the exception than the rule. A good laboring man will mix mortar and carry it and bricks for the bricklayers, if mortar and bricks are not more than 25 ft. from the building, and provided he does not have to carry water or climb a ladder. As the brickwork of a building rises, so does the cost. Whatever may be the figures obtained as the cost per 1,000 of laying bricks for the first story, 5 per cent. should be added to it for laying the bricks for the second story, and $12\frac{1}{2}$ per cent. for the third story, and a corresponding percentage for the work laid in higher stories.

SURETY ON BOND OF CONTRACTOR.

WHERE a building contract provides as a condition precedent to the final payment that there shall be no legal claims against the contractor for work or materials furnished, a surety on the bond of the contractor cannot enforce a lien for work or materials. He cannot be permitted to recover without violating his contract of suretyship, and he must therefore be held to have waived the right to file any lien in the face of his contract. — *Supreme Court of Pennsylvania.*

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

CHICAGO. — Foundation walls are being constructed for a church which promises to be a very interesting piece of brick architecture. The designs of the architect, Mr. H. J. Schlacks, show the extreme dimensions of the building in plan to be about 108 by 203 ft. The style is denominated by the architect "late Romanesque Gothic." The plan is a modification of the general Gothic type of the middle ages. The nave is 40 ft. wide between piers, while the aisles are narrow, and having no seats, serve for aisles only.

The foundation walls are of rubble stone and rest directly on natural rock 15 ft. below grade, the same stratum which is more than

TERRA-COTTA PANEL, MISSION LODGE HALL, SAN FRANCISCO, CAL.
Hermann & Swain, Architects.
Executed by Gladding, McBean & Co., San Francisco, Cal.

100 ft. under sand and clay at the business center of Chicago, five miles from this St. Paul's Catholic Church, which is located at 22d Street and Hoyne Avenue. All the walls are stone up to and including a granite water table 18 ins. above grade. Above this water table all the walls are to be brick, built hollow. The entire exterior and interior, including vaulted floors and the lofty vaulted roof, are to be faced with special brick and terra-cotta of various colors. Several large finial crosses are to be terra-cotta, and copings and other trimmings will be of the same material. The splay molded sills and jambs of windows both outside and inside, the buttress caps, etc., and the vaulting as well as the plain wall surfaces are all to be of fire-clay stiff mud brick repressed and vitrified. The full-size diagrams of all these brick are being made in the architect's office. There are probably fifty different special shape brick. The standard adopted for a finished brick is $4\frac{1}{8}$ ins. by $8\frac{3}{8}$ ins. by $2\frac{7}{16}$ ins., the vertical mortar joints are allowed $\frac{1}{8}$ in., and the horizontal joints $\frac{3}{16}$ in. The archi-

TERRA-COTTA DETAIL, HUDSON BUILDING, 32 BROADWAY, NEW YORK.
Clinton & Russell and A. F. Leicht, Architects.
Executed by the White Brick and Terra-Cotta Company.

QUEEN INSURANCE COMPANY BUILDING, BROADWAY, NEW YORK CITY.
Geo. Edw. Harding & Gooch, Architects.
Face brick supplied by Sayre & Fisher Company.

tect's aim has been to make the building look what it is, a brick building, and in designing the terra-cotta ornament care was taken that it should not be an imitation of carved stone.

All the work is to be laid in imported Portland cement mortar. The piers carrying the vaulted roof are solid construction, not iron columns veneered with terra-cotta. Massive walls, instead of being filled with useless concrete, are hollow, carefully laid with thickness proportioned to imposed loads. The result ought to be both strength and economy. As for color, the exterior is to be a mottled mahogany, while the interior is to be treated in light shades of buff mottled, and with the mahogany color for trimming. Bricks are being delivered on the ground now.

The design shows a simplicity and beauty of composition, and yet a building so large and imposing that one thinks he is looking at a cathedral costing a half million of dollars. Imagine, then, one's astonishment when assurred by the architect that the church will be constructed and completed for $75,000! It might be added that the construction of this building is intended to be as nearly fire-proof as possible. The door frames are iron, while windows are minus frames and sash, the glass being set directly in the brick.

Work on the new government building has begun in earnest and is being pushed seven days in the week, and nights as well. This great excavation, a block square, busy with men, teams, and pile-driving apparatus, is now the center of all eyes in Chicago.

The Governor of Illinois has appointed the examining board of architects, the members being Mr. D. Adler, Mr. P. B. Wight, Prof. N. C. Ricker, Mr. Wm. H. Reeves, and Mr. Wm. Zimmerman. The effectiveness of the new law will depend in great measure on the efforts of this board.

In the way of building items we note: A mill and warehouse $160,000, by Flanders & Zimmerman; a factory, $50,000, by J. H. Wagner; a fire-proof office and theater building, by Inland Steel Company, $65,000; Wells-Fargo stable, $75,000, by M. L. Beers; Dormitory at Beloit, Wis., $30,000, by Patton & Fisher; Lehman apartment house, $200,000, by E. R. Krause; a row of twelve stone houses, $90,000, by H. L. Ottenheimer; apartment building, $25,000, by Pond & Pond.

NEW YORK. — That the immediate outlook for prosperity, or at least better times for the building and real estate trades, in this city is near may be inferred by the observant in connection with two very important kinds of transactions which have been the features of the past month.

The first is the selling of private houses to those who will occupy them. This is the healthiest sign that has shown itself in the real estate market in months. Purchases of this kind mean that small investors in considerable numbers have entirely recovered confidence and are ready to do business. The few sales already closed will inspire hesitating buyers to come forward with some assurance, and with the great improvement in general trade, and the splendid condition of the stock and grain markets. there cannot but be, at least, the beginning of an active fall season.

The second line of sales is not so gratifying. One of the leading New York papers is authority for the statement that New York has an oversupply of many kinds of structures. Flats and tenements there are in plenty, as thousands of vacancies testify, and in small low-priced dwellings the demand hardly equals the supply. Looking back on the work of the past spring and summer, the casual observer would naturally think that the architects must be very busy; but on investigation it is found that this large work is, as is perfectly proper, entrusted to those few who have attained a reputation for carrying on work of that kind, while it is a fact that those men whose special study is smaller work, residences, etc., are not terribly overworked, and there are still draughtsmen looking for jobs, which will probably be forthcoming to those who are worthy. Among the recent items of news are:—

A fifteen-story office building at 35 Broadway for the estate of A. Hemenway. It will be a

TERRA-COTTA DETAIL, PRESBYTERIAN BUILDING, PHILADELPHIA, PA.
Jos. M. Huston, Architect.
Executed by the Conkling, Armstrong Terra-Cotta Company.

brick building and will cost $800,000. Clinton & Russell are the architects.

The Medical Society of the county of Kings are holding a competition for a new club house to be erected on Bedford Avenue, Brooklyn, at a cost of $50,000. Drawings are due September 20. The building committee has appointed Frank Freeman, a practising architect, to be their professional adviser. This is not usually considered proper practise; but in this case we can assure competitors of fair treatment, as the architect mentioned is one who holds the honor of this profession above all thoughts of personal gratification.

A five-story brick business building will be erected on Prince Street, corner Marion, to cost $50,000. Richard Berger, architect.

Howard & Cauldwell, architects, have made plans for a $20,000 addition to the Ladies' Christian Union Building, 27 North Washington Square.

George Keister, architect, has planned a $40,000 addition to an eight-story brick and stone business building for Mr. J. B. Cole.

G. F. Pelham, architect, has made plans for a five story brick apartment house on Amsterdam Avenue, to cost $70,000.

Edward Wenz, architect, has planned three five-story brick flats and stores to be erected at Lenox Avenue and 113th Street, at a cost of $95,000.

M. J. Garvin, architect, has planned two five-story brick flats and stores to be built on 171st Street. Cost, $55,000.

Henry Anderson, architect, has planned a flat building to be erected on 115th Street, corner Seventh Avenue, at a cost of $90,000.

Neville & Bagge, architects, have planned five five-story brick flats to be erected on 115th Street, near Lenox Avenue, at a cost of $115,000.

C. B. J. Snyder, architect, has prepared plans for a five-story brick public school, to cost $220,000.

ST. LOUIS. — The revival of business throughout the entire West, and the improvement in local realty circles, although not affecting the architects much as yet, offers considerable encouragement, and it seems to be the feeling with every one that next year will be a busy one, and that work will commence early in the season.

During the last few months there has been a gradual increase in the value of the improvements that have been made, which have been of the character of flats and small residences in the outlying districts, but now the improvement or alteration of business houses, and the building of additions to factories, seems to be attracting considerable attention. Many of these improvements are of considerable importance; as, for instance, the alterations in the Southern and Hurst hotels, the erecting of a $90,000 factory by the Curtis Manufacturing Company, a $100,000 plant by the Brecht Ice Machine Company in North St. Louis, and a large ice factory by the Anheuser-Busch Brewing Company.

Work has also been commenced upon several buildings where it was suspended last year on account of money matters.

John Conradi is the architect for the new Deutches Theater, which is being built on Broadway, between Market and Walnut Streets, at a cost of $40,000.

The transfer of 107 ft. of land on the north side of Washington Avenue between 9th and 10th Streets, and extending through 225 ft. to Lucas Avenue, was recently made, and it is reported that improvements in the way of a large wholesale house to cost nearly half a million dollars will be made. The building is to be occupied by the Hagardine-McKittrick Dry Goods Company, and work is to be carried on night and day to have it ready for occupancy by the first of May. Eames & Young are the architects. This location is fast becoming the center of the wholesale

DUNN BUILDING, BROADWAY, NEW YORK CITY.
Geo. Edw. Harding & Gooch, Architects.

RESIDENCE AT MADISON, N. J.
Boring & Tilton, Architects.

dry goods and boot and shoe trade, and other improvements are under consideration.

The Barnes Medical College will open their school year in their new building on Chestnut and 31st Streets, which they have recently completed. The building is five stories and basement, in the Italian renaissance style of architecture. Buff brick and white stone have been used in the exterior. J. B. Legg was the architect.

TERRA-COTTA DETAIL, MAIN ENTRANCE, ST. JOHN'S CHURCH, JOHNSTOWN, PA.
Beezer Bros., Architects.
Made by the Standard Terra-Cotta Company.

PITTSBURG. — The outlook for building during the fall is far more promising than it has been for several years. So great has been the demand for building permits, and so decided and general the opinion that building operations will assume vast proportions in the near future, that property has been affected in all sections of the city, and values will naturally be enhanced materially. Preparations and plans are being made for the erection of a market house in the East End, by a new corporation, under the title of "The Liberty Market." $200,000 will be spent; steel framing, Pompean and white enameled brick will compose the structure, and all modern improvement and convenience will be installed. A charter was issued at the State Department at Harrisburg for the Bellefield Company of Pittsburg, which proposes to erect a hotel near the entrance of Schenley Park. The capital stock is $300,000. The plans have been prepared by Architects Rutan & Russell, for a modern building in every particular.

Architects Vrydagh & Wolfe; Struthers & Hannah; J. L. Beatty; Bartberger & East; and E. E. Miller, have submitted sketches for the U. P. Shadyside Presbyterian Church.

Architect Charles Bickel is receiving bids for the erection of the Majestic apartment house, at Butler and 35th Streets, for Capt. M. A. Cutter, to be five stories, pressed brick and terra-cotta.

Architects Vrydagh & Wolfe are preparing plans for a brick colonial residence for W. L. Smith on Morewood Avenue, to cost $10,000.

Architect J. N. Campbell is preparing plans for a $10,000 buff brick colonial residence at Crafton for James McAleer, Esq.

Plans are being prepared for a new school building for the 10th ward, Allegheny, to cost $125,000.

Architects Rutan & Russell are preparing plans for a hotel at Sewickley.

George Booth, of the Department of Charities, has had plans prepared for a brick building for children at the poor farm at Marshalsea.

Architect J. E. Obitz is preparing plans for a brick church to be erected at Tarrentum for the Trinity Evangelical Lutheran congregation.

Architect U. J. L. Peoples's plan for the new high school at McKeesport has been accepted.

NEWS FROM THE BUSY.

THE Pioneer Fire-proof Construction Company, of Chicago, have taken a new suite of offices in the Marquette Building.

IN our last month's Boston letter, it was reported that Mr. George B. Rogers was the architect of the new Times Building, at Hartford. We have since learned that Mr. A. W. Scoville is the

MERCANTILE BUILDING, ST. PAUL, MINN.
Cass Gilbert, Architect.

architect of the building, Mr. Rogers being in his employ as draughtsman at the time that the plans were being made.

CHARLES T. HARRIS, Lessee, will supply the Celadon roofing tiles for the following new buildings: —

Residence for N. W. Bowen, Delphi, Ind.: Dauphin Park School Building, Chicago, Ill.; residence for Mrs. A. H. Armour,

RESIDENCE AT PITTSBURG, PA.
Alden & Harlow, Architects.
Face brick manufactured by the Harbison & Walker Company.

RESIDENCE AT MADISON, N. J.
Boring & Tilton, Architects.

Kansas City, Mo.; Railroad Station, at Franklin, Penn.; Biological Building, Columbus, Ohio; Susquehanna Avenue Church, Philadelphia, Penn.; residence, Newark, N. J.

WE have had sent us by the Powhatan Clay Manufacturing Company, a sample of their new silver gray brick. In shade and texture it is an ideal brick which shows that same excellence of manufacture that has made the cream-white brick, made by this company, so popular.

THE "Brooklyn Bridge" brand cement was specified on the thirty-story office building, on Park Row; R. H. Robertson, architect; John Downey, general contractor; Dawson & Archer, masons. The latter have adopted this brand of cement, and it will be the only Rosendale cement used in the construction of what will be the largest office building in the world. It may be also stated that this brand was the only Rosendale cement used in the largest hotel in the world, the "Astoria."

CHAMBERS BROTHERS COMPANY, of Philadelphia, report decided improvement in inquiries for brickmaking machinery within the past two months, and have booked an order for machinery to go to South America, and have recently shipped another of their well-known automatic end-cut brickmaking machines to Europe. They are very much gratified with the interest taken in their new steam-power repress for plastic brick, and have received two orders for this press within a few weeks. It is illustrated on page xl of this issue, and weighs about 14,000 lbs.

CENTRAL MOTIVE, DENTAL HALL, UNIVERSITY OF PENNSYLVANIA.
Edgar V. Seeler, Architect.
Executed in Terra-Cotta by the Conkling, Armstrong Terra-Cotta Company.

THE PHILADELPHIA AND BOSTON FACE BRICK COMPANY report that their business is better than it has been for years past. They are running a very large force of men at their works in Charlestown, and say that their brick mantel business the last week in August was the largest in the history of the company. In all their departments the demand is so great for their goods (which are sent to all parts, not only of the United States, but of the world) that they may have to run extra time to fill their orders.

THE following is a list of new buildings, for which the White Brick and Terra-Cotta Company have furnished the architectural terra-cotta: —

TERRA-COTTA LION'S HEAD IN CROWN MOLD OF CORNICE OVER 12TH STORY ST. JAMES BUILDING, BROADWAY, NEW YORK CITY.
Bruce Price, Architect.
Executed by the Perth Amboy Terra-Cotta Company.

Hospital for Crippled and Ruptured, Lexington Avenue and 43d Street, New York; architect, C. C. Haight. Addition to Normal School, Jamaica, L. I.; architect, I. G. Perry. Mercantile Building, 134–138 Mott Street, New York; De Lemos & Codres, architects; "The Washington Irving" apartment house, 112th Street, near 7th Avenue; architect, George Keister. Hudson Building, 32–34 Barry Street, New York, Clinton & Russell and A. F. Leicht, architects, Mercantile Building, 10th Street and University Place, New York; architect, W. J. Dilthey. Mercantile Building, 7 Great Jones Street; architect, L. Korn. Memorial Chapel, Wellesley College, Wellesley, Mass.; architects, Heins & La Farge.

FISKE, HOMES & Co. report an active demand for their light brick specialties, sales for August being largely in excess of previous month.

Amongst principal orders booked are: —

Extension of Hotel Reynolds, Boylston Street, Albert Geiger, Esq., owner, Arthur H. Vinal architect; the Home for Incurables, Cambridge, Mass.,

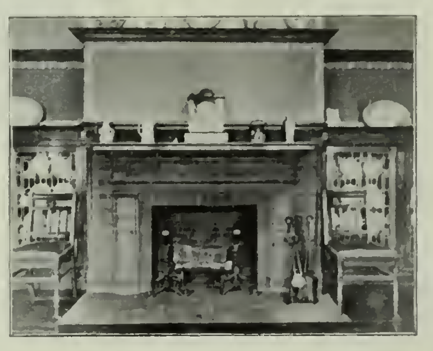
W. H. and J. A. McGinty architects; United States Post-Office, Lynn, Mass.; chapel and office, Mt. Auburn Cemetery, W. A. Sears architect; Mercantile Building, Merrimac Street, Boston, T. E. Clark

PORTION OF PARAPET RAIL, C. WEYAND BREWERY, BUFFALO, N. Y.
Geo. J. Metzger, Architect.
Executed in terra-cotta by the Northwestern Terra-Cotta Company.

architect; Mercantile Building, Main Street, Cambridge, Mass.; Twombly Block, South Framingham, Mass., C. E. Barnes & Co. architects; Legal Chambers, Spring and Poplar Streets, Boston, F. A. Norcross architect; Slocum Block, New Bedford, Mass., Nat C. Smith architect; extension of Parker House, New Bedford, Mass., Nat C. Smith architect; private residence, Cambridge, Mass., H. Langford Warren architect; business block, Lawrence, Mass.; Galvin's Block, Exeter and Boylston Streets, Boston; residence, New Haven, Conn.; barn for Springfield Street Railway Company, Springfield, Mass., brick and terra-cotta, Gardner, Pyne & Gardner architects; Tyler Block, New Haven, Conn.; Besse Block, Springfield, Mass.; together with about fifty apartment houses, business blocks, and private residences in Boston and immediate vicinity, taking approximately one million bricks.

We are in receipt of some very handsome blotters from the Clinton Wire Cloth Company, of Clinton, Mass.

It is the intention of the company to mail a new blotter each month to all parties interested in the use of wire cloth for building or other purposes. Any parties desiring to receive them regularly may have their names put on the list by sending their address to the Clinton Wire Cloth Company, Clinton, Mass.



INDEX TO ADVERTISEMENTS.

DYCKERHOFF Portland Cement

HAM & CARTER,
560 Albany Street, BOSTON.

E. THIELE,
78 William St., NEW YORK.
SOLE ACENTS.

"With a true sense of economy we would buy nothing in Europe but of necessity. The gold reserves of our government and individuals would then increase without even the intervention of tariffs."

Alpha Portland Cement

is the most economical. It is the finest ground cement on the market. For that reason it will take more sand and broken stone than any other cement in existence. To-day our best contractors and engineers consider it superior to any imported cement on the market. We guarantee every barrel of the "Alpha" to be uniform in quality, and to pass any requirement yet demanded of a Portland Cement.

WM. J. DONALDSON,
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Betz Building, Philadelphia, Pa.

JAMES A. DAVIS & CO.,
Sole N. E. Agents,
92 State Street, Boston.

Union Akron Cement Company,

SOLE MANUFACTURERS OF THE

Akron Cement,

(STAR BRAND.)

The Strongest Natural Hydraulic Cement Manufactured in America. In Successful Use for the past Fifty Years.

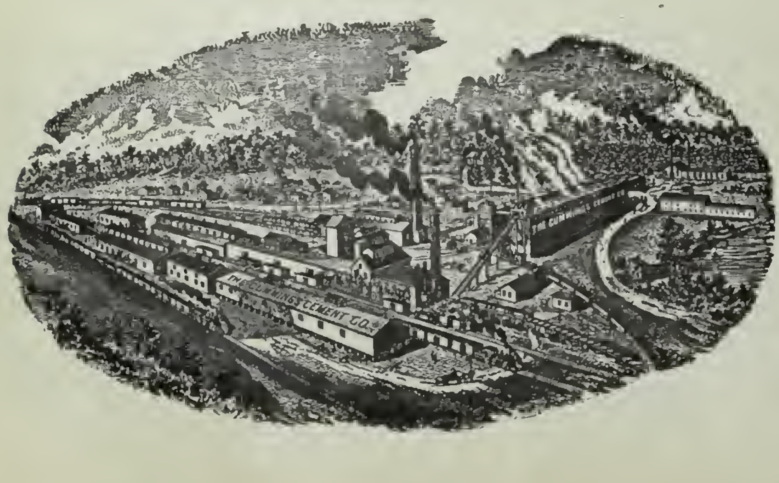
CAPACITY OF WORKS 2,000 BARRELS DAILY.

OFFICE, 141 ERIE ST., - BUFFALO, N. Y.

ALSEN'S PORTLAND CEMENT.

The strongest, finest ground, and most uniform Cement in the world. Permits the admixture of more sand than any other, and is the best for mortar or stuccoing.

143 LIBERTY STREET - - - - - - - - NEW YORK.
WALDO BROS., - - 102 Milk St., Boston.
AGENTS FOR NEW ENGLAND.



ESTABLISHED 1854.

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HOMER S. CUMMINGS, Secretary.
Stamford, Conn.

PALMER CUMMINGS, Treas. & Gen'l Mgr.
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VOLVME VI OCT. 1897 No. 10

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,

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PUBLISHERS' STATEMENT.

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The Brickbuilder is published the 20th of each month.

IN colonial times, and down to a comparatively recent date, to lay brick in Flemish, or in English bond, was a common practise. Specimens of both may still be seen in the older parts of nearly all of our Eastern cities; but we fear that what was formerly a rule — and a very good rule, too — has long since become the rarest exception. This is especially true of New York, where, of all the work done by the present generation of builders, we know but a few righteous examples.

America has gained immensely in many things by adopting the good, rejecting the bad, and avoiding the mistakes of older nations. In the bonding of brickwork this wise policy seems to have been reversed. Notwithstanding the force of both precept and example, we have contracted the inexcusably bad habit of laying brick in vertical tiers, with little more than a pretense at bonding. Worse still, we seem inclined to pursue this retrograde and dangerous career in spite of all warning and remonstrance. The sham that goes under the name of "American bond," and at which people who have seen it for the first time laugh ironically, has not the poor merit of being a successful delusion. Nobody, we suppose, is expected to believe that the four inches of face brick, in which no headers are permitted to appear, can be counted in as an integral part of the wall's thickness. A brick-mason of some thirty years' experience in England assured us, not many days ago, that "to face a wall without using *bona fide* headers is a thing utterly unknown there, — except as a criminal offense." We hope that here, too, there is a time coming when it will be classified in the same category, and similarly branded in public estimation.

The first, but we think the only practical difficulty encountered in this is the various sizes of face brick now in general use, and the want of corresponding sizes of common brick to work with them. These sizes, however, resolve themselves into two classes, the one being a brick of $2\frac{5}{16}$ ins. average thickness, which, with a $\frac{3}{16}$ joint, will course at a common multiple of $2\frac{1}{2}$ in. centers. The other, but much smaller class, comprises the various kinds of Pompeian brick, the approximate thickness of which may be set down at $1\frac{1}{2}$ ins. This with a mortar joint of $\frac{3}{16}$ gives us $1\frac{11}{16}$ ins. as the unit of measurement. It is with the latter class that the obstacles to be overcome appear most formidable; but they are only apparent, and in both cases can be made to vanish.

One way in which this may be done is to have common brick made to the same thickness as the face brick; or just a trifle less, to allow for a necessarily greater degree of irregularity in the bricks, and a more liberal use of mortar in bedding them. That a demand for common brick to be used in this way exists may have been gleaned from many inquiries made by architects from time to time, echoed by The Brickbuilder, and reechoed by some of our contributors. We would be glad to see that demand grow more general and insistent on their part. It would be an encouraging evidence of good intentions, and an augury of awakened interest. We can answer for the brickmaking fraternity that the supply would soon be forthcoming. The movement would be supported by all well-conditioned builders, as nobody knows better than they do the indefensible character of prevailing practises.

So far as the architects are concerned we have given them credit for good intentions, but these of themselves are inadequate. They are entitled, and by virtue of their office empowered, to do more than this. They should insist upon having the kind as well as the quality of material necessary to produce work that will be lastingly serviceable to their clients; therefore creditable to their own judgment, forethought, and integrity. They are supposed to know, and as a rule they do know what is right in such matters; it is equally incumbent upon them to point the way, and to see that the desired end is substantially attained. If not by a faithful discharge of these duties, then we would willingly listen to such other reasons (if any) as may be adduced in vindication of their existence.

It is the policy of this journal to find a market for good materials, and encourage those who seek to propagate honest methods of using them. Not everything that is offered comes up to this standard, but we have not found it at all necessary to single out individual men or things for invidious criticism, much less wholesale denunciation. We have been content to advocate and uphold that which is beyond reproach; leaving that which is otherwise to perish, as it ought, and as it undoubtedly will, from lack of patronage. Pursuing the present subject in a similar spirit, towards a tangible conclusion, we invite feasible suggestions in further elucidation of this question of brick bonding. We anticipate for them, on behalf of our respected readers, a discriminating appreciation, if not a willing acceptance. In any event, their sponsors shall have the opportunity of addressing a large and interested audience, whom we have reason to believe regards the question at issue as one ripe for discussion.

WE are so slow in this country to appreciate the value of proper esthetic treatment of our public work that it comes almost as a matter of course that, when a great undertaking which is primarily of a utilitarian character is undertaken by a municipality, the result, however satisfactory from a standpoint of mere prosaic fitness, is pretty sure to be hopelessly inartistic. Our lost opportunities are legion, and to them must be added the Boston Subway. This was a piece of work which from its very nature would suggest the use of brick masonry. The past is so full of instances wherein vaulted structures have been made both practical and attractive, and it would seem so natural a desire on the part of our commissioners to at least attempt a species of good looks in connection with subterraneous constructions, that the utter lack of any attempt at anything more than a strictly utilitarian treatment of the problem is certainly disheartening. The stations where the public is supposed to enter and leave the cars — we refer now to the underground portions — are spacious, well arranged, and, considering the conditions, excellently well lighted. We have every assurance that the supporting members are well proportioned and the structure, as a whole, perfectly stable. But the rank Philistinism which would utterly ignore such a splendid opportunity for striking architectural effects as these stations offer is certainly to be deplored. The commission, in its inscrutible wisdom, has seen fit to employ glazed brick quite extensively as a facing to the walls of the stations. So far this is excellent; but not the slightest attempt has been made to do anything moie than face a barren, uninteresting wall with a dead white glazed surface. The isolated columns, the iron girders, the brick arches between the beams, all stand out in naked insistence, and the daily traveler through the subway can find nothing more attractive to cheer his eye than the dreary reflections of white from the paint on the columns, the enameling on the beams, and the glazing on the bricks. It is surely not from lack of precedent that the opportunity has been neglected. One has only to go through the new Public Library Building to see how strikingly successful effects can be obtained by combinations of vaulting with the use of either the Guastavino arches or some kindred form of brick or terra-cotta. The subway has been well built, well planned, and has been in the hands of a commission which was able in every respect except in its ability to appreciate the desirability of good looks. In this respect the subway stations present a dismal, hopeless failure.

public, fulfilling as many of their requirements as possible, and increasing the revenue of the company as well as the architectural beauty of the city.

MR. EDMUND M. WHEELWRIGHT'S series on American Schoolhouse Architecture will begin in the November number of THE BRICKBUILDER. The series will comprise probably four articles, which will be published in consecutive issues. Mr. Wheelwright's superior knowledge of the subject, gained by a thorough study of foreign methods of planning and construction, and his experience as city architect of Boston, at a period when many of its best schoolhouses were built, should make this series of added interest and value.

ILLUSTRATED ADVERTISEMENTS.

PANEL executed by the New York Architectural Terra-Cotta Company. Gardner & Pyne, architects. Louis Roncoli, modeler.

The accompanying panel is suggestive of modern locomotion in its latest phase of development; it is likewise more realistic than symbolic in point of conception. This will become sufficiently apparent when it is stated that the panel is intended to be placed over the entrance to a building now in course of erection for the Springfield (Mass.) Street Railroad Company.

To model in perspective a series of scenes, giving the principal features a certain degree of relief, and to treat the subject so that the composition as a whole may appear correct in its lines, when it, in turn, is seen in perspective from various points of view, is a task that has never yet been fully accomplished. The difficulties are inherent, and, beyond a certain point, may be considered insuperable. The best that can be done is but a well-balanced approximation to the truth, and this is as far as Mr. Roncoli has essayed in the present instance. His famous countryman, Ghiberti, did not accomplish much more than this in his bronze gates at Florence, which, though an acknowledged masterpiece in their way, have often been questioned as to the convergence of the vanishing points.

PERSONAL AND CLUB NEWS.

MR. J. C. NIEBEL, architect, 59 Court Street, Brooklyn, N. Y., succeeds to the business of Carl F. Eisenach, who retires from practise.

MR. HAROLD F. ADAMS, architect, formerly associated with Mr. Wm. G. Hoopes, Atlantic City, N. J., has opened an office in the Real Estate and Law Building, Atlantic City, and would be glad to receive catalogues.

THE second annual redesigning competition, held by the T Square Club, of Philadelphia, called for the redesigning of the Reading Railroad Terminal, "under conditions which the citizens of Philadelphia had every right to expect and demand. In consideration of the privilege of building over the streets, which the city owned, councils should have insisted upon the acquirement by the railroad company of the entire block from 11th to 12th Street, and from Market to Filbert Street, and also upon the proper recession of all fronts so as to accommodate the accumulated traffic," says the program. Some of the conditions were: one or more courts of approach; accommodations for shops, stores, a bank, and such trades as would necessarily have to be provided for in this rearrangement; facilities for checking bicycles, and their convenient storage, etc.; waiting places for street cars; hotel accommodations. In general, the building should be considered and arranged to be a central place of convenience for the

In their advertisement, page xiv, R. Guastivano Company show a cut of their large roof construction, being the fourth recently built for the West End Street Railway, of Boston, for their power stations. The cut shows the roof in process of construction, after which the haunches of the arches are concreted over the beams, and the whole surface asphalted and graveled. It is similar in construction to the roof built by them for the Union Railroad Company, of Providence, the Colorado Telegraph Company, and others.

No. 4 of the series of brick and terra-cotta fireplace mantels which is being illustrated in the advertisement of Fiske, Homes & Co., page vii, is one designed by J. A. Schweinfurth, architect, and modeled by Tito Conti, the drawing being by H. F. Briscoe.

The always interesting building of the Exchange Club, Boston, Ball & Dabney, architects, is illustrated in the advertisement of the Boston Fire-Proofing Company on page xi.

The Harbison & Walker Company illustrate in their advertisement for this month, on page xxv, the Conestoga Building at Pittsburg, Penn., Alden & Harlow, architects.

A section of a wall laid up with seam-face granite is shown in the advertisement of the Gilbreth Seam-Face Granite Company, page xxxviii.

Many other advertisements which appear in this month's number have interesting illustrations which have been mentioned before in this column.

Some Important Problems in Construction. I.

BY WM. W. CREHORE, ASSOC. M. AM. SOC. C. E.

THE title selected for these studies is perhaps not as truly significant or descriptive as it might be, since it is the writer's intention more particularly to discuss what not to do and why than to enter upon the statement and solution of any of the numerous problems which are presented by the various conditions of modern construction. General questions as to which of two or more alternatives is the best and most economical might, however, quite properly be propounded like problems for solution, and with this explanation the title may perhaps be allowed to apply.

One of the first things to be decided in designing the skeleton frame of a fire-proof building is whether to use cast-iron or built-steel columns. If the building is to be a high one, or one whose height is many times its least dimension, the necessity for some effectual system of wind bracing will preclude the use of cast-iron columns; for wind bracing must be riveted and fastened to connecting members by rivets, whereas rivets cannot be driven in cast iron without liability of cracking it. Everything considered, perhaps the best and safest course to pursue is to reject cast iron altogether and proceed to use steel throughout; but at present prices, as long as the law does not absolutely prohibit the use of cast iron, there are certain limits between which it is safe and a little less costly than steel. These limits are not by any means to be determined off-hand, nor, unfortunately, by the legal limitations of the use of cast iron. A safe designer will take into account the possibility of making details of connections which will be fully as strong as the members connected.

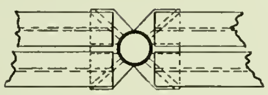


FIG 1

Fig. 1 shows a 6 in. cast-iron column carrying a 12 in. double beam girder on each side. The total width of this girder over flanges being a little more than twice the diameter of the column, it becomes a serious problem to design a seat and brackets which will convey the load into the body of the column. Fig. 2 represents the same thing in a worse form, as the loads come from adjacent instead of opposite sides of the column, and this eccentric loading causes an additional moment in the shaft of the column. Cast brackets and seats in cases like these are out of proportion to the size of the column, and must of necessity be clumsy and unsuitable, to say the least. The column, although theoretically of sufficient size for the imposed loads were they laid vertically on its shaft, is not large enough to receive them through side brackets.

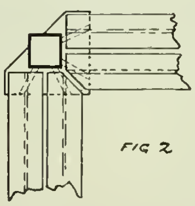


FIG 2

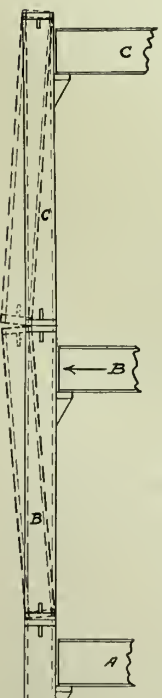
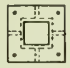


FIG. 3

Six or seven inch cast columns are seldom made thicker than one inch, because the same amount of metal put into a larger sized column is more economical. A small column 1 in. thick reduced to three quarters of an inch on one side by the shifting of the core, as is frequently the case, is not heavy enough to withstand the pull of 1¼ and 1½ in. seats and brackets attached to it. The metal in the body of the column in the immediate vicinity of the bracket is more severely stressed than any other portion of the column or the bracket itself, and the tendency of the seats and brackets to pull out of the column is increased. This might have been theoretically inferred, but it is confirmed by observation of cast column failures of recent years.

It seems clear from the preceding remarks that the use of small cast-iron columns is often accompanied by considerable risk, even when they are most carefully designed and used within the legal limitations. In the writer's opinion, the "line" should be "drawn" at the 8 in. column, and nothing smaller should be used except in very rare instances where the loads can be symmetrically imposed. This limitation having been determined, it will be found a little less costly at present prices to use riveted steel columns in the three or four top stories of an ordinarily loaded building, and this method has also the advantage of stiffening the building where stiffness is most needed to resist wind forces. These upper story columns may be made of four angles and a plate, or of four angles latticed. To produce the desired rigidity, all beam and girder connections to them as well as their connections to each other should be riveted.



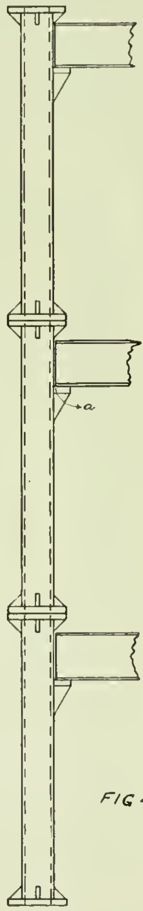


FIG 4.

On the other hand, the 16 in. cast column may be taken as the upper limit. Beyond this steel box columns can be built of angles and plates to better advantage and will be found less costly. In the manufacture of very heavy cast columns it is difficult to keep the core from shifting considerably, owing to the increased action of gravity on the molten metal, causing it to flow underneath and buoy the core up. Then, too, imperfections are less easily detected in heavy castings, and one cannot be as certain of getting good material.

A shaft made up of a number of cast columns is very dependent on the flange connections for its stability. Fig. 3 shows an error (much too common among designers) whereby the stability of the shaft is practically reduced to zero. The column flanges should extend equally in all directions, as shown in Fig. 4, and not in two opposite directions only, as in Fig. 3. A thrust along the line of the beam at B would tend to separate the two columns B and C, and to cause them to take the positions indicated by the dotted lines. The only possible advantage to be gained in this side flange construction is in case of columns built in the wall to permit the brickwork to pass more easily around them, but the risk is too great and it should never be allowed. Column flanges should be reinforced also by small 45 deg. brackets, as shown in Fig. 4, and the bolts should be located as far out as possible in each direction for the purpose of increasing the column's stability or of broadening its base (which amounts to the same thing).

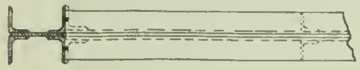
Another error, not now so common as it used to be, is the use of shallow brackets under the beam seats. A 45 deg. bracket for this purpose is too shallow. The depth of the bracket not only affects the resistance of the material to the external shearing forces, but also determines the tensile stress at the point where the seat joins the main body of the column, that is, at the point a in Fig. 4. The deeper the bracket the less this tensile stress becomes for a given load. If we assume the bracket and seat together as one rigid body, then the load from the beam acting downward at P (Fig. 5), a distance x from the column, causes a pull or a tensile stress along the line of the force H and in the opposite direction. It will be easily seen that the amount of this pull, H, is dependent for a given load, P, upon the two distances x and y (or rather their relation to each other), and that this pull increases as x increases, but decreases as y increases. Multiplying each force by its perpendicular distance from the point a and equating these products, we have

$$Hy = Px,$$

giving the amount of the pull

$$H = P\frac{x}{y}.$$

Although, strictly speaking, the strain does not all reach the column in the line of H, but is distributed along the whole height of the bracket, still much the greater part of it must be resisted by the metal in the line of the force H, and the deeper the bracket the less this force is. With a 45 deg. bracket the force H is just equal to the load P, and diminishes as the angle between the seat and the bracket increases. These brackets are now usually made with a 60 deg. slope.



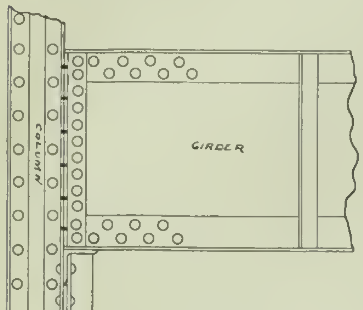


FIG 8

In the preceding discussion the load is assumed to be applied at the very tip end of the column seat, and were the beam to deflect, however slightly, this would be the actual point of its application. To prevent this and thus add strength and stability by applying the load close to the column, the seat is often made slightly sloping (see dotted lines, Fig. 5), say $\frac{1}{16}$ to $\frac{1}{4}$ in. to the foot, just enough to exceed the largest anticipated deflection of the beam.

A similar line of reasoning applies to the brackets or webs of a cast-iron shoe. Such a shoe as is represented in Fig. 6 is too shallow for its width, and the lower flange is subjected to a greater tensile stress at a than that of a deeper shoe would be, as in Fig. 7. A slight unevenness in the grouting of a cast-iron shoe is not an unusual occurrence, and as it is sure to set up irregular and almost incalculable stresses in the metal, a shoe should be designed with an ample factor of safety to begin with. This, it should be noted, does not mean that the metal should be used wastefully merely to increase the weight of the casting, but that it should be properly placed where it will do the most good. The commonest errors are making the shoe too shallow and placing the brackets or webs too far apart, thus weakening the lower flange or base-plate. A slope of 60 degs. usually figures out about right for these shoe brackets also.

Another reprehensible practise is that of leaving columns (especially cast columns) unbraced or insufficiently braced in one direction. It nearly always happens that the principal loads to be carried come from opposite sides of the column only, but it is quite essential, both for economy and stability, that the lesser loads coming from the other directions should be so spaced that a pair of them may be directly supported by the columns, and of the intermediate pairs none should load the girder at its center. In strictly fire-proof construction, where all the beams and columns are of metal and the floors of some solid material, the structure is usually rigid enough if its base is not too narrow; but in a combination semi-fire-proof structure of cast-iron columns, steel girders, and wooden beams, where the beams rest on top of the girders, there is almost no lateral stiffness through the whole length of a line of girders unless special stiffening beams are placed between all columns in the direction at right angles to the girders.

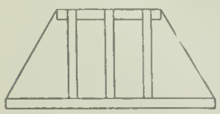


FIG 7.

There is a frequent tendency to use the girders in this kind of construction on very long spans, which of course means on spans which bear a high ratio to the depth of the girders. Theoretically there is a fixed limiting span up to which a beam of a given depth may be used with its maximum allowable loading before excessive deflection will take place. In fact, the amount of deflection for quiescent loading may be accurately calculated beforehand. But practically ordinary loading is not always quiescent, and the effect of suddenly applied, moving, or vibratory loads increases disproportionately with the length of the span; so that where any possibility of such loading exists the girders should be made on the longer spans proportionately much deeper than required by the theory of flexure.

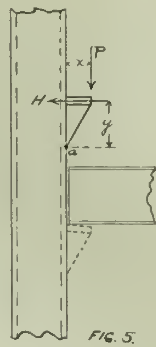


FIG. 5.

In using girders three or four feet deep their ends should be rigidly connected for their full depth, and not left simply to bear on the column's seat, and perhaps with an additional bolt or two at the top of the girder. Such ineffective connections do not develop the girder's full strength under torsional or eccentrically applied forces. Aside from this, the strength of a structure as a whole does not depend upon individual members in it, but upon the united effect of all its members combined, so that it becomes a positive waste of material to connect members to each other in an inferior manner. For this reason deep girders cannot be used to advantage with cast-iron columns. Used with built-steel columns deep girders should be connected by rivets the full depth of the web, as in Fig. 8, and not as in Fig. 9. The open holes show positions of the field rivets.

FIG 6

In reviewing an experience of several years in designing new structures and examining old ones, it can be said that the more experience one has the less likely he is to lay down any hard and fast rules of procedure. The conditions affecting each case are so various that construction which might be safely used in one case would be totally unsuitable in another case, while to the inexperienced eye the same two cases might have every appearance of similarity. The indiscriminate use of manufacturers' tables by those whose knowledge of the subject stops there often leads to incongruous, not to say harmful, results in practise. It reminds one of the young dressmaker who started out by attempting to fit all her customers with the same pattern. Tables and formulæ are exceedingly useful when rightly understood and applied, but a thorough acquaintance with their limitations in actual practise, as well as the power to know good from bad practise, is a necessary preliminary to their intelligent application.

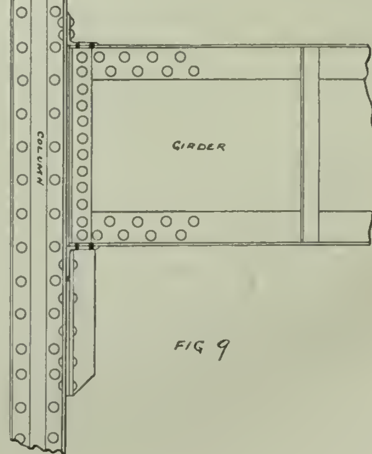


FIG 9

There can be no doubt that the best windows for brick churches are either those beautiful Italian developments of plate tracery in which all the bricks are carefully cut and rubbed for their proper place, or those in which, within an enclosing arch of line upon line of brickwork, a small portion of stone is used for the traceries.—*Street.*

Architectural Terra-Cotta.

BY THOMAS CUSACK.

(*Continued.*)

THE building now before us (Fig. 39) will be found to coincide in many things with the one chosen as the subject of last example, besides the construction of its cornice, of which more anon. This similarity is sufficiently marked to suggest comparison, which, if made, must reveal some of the points of divergence. But first, as to the resemblance. The two buildings were designed and erected simultaneously; granite being used in the lower stories of both, with gray terra-cotta and brick for what may be considered the shaft of the building. The last story and the main cornice are, in each case, entirely of terra cotta, no face brick being used above the lintels of the story below. They were, we presume, planned to meet the greatest number of known wants, with the least sacrifice of space, and, in other respects, carried out in accordance with approved practise, the best classical authorities available having been consulted and followed (perhaps too literally) in determining their respective styles of exterior detail. At this point they begin to part company. They are by different architects, belong to different cities, and have nothing in common as to origin or ownership. The former building is fifteen stories, and standing on a corner, has one frontage on a side street, and the other on a thoroughfare more widely known than any other on the American continent. The remaining sides abut on adjoining property to about one third of that height, above which they are frankly exposed as rear walls, pending a similar upward movement on the sites now occupied by these dwarfed, diminutive relics of a bygone time. The latter, standing free from encroachments on all sides, afforded what we can well imagine to have been an eagerly accepted opportunity for harmonious treatment on four elevations. Here was a chance for the erection of an architectural entity, prized, we presume, in proportion to its exceeding rarity in the business center of most cities. The opportunity, in this case, has not been wasted. For, if "design, order, and congruity" be the essentials of good architecture, we have them embodied to a degree that is both creditable and encouraging. The fortunate architects were Mr. James Windrim and his son, John T. Windrim, of Philadelphia. The building virtually belongs to that city, being part of the Girard estate, of which Mr. Joseph L. Caven is chairman of committee, and to whose enterprise the success of this project is said to be largely due.

More closely examined, the fundamental difference will be found to consist in the adoption of the Ionic order as the prevailing keynote, in preference to the Doric of last example. This has been done subject, of course, to such modifications as become expedient in applying either of them to a thirteen-story building. Avoiding, so far as is possible, anything in the nature of an invidious comparison, we think this is unquestionably the more manageable of the two orders; and of that the building now under notice affords a particularly happy illustration. The freedom with which it has been handled by Mr. Windrim, without incongruity, is not merely an evidence of care and deliberation; it shows that he had a comprehensive grasp of his onerous undertaking as a whole and from the outset. There are few, if any, indications of his having taken hold inconsiderately of an unknown quantity, for in no case (to use an inelegant but very expressive phrase) has the tail been able to wag the dog. If there be an exception to this throughout the building, it is probably confined to the columns at the thirteenth story. There is nothing to be said against the use of these columns *per se;* on the contrary, much might be urged in their favor, but, considering their distance from the average spectator, a certain exaggeration with the view to greater boldness of detail would have been quite justifiable. If "'twill be recorded for a precedent," then so much the better in all such cases, provided it is done with judgment and discretion. The persuasive Portia, with an artist's eye to a still more effective climax, did not deign to "alter a decree established"; yet, with due deference to the strict laws of Venice, whereof she was adjudged a well-deserving pillar, there are times and places (of which this is an instance) where the eye is the ultimate arbiter, when one may say with Bassanio: "To do a great right, do a little wrong." Columns of the same general proportions are used in the vestibule, etc., in which positions they are unexceptionable. But in those placed at a height of 160 ft. from the street level, we think the number of flutes might have been reduced to, say eighteen, allowing a proportionate increase in the size of flute and fillet. For the same reason the finer lines in capital could have been omitted, and its projection, especially that of the abacus, increased with obvious advantage. As it is, the striation in the columns is not sufficiently perceptible, and the capitals appear rather meager, therefore the general effect less satisfying to the eye than could have been desired in this otherwise spirited composition.

FIG. 39. GIRARD BUILDING, PHILADELPHIA, PA.
James Windrim & Son, Architects.

To be sure, this, like other tall buildings, is bound to be viewed from a variety of points other than the one already mentioned. This much we gladly admit in extenuation of the foregoing criticism. An ever-increasing population is destined to spend most of its waking moments at various levels in surrounding buildings of corresponding height. From these points much of the detail will be seen under more favorable conditions. It may likewise be fairly conceded that no stage setting has been invented that will suit all parts of the house. With that understanding, a compromise is made between the parquet and the dress circle; less regard being had to the supposedly less critical "family circle," and no attempt

The construction of balconies at the tenth story is withheld for subsequent discussion, in connection with others of a like character.—T. C.

made (in this one particular) to "split the ears of the groundlings," ye gods of the gallery. So, too, in another branch of the arts — painting; whether in the works of old or, shall we say, new masters, they are seen best from an approximately correct focus: adjusted instinctively to the vision of the individual spectator. But after all, in the case of buildings — it may be from force of habit coeval with the human species, amounting to a pre-"sky-scraper" prejudice — most of us are inclined to fix our judgment seat at some coign of vantage on the opposite sidewalk. Of the future we must speak with reserve; but from this point of view the buildings of the present, like those of the past, will be criticized, commended, or condemned. It may be noted in this connection that the well-known optical illusion which makes a high building with parallel sides appear top heavy has not been ignored or forgotten in this one, where the remedy is simple, and the result undoubtedly effectual. At the fifth story, and again at every second story up to the eleventh, the wall line recedes three quarters of an inch, or 3 ins. in all, making a total difference of 6 ins. each way in the plan area of the building, at bottom and top respectively. Practically as well as æsthetically considered, it will be admitted that this gradual batter is equally beneficial in all high buildings; and if anybody is in search of a precedent, Mr. Windrim has furnished one here that is not likely to be assailed.

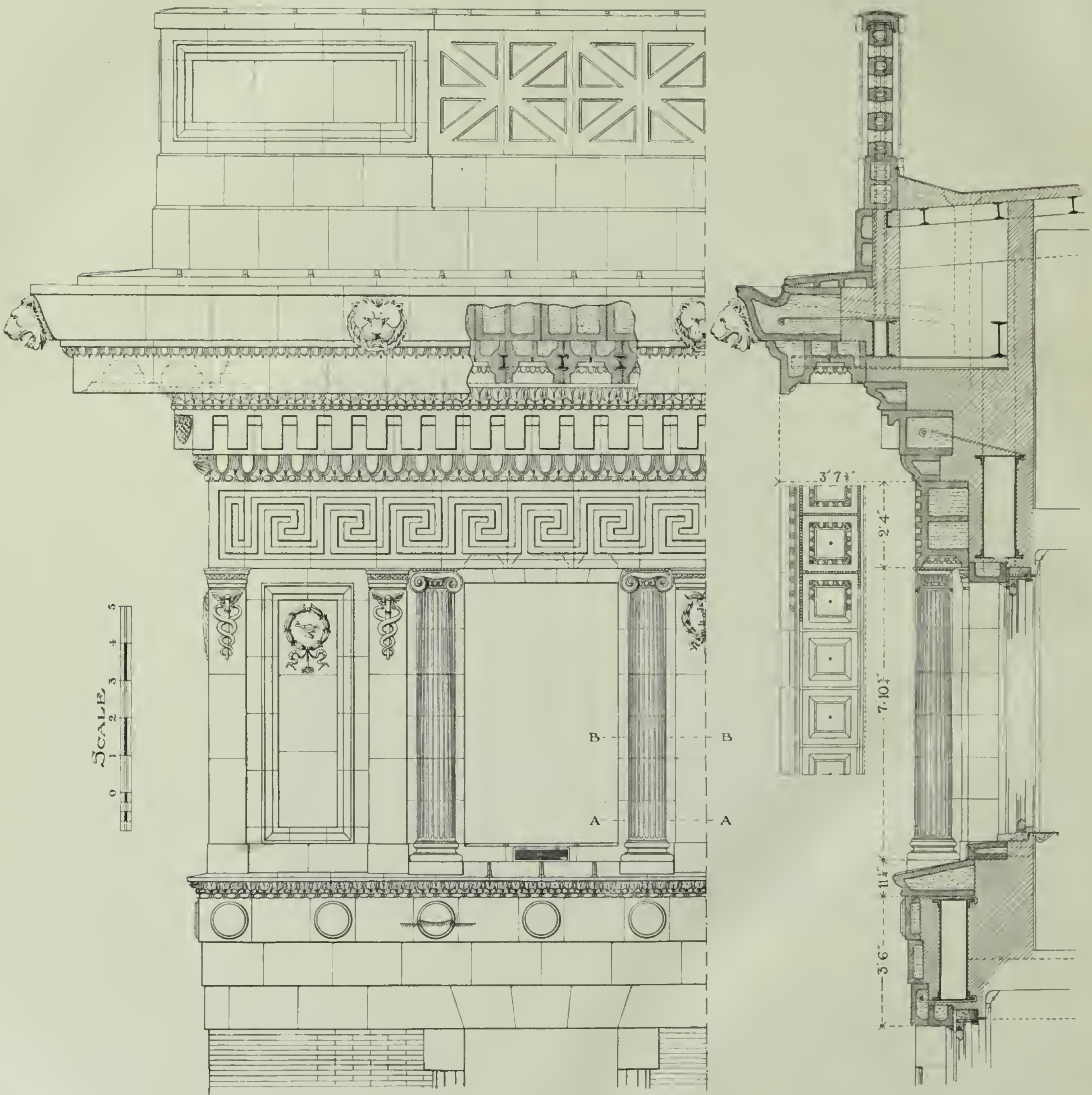


FIG. 40.

A true section through thirteenth story, the cornice and parapet above, with part elevation of same, is shown at Fig. 40 as executed. At Fig. 41 are plans through one of the piers showing their construction, from which it will be seen that all the blocks are made to alternate; breaking bond at every course, except at back of square shaft, in which provision is made for cramping it to the adjoining block; which, in turn, is locked in position at each succeeding course. In addition to this, the brick backing is built into the chambers of the blocks and around the main column; an example of well-knit composite construction, the strength and reliability of which it is impossible to gainsay. No misplaced effort this, in a building bearing the name of Stephen Girard, whose biography was among the school books of the present writer. It is not unworthy, in point of strength and tenacity, the business methods of the old sea captain, from whose magnificent bequest this building is but an offshoot — albeit, we think, an enduring one.

The fret course forming frieze is jointed vertically throughout, to save cutting through the pattern diagonally. This is on the face only, however, and to a depth of about 3 ins. in the blocks spanning apertures below, in which case the joints are radial to the remainder of their depth; thus forming an arch-lintel. This principle of construction we have from the Greeks, and yet we are often asked to believe that they had no knowledge of an arch! while their more enterprising successors are given all the credit of that invention.

The cornice has a total projection of 5 ft. 6 ins. from wall line to tip of lion's head: and is carried by 4 in. 12 lb. I beams, spaced on 1 ft. 7 in. centers. These cantilevers might have been farther

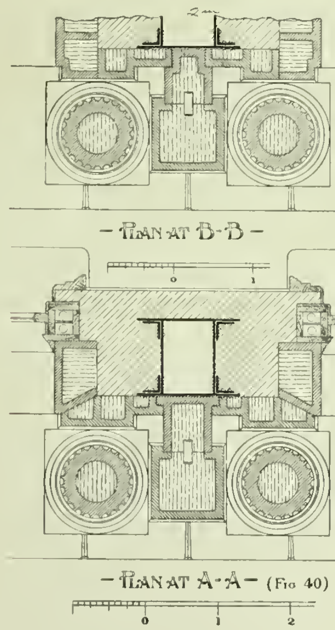


FIG. 41.

apart, but their position is determined arbitrarily by the arrangement of paneling in the soffit; which, for reasons to be explained presently, had to be uniform in size, and, as nearly as possible, rectangular. The vertical joint, as it approaches the lower surface, is deflected from center of rail just enough to avoid cutting through the row of buttons at that point. In other respects, the method of inserting the I beams and of setting the blocks themselves does not differ materially from those described in last example. To such as have noted what there was to say in that connection, it will not be needful to add much on this occasion. Those who have not done so cannot do better than accept our invitation in this regard, and refer back to last issue of this journal. If it serves no other purpose, it will at least spare us the weariness of a twice-told tale.

The two 12 in. channels seen directly under the superincumbent parapet are well placed. They equalize the weight resting on them and distribute it over the cantilevers below, and they, being securely bracketed to a 12 in. I beam running between main columns, require no better fulcrum than the solid brick and terra-cotta on which they rest. The size of these channels may be in excess of actual requirements; but as to that, we defer to the opinion of the capable engineer who fixed the weight of section to be used; if a fault, it is on the side of safety. The pierced parapet is made in single blocks, as shown, with a series of stanchions passing up between them; to these is secured a continuous channel, into which the blocks are molded to fit snugly between the flanges. The top coping is then bedded down in cement, securing the iron from atmospheric action; *minus* exposed tie-rods and stays, which, even on a roof, can hardly be divested of an unpleasant suggestiveness. Do what we may, they seem to shape themselves into alphabet from which we involuntarily spell out — "hold me up until I get paid for"; then come disturbing visions of sheet metal, followed by symptoms of *mal de mer*.

In the panels of the cornice soffit, to which allusion has been made, there is a fanciful device for artificial lighting, which, if not unique, is an evidence of progressive thought and resource. Instead of the usual rosette, an incandescent bulb is inserted in the center of each panel, which, like Goldsmith's bedstead, is "contrived a double debt to pay." This row of pendants marks the place of a conventional ornament from the rising until the going down of the sun. When old Sol has disappeared for the day, away to the west of Fairmount Park, the building will become outlined by a fringe of luminous jets, from which its detail may be studied under a subdued light; for, in truth, a fixed planetary system of its own will begin to twinkle, as is the custom of stars of greater magnitude in the milky way. If modern invention has robbed life of half its poetry, it has brought compensating enjoyments within the reach of all, since the founder of Girard College went aloft for the last time in 1831. Thus does science pay tribute to art, — to the fine as well as to the industrial arts, — for in architecture, rightly understood, and at its best, we have a blending of both.

SHATTERED SURFACES ON BRICKS.

FOR many years architects have been puzzled to account for the "blistering" so frequently found on otherwise sound bricks. It commences by the development of minute cracks on the surface, radiating from a central point, and the center gradually becomes lifted up so as to form a shallow miniature cone. Eventually this may drop off, leaving a scar on the surface, and rendering the whole unsightly. This phenomenon has generally been ascribed to chemical action, and for working out the problem it has been assumed that the center of the disturbance is a piece of lime (burnt chalk, for instance), which, by slaking, expands and produces the cracks alluded to. Of course, there can be no question that lime is often guilty in cracking bricks; but we feel certain that in the case of the blistering above referred to, lime is not the culprit. For you may examine as many of these shattered surfaces as you like, and you will find that the phenomenon is as clearly pronounced in those bricks which do not contain lime lumps as in those which do. Others have suggested that the scaling is due to the accumulation of moisture behind the skin, or real surface of the brick, and they have suggested that the damp course should be improved, and there is much in that contention. At the same time it is undeniable that shattered surfaces are seen under such conditions that the damp course could not be held responsible, and it frequently happens that out of several square yards of brickwork, only a dozen or so of the bricks are affected in the manner now indicated. The writer is under the impression that much of this scarring is due to unequal contraction and expansion in heterogeneous bricks, and it shows that the brick earth has not been thoroughly pugged in the first place. Even a cursory examination shows that these low-grade bricks are full of hard pellets, and these would expand and contract at different rates to the comparatively looser material. A cone would tend to form over these pellets at the point of least resistance — and that would be at the surface — in much the same way as a sheet of lead becomes corrugated when used as sink lining, owing to the alternate application of hot and cold water.— *The British Brickbuilder.*

The Art of Building among the Romans.

Translated from the French of AUGUSTE CHOISY by Arthur J. Dillon.

PART III.

CHAPTER II.

THE ART OF BUILDING AND THE ORGANIZATION OF THE WORKING CLASSES.

(*Continued.*)

THE servile condition of the corporations was the consequence of an evidently vicious economic system; but to the credit of the Roman law makers, it must be said that they always endeavored to keep this dependence within the limits made necessary by their political system: and the same principle that led them to respect municipal franchises kept them from all useless interference in the interior management of the workingmen's corporations. This is shown even in the decemviral laws. The law of the XII. Tables says, "Power is given to corporations to organize themselves in any manner they please, provided they do not infringe the public law."[1] And it was by virtue of this broad tolerance that the workingmen were enabled to establish separate associations among themselves, to place themselves under the direction or financial responsibility of some more enterprising or wealthy workman who could interpose between them and the State, dealing, usually under bond, with the magistrates who were charged with the duty of erecting public buildings, and playing the rôle of an actual contractor (redemptor or locator operis).[2]

Moreover, there was unconsciously formed an administration in each corporation entirely distinct from the general administration of the city.[3]

The Senate reserved the right of authorizing or suspending the meetings of the corporations; but, once authorized, the corporation had an existence of its own independently of that of the city of which it was a part; it made its own special police regulations, some of which have come down to us; and it created in itself a series of officers whose functions and mutual subordination seem copied from the organization of the Roman city. Far more than the city, the corporations were the ties that united the Roman workingmen, and their lives were so concentrated about them that they came to date the years, even in public acts, from the time of the foundation of their special corporation.

Just as the municipalities, the corporations were divided into centuries and decuries, under chiefs ordinarily elective, known as masters, quinquennials, etc.; the members placed themselves collectively under patrons and took honorary associates; they met on certain days in meeting places, which are designated scholæ in the inscriptions; and there they celebrated feasts from which religion was rarely missing. They had their priests, their temples, and a complete system of religious institutions that persisted even until after the triumph of Christianity, and called down on such corporations that still retained the pagan tinge all the rigor of the laws of the emperors who succeeded Constantine.[4] Besides the religious and administrative divisions, there was another division, founded on the nature of the occupations followed by the members of the same college. The corporations were divided into distinct classes of workingmen, whose sharply separated prerogatives marked the extreme division that existed in industrial operations. As far as concerns the collegium structorum, or corporation of workingmen who had charge of Roman masonry, I have not been able to find with any certainty the names of the categories whose existence I have indicated; this college left no traces except in short inscriptions, and it is to be hoped that new discoveries will supply us with the documents that are still lacking in its history. But if we judge from the corporation of aquarii whose details are given by Frontinus, the division of labor was marked in the organization of the corporations by very distinct categories. But whether this division coincided with that into centuries and decuries is a question on which the documents so far seem to throw no light.

Frontinus (de Aquæd., 177) divides the corporation of aquarii into villici, castellarii, circitores, silicarii, tectores, etc. I will not stop here to discuss the meaning of these distinctions, which would lead me far from my subject, but will only note their multiplicity and call attention to the deductions that can be drawn therefrom. The aquarii, it is true, constituted a familia publica and not a corporation properly so called, but the distinction between corporations and

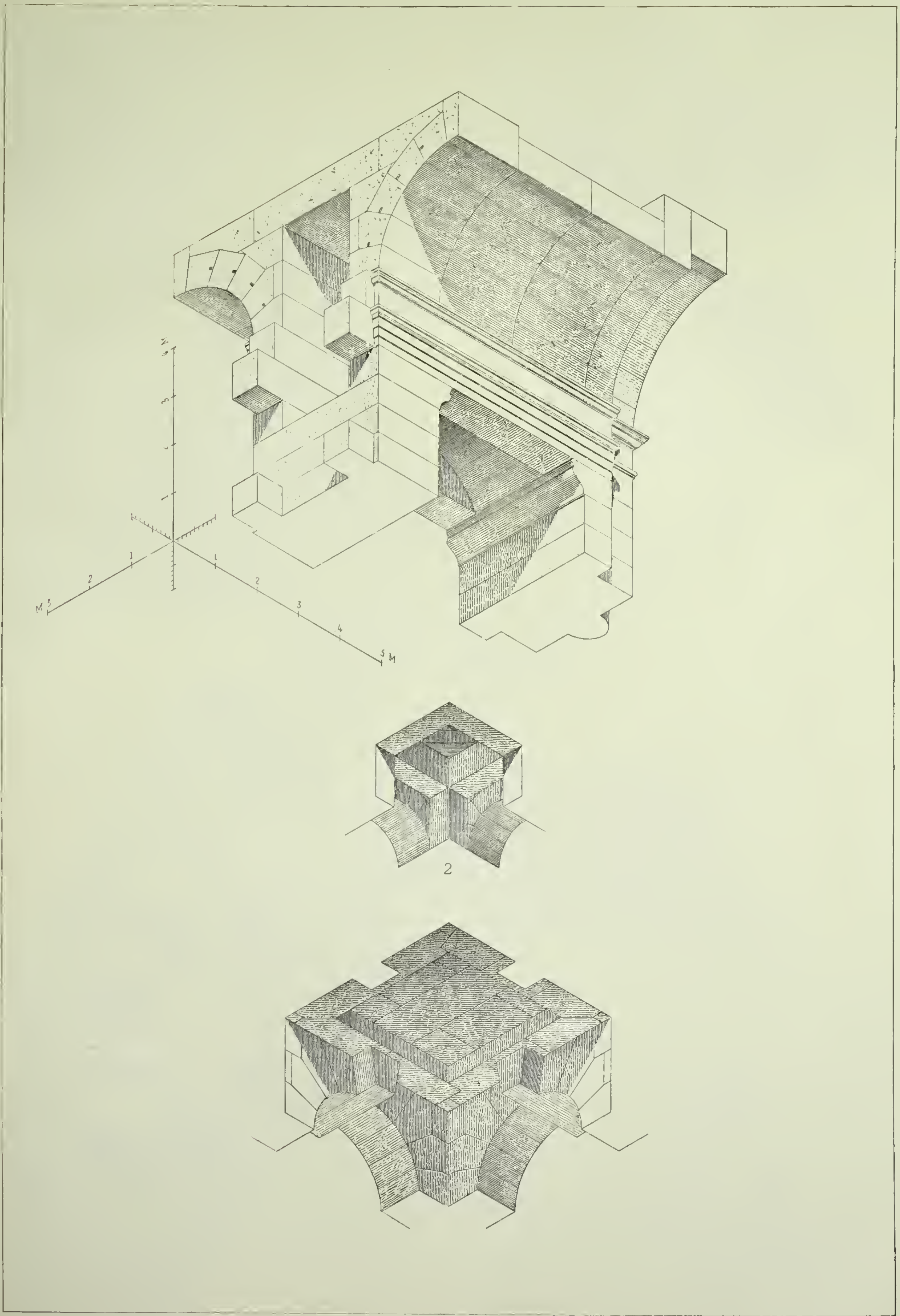
[1] Digest., Lib. XLVII., tit. XXII., l. 4. Cf. Dig., Lib. III., tit. IV., l. 1; Lamprid., Alex. Sev., Cap. XXXIII.

[2] The attributes of contractors are fixed by the Digest, Lib. L., tit. X., l. 2, § 1. For evidence that the bargains with the contractors were usually made under bond, see Cic., in Verrem, Act II., Lib. 1, Cap. 54–56. Cf. the Lex puteolona, p. 144, etc. The same custom is brought out in the account of a difficulty that arose between Q. Cicero and his contractor (Cic. ep. ad Q. Frat., Lib. III., ep. 1, § 5). See also Cic., ad Attic., Lib. IV., ep. XVI., § 14; and finally, the numerous conventional inscriptions, such as "Opus ex . . . HS faciendum locare," everywhere the "locatore" or "redemptor" seems to undertake the responsibility of executing the work at his own risk, in return for a round sum. Ex.: Orell. 3148; 3277; 3325; 4616; 6605; 6609; 7420 a θ, a κ, a λ; 1476 (with the correction of M. Henzen), etc. (On the customary bargains of this nature among the Greeks, see Rangabé, Ant. hell., 771; Corp. inscrip. gr., 2266).

[3] Below is a table of the most important texts in support of this account of the internal organization of the corporations, and of safeguards opposed to them by the central administration;

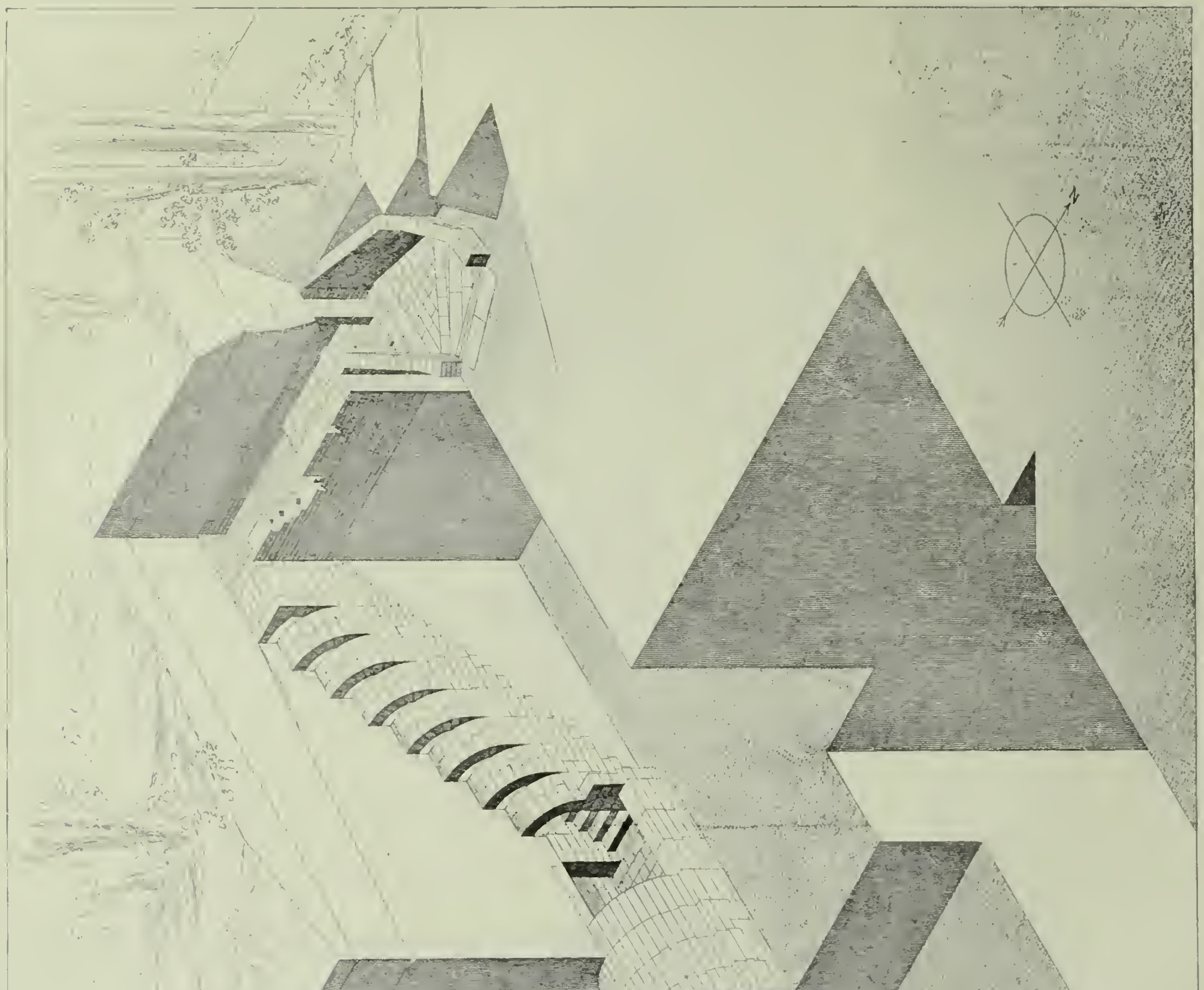
1st. Intervention of the government into the internal affairs of the corporations.
The right retained by the Senate to forbid the meetings of the workingman's corporations,
Digest. Lib. III., tit. IV., l. 1; Lib. XLVII., tit. XXII., l. 3:
Orelli, 2797, 3140, 4075, 4115, 4235 . . .
Corporations where the number of members was limited by the government,
Plin. Epist., Lib. X., ep. 42.
2d. Existence and examples of an internal police freely accepted by the corporations,
Digest, Lib. XLVII., tit. XXII., l. 4.
Orelli, 2417, 6086.
3d. Division into centuries and decuries,
Orelli, 4060, 4071, 4085, 4137
4th. Hierarchy and magistracy of the corporations,
Ordo collegii, Orelli, 2417, 4115.
Magistri, Orelli, 4054. . . . 4137.
Quinquennales, Orelli, 4054. . . . 4137.
Plebs, Orelli, 4054. . . . 4137.
Offices whose hierarchical order is distinctly shown,
Actor or Syndicus, Digest, Lib. III., tit. IV., l. 1.
Præfectus, Orelli, 7198.
Quæstores, Orelli, 2863.
Curatores, Orelli, 7194.
Scribæ, Orelli, 1687.
Honorary titles,
Pater collegii, Orelli, 4134.
Patronus collegii, Orelli, 4054. . . . 4137.
Immunis collegii, Orelli, 4137.
5th. Election in the nomination of certain officers of the corporations,
Orelli, 4057.
Reservations in favor of the government,
Orelli, 2163.
6th. Religious organization of the corporations,
Priest of the corporation, Orelli, 4094, 7213.
Temple, Orelli, 4133.
Special divinities, Orelli, 1710, 1711, 4122.
Funerals, Orelli, 4107.
Banquets, Orelli, 6086.
7th. Slavery in the corporations,
Cic., in Pisonem, Cap. IV.
Digest, Lib. XLVII., tit. XXII., l. 3, § 2; Lib. XXIX., tit. II., l. 25, § 1.
Orelli, 7214, 2886, and particularly inscrip. No. 6086 where slaves are put on a footing of equality with freemen.
Names of freedmen, Orelli, 3019.
8th. Civil rights of the corporations,
Rights of proprietorship, Digest, Lib. X., tit. IV., l. 7, § 3.
Colleges forbidden, at least in principle, to receive legacies,
Cod. Justin., Lib. VI., tit. XXIV., l. 8.
Exceptions to the rule,
Orelli, 4080; Murat., 516, I.
9th. Various details,
Common treasury, Orelli, 1702, Digest, Lib. III., tit. IV., Lib. I.
Special chronology, Orelli, 1702, 820, 3891, 4064.
Meeting places (Scholæ), Orelli, 4088 . . . .
Seals of certain corporations, Orelli, 2395.

[4] It was for such cause that the Emperor Honorius made a law against the dendrophori and the centonarii which excluded them from Roman society (Cod. Theod., Lib. XVI., tit. X., l. 20).



ARLES (Upper Figure). ST. REMY (Middle Figure). VIENNE (Lower Figure).

PLATE XVII. THE ART OF BUILDING AMONG THE ROMANS.



FORET DE RETZ.

PLATE XVIII. THE ART OF BUILDING AMONG THE ROMANS.

the familæ publicæ seemed to consist in the exclusively servile condition of the members of the latter body. Moreover, the reasons for the division into classes were the same in both cases, and the most evident conclusions lead to the supposition that it existed in the corporations just the same as in the familia publica that is the best known to us.

Is it even necessary to have recourse to the analogy? The wide division of functions is written, as might be said, in the structure of the edifices. I will take up an example previously cited, the Coliseum (Plate XXII). We saw that each part of this gigantic building constituted a separate piece of construction; that there were special work-yards and different workmen for the body of the walls and the pilasters that terminate them; that a pier of squared stone, placed in the rough rubble of brickwork, was built by other workmen from those that laid the filling of the walls. Sometimes the work of the mason and that of the stone-setter were conceived in contrary views; the concrete vaults of Provence, compared with the vaults of cut stone, furnish an example of this queer contradiction of principles. Moreover, the sharp distinction made by the Romans between the structure and the decoration is significant; it evidently corresponds to a clearly marked separation between the classes of artisans who erected the buildings and those who ornamented them: perhaps a place must be given to the rivalries that are brought about by such a system of brotherhoods, and we may see that even the paltry jealousies of the workmen of the empire, the least details of their history, are marked in the works they bequeathed us.

The custom of placing the contractors under bond had also marked results, so that it is possible to distinguish to-day between the works executed by contract and those built directly by the State through its own agents.

Frontinus insists on this distinction (de Aquæd., 119) and a single example is sufficient to make it clear. We spoke of the amphitheater of Verona, and cited the incorrectness of details; among others, the flat arches, where the stones, scarcely squared up, show everywhere negligence or mistakes; this is an edifice built by the State by means of irresponsible labor; perhaps it was done by corvees, but it is certain that the amphitheater of Verona was not the work of a contractor bound, in return for an agreed sum, to the strict application of the rules of his art. Certainly it was not by contracts that the Greeks obtained those perfect works whose ruins we still admire; that method was sufficient for the building of the walls of the Pireus, but in building the Pandrosium, the State dealt directly with each of the workmen it wished to employ on its works.[1] The Romans followed, for their purely utilitarian constructions, the same course as the Greeks took in building the walls of the Pireus; they simply made one of those contracts of which the celebrated contract of Pouzzoli is the type.[2] The building was minutely described, but the methods to be followed were left to the device of the contractor. The construction was entirely under his care, and he only could profit by any improvements he should make in it,— an important point, for it explains the reason of the personal interest which resulted in the introduction of the many ingenious artifices that were employed to render the auxiliary work simpler or more economical.

But a detail that was more closely connected with the organization of the corporations had a still stronger and more distinct influence on the future of Roman construction; this was the regulations that fixed the methods of the art of building in every corporation, and that consecrated, it might be said, all the lessons of the past. The corporations were not satisfied in following the regulations of order and discipline; aside from the articles that treated of the policing of the associations, the lex collegii comprised technical prescriptions similar to the statutes that forbade members of our ancient guilds following vicious methods, or that rendered certain traditional methods obligatory. These ordinances were retained in the corporations and, doubtless, were never made entirely public; so that it is easier to establish their existence than to determine their details. Those that are the best known belong to the corporation of fullones. Pliny gives them entire, and adds that they were submitted to the sanction of the people and voted as laws of the State. Evidently this was not an isolated case; and limiting ourselves to our special subject, it is quite reasonable to admit that there were regulations relative to construction when we see that the Romans fixed the treatment of woven goods by law; furthermore, it is known through evidence in Frontinus that a law fixed the seasons when works in masonry could be carried on, and the season when they should be suspended because they could not be executed with success (Front., de Aquæd., 123).[3]

On the whole, these corporations resemble the institutions of the middle ages by a remarkable conformity of institutions and customs; and, if it were allowable to neglect the part occupied by slavery in the ancient corporations, one might say that the ones were the likeness and continuation of the others.

The corporations had under their orders — and sometimes included among their members — a large number of slaves; and there is no doubt that the cooperation of this class, whom the ancients spared but little, aided greatly in making the rude methods of Roman construction possible. But the distinction that separated slaves from freemen in the corporations must not be exaggerated; there were, perhaps, some reasons to make this distinction sharp in the corporations of builders, but in the other corporations they were not so great. By a privilege that one would little expect to find in ancient society, slaves, or foreigners, affiliated to the corporations seem often to have been put on an equal footing with freemen or Roman citizens; and on reading some of the regulations of the corporations that have been preserved in inscriptions, one is astonished by the perfect equality that seems to have existed here between the two classes, elsewhere so profoundly separated.[4]

[1] See Rangabé, Ant. hell., inscrip. No. 771, for the walls of the Pireus, and inscrip. Nos. 56 to 60 for the Pandrosium.

[2] Orell., 6428.

[3] This regulation contained three principal parts:

1st. To commence masonry not sooner than April 1.

2d. To suspend operations during the great heat of summer, in order to avoid the sudden drying of mortar.

3d. To finish work before November 1.

The last article calls for a comparison which I think quite useful. By a remarkable coincidence it is this same date of the first of November that is indicated in the Lex puteolana before cited (Corps. inscrip. No. 577), as the date when the work should be completed. It is perhaps a fortuitous coincidence, but it seems natural to explain it by attributing a common origin to the two documents, which would then be distinct enunciations of the same custom to which Frontinus alludes, recommending it "as an excellent practise, though seldom observed in spite of the law that prescribes it."

I do not know whether we should place in the same series the extract from the leges operum, given by Pliny (Hist. nat. XXXVI., 55), which forbids contractors from using lime less than three months old; these leges operum — the Lex puteolana is an example of them — seemed to have less the character of general laws than of special agreements in particular cases.

For the regulation in form of a law imposed on the collegium fullonum see Pliny, Hist. Nat., XXXV., 57.

[4] To complete this article a list of the principal corporations that were occupied in public works is necessary, which is the object of this note.

1st. We have first the Collegium structorum. This corporation was composed exclusively of men working on rubble masonry (struere, structura is never applied to works of cut stone without mortar) The Colleg. structorum is mentioned in the following inscriptions: —

Gruter, p. 106, 8; 646, 6; 1002, 1; 1117, 10 (?); Orelli, No. 6354: this inscrip. is noticeable in that it establishes the incorporation of slaves in the Colleg. structorum.

Spon. Miscell. ant., p. 231. This inscrip. seems to indicate a special category of structoris parietarii in the Colleg. structorum. The Digest also seems to distinguish the arcuarii who constructed vaults from the structoris (Lib. I., tit. VI., l. 6).

Privileges: The structores were included in the list of 32 professions that were exempted from all public charges, and particularly from the corvee by a law of Constantine (Cod. Theod., Lib. XIII., tit. IV., l. 2).

2d. With the Colleg structorum there may be cited a series of clearly distinct corporations, comprising the workmen occupied in preparing blocks of dressed stone to be used without mortar. With the structores they enjoyed the complete exemption given by the constitution of Constantine. Their names were Lapidarii, Maffei, Mus. Veron., 130, 1; Orelli, 4208, 4220; Marmorarii, Orelli, 4219, 4220, 7245; Quadratarii; Godefroy, Cod. Theod., commentary on the text cited.

3d. The group of corporations which we assemble because they are almost invariably associated in the texts, the fabri ferrarii, tignarii, centonarii, dendrophori:

(*a*) The fabri ferrarii, or simply fabri, worked in metal used in building.

(*b*) The tignarii worked in wood, included in the list of exempts (Cod. Theod., Lib. XIII., tit. IV., l. 2) and to which were attached either as subdivisions or as allied trades certain secondary professions, of which a list will be interesting because it gives a measure of the division of labor of which we have so often spoken.

The Clavarii materiarum (Orelli 4164), whose special duty was to prepare the dowels

The institution of corporations as shown by this summary review seems to carry as a consequence these general facts: —

1st. It should have assured the regular execution of public works, but, in return, to have lent itself but little to changes and innovations. It is the fate of all systems, where detailed regulations are interposed between the agents and the object, to lead quickly to formulas, to consecrated types, which may be excellent but which are unchangeable. This happened to Roman construction. The moment of its taking form was a time of a general overturning of ancient institutions, but the period of formation was brief and suddenly the methods became fixed; and, as we have already had occasion to say, they remained invariable for nearly four centuries, from the reign of Augustus to the time of the final removal of the seat of the empire.

2d. Corporations such as these, whose membership is hereditary, who govern themselves, and whose territorial limits are more or less narrow, will quickly develop differences in their manner of working that will distinguish them from each other. Two corporations bearing the same name, in different municipalities are really entirely separate and distinct and have each its own traditions; so that, in surveying the system of the working classes of antiquity, it is less astonishing to find some differences of detail in the methods used in different cities than it is to find, in all these methods, a certain uniformity that extends from one end of the empire to the other.[1]

This uniformity, which, in spite of the shades of difference, dominated the whole system, came from the influence of the examples of Rome; and furthermore, from the control exercised over the works executed by the corporations of the provinces by the agent appointed by the central administration. The emperors gave to the constructions of the municipalities a curator whose functions were more or less well defined according to the period, but who seems to us to represent, to personify, the intervention of the emperors in the provincial works. Nothing leads us to believe that each work of public utility had a curator thus appointed by the emperor; but at least a large number of undertakings were directed in this manner, and it is most probable that this control on the part of the central power was not without influence in establishing common methods in the different provinces. This was particularly true about the time of Hadrian.[2]

Later the curator tended to lose his character as an agent of the emperor, to assume that of a municipal magistrate; and, finally, towards the last days of the empire, his office became one of those overpowering dignities that were imposed on the rich inhabitants of the cities, from which an exemption was considered as a special benefaction of a munificent prince.

Apart from this general direction given to the great works, there was another influence that tended to establish uniformity of methods throughout the empire; this was the participation of the legions in works of public utility. The Roman troops were regularly employed in building, and either alone or with the corporations of workingmen worked on the municipal monuments. Vegecias insists on the organization of a certain corps with this view: "The legion," says he, "includes carpenters, masons, wagon-makers, painters, etc.," and a law allowed the employment of these soldiers on public works, only forbidding their employment in private constructions. Another portion of the law authorized the proconsuls, in case of necessity, to place the troops at the service of the curator operum for the construction of temples and other public buildings. "Ministeria quoque militaria, si opus fuerit, ad curatores adjuvandos publicis dare."[3]

As for the application, the epigraphic texts not only show us the legions assisting in the erection of public buildings, but also represent them as being occupied in quarrying the stone or making the bricks to be used in provincial works. On every page of the collection of the inscriptions of the Rhine are to be found marks of bricks that recall the corps that made them. Sometimes only the number of the legion or of the vexillatio is placed on them: sometimes one can read on them even the names of the workmen (figuli) or of chiefs of the military workmen (magistri figulorum) who prepared them.[4]

used in assemblages. The Sectores materiarum (Orelli, 4278), who sawed the timber. The Lignarii (Orelli, 4265); and finally, the Fabri intestinarii (Orelli, 4182), who did the lighter woodwork for the interior of buildings.

(*c*) The two last professions that were part of this group were the dendrophori and the centonarii, of whom little is known.

The dendrophori can be taken either as those employed in taking care of the forests, or else in hoisting the timbers used in the scaffoldings. There are two opinions as to the functions of the centonarii; one of them holds that they made coarse clothing (vestarius centonarus; Orelli, 4296) from fragments of cloth, or else the thick covers which were used, according to Vegecus (Lib. IV., Cap XVII.), to prevent the combustion of engines of war. The other opinion, however, recoiling from the idea of associating a corporation of tailors with those of the smiths, foresters, etc., takes it that the centonarii were simply roofers whose work of tiles or of shingles had more or less the aspect of that "cento" or patchwork whose name was given to the corporation. (See for the two interpretations, Rabanais, Recherches sur les dendrophores; Serigny, Droit public et adminis. rnmain, t. II., p. 336; Wallon, Hist. of slavery, etc.)

Perhaps the word which in Greek corresponds to the centonarius of Latin will help to settle the question. There is found in the MS. of the *ἑρμηνεύματα* of J. Pollux, which was discovered by M. Boucherie, to whose kind favor I owe my knowledge of it, (*κεντρωνοράφος*) centronarius (sic). This translation seems a conclusion in favor of the first hypothesis.

However that may be, it is easy to perceive the reason that led the Romans to group together the four principal professions we have just cited. The ancient authors speak of a corporation formed to guard against fires, though the inscrip. make no explicit mention of this corporation. Pliny (Epist., Lib X., ep. 42 and 43) proposes to Trajan the creation of a colleg. fablorum for this object, and how could this corporation be better recruited than from the smiths, the carpenters, the navvies, and from the centonarii, whether these last were roofers or makers of the "centos" that protected the engines of war from fire? May this not be the nrigin of the grouping together of all these artisans and the explanation of their privileges? Sometimes the dolabrarii and the scalarii were joined with the centonarii, which would seem to furnish a further argument in favor of our opinion, which has, furthermore, the support of the authority of Heineccius (de Orig. et juve coll. et corp.).

4th. We will recall, in terminating this list of the corporations, those we have designated as calcis coctores, who prepared the lime for public works, and the vecturarii and navicularii, who did the transporting.

Above, and probably outside of these corporations, we find the heads who directed the public works, of whom the principal ones were: —

The curator operis (Orelli, 24, 1506, 2273, 3264, 3265, 3382, 4011), who had the general direction of the works, and who, once they were accepted (opere probato) took on himself the entire responsibility; it was with the curator alone that the State had any dealings. (Dig. Lib. L., tit. X. l. 2, § 1.)

The contractor (redemptor, or locator operis) of whom we have previously spoken; it seems, from the Digest, where his duties are fixed, that his functions were those of a subordinate to the curator. "The curator is responsible to the State, the redemptor to the curator."

The mensor ædificiorum (Orelli, 3223); the name of the prnfession and the instruments for measuring engraved on the tomb of one who followed this profession are the only indications we have of its duties.

The architect, the technical overseer — who did not, however, always correspond to the architect of to-day, for the ancients, and particularly the Greeks, sometimes gave the name of architect to the contractor (Bockh: Die Staats-haushaltung der Athener, Liv. II. Cap. X. and XIII.).

Finally, at the other end of the scale, far below the ordinary conditions of the corporations of artisans, was all the class of men who provided the material for public works, and who were placed by a closer dependence on the State in a condition but little better than slavery, the metallarii (Cod. Theod., Lib. X., tit. XIX.). These not only worked in the mines, but, with the convicts, quarried the stone to be used in construction. (See constit. No. 8, etc., of the tit. cited.)

[1] I have previously endeavored to state exactly the degree of uniformity that is to be found in Roman art, as well as the importance of the local deviations.

[2] It will be recalled that Hadrian had the first idea of registering the artisans of the empire. It was he who appointed the curators to the baths of Venusia and of Benevento (Orelli, 3263, 3264); and it was he whn imposed the quinquennials nn certain building corporations (Orelli, 2163). No ruler seems to have mixed himself up in the details of construction in the provinces as much as this emperor-architect.

[3] Organization of the legion in view of works of construction.

Veget., Lib. II., Cap. XI.

Prohibition against placing soldiers under the orders of private contractors. Digest, Lib. XLIX., tit. XIV., l. 12, § 1.

Troops put under the orders of the curators operum pub. by the proconsuls. Digest, Lib. I., tit. XVI., l. 7, § 1.

In this case the cost of supporting the troops was placed on the province for whose profit they worked. This fact is known from a sentence of Philo (adv. Flacc., p. 966), where the author shows us the system by citing the abuses to which it gave rise. It is also indicated in some inscriptions that can be found in the résumé of the Corps. Inscrip. græcorum, Vol. III, p. 314 (Inscrip. Ægupt., Introd.).

[4] I owe all these indications to M. Fr. Ritschl, who kindly pointed out, among the documents of his collection of Inscriptions of the Rhine, the following: —

1st. Stone quarrying by the legions;
Corpus Inscrip. Rhen. No. 651 et seq.

2d. Brickmaking by the legions;
Corpus. Inscrip. Rhen. No. 223, p. 63, i, 2.
Mention of the vexillationi who aided in the brickmaking.
Corpus. Inscript. Rhen., p. 118, d. 3.
Names of figuli and magistri figulorum, belonging to the army.
See the list drawn up by M. Brambach; Corpus. Inscrip. Rhenan., p. 380.

3d. M. Ritschl thinks that the Inscrip. of the Corpus Inscrip. Rhen. under the number 1397, and the three inscrip. 837, 1548, 1554, are relative to the works executed by the troops.

COLONIAL DOORWAY, HARRISBURG, PA.

WATER POWER HOUSE, INDIANAPOLIS, IND.
KIMBALL & THOMPSON, ARCHITECTS.

Fire-proofing Department.

FIRE-PROOFING UNDER FIRE-PROOFING LAWS.

THE ideal condition of architecture and structural practise would be one which is in the hands of competent, trained architects and builders, who so thoroughly understand their business, and whose integrity is so above question that municipal regulations would not be needed for their direction and control, but each problem as it arose would be solved in the best manner for the particular case, and intelligent preconceived judgment would take the place of the arbitary and often irrational laws which, because of our human limitations, are necessarily imposed upon the practise and the theory of building. Laws which, of themselves, may in a general sense be commendable, are not always applicable, and there are crudities and even absurdities in all of our municipal regulations which, so far from attaining the object sought, — namely, a production of the best kind of work,— often through the ignorance of the law makers, if not through the carelessness of the executives, will produce a directly opposite result. This is especially true, we are sorry to say, in regard to the specific statutes which are intended to regulate, define, and limit the use of the so-called fire-proof construction.

Every architect and builder knows what first class fire-proof construction is. We all admit that iron is absolutely worthless for structural purposes unless perfectly protected against intense heat. We theoretically know and practically admit that very few mediums are efficient to properly protect the steel; and while a number of materials have been tried with varying success, the choice is limited within very narrow bounds. We make experiments which determine just how far much material can be trusted; we know just what should be done for theoretical cases; and yet in probably every large building which is put up in our principal cities there are weak points in the construction, or more properly in the fire-proofing, which the law allows and even sanctions in some cases, and yet which no one, if put to the direct question, would for a moment claim to be efficient or even intelligent. One reason for this arises from the workings of the contract system. The architect is expected to decide in advance every detail of the construction, and no individual architect has yet arisen who is sufficiently all-knowing to include everything. Then, in estimating, the builders are obliged to figure as closely as they can. The builder cuts prices with the fire-proofing contractors, the iron worker cuts with the fire-proofer, the general contractor cuts with the whole of them, and the owner keeps up with the procession by crowding down the general contractor. Then when the building by any chance is caught in a serious conflagration and is partially or totally destroyed, we say that another fire-proof building is gone wrong, and we hold up our hands in structural horror at the blindness of such and such architect, or such and such builder, to permit such scant fire-proofing, when, perhaps, in the very next building we will do just as badly ourselves. We are too inclined at the present period to consider cost before efficiency. The fire-proofing is hid away from view. After it is neatly plastered over no one can tell what is inside; the odds we assume are one hundred to one that the building will never be burned down, and we take our chances, fortunately, with a very large degree of impunity. In these days of the wide dissemination of knowledge through books of all sorts there is no excuse for any architect or builder being ignorant of proper methods, and the practical theories of fire-proofing as applied to large buildings, but we unfortunately encourage cheapness rather than excellence. Too many of our architects will bank their reputation on the stability of an important structure upon the remote chance of the building catching fire, and will not be particular enough to insist upon the very best for that part of the work which is never seen, is little appreciated, and is often not understood at all by the man who pays the bills. There is altogether too much chance entering into much of our fire-proofing. In these pages we have repeatedly emphasized the value of burnt clay as a fire-resisting medium. We cannot afford to take very many chances when so much is at stake, and when we know a material will resist a high degree of heat it behooves us to be very cautious in tolerating anything else.

Any one who has passed by a building in process of erection cannot have failed to be struck with one or two weak points which seem to be neglected. One very frequent lapse of this kind is in the so-called fire proofing of external steel beams and columns. According to the laws of the city of Boston, which, by the way, are much less exigent than those of some other cities, one inch of ordinary plaster is accepted as sufficient protection for any structural steel work. We will not undertake to discuss the fire-resisting qualities of an inch of plaster; but the so-called inch becomes in many cases barely one sixteenth as actually applied, and we have repeatedly noticed instances where a coarse mesh of iron wire will be stretched over an iron beam and a rough coat of plastering applied thereto, the plastering being so thin and crowded so closely against the iron that every mesh of the netting is visible in the finished plaster. And yet this passes as a fire-proofing of the iron beam, when, as a matter of fact, it is doubtful if a beam so protected would last five minutes in an ordinary conflagration.

We know of one instance in a city not more than a thousand miles from Boston where the theory of fire-proofing was carried to even a more absurd extent. A certain manufacturing company desired to build an iron truss over its engine room. The statute in this particular city distinctly stated that all structural metal work must be protected in specific ways; but in another part of the building law there was a clause which recognized the value of so-called fire-proof paint, and by virtue of this latter ambiguous clause the builder was allowed to simply paint the ironwork of the girders with one of the whitewashes which passes for fire-proof paint, and the work was then accepted and passed by the local inspector as being thoroughly fire-proof. This is, of course, an extreme case; and yet in buildings of the first magnitude and importance we have seen steel columns intended to support loads running as high as six and seven hundred tons, which were protected only by a thin enclosure of expanded metal and Windsor cement, which formed both the fire-proofing and the finished plaster work, and was so scanty in places that a lead pencil was inadvertently punched through the wall and through the fire-proofing. When the building was finally inspected it was found that the enclosure ran only to the floors, and on account of some furring on the ceiling below there was ample chance for a draft of fire being carried up in the construction of the column itself in such manner as to convert the angles of the column into what might easily become a blast furnace.

The fact is, that notwithstanding the many substitutes which have been devised and advocated on the score of economy, there has nothing yet been found on the whole so satisfactory, so efficient, and so stable in its preserving qualities as terra-cotta. Not terra-cotta one half an inch thick, run out in thin slabs and deeply grooved at that, and then stuck up against an iron column with a little plaster of Paris, but a good, generous envelope of burnt clay, thick enough to act as a real insulator, solid enough to bear considerable jarring, and secured in place so strongly that the force of a jet of water from a steam hose will not dislodge it and break down the protection. We imagine that nine owners out of ten, if asked whether they could spare the space equal to four or five inches on the outside of all the flanges of isolated steel columns in the first story of a building would anxiously say no, that the space was too valuable, and that fire-proofing must be devised which would not take up so much valuable space. But it is the province of the intelligent architect and builder to decide these questions, not on the score of economy *per se*, nor of renting space alone, but to make his fire-proofing, like Cæsar's wife, beyond suspicion. The lesson of the Pittsburgh fire is that it is perfectly possible to protect steel in a most efficient manner, and we cannot afford to take possible chances when it is so easy to make sure. An investor, a real estate owner, will very naturally economize in the construction in the hidden parts of a building to almost any extent to which an architect will let him, sometimes this economy resulting from ignorance, but quite as often from deliberate intent to take advantage of a law which is framed in ignorance and allows only too many loopholes for inefficient construction. But we believe that every one would be better satisfied in the long run if our architects and builders would take the stand that they would not for one moment countenance experiments in fire-proof construction except when the experiments are conducted simply for their own sake; that in a large modern building the fire-proofing above all things must be of the best; and fire-proof paint, a light skimming of plaster or a thin furred plaster wall around the column, while having a purpose and perfectly proper under some conditions, are totally inadequate as a fire resistant. The best is none too good. We have never been able to reach perfection in this most uncertain of the applied building sciences, and the architect or builder who lends himself to the employment of anything than that which he knows is going to stand the most severe tests is imperiling his own reputation, is preparing the way for a possible catastrophe, the evil results of which can hardly be measured, and though he may be acting for the seeming benefit of his economical client, he is really doing just the reverse. In construction the architect must take the ground that he knows more than the investor, that he himself is the arbitrator of what shall be done, and he should make it his rule always to give his client what he really wants rather than merely what he thinks he wants. And, beyond this, our laws relating to fire proofing should be rigidly revised by those who know more about the subject than the average lawyer or legislator.

We have sometimes had a Utopian dream, which at the very outset is admittedly impracticable, and yet which is fascinating by its simplicity, and that is to abolish off hand all building ordinances which relate to the use of materials, strength, protection, etc., and instead of spreading the shield of the law over doubtful interpretations and questionable local practises, to put the whole responsibility for the success or failure of every building, where by right it belongs, on the shoulders of the architect, holding him to the strictest accountability, and compelling him by severe penalties to build in accordance with what in ninety-nine cases out of one hundred he knows is right. Unfortunately, so long as architecture is an open profession, such a condition of affairs is impossible, and we can only hope that the repeated severe lessons, which we have at times presented to us, may be the means of a surer appreciation and a more thorough application of the fundamental principles of fire-proof construction. We cannot afford to continue to send up millions in smoke, when a small percentage of those same millions, if judiciously expended, would make our buildings impregnable.

FIRE-PROOF CONSTRUCTION.

ONE probable result of the increased duty upon lumber will be to increase the number of buildings put up of absolutely fire-proof construction. With this form of building material on the free list, the gradual reduction in the cost of steel beams, terra-cotta, tiles, bricks, and other non-combustible materials has been sufficient to make the cost of an ordinary building hardly more than 10 per cent. greater, if of fire-proof construction, than if put up in the old-fashioned way. But if lumber of all kinds is to have its price increased, as seems probable, by these tariff changes, then it is not unlikely that even this difference will be reduced, so that it may, in a short time more, become absolutely cheaper for a person putting up a brick or stone building to have the interior built in an absolutely fire-proof manner, than it will to have this same interior constructed of wood. As to the duration and to the cost of repairs, the advantages are all on the side of fire-proof construction, while the added space obtained is of itself almost enough to justify the change. In the matter of speed of construction, recent experience has shown that a modern fire-proof building can ordinarily be put up in about two thirds the time required to construct one of the old-fashioned type.— *Boston Herald.*

Mortar and Concrete.

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

BY CLIFFORD RICHARDSON.

THE ROSENDALE CEMENT INDUSTRY.

TREATMENT OF BURNED STONE.

THE burned stone, as drawn from the kilns, is carefully sorted in order to reject any partially fused clinker or underburned portions. In a carefully conducted works there is but little of such material, yet always enough to require careful attention. It should, of course, be rejected because of the injury it would do to the quality of the ground cement, but it is probably oftener thrown out on account of the difficulty of grinding it, because it is so much harder, whether over or underburned, than the properly burned stone. With some rock, free from magnesia, the overburned material is ground by itself and sold as natural Portland cement.

Depending on the character of the original limestone, the burned stone may go immediately from the kiln to the mill for grinding; or if it yields a fiery and too quick setting cement, as many of the limestones free from magnesia do, it must either be sprinkled or steamed to make the cement slower setting. The object is to slake the excess of free lime, which would, in the course of making a mortar of the ground cement, raise the temperature so much as to cause a too rapid set. This result can also be accomplished by air slaking the ground cement, but such a proceeding requires very considerable storage facilities and much time. It is, therefore, more expeditiously brought about by treatment of the burned stone before grinding.

For sprinkling a water-pot is used, and a measured quantity of water is carefully dirtributed over the lumps of burned stone as it comes from the kiln. The amount necessary for different stones must be learned from experience. It is usually from one to two gallons for each ton of the burnt material.

For steaming, the burned stone is dumped into a hopper, or bin, with shelving sides, where it is exposed to the vapor from steam which enters at the bottom. Such a bin may have a capacity of from 2,500 to 3,000 barrels of cement. The burned rock after a suitable time is drawn off and treated like that which has been sprinkled.

On reaching the mill it is crushed coarsely in any of the ordinary forms of rock crusher, or with a spalling hammer. It then goes to one of the many forms of crackers, or pot mills, where it is reduced to the size of peas, or finer. At this point it may be screened or sent to the buhrs, or mills, direct. The former process results in a much increased capacity for grinding. The fine powder, which is removed, amounts to about 25 per cent. of the stone, and is, of course, conducted to the receiver containing the ground cement from the mills, and again carefully mixed with it by means of worms. The coarser stone, or the entire run of the crushers, goes to the grinding apparatus, which commonly consists of buhr stones in their many forms. Although they need frequent redressing, every two or three days, stone mills have been found more economical for grinding such a soft material as burned limestone, than any of the forms of mill used for Portland cement. One run of stone, depending on its size and the degree to which the grinding is carried, will take care of from 200 to 150 barrels of cement per day of ten hours.

It is now customary to grind much finer than several years ago, so that as much as 94 per cent. of a high-grade cement will pass a sieve of 100 meshes to the lineal inch. The increased cost is found to be fully repaid in the improvement in quality of the product.

The best Rosendale brands now sift as fine as, residue on 200 mesh sieve, 10 per cent.; on 100 mesh, 6 per cent.; on 50 mesh, 2 per cent.; but ordinary natural cements average 15 per cent. on the 100 mesh sieve.

From the mill the ground cement generally goes to a large warehouse or bin, being thoroughly mixed on the way, so that there shall be no segregation of the harder and softer or coarser and finer particles. From storage it is drawn off by special apparatus and packed in either barrels, coopered near at hand, or in bags. The cement is compacted in the barrels by a shaking machine, or jig. The amount is carefully weighed to 300 lbs. in Ulster County, N. Y., and on the Potomac, but in the West it frequently falls as low as 260 lbs., owing to the smaller volume weight of the Western cements. When properly labeled with brand and date of packing it is ready for the market.

PHYSICAL PROPERTIES AND CHEMICAL COMPOSITION OF NATURAL CEMENTS.

Color. The numerous natural cements of the United States differ in appearance very decidedly, varying in color from the very pale and light buff of the magnesian Potomac and some Western cements, through a gray color, resembling Portland, to the dark brown of the Rosendale brands. The color is due to the oxides of iron, manganese, etc., and the varying proportions and forms in which they are present. The value of the material as a hydraulic cement is not, however, at all affected by its color.

Specific Gravity. The specific gravity of natural cement varies with the rock from which it is made; the denser the rock, the denser the cement. Some well-known brands have the following specific gravities:—

Brand.	Rock.	Cement.
Rosendale	2.84	3.04
Round Top	2.73	2.84
Minnesota	2.74	2.81
Fort Scott, Kans.	2.72	2.79
Utica, Ill.	2.67	2.70

These specific gravities are, however, for freshly burned cement. If cement has been exposed for some time and absorbed water and carbonic acid its specific gravity becomes much less, falling in one case from 2.84 to 2.57 after a year.

Weight. The volume weight, or density of a natural cement may be roundly expressed as 1.28, water being unity, when packed as ordinarily found in the East in barrels of 3.75 cu. ft. capacity and 300 lbs. weight. A cubic foot in this condition weighs 80 lbs., and a struck bushel 100 lbs. With cements not so dense 300 lbs. may require a barrel of considerably larger capacity and the volume weight be considerably less. When very coarsely ground all cements will, of course, weigh more per given volume than when fine.

COMPOSITION AND PROPERTIES OF NATURAL HYDRAULIC CEMENTS.

From what has been already said of the variation in the composition of the hydraulic limestones in different localities, and even in the same quarries, it is evident that great difference in the composition of the resulting cements and in their properties must exist as well, and that there is no such uniformity in their composition as is the case with Portland cement. That this is so appears from analyses, which are given in the following table, of most of the well-known brands of natural cements, as they are found in the market.

	Lime. CaO	Magnesia. MgO	Silica Comb. SiO_2	Alumina. Al_2O_3	Iron Oxide. Fe_2O_3	Soda. Na_2O	Potash. K_2O	Sulphuric Acid. SO_3	Loss on ignition. $CO_2 + H_2O$	Silicates undec.
ROSENDALE.										
Hoffman, 1897	34.64	14.82	16.49	10.96	4.68	.55	1.25	1.04	4 50	12.42
Hoffman, 1890	35.84	14.02	18.38	15.20				.93	3.73	11.46
Hudson River	36.67	14.35	18.17	11.30				1.32	4.27	13.11
New York & Bridge	33.18	19.61	11.28	9.40					4.40	14.64
Newark & Rosendale	34.14	19.61	24.43	8.68		.23	1.39		3.57	6.35
Rock Lock	35.35	14.75	14 82	17.50				1.41	4.68	12.18
NEW YORK—WESTERN.										
Akron Obelisk	37.54	26.14	13.94	10.02		.52	1.60		4.58	6.81
Star	41.60	22.24	16.20	4.40	2.80	.23	1.39	2.06	6.90	4.00
Buffalo	39.20	26.52	13.24	4.40	2.00	.41	1.44	1.39	6.80	3.24
PENNSYLVANIA.										
Siegfried	45.95	11.53	5.78	6.86				.69	26.17	13.83
Milroy	41.90	29.73	13.56	5.00				.74	6.40	4.68
WESTERN.										
Sellersburg, Ind. Anchor.	38.28	11.94	18.52	4.78	3.24			1.97	10.39	6 24
Milwaukee	33.40	22.60	13.80	4.00	2.80	1.64	.87	2.59	9.50	11.20
Louisville	46.64	12 00	20.42	4.76	3.40			2.57	6.75	3.74
Utica, Ill.	29.99	19.79	9.58	2.76	2.16	.26	1.51	1.35	15.96	17.42
KANSAS.										
Ft. Scott	49.80	12.16	17.60	4.00	5.00			2.04	4.50	4.20
MINNESOTA.										
Mankato	45.51	15.02	16.30	3.34	3.80	1.33	.70	1.94	10.00	5.06
POTOMAC.										
Shepardstown	34.83	11.33	22.89	9.36			1.25	1.49	5.13	13.62
Antietam	29.38	13.37	14.54	10.44	3.25			1.15	7.15	18.96
LIME CEMENTS.										
Round Top	45.66	2.86	21.68	8.34	4.14			1.31	8.13	7.96
Cumberland & Potomac	39.54	3.80	20.42	8.38	5.38				10.20	9.80
Cumberland	41.96	3.19	20.25	14.76					7.97	9.41

Among these cements the following extremes of composition are to be seen:—

	Total Lime and Magnesia.	Lime.	Magnesia.	Silica combined.	Alumina.	Iron Oxide.	Soda.	Potash.	Sulphuric Acid.	Loss on ignition.	Silicates undec.
Highest	65.84	49.80	29.73	24.43	10.44	5.08	1 64	1.60	2.59	26.17	17.42
Lowest	42.75	29.38	2.86	5.78	4.92		.23	.87	.93	4.20	3 24

The differences are very great. If, however, the inferior brands are excluded and only those considered which are standard, such as Hoffman Rosendale, Milwaukee, Louisville, Round Top, and Fort Scott, the following figures are obtained:—

	Total Silica and Magnesia.	Lime.	Magnesia.	Silica combined.	Alumina.	Iron Oxide.	Sulphuric Acid	Loss on ignition.	Sand.
Highest	61.96	49.80	22.60	21.68	15.20		2.59	9.50	11.46
Lowest	48.52	33.40	2.86	13.80	4.00	2.80	.93	3.73	3.74

Among these standard brands there is still, however, a great diversity of composition, and each seems to be more or less a type in itself.

The results of these differences in composition, of course, affect the hydraulic value and other physical properties of the cements.

THE USE OF WET SAND IN THE MAKING OF MORTARS.[1]

BY P. HERVIEU.

THE influence of the degree of dryness of sand upon the setting of mortars is well known; it suffices to say that, without having any very serious effect upon lime or slow-setting cements, wet sand can, with rapid-setting cements, retard the setting by inducing the formation of aluminate of lime. Otherwise, the resistance of mortars does not appear to be diminished, to judge from the experiments of Candlot.

More or less water in the sand used has another consequence, equally well known, but which has not received the attention that it merits; *i. e.*, the difference of volume which exists between dry and wet sand.

The following table gives the results of experiments made by Candlot.

Kind of Sand.	Weight of 1 Liter of Sand Measured without Packing. Dry.	Wet.	Loss of weight due to humidity.	Observations.
	Grams.	Grams.	Grams.	
Rounded Quartz Grains.	1418	1170	248	Average sand: grains pass through No. 20 screen (19 meshes to an inch), and remain upon No. 30 (28 meshes per inch).
Angular Quartz Grains.	1300 1560	1019 1148	281 412	Mixture of six sizes of sand passing through screens No. 50, 30, 20, 12, 6, and 2.

[1] Translated from *Nouvelles Annales de la Construction*, August, 1897.

This is for average sand: it increases to 300 grams for very fine sand, and descends to 25 grams for large particles: the maximum was attained with a mixture of different sizes.

These diminutions in weight are naturally accompanied by a proportional increase in volume; thus, in the examples in the table, the volume of wet sand increased $\frac{1}{212}$th, $\frac{1}{276}$th, and $\frac{1}{359}$th, of that of the dry sand; inversely, the dry sand is 0.825, 0.784, and 0.736 of the volume of wet sand.

These results have been confirmed by experiments which we have made and which it is easy to repeat:

1. A liter of river sand thrown upon a platform in the ordinary condition of wetness, exposed to the sun, was reduced, after apparently completely drying, to 0.782 liter.

2. A liter of the same sand, dried upon a heated iron plate, was reduced to 0.761 liter.

These figures approach quite closely to those of Candlot.

Variations in volume increase for the same sand with the degree of wetness up to a certain limit only; in fact, it diminishes when the sand is soaked and disappears when the sand is entirely immersed.

We will not attempt to explain these facts, as such discussions will be found in all works on the subject, but we will show the effects by an example.

Suppose a cement mortar is to be made composed of 300 kg. per cubic meter (500 lbs. of Portland cement per cubic yard of sand) mixed in a box graduated to secure this proportion (generally it is more con venient to mix half this quantity of mortar). The volume of dry sand will be exactly 1 cu. yd. and the proportions exact; with wet sand the real volume will not be more, but by reason of the moisture there will be less dry sand, making the relative proportion of Portland cement 394 instead of 300 kg. per cubic meter (650 instead of 500 lbs. per cubic yard of sand). It will hence be necessary to take 500 × 0.782 = 390 lbs. of cement to add to the wet sand, a difference of 650 — 500 = 150 lbs., which at 64 cents per 100 lbs. (price at Paris) corresponds to an extra expense of 96 cents per box of mortar. Lime and cement can be readily weighed before mixing, but it is inconvenient to weigh the proportions of sand.

On the other hand, river sand, which is more frequently used, is often brought directly by boats from where the dredge had taken it; it is hence very wet when placed in the mortar boxes, and to obviate this by artificial drying is not to be thought of.

It is a question as to whether dry or wet sand should be considered as the type. It is doubtful whether dry sand alone can be considered as such.

The proportions adopted in each case for mortars is fixed by the results of tests made on small specimens. To compare these tests in order to arrive at definite conclusions, it is necessary to use material not only identical in nature, but in the same physical condition also at the time when it is used; that is to say, the sand should not be taken for this purpose as it comes, but should be dried in such a manner as to render the samples as nearly uniform as possible, in order to be able to evaluate their influence correctly in the finished briquette.

Then a mixture of 500 lbs. of cement to 1 cu. yd. of dry sand would be considered as the normal, and it would simply remain to find what proportion of wet sand should be used. The most simple method of doing this is to shake up the sand measure in such a manner that the wet sand will be of the same volume as dry sand; this cannot be done exactly, but the difference will be small. One liter of sand, the same as was used in the preceding experiments, has been brought by shaking to 0.808 liters, exceeding sun-dried sand by 0.018 liters. But such shaking up or settling is not possible on all public work, and the measuring devices are not adapted to it. It has, however, been thought well to call the attention of engineers to this fact in order to prevent serious mistakes in proportioning mixtures. No rule could be made which would be universally applicable, but each one must use his own judgment and experimental data. If it is important that a definite mixture should be specified, it is equally so that methods be employed to carry out the specifications rigidly.

PRODUCTION OF HYDRAULIC CEMENT IN 1896 IN THE UNITED STATES.

THE reports upon the production of Portland and natural cements in the United States in 1896, by Spencer B. Newberry and Uriah Cummings, for the Annual Report of the Director of the Geological Survey for 1896–97, Part V., Mineral Resources of the United States, have been recently made public, and contain much information in regard to our cement supply that is of interest.

The production of American Portland cement reached 1,543,023 bbls., in 1896, as compared with 990,324 in 1895, an increase of nearly 56 per cent. over the previous year. This increase was most marked in the Lehigh Valley region, the largest producing center in the country, where five plants yielded 1,048,154 bbls., or 68.1 per cent. of our entire supply, as compared to 485,329 bbls., or 61.2 per cent., from the same source in 1894. New York and Ohio were the only other localities where a steady and considerable growth occurred, the remainder of the country showing a decline.

The imports of Portland cement were 2,989,597 bbls. in 1896, which is a slight decrease over those of 1895, but the amount imported annually during the past six years has been very uniform. Over 40 per cent. of the imported cement was German, the proportion having gradually increased, with a diminution in the amount received from Great Britain, owing to the increased appreciation of the character of the German cements, and the more careful methods employed in the German factories, the English manufacturers clinging, until very recently, to the old methods, and being, in consequence, not up to modern requirements.

The imports of Belgian cement were equal to those of English brands, but their character was inferior. They consist largely of so-called natural Portland cements made by burning, at the temperatures usually employed for the production of Portland cement, a natural hydraulic limestone which approximates the composition requisite for a high-grade Portland cement.

The production of Portland cement in the United States was, in 1896, 34.7 per cent. of our entire consumption, where it was only 13.2 per cent. in 1891, and 25.3 per cent. in 1895, so that, while the importations have not increased, the factories of this country have tripled their output. The prospects of the industry, therefore, seem to be good, especially as the high character of the best brands is recognized. The price of American Portland is, however, much below that of the imported article, with the duty included, owing to the sharp competition among the leading manufacturers, so that a difference of price at from 30 to 50 cents per barrel between the two may occur.

By far the largest amount of American Portland cement is made from limestone, eighteen factories using this substance as compared to eight which use marl, while the use of rotary furnaces, instead of vertical kilns, is also increasing relatively.

Attention may also be called to the fact that our markets, probably in response to a demand for cheap cements, is filled at the present time with very inferior second and third grade material, which is called Portland cement, and which consists of either overburned natural cement rock, improperly burned cement clinker, or some mixture, such as a good Portland cement intimately ground with a large proportion of sand or limestone, which, while in itself perfectly suitable for use under certain conditions, should not be sold as Portland cement and at a price which is relatively much too high.

The production of natural cement increased slightly in 1896, accompanied by a very slight rise in value. The total output is stated to be 7,970,450 bbls., of which Ulster County, N. Y., produced 3,426,692; New York State, 4,181,918; and Indiana and Kentucky, 1,636,000; while the output in pounds *per capita* of our population was 33.93 as compared to 13.04 in 1880. For much masonry, which was formerly laid with lime, natural cement is now used.

Attention is called by Mr. Cummings to the differences in the standard of weight in a barrel of natural cement in the East and West, in the former case 300 lbs. constituting a barrel, and in the latter 265 being considered one.

The Masons' Department.

SOME REASONS FOR ARBITRATION.

CONSIDERING the fact that almost every building contract contains a clause providing that, in case of difference of opinion regarding the value of extra work or work omitted the matter shall be settled by arbitration, it seems rather strange that we hear so comparatively seldom of disputes of this kind being adjusted in such a way. In discussing the difficulties attending the accurate valuation of work attention has been called to the fact that it is almost impossible for an architect to do better than approximate the cost of labor and materials, and the results which he obtains, it must be admitted, are often unreliable and inaccurate. What the architect wishes to determine in cases of dispute over the value of work is what is fair and reasonable, but under existing conditions it seems practically impossible for him to obtain such information, for the simple reason that he cannot get at the bottom facts. The natural conclusion to draw from such conditions is that contractors are unwilling, as a rule, to let an architect know the true value of work and materials, which, in turn, shows one of two things; either that the contractor feels that the architect will misuse such information if he is allowed to have it, or that the contractor, for certain reasons, does not care to have it known where his profit is made. After making all due allowances for the shortcomings of the profession, it can hardly be claimed that the first-named reason is a just and valid one. On the other hand, it is usually admitted by a contractor that his profits are both irregular and uncertain; that is to say, while the totals on a given piece of work may be very close, detailed estimates would show wide variations. While such a state of things exists both architects and contractors must work more or less in the dark so far as their knowledge of the actual value of certain work and material is concerned. The way to have such matters definitely determined is to have a certain number of experts, with opportunities for knowing all the facts of the case, sit down together and, after a discussion of the question, both in general and detail, figure the cost of the work individually, and after a comparison of the different results, agree finally on a certain definite sum as representing as nearly as possible the true value of the work and materials. After a certain number of cases had been settled in this way, they would constitute valuable precedents which could be referred to as a basis for setting a fair price on similar work. It is true that, as no two buildings are alike, the cost of the labor and materials necessary to perform a given piece of work varies also. But with a reliable unit to start from, it is comparatively easy to approximate with a considerable degree of accuracy the value of work which is similar in character to that of which we have a precise and definite knowledge. There seems to be a decided inclination on the part of contractors in this country to keep from the architects the true cost of the various things which enter into the construction of a building. As has already been stated, unless there is reason to believe that the architect will misuse his knowledge of prices, there is really nothing to be gained by keeping him in the dark on matters of this kind; for, without any definite basis upon which to found his opinion, he naturally inclines to under rather than over estimate values, and, of course, the contractor suffers to whatever extent this is done. To show that the architect can be trusted with a knowledge of prices we need only to refer to the English practise, where, before a contract is signed, the builder is required to deposit with the architect a detailed bill of quantities with the prices for each different kind of work and materials stated. Attention has been called to the fact that if contractors could be compelled to depend on what may be called legitimate profits, building contracts would be awarded more fairly than at present; for upon this basis an estimate would include the fair profit to which the builder is justly entitled, and he would not dare to run the risk of taking the work at cost or less, and depending on changes for which he can charge a price wholly out of proportion to the true value of the work.

Unless we can introduce the English method of estimating, which seems for the present impossible, the only way for the architects to learn definitely the value of work and materials is in the line of arbitration. In point of fact it would seem desirable in many ways to have some permanent board of arbitration, under the control of the architects' and builders' associations, whose duty it should be to settle all disputed claims arising between members of either of these bodies.

HOW TO BUILD A CHIMNEY.

THERE are floating through building literature a thousand and one remedies for curing smoky chimneys, but very few methods suggested of "how to build a chimney that will not smoke." This, of course, is a pretty difficult task, particularly if the chimney is placed in a multi-gabled house, or near other buildings, trees, or hills. Yet fairly good results can be obtained by the scientific builder if he follows certain given rules. If a chimney is intended to carry smoke from an open fireplace it is a good plan to make the throat not less than 4 ins. wide and 16 ins. long, which will give an area at that point of 64 ins.,— of course something will depend on the size of grate,— then the flue should be abruptly enlarged so as to nearly double the area, and so continue for a foot or more; then it may be tapered off gradually until the desired area is obtained. The inside of the chimney should be "parged" or plastered throughout its entire length, and made as smooth as a trowel can make it, and the mortar used should be the very best so that it will harden with age. No flue should contain less area than 60 sq. ins. The best shape for a chimney flue is circular, or many sided, as giving less friction. Brick is the best material for the purpose, as it is a non conductor. The higher above the roof a chimney rises the better. When expense is no object, 8 in. drain tile (glazed), built in the chimney, makes the best flue known, if properly jointed.— *Canadian Architect.*

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 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.*

THE LAW.

WHERE lots have been conveyed subject to a covenant that no buildings shall be erected on the same within a certain distance of the street, such covenant is enforceable, though the streets on which such lots abut has changed from a residence street to a business street.— *Superior Court of New York.*

WHERE a contract for the sale of real estate provides for a variance in the dimensions of the premises of one inch in width and depth, the purchaser will be relieved from the contract if the building on the premises encroaches more than one inch on the adjoining premises.— *Superior Court of New York.*

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

NEW YORK.—Nothing of great importance has occurred during the past month in building and real estate circles, although the aggregate has been important enough to fulfil predictions of a prosperous winter, and places September among the successful months of the year. There appears to be no cessation to the building of homes in the metropolis, as the reports of building enterprises show. There seems to be an endless supply of apartment houses in the city for people of every class, and fortunately the demand is equal to it. After the first of January there may be many radical changes made in the building laws, owing to the new building department, which will have complete charge of the building interests of the greater city, according to the new charter. This event will be awaited with great interest by architects and builders especially, and we can confidently look for great improvements.

Cady, Berg & See, architects, have prepared plans for an interesting building to be used for public baths. The building will be three stories in height, of brick and terra-cotta. It is situated on Rivington Street, and $75,000 is to be expended. This venture will be considerable of an experiment for New York, but promises to be successful if popular interest and public opinion are any criterion. Great credit is due to the *Cosmopolitan*, which drew attention to the subject by a competition several years ago, in which the scholarly designs of Mr. John Galen Howard were placed first.

RESIDENCE, MORRISTOWN, N. J.
Built of mottled brick furnished by the Raritan Hollow and Porous Brick Company, 874 Broadway, New York City.

The most important large work in contemplation is the new home for the Geographical Society of New York, for which purpose a fund of $400,000 is already on hand. The site has not yet been chosen nor plans selected. Judge Charles P. Daly is president of the society, a position which he has held for the past thirty-three years. Its first president was George Bancroft, the eminent historian.

George Crocker, the Californian millionaire, has purchased the old Knickerbocker mansion, corner of Fifth Avenue and 64th Street, at a cost of $250,000. He intends making improvements which will cost as much as the site.

Louis H. Sullivan, architect, has drawn plans for a twelve-story office building to be erected at the corner of Bleecker Street and Broadway. Cost, $400,000.

Edward Wenz, architect, has planned two five-story brick flats to be built on 112th Street, near Lenox Avenue. Cost, $38,000.

R. H. Robertson, architect, has prepared plans for a four-story brick and stone dwelling for Mr. George Sherman, to be erected on 55th Street, near Fifth Avenue, at a cost of $65,000.

John Hauser, architect, has planned four five-story brick flats to be built on Madison Avenue near 101st Street. Cost, $100,000.

Henry Anderson, architect, is making plans for the new Lutheran church on 140th Street, corner Edgecombe Avenue. It will be a brick building, and will cost $60,000.

John Woolley, architect, has planned four five-story brick flats to be built on 67th Street, near Amsterdam Avenue. Cost, $72,000.

W. C. Dickerson, architect, has planned four five-story brick flats to be built on 117th Street, near Lenox Avenue. Cost, $80,000.

George F. Pelham, architect, has drawn plans for four five-story brick flats to be built on 103d Street, near St. Nicholas Avenue. Cost, $125,000.

Brazier & Simonson, architects, have drawn plans for a brick warehouse to be built on Center Street, near Elm Street. Cost, $80,000.

Lamb & Rich, architects, have planned a new brick edifice for the Washington Heights church at 145th Street, corner Convent Avenue. Cost, $80,000.

CHICAGO.—Building operations in Chicago are not large enough to attract much attention, unless we except the high board fence which the government has extended entirely around the block comprising the site of the new post-office. An advertising company will make beautiful this lofty screen. Think of 1,600 lineal feet of soap and breakfast food advertisements 12 ft. high shutting out the curious eyes of all the citizens who are patriotically anxious to see that all the pile foundations are properly driven!

While building statistics show an average of greater value as compared with the activity a year ago, yet business is slow. In the long list of Chicago building permits issued during a period of two weeks only three items were for buildings exceeding $14,000 in value, and only one was above $20,000. This latter was a street railway power house, by D. H. Burnham & Co., the cost being given at $65,000.

A new building project is a large factory for the New York Biscuit Company. The improvement, it is said, will amount to $250,000. Mr. S. A. Treat is the architect.

The school board, as usual, has some new school buildings under way; W. S. Patton, architect.

A fire-proof apartment building, to cost $125,000, has been reported. Mr. August Brosseau is named as the owner, who is having the plans made.

ST. LOUIS.—There is evidence of continued improvement in the building line in this city, and the outlook for the future is improving. The opinion seems to prevail, even among the most conservative, that the coming year will be the commencement of an unprecedented building era, and the number of investments being made by outside capitalists in the manufacturing and wholesale districts, and the large number of factories coming here from other cities, or being inaugurated among our own people, lends a color of truth to the prediction.

Only recently the Liggett-Myer Tobacco Company, finding it advisable to concentrate their business, erected in Dundee Place perhaps the largest tobacco manufactory in the world. The site is quite a

RESIDENCE FOR R. FULTON CUTTING, ESQ., 67TH STREET AND MADISON AVENUE, NEW YORK CITY.
Ernest Flagg, Architect.

distance from the business portion of the city, and at the time of its commencement was in a comparatively unsettled part of the city. The plant itself cost upwards of one and a half million dollars, and equally as much more has been expended in the immediate neighborhood in providing homes for the employees, etc.

In addition to this, the same architect, Mr. Isaac Taylor, has just awarded the contract for another tobacco factory in the same vicinity, being on Park Avenue and Lawrence Street. The building is for the Wellman-Dwire Tobacco Company, who intend moving here from Quincy, Ill., and is five stories high and 300 ft. long. The cost will be $100,000.

Eames & Young have let the contract for a five-story, slow-combustion building for the Cupples Real Estate Company. The building is one of the large number of buildings built by this company within the last few years at what is known as Cupples Station, the heaviest wholesale district in the city.

Another long-felt want is about to be provided in the erection of a passenger station at Vandeventer Avenue by the Wabash Railway. Architect A. M. Beinke's plans call for a building 100 by 350 ft., with Bedford stone for the basement, while granite brick and white terra-cotta will be used in the superstructure.

The same architect is also building a 60 by 130 ft. addition to the Christian Orphans' Home on Auburt Avenue.

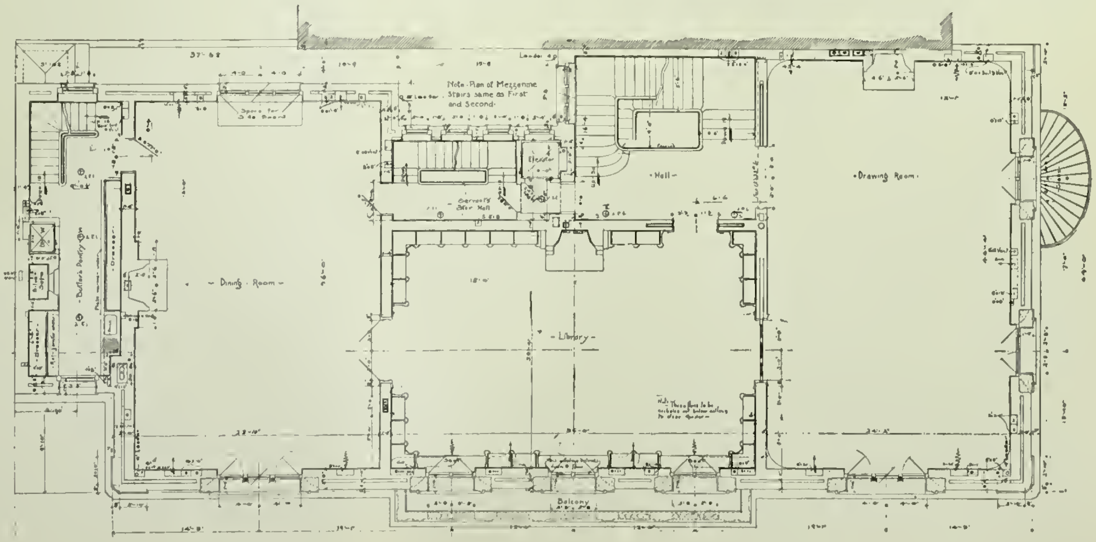
There has been another effort made to improve the northeast corner of Pine and 9th Streets, and it is to be hoped that better success may attend the effort than heretofore. This corner has had a peculiar history, two prominent citizens identified with schemes for its improvement having taken their own lives. After numerous failures by others, the owners undertook the erection of a ten-story building, but about the time the foundations were finished the stringency in financial circles caused a suspension of work, which has just been resumed again. The original idea of making the building ten stories will not be carried out at present, but seven are to be finished now, and later on it is expected that the other three stories will be added. Brick and terra-cotta will be used for the street fronts, while the construction will be of steel. About $150,000 will be expended.

The beautiful club house of the St. Louis Country Club, at Claton, which was destroyed by fire a few weeks ago, is to be rebuilt on a grander scale, and Shepley, Rutan & Coolidge have the plans about completed for same.

The same firm is also building a residence in Portland Place for Mr. J. H. Holmes, which will cost $65,000.

BUFFALO.— The better feeling amongst builders, which was noticed some two months ago, is pushing itself forward, and though, so far as large buildings are concerned, there is not a great deal of show, the building trade generally shows unmistakable signs of returning prosperity. There is already a slight rise in prices, which, it is to be hoped, will continue.

Last month the specifications for the new armory for the 74th Regiment, N. G. N. Y., were issued, and bids were asked for, with the result that the lowest bid was close on to $125,000 higher than the amount appropriated by the legislature. Naturally, there were only two courses before the commissioner, viz., either to take the lowest and finish the building as far as possible and trust to another appropriation, or to so modify the plans that the building might be



FIRST FLOOR PLAN.
RESIDENCE FOR R. FULTON CUTTING, ESQ., 67TH STREET AND MADISON AVENUE, NEW YORK CITY.
Ernest Flagg, Architect.
Elevations shown in plates 85, 86, and 87.

RESIDENCE, EDGEWATER, ILL.
George W. Maher, Architect.
Roofed with Spanish A tile. Manufactured by the Chicago Terra-Cotta Roofing and Siding Tile Company.

completed within the amount, $375,000. The latter course prevailed, and the State architect is now working hard on the plans, etc., in order to bring about the desired result. Captain Lansing, the resident architect, says that it is altogether likely that the building, instead of being built of stone, will be brick, though he thinks that the specifications could be cut down so as to leave the outer shell of stone, whilst altering the interior so as to bring the cost down to the required figure.

Phillips & Graves have prepared plans for a four-story brick and stone flat building on the corner of Main and Balcom Streets, to cost $50,000.

Architect Coxhead has made drawings for a new Roman Catholic school for the parish of St. Bridget's. It is to be built of brick with terra-cotta trimming, at a cost of $40,000.

Pentecost & Baggaley have filed plans for a five-story brick flat building, ten families, for Mr. W. Larkin, at 74 Day's Park. It will be practically fire-proof, and will have every convenience, including electric elevator.

Lansing & Beierl have deposited plans with the Bureau of Building for a Roman Catholic church on the corner of Alabama and Sandusky Streets. It will be built entirely of undressed stone, and will cost, exclusive of the interior fittings, about $40,000.

The new Federal building is beginning to look as though some thing were being done. The walls are now up to the second-story joists, and if the remainder of the work can be judged from present appearances, the building will be a credit to the contractor, and a decided acquisition to the architecture of Buffalo.

The competitive designs prepared by the eight selected local architects for the new banking premises for the Buffalo Savings Bank, to be erected on the corner of Main and Huron Streets, have been sent in, but it is not at all likely that any decision will be arrived at in the near future, as it has been decided not to start on the building until next spring.

BOSTON.— During the past thirty days there seems to have been a decided improvement in the condition of affairs as regards the building business in this city, and extending generally throughout New England. There are rumors of a number of large building operations that will in all probability come into the market before the first of the year. In the meantime contracts are being awarded, or at present being filled, on some fair-sized work, the plans of which have recently been completed. There is certainly considerable activity in the building of apartment houses in Boston and in the outlying sections. A larger number of these are being constructed of brick in preference to other materials than have been heretofore, which is encouraging evidence as to the increased popularity of well-constructed brick buildings, as compared with the flimsy wooden structures that in years past have been erected in sections where the law permitted.

Among the new buildings either now under process of construction or on which work will shortly be begun may be mentioned a large business block on India and Sears Streets, Hon. John D. Long, owner: Rand & Taylor, Kendall & Stevens, architects; to be constructed of brick. A $75,000 apartment house, corner of Brimmer and Pinckney Streets, John W. Bemis, architect, with Cabot, Everett & Mead, Boston; to be constructed of brick and limestone. The Boston Eye and Ear Infirmary's new hospital on Charles Street, Shaw & Hunnewell, architects. A $200,000 office building on India Street, Charles M. Dean, owner; Hartwell, Richardson & Driver, architects; George A. Fuller & Co., contractors; to be constructed of brick. New engine house for the Grove Hall district, Boston, Perkins & Betton, architects; L. K. Marston, contractor; to be constructed of brick and terra-cotta. The new building for the Massachusetts Institute of Technology (plans for which were prepared last year), to cost $150,000, Professors Chandler & Homer, architects; to be constructed of brick and terra-cotta. City Laundry Building, Wheelwright & Haven, architects; to be constructed of brick. New car house for the West End Street Railway, at Forest Hills, Boston; to be constructed of brick. Free Baptist Church, Warren Street, Roxbury, Mass., A. L. Darrow, architect; to be constructed of brick. New Catholic Church, to cost $100,000, at Whitinsville, Mass., for the St. Patrick's Catholic Parish, Charles D. Maginnis, architect, Boston; to be constructed of brick and stone. $200,000 building for the Hartford Brewing Company, Hartford, Conn. Adam C. Wagner, architect, Hartford; to be constructed of brick. $50,000 business block, Malden, Mass., Tristram Griffin, architect, Boston; to be constructed of brick. $150,000 hotel at Pittsfield, Mass., Samuel W. Bowerman, owner, Pittsfield, H. Neil Wilson, architect, Pittsfield; to be constructed of brick and stone. Society hall and dormitory at New Haven, Conn., Brite & Bacon,

RESIDENCE, COMMONWEALTH AVENUE, BOSTON.
McKim, Mead & White, Architects.

EXECUTED IN TERRA-COTTA FOR THE ERIE LIBRARY, ERIE, PA.
Alden & Harlow, Architects.
By the Northwestern Terra-Cotta Company.

architects, New York City; to be constructed of brick. New high school at Brockton, Mass., C. L. Mitchell, architect, Brockton. New school, Fall River, Mass., L. G. Destremps, architect, Fall River; to be constructed of brick.

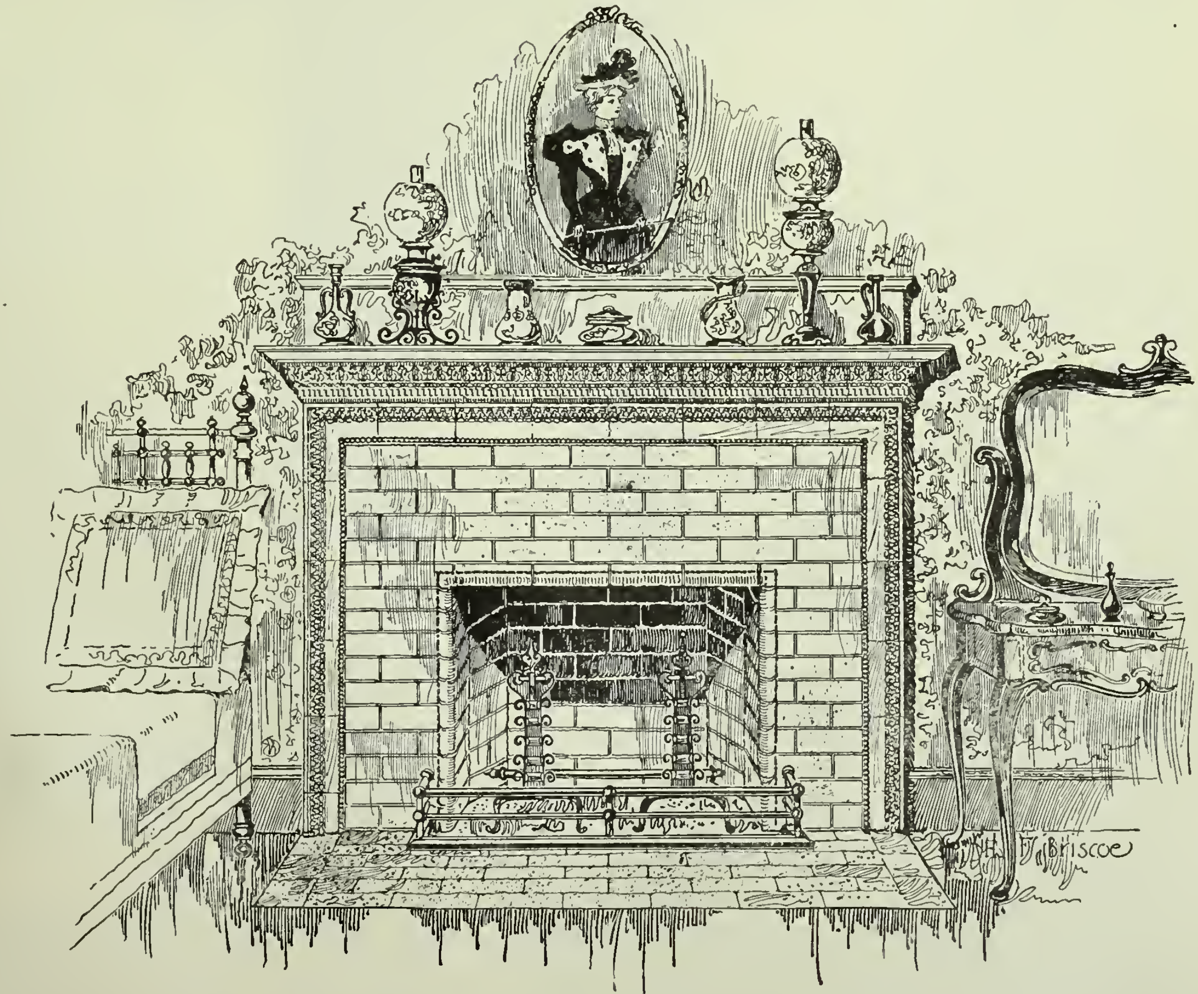
NEW TRADE LITERATURE.

THE disposition to freely introduce the open hearth as an essential and important feature in the construction of the modern dwelling is certainly a tendency in the right direction, and one that deserves every encouragement.

Viewed both from an artistic and sanitary standpoint, the general adoption of the open fireplace in the living and sleeping rooms of our habitations is most desirable and should be strongly urged. No part of our home contributes more to the comfort and health of the inmates than the chimney corner. Its quiet influence of good cheer is impressive and restfully effective, while the peaceful charm of its bright circle lends contentment to the mind. Taken from a sanitary standpoint, the open hearth has much to recommend it. Perfect ventilation is a necessity for any healthy habitation, and the best possible ventilator is an open fireplace. With the coming of the hot-air furnace the fireplace passed into disregard. For many years its virtues were ignored and its artistic possibilities lost sight of. Comparatively very few of the new houses then erected embodied the fireplace in their construction, while most of those that existed in the old habitations were sealed from use. Within the past few years all this has changed; the claims of the open hearth to popular favor are once more recognized and far better understood. At present there is hardly a structure built for residential purposes but that contains its open fireplace, no matter how inexpensive is the dwelling.

In connection with this subject an interesting and instructive volume has reached our table, which we earnestly recommend to the attention of our readers. This work is entitled "The Open Hearth," and is issued by Fiske, Homes & Co., 166 Devonshire Street, Boston, for distribution among the architects and builders. While this work is published with the objective view of bringing to the attention of the architectural profession the large assortment and artistic beauty of the line of fireplaces which the firm manufactures, yet in its compilation they have gone far beyond the standard of a mere catalogue, and have amassed together such material as make it of real interest to the architect, by virtue of the many valuable suggestions therein contained.

There are some thirty full-page illustrations of the different styles of fireplaces that the firm carry in stock, facing which, on the opposite page, is a full description of the fireplace illustrated. These designs embrace a wide range of patterns, each being especially adapted to harmonize with the particular requirements of various



BRICK AND TERRA-COTTA FIREPLACE MANTEL, DESIGNED FOR FISKE, HOMES & CO., BOSTON.
Built of 8½ by 2½ in. bricks, with a border and shelf course enriched by leaf and bead and reel moldings. Height, 57 ins.; height of shelf, 50 ins.; projection of shelf, 7½ ins.; width, 64 ins.

rooms, from banquet hall to bath room, and range in price from the most expensive of patterns to those of a surprisingly low cost.

We certainly recommend to our readers a careful perusal of "The Open Hearth," a complimentary copy of which may be had by addressing Fiske, Homes & Co., 166 Devonshire Street, Boston, Mass.

WE are in receipt of a very interesting catalogue from the Lehmann-Kohlsaat Clay Works, Chicago, that explains in a most comprehensive way a number of new and special features which the firm are introducing in a line of clay products now being placed by them upon the market. A very complete set of over seventy illustrations serve to make the purpose of these features easy to comprehend.

Special attention is called to what they term their "Angle Iron Fire-proofing Construction, Wall, Floor, Ceiling, and Roof, all made of the same tile in connection with angle iron, which offers a perfect protection of the iron and wood construction, combines lightness with strength, and can be constructed with ease and economy."

The particular feature of this invention is the embedding entirely of the angle iron between the tiles.

Now that the subject of the best and most approved methods of fire-proofing is justly receiving so much attention, it would not be amiss for such of our readers as are interested in the question to obtain a copy of this catalogue. Address Lehmann-Kohlsaat Clay Works, Chicago, Ill.

ITEMS OF INTEREST AND VALUE.

THE contract for the buff terra-cotta for Everett, Mass., grammar school has been awarded to Waldo Brothers.

T. W. CARMICHAEL, manufacturer of clay steamers, has removed from Wellsburg, W. Va., to Clarksburg, W. Va.

THE white terra-cotta to be used in the new Casino and Pergola for Hon. Charles F. Sprague, Brookline, Mass., will be furnished by Waldo Brothers.

T. W. CARMICHAEL reports the sale of his fifteenth clay steamer for the season, the purchaser being the Clarksburg High-Grade Shale Brick Company, Clarksburg, W. Va.

TERRA-COTTA MULLIONS, SHOWING FACE AND REVEAL, STORE FRONT, CHESTNUT STREET, PHILADELPHIA, PA.
F. R. Watson, Architect.
Made by the Conkling, Armstrong Terra-Cotta Company.

THE Gale Automatic Safety Sash Lock will be used in the Dun Building, at the corner of Broadway and Reade Street, New York City; Harding & Gooch, architects.

WALDO BROTHERS are furnishing Alsen Portland and Hoffman Rosendale cement to Norcross Brothers for Congregational Building, Beacon Street, Boston.

G. R. TWICHELL & CO., Boston, have secured the contract to supply the buff brick to be used in eight apartment houses on Washington Street, Brookline, Mass.; also four apartment houses at Allston, Mass.

WALDO BROTHERS have secured the cement contract for Longwood Avenue Bridge, Boston, furnishing Atlas Portland and Hoffman Rosendale; Woodbury & Leighton, contractors.

THE CONKLING, ARMSTRONG TERRA-COTTA COMPANY have secured through their New England agent, Charles E. Willard, Boston, the terra-cotta on the St. John's Parish Church, East Boston, Mass.

WALDO BROTHERS have the contract for furnishing the white terra-cotta for new Telephone Building, Newport, R. I.; Perkins & Betton, architects, Boston. Elaborate modeling will be used.

THE MOUNT SAVAGE ENAMELED BRICK COMPANY, Mount Savage, Md., have secured through their New England agents, G. R. Twichell & Co., Boston, the contract to supply the enameled brick to be used in a residence at Somerville, Mass.: Samuel D. Kelley, architect; D. W. Welch, builder; also a residence in Readville, Mass.; Karl Zerrahn, architect; Mitchell & Sullivan, builders.

CHARLES E. WILLARD, Boston, has secured the contract to furnish the white brick to be used in a large business block in Worcester, Mass., also the fire-proofing to be used in the L. W. Bessee Block, Springfield, Mass.

THE RIDGWAY PRESSED BRICK COMPANY, Ridgway, Penn., have secured through their New England agents, G. R. Twichell & Co., the contract to supply the gray brick to be used in the new Catholic Church, at Jamaica Plain, Mass.; P. W. Ford, Boston, architect.

THE SHAWMUT BRICK COMPANY have secured through their Boston agent, Charles E. Willard, the contract to furnish the buff brick on the Moriarty Block, Waterbury, Conn., and in the residence for the Sisters of the Sacred Heart, Jamaica Plain, Mass.

G. R. TWICHELL & CO., Boston, have secured the contract to supply the brick to be used in the new car house for the West End Street Railway, at Forest Hills, Mass.; also for a new schoolhouse, at Dedham, Mass.

THE WEBSTER BRICK COMPANY, South Webster, Ohio, have secured through their New England agent, Charles E. Willard, Boston, the contract to furnish the mottled brick in the Standhope Building, Providence, R. I.

IT will interest those using Portland cement to learn that the N. Y. C. & H. R. R. R. Company has just executed a contract to use Alpha Portland cement stone entirely in the erection of the new Grand Central Station, 42d Street and Vanderbilt Avenue, New York City.

A CONTRACT has just been closed by Edward R. Diggs & Co., for placing nearly five hundred of the Bolles' Sliding and Revolving Windows in the new office building of the English-American Loan and Trust Company, of Atlanta, Ga.; Bradford L. Gilbert, architect, of New York.

THE SAYRE & FISHER COMPANY have secured through their

Boston agent, Mr. Charles Bacon, the contract to supply the gray mottled brick to be used in the new Terminal Station, at Boston; Shepley, Rutan & Coolidge, architects; Norcross Brothers, contractors. These bricks are of a special color, and of Norman shape (dimensions, 12 by 4 by 2¼ ins.).

Meeker, Carter, Booraem & Co., New York City, have, since May 1, 1897, sold over eight million paving brick for the Eastern Paving Brick Company, for whom they are Eastern selling agents. Their last contract, recently closed, calls for six million bricks to be supplied the town of Jamaica, N. Y., which will be used in gutters on forty miles of street improvement, the roadways being macadamized. This is one of the very largest, if not the largest contract for paving brick ever closed in this country.

The Ridgway Pressed Brick Company, Ridgway, Penn., have secured through their Boston agents, G. R. Twichell & Co., the contract to supply the gray brick in the Free Baptist Church, Roxbury, Mass.; A. L. Darrow, architect, Boston; also the gray brick to be used in eight apartment houses, corner of Columbus Avenue and Northampton Streets, Boston; D. D. Kerns, architect; also the gray brick to be used in the apartment houses on Northampton Street; T. A. Tracey, architect.

The American Enameled Brick and Tile Company are supplying their patent interlocking tile for the halls of the College of History, American University, Washington, D. C.; James L. Parsons, builder; also the elevator shafts in the Gatlin Building, Hartford, Conn.; Hopkins & Roberts, builders. They are also making a large delivery on contract closed three months ago, to supply semi-glazed front brick for the new Dun Building, Broadway and Reade Streets, New York City; W. A. & F. I. Conover, builders.

TERRA-COTTA CAP TO COLUMN, INTERIOR OF ENTRANCE, SYRACUSE UNIVERSITY, SYRACUSE, N. Y.
Green & Wicks, Architects.
Made by the Perth Amboy Terra-Cotta Company.

The Celadon Terra-Cotta Company have recently supplied their roofing tiles on the following work: Residence, W. B. Snyder, Newark, N. J., buff Conosera; Thomas Cressey, architect. Residence, W. H. Lawrence, Cleveland, Ohio, red Conosera; Coburn & Barnum, architects. Passenger station, Illinois Central Railroad, Springfield, Ill., red closed shingle; F. T. Bacon, architect. Gate lodge, National Soldiers' Home, Dayton, Ohio, brown Conosera; Peters, Burns & Pretzinger, architects. Gate lodge, Woodlawn Cemetery, Everett, Mass., red open shingle; Wm. Hart Taylor, Boston, architect.

The Ohio Mining and Manufacturing Company, makers of the "Shawnee" front brick (works at Shawnee, Ohio), have sent us four samples of their product, which we are glad to recommend as being a splendid brick in every particular.

The colors are a light mottled buff, a dark mottled buff, a cream white, and a chocolate brown. The surface texture of the bricks is fine, and the sharp metallic ring which they give when struck with a hammer shows that the clay has been well burned, which is one of the principal requisites of first-class brick.

"People have gone wild on the reports of rich gold finds in Alaska, and are willing to undergo the perils and discomforts of the frigid North to extract from its frozen soil the nuggets which will bring them wealth. You don't need to go to Alaska! There is a 'golden opportunity' right here at home. It lies within your power to extract from the earth around you 'golden bricks,'" says the American Clay-Working Machinery Company, on an attractive novelty advertising card which they have recently sent out. "Your clay with our machinery will bring you gold without the privations of Alaska. The demand for good brick and other clay products is going to be heavy; get ready to meet it."

A novel application of the Mason Safety Tread has recently been completed in New York, which attracts the notice and elicits the commendation of pedestrians. Set in the sidewalk in front of the office of the New York *World* is an immense iron circle representing the globe. As the sidewalk toward Frankfort Street has a decided pitch, this circle, worn to a polish by the great amount of traffic, became a source of constant danger, especially in wet weather. With its smooth outlines and zones covered with stripes of the Mason Safety Tread, the danger of slipping is removed, and the illustrative effect of the great globe is intensified.

We would call the attention of those of our readers who are interested in the manufacture or sale of clay products, to the particularly desirable property which is offered for sale on page xxxvii of this issue. This property is located in the northwestern portion of Pennsylvania, and is so situated as regards shipping facilities as to have cheap and easy access to the markets of the Middle and New England States. The property is said to contain twelve different kinds of fire-clay and shale in inexhaustible quantities, which burn white, buff, pink, salmon, and red in color. These clays are of such a quality as to be particularly suitable for the manufacture of all kinds of brick and terra-cotta products. The fact of the extreme cheapness of fuel in this section is an item of considerable importance in the cost of manufacturing.

The Chicago Terra-Cotta Roofing and Siding Tile Company report the following buildings completed last month on which their goods were used for roofing:—

Woodmere Cemetery Gate, Detroit; Donaldson & Meier, architects; house and barn, F. B. Stevens, Detroit; Donaldson & Meier, architects; depot, Kansas City, Pittsburg & Gulf Railroad, Point Arthur, Texas; George Matthews, Architects; residence for P. Wheeler, Mr. Pruyn, architect; office East End Avenue, Chicago, building, Battle Creek Steam Pump Company, Battle Creek, Mich.: R. T. Newberry, architect; residence, Michigan Avenue, Chicago: Charles S. Frost, architects: two houses for Mrs. Fellows, Chicago;

RESIDENCE AT PORTSMOUTH, N. H.
Ball & Dabney, Architects.

Cowles & Ohrenstein, architects; residence, Grand Boulevard, Chicago; J. F. & F. P. Doerr, architects; residence, Sullivan, Ind.; Wing & Mahurin, architects; carriage house for E. S. Pike, Beverly Hills, Ill.; H. H. Waterman, architect; apartment building, Chicago; J. F. & F. P. Doerr, architects; three-apartment building, Chicago; Burtar & Gassman, architects.

The Boston Fire-proofing Company are furnishing the terra-cotta fire-proofing on the following large buildings: The new Converse Building, corner Milk and Pearl Streets, Boston; Winslow & Wetherell, architects, L. P. Soule & Son, contractors. Puritan Brewery, Charlestown, Mass.; Hettinger & Hartman, architects, Mack Brothers, contractors, Salem. Jewelers' Exchange, Bromfield and Washington Streets; Winslow & Wetherell, architects, Geo. A. Fuller & Co., general contractors.

Sayre & Fisher Company have secured the contract through their Boston agent, Mr. Charles Bacon, to supply the enameled brick to be used in the interior of the new engine house now being built at Grove Hall, Boston; Perkins & Betton, architects, L. R. Marston, contractor.

O. W. Peterson & Co. are supplying the dark speckled buff brick for the St. Alphonso Hall, Roxbury; F. Joseph Untersee, architect.

Charles E. Willard is supplying the old gold mottled brick that is being used in the Macabe Building, New Britain, Conn.; W. H. Cadwell, architect, New Britain, O. W. Curtis, contractor.

The Standard Terra-Cotta Company are supplying, through their New England agents, O. W. Peterson & Co., the terra-cotta for a new hotel at the corner of Snow and Weybosset Streets, Providence, R. I.; W. R. Walker & Sons, architects, Providence, M. J. Houlihan, contractor.

INDEX TO ADVERTISEMENTS.

DYCKERHOFF PORTLAND CEMENT

Is superior to any other Portland cement made. It is very finely ground, always uniform and reliable, and of such extraordinary strength that it will permit the addition of 25 per cent. more sand, etc., than other well-known Portland cements, and produce the most durable work. It is unalterable in volume and not liable to crack.

The Dyckerhoff Portland Cement has been used in the Metropolitan Sewerage Construction, Boston, and is now being employed in the construction of the Boston Subway, Howard A. Carson, Chief Engineer.

Pamphlet with directions for its employment, testimonials, and tests, sent on application.

HAM & CARTER, 560 Albany Street, Boston.

E. THIELE, 78 William Street, NEW YORK. Sole Agent, United States.

ALPHA · PORTLAND · CEMENT · COMPANY · MANUFACTURERS
ALPHA PORTLAND CEMENT
JAMES A. DAVIS & CO. SOLE N. E. AGENTS, BOSTON, MASS.

"With a true sense of economy we would buy nothing in Europe but of necessity. The gold reserves of our government and individuals would then increase without even the intervention of tariffs."

Alpha Portland Cement

is the most economical. It is the finest ground cement on the market. For that reason it will take more sand and broken stone than any other cement in existence. To-day our best contractors and engineers consider it superior to any imported cement on the market. We guarantee every barrel of the "Alpha" to be uniform in quality, and to pass any requirement yet demanded of a Portland Cement.

WM. J. DONALDSON, General Agent, Betz Building, Philadelphia, Pa.

JAMES A. DAVIS & CO., Sole N. E. Agents, 92 State Street, Boston.

Union Akron Cement Company,

SOLE MANUFACTURERS OF THE

Akron Cement,

(STAR BRAND.)

The Strongest Natural Hydraulic Cement Manufactured in America. In Successful Use for the past Fifty Years.

CAPACITY OF WORKS 2,000 BARRELS DAILY.

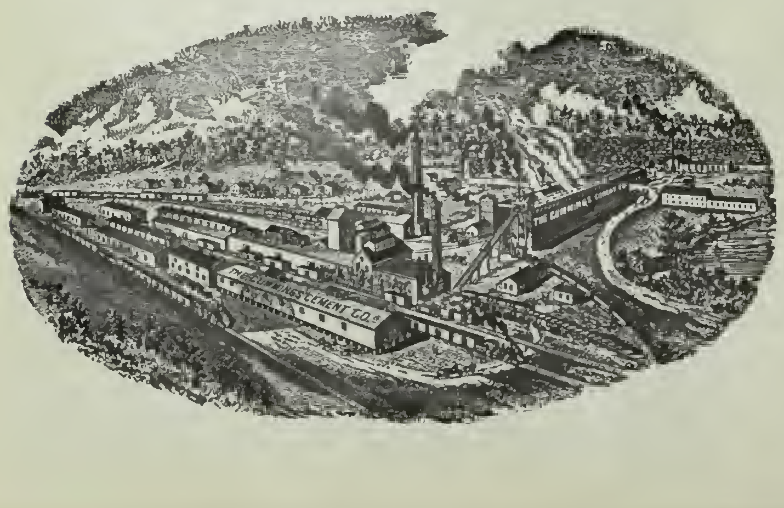
OFFICE, 141 ERIE ST., - BUFFALO, N. Y.

ALSEN'S PORTLAND CEMENT.

The strongest, finest ground, and most uniform Cement in the world. Permits the admixture of more sand than any other, and is the best for mortar or stuccoing.

143 LIBERTY STREET - - - - - - - - NEW YORK.

WALDO BROS., - - 102 Milk St., Boston.
AGENTS FOR NEW ENGLAND.



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HOMER S. CUMMINGS, Secretary.
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PALMER CUMMINGS, Treas. & Gen'l Mgr.
RAY P. CUMMINGS, Vice-President.
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Gen'l Offices: Ellicott Square Bldg., Buffalo, N. Y.

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Cement Works at Akron, N. Y. The largest in the United States.

....Established 1856....

HENRY MAURER & SON,

Manufacturers of

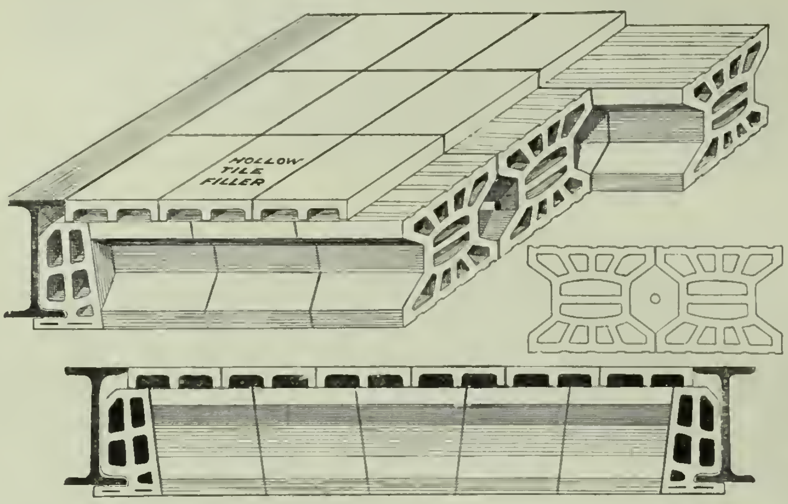
Fire-Proof Building Materials.

Floor Arches,

Partitions,

Furring,

Roofing, Etc.



Porous Terra-Cotta

of all Sizes,

Flue Linings,

Etc., Etc.

"EXCELSIOR" END CONSTRUCTION FLAT ARCH (Patented).

25 per cent. Stronger and Lighter than any other method.

Office and Depot,
420 EAST 23d STREET,
New York.

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Factories,
MAURER, N. J.
On C. R. R. of N. J.

Pittsburgh Terra-Cotta Lumber Company,

Manufacturers and Contractors for the Erection
of Porous and Dense Hollow Terra-Cotta . . .

FIRE-PROOFING.

Also, Manufacturers of Plain and (under
the Durant Patents) Ornamental . . . .

Hollow Architectural Terra-Cotta Building Blocks.

Hollow, Porous, Front, and Paving Brick.

WORKS at PITTSBURGH, PA., and at WASHINGTON, N. J.

General Offices: CARNEGIE BUILDING, PITTSBURGH, PA.

Western Office: Chamber of Commerce Building, Chicago.

Eastern Office: Metropolitan Building, New York City.

The Mosaic Tile Co., Zanesville, Ohio.

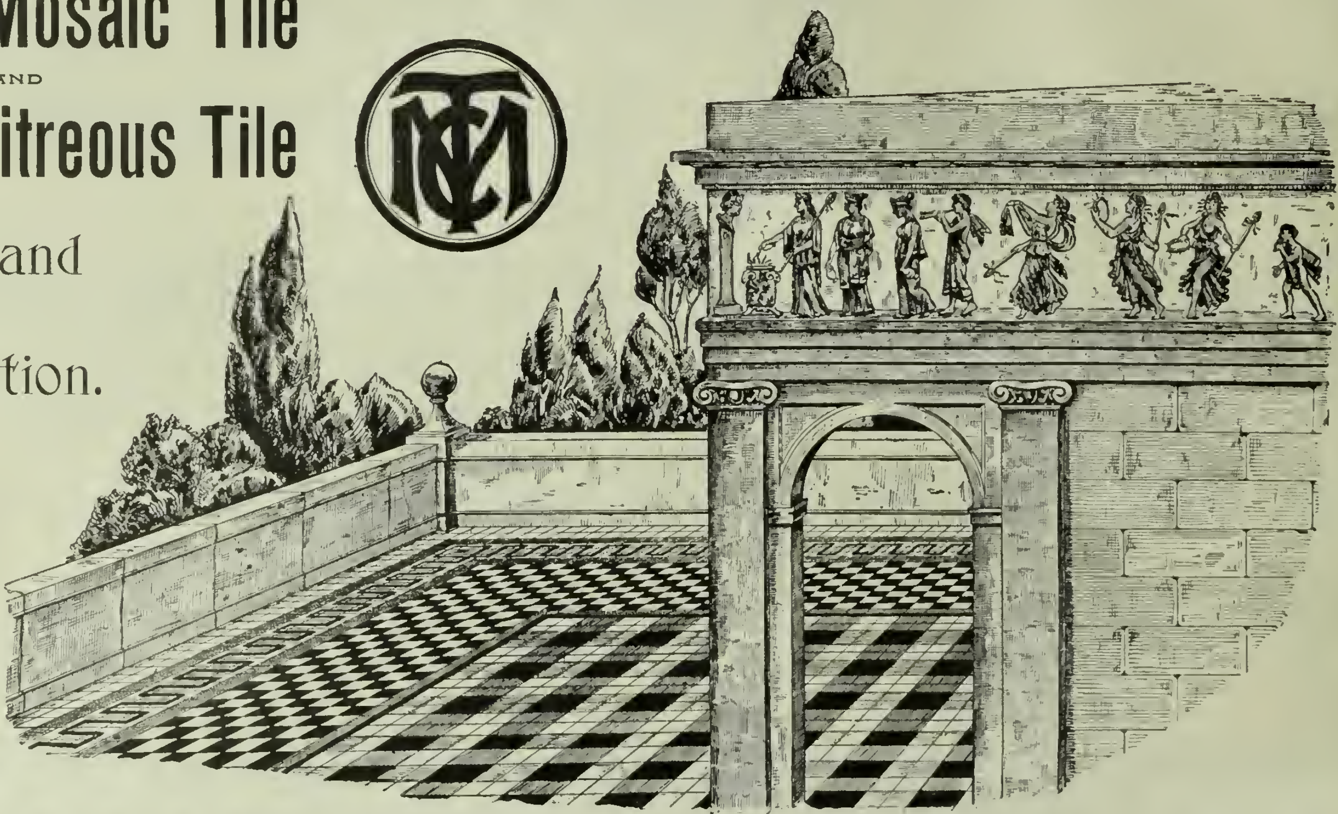
MANUFACTURERS OF

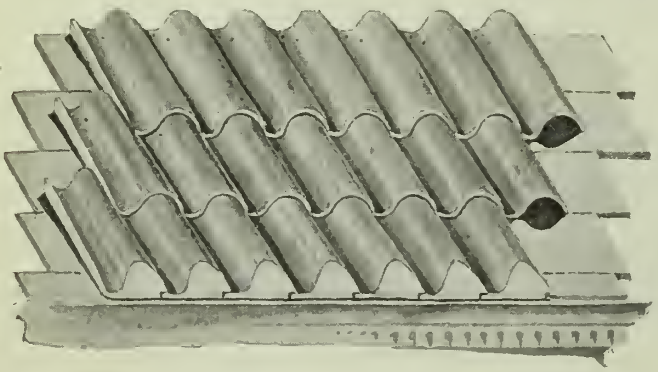
(The Strongest Tile in the Market.)

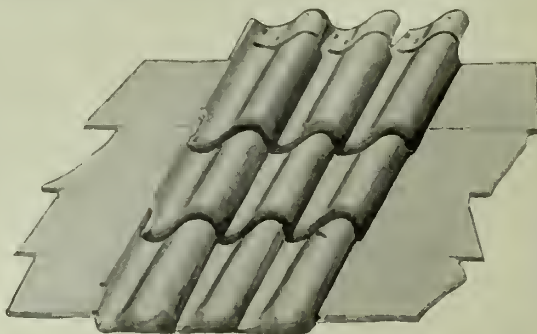
Ceramic Mosaic Tile
AND
"Parian" Vitreous Tile

For Floors and Mural Decoration.

Estimates, Samples, and Designs on Application.







Chicago Terra-Cotta Roofing & Siding Tile Company,

1122 Marquette Building, Chicago.

Vitrified Roofing Tile of all Kinds.

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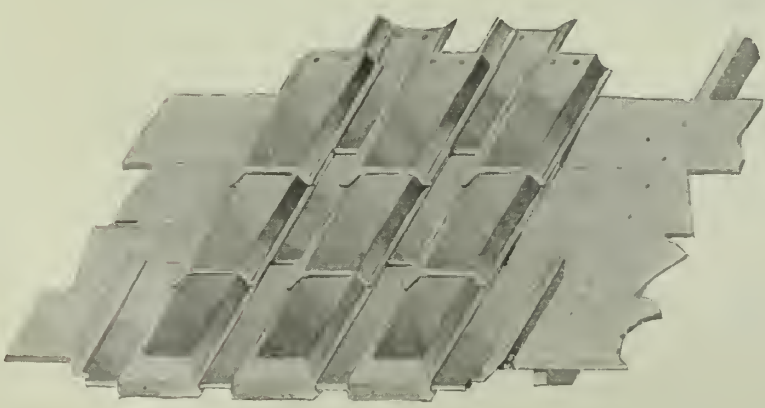

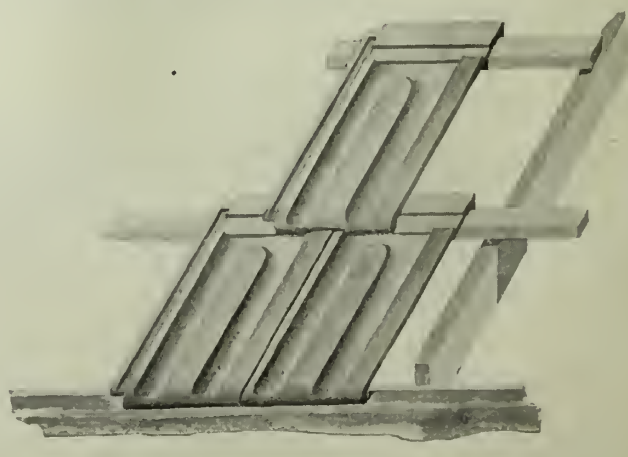

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THE BRICKBVILDER

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THE BRICKBUILDER.

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

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IT is so much easier to see the outs than it is to appreciate the ins, that we often hear a great deal more of the objections to brick and terra-cotta as building materials than we do of their excellent qualities. The criticism, so called, which is leveled against products of this description is very apt to be limited to fault finding and invidious comparisons without any attempt to show how the best results can be obtained with this vehicle. No material which is used for building construction is perfect, and so long as human agencies are the medium through which a structure is evolved, so long will mistakes and errors of judgment occur. There are naturally, therefore, directions in which the value of brick as a material can be greatly increased and the desired results more readily accomplished. The architectural profession is an extremely critical one. By training, by association, and as a matter of self-protection, architects are forced to be conservative in their views, to take slowly to new inventions or methods, to hold fast to established ways, and to let experiments be tried by the unwary and unprofessional; while because of the retrospective character of the architecture of the present day the new forms of brick and terra-cotta sometimes receive scant favor when first put on the market, and a color or texture which does not find a precedent in the work of the past obtains slow recognition. This is in a way as it should be, and yet the spirit of conservatism which would exclude doubtful products or reject untried methods must not be carried to the extent of ignoring possibilities or of exacting more than can fairly be required of the burnt clay products. We have very nearly outgrown the spirit which would prompt an architect to discard the more finished, workmanlike products of our kilns in favor of the crude, misshapen, but finely textured brick which was so much in favor a few years ago We occasionally find instances where the rough, unfinished look is sought for and where an appearance of studied carelessness is considered to be equivalent to an artistic effect. Without undertaking to question the picturesque possibilities of an imperfect brick or a poorly burned piece of terra-cotta, we do feel, and we find this belief is quite generally accepted, that better results will be obtained in every case by the use of the best product that our manufacturers can turn out; and if it is desirable to procure such excellence of product, our architects can lend great aid by their personal encouragement of the efforts which are every year put out by our manufacturers to more fully and completely meet the artistic growth of the country. It is very easy to find fault with the size of the brick, the sharpness of the edges, or the variations in tone, but if instead of indulging such a captious spirit we would be prompt to recognize a good brick when we see it, and not only recognize it by a pleasant word spoken to the manufacturer or salesman, but to acknowledge it in the more practical method of using it in our buildings, it would be much easier in a few years to secure the uniformity of product which is so generally desired. And with this uniformity it is our belief that the artist's desire to employ the rough or crudely burned product would be very much lessened, the element of uncertainty could be handled with more precise results, and our architectural designs would be clearly expressed in a medium that we could depend upon. Good brick always costs money. Terra-cotta which is irregular in shape, imperfect in burning, and out in color is of course a great deal cheaper than the product which is firm, even, and true. We all want the latter. If the architects would insist upon having nothing but that and should not give their clients even the opportunity of electing to take the cheaper material, but consider that terra-cotta and brick always means good terra-cotta and brick, and if not always the very best the market affords, at least a fairly reliable first-class product, there would be less cause for complaint on the score of poor material, and the manufacture would be raised more nearly to the ideal of which we believe it is capable.

IN the fire proofing department of our last issue we called attention to some conditions which exist under the so-called fire-proofing laws. Since then an illustration in point has been brought prominently into notice. A building has recently collapsed in Boston under conditions which were so exasperating that it is hard to have patience with either the authorities which will allow or the statutes which will tolerate such occurrences. The building law of Boston, very wisely, we believe, provides that every building to be used as a tenement or lodging house shall be fire-proof in the first story, and that every building used under certain conditions so as to be practically a hotel shall be entirely fire-proof; but, unfortunately, the law does not apply to alterations, or, perhaps, to be more exact, the ordinance is not clear in defining the limits of what can be passed as an alteration. Boston is full of old tumble-down structures which have been used for tenement houses for years. These have been acquired quite extensively during the past decade by a class of property owners who care so much more for revenue than for a decent building that their continual increase in the acquisition of such property constitutes a serious menace to good construction, to say nothing of danger to life and limb, for the reason that these old structures when acquired, invariably undergo a species of rebuilding and repairs, and as in nine cases out of ten the structures were orginally but imperfectly built, they are seldom improved by the alterations. In this particular instance, in order to enlarge the building and at the same time avoid the requirements of fire-proof reconstruction, the building underwent what was claimed to be a process of alteration: but as only the wall on the party line and the floor beams themselves were left intact, the elastic limit of the statute was very closely touched. Some of the walls were only 4 ins. thick, none of them were well built, and the work of alteration was confided apparently to a set of mechanics who know almost nothing about proper building, with the natural result that before the work was half completed it all tumbled into the cellar. Boston's building law is in theory a very fair one, but in practise it allows loopholes of sufficient size to permit of outrageous violations of what ought to be considered fairly good practise. There is no possible excuse for the collapse of any building. With ordinary care and a slight mixture of intelligence the most extensive alterations can be carried through without the slightest danger or risk, but with poor masonry, mortar which is nearer mud than anything else, and mechanics who are ignorant of the ordinary principles of building, coupled with an elastic interpretation of a law which at the best can only be vague in its limitations, the wonder is we do not have more accidents than really occur.

BONDING OF BRICKWORK — CORRESPONDENCE.

EDITOR THE BRICKBUILDER.

Dear Sir: — Your editorial on the bonding of brickwork, in the October issue of THE BRICKBUILDER, touches upon one of the most serious evils in American building. It is not unusual to find bad methods tolerated because they are less expensive, but it is rare indeed to find a distinctly wrong practise that is also more costly from the start. This is most emphatically true of the practise of veneering walls of common brick with "face" or pressed brick. We must now make the real burden-bearing wall of the full thickness necessary to carry the load of roof and floors and then add the 4 in. skin of face brick, bonding this to the real wall in various questionable ways that impair the strength of the backing. All of this iniquity of weak construction and unnecessary expense is due to difference in coursing of front and common brick.

I am unable to explain the origin of the numerous brick sizes, but it is fair to presume that many of the existing dimensions are arbitrary, and can, therefore, be changed without shaking the foundations of society. If the common brick would course with the face brick used in the body of the wall and were accordingly laid with bonding of header bricks, we should at once do away with the extra 4 ins. of thickness, and could consider the face as an integral part of the wall, capable of bearing its share of the imposed load. These advantages are entirely economical and constructional and sufficient to justify the changes suggested. The esthetic gain would be most desirable: we should have in the place of the characterless wall face composed entirely of stretchers, a wall diversified by the exhibition of ends of the headers, and suggesting, even to the layman, thickness and strength.

The charm of the colonial brickwork is due more to the evident bonding than to picturesque combination of the dull red brick and thick joints of white mortar. Many architects are now insisting upon the so-called Flemish bond on the face of exposed brickwork, but they are satisfied to have the appearance without the strength, as they are content to have show headers. In some of the recent work selected common brick have been used on the face of the wall, and the bonding has therefore been honest. To have real bonding between face brick and common is at present almost impossible. I know of but one satisfactory example, and this was only possible by having the face brick made of special dimensions to course with the common brick. The building referred to is the recently constructed Jefferson Hotel in Richmond, Va. As every inch of the walls could be counted upon to carry its share of load, the saving in space and in expense by avoiding the extra thickness became in this extensive building a very large item.

The consideration of this question brings us at once to another and important one, which is, the existing variation in dimensions of common brick from different districts. We should have throughout this country a uniform standard of size for common brick, and then we can logically proceed to fix upon a size of face brick which will course with it.

I hope that THE BRICKBUILDER will continue to direct the attention of architects, masons, and brickmakers to this matter.

OWEN BRAINARD.

NEW YORK CITY, Nov. 15, 1897.

EDITOR THE BRICKBUILDER.

Dear Sir: — According to your invitation in the October number of your highly esteemed paper, regarding improvement on American bond, I will submit to your readers the practise I have followed for some time; a simple method which not only gives no additional work to the mason, but also very little trouble to the brickmaker.

I am using for headers, bricks 8 ins. square. This allows for a perfect, uniform bond, and does not limit you to a header every sixth course only.

This system has especially great advantage in building with hollow bricks, where one is obliged to use solid bricks for headers.

The square bricks are very handy on corners, and I have found that the masons save much time by using them.

I am sure every brickyard will be willing to furnish them along with the ordinary size, as they represent virtually two bricks.

GUSTAV LIEBAU.

MAURER, N. J., Nov. 2, 1897.

PERSONAL, SOCIETY, AND CLUB NEWS.

THE designs of Carrère & Hastings, submitted in competition, have been selected for the new Astor, Lenox & Tilden Public Library Building, New York City; also for the new building for the National Academy of Design, which will be located on Bloomingdale Heights, New York City.

E. R. DUNLAP, architect, has opened an office at 32 School Street, Pontiac, Mich., and would be pleased to receive catalogues.

THE Detroit Camera Club held their annual fall exhibition of photographs in the east galleries of the Detroit Museum of Art, Thursday, Friday, and Saturday, and Saturday evening, November 18, 19, and 20.

THE second annual exhibition of the Society of Western Artists was opened Thursday evening, November 18, at the Museum of Fine Arts, 19th and Locust Streets, St. Louis.

THE Illinois Chapter of the A. I. A. and the Chicago Architectural Club have made arrangements for a course of five lectures by Prof. William Henry Goodyear, of the Brooklyn Academy, on Greek, Roman, and Syrian architecture and archeology. The first lecture will be on horizontal curves and other optical refinements in Greek architecture (including recent photographs of the curves in Sicily and at Pæstum and in the Maison Carrée at Neims). Topics for the remaining lectures will be announced. The lectures will be given in the North Lecture Room (first floor) of the Art Institute on Thursday evenings at 8.15, November 18, December 2, 9, 16, and 23.

A REGULAR monthly meeting of the "T Square Club" was held on Wednesday evening, October 20. This was the first meeting held by the club in its new house. For some time past the club has been without a home, holding its meetings in the offices of the various architects, who have kindly extended their hospitality to their fellow-members. This, however, was always considered a merely temporary arrangement, and the executive and house committees have been active in their search for suitable quarters, and now feel that a place has been secured as nearly ideal as is possible under existing conditions, having rented on a five years' lease an old stable, the ground floor of which has been sub-let as a carpenter shop, the club retaining the two upper floors for its own use. The upper floor has been converted into one large room 30 by 35 ft., where the club will hold its meetings. Five casement windows extend all across the front and three at the back. A generous brick fireplace has been built at one side, and the walls and ceiling are lined with wood of a dark color. Very little was necessary to be done to this place, with its sloping ceiling and general Bohemian air, to make it a cozy home, and just what all the members have wanted so long.

ILLUSTRATED ADVERTISEMENTS.

THE New York Architectural Terra-Cotta Company send us a view of the Samuel Ready Memorial Library, Baltimore, of which Messrs. Wyatt & Nölting, of that city, were the architects.

The Excelsior Terra-Cotta Company show in their advertisement on page iv, two figures executed by them for the Smith Building, Market Square, Washington, D. C.; T. F. Schneider, architect.

Number 5 of the series of brick and terra-cotta fireplace mantels, which is being illustrated in the advertisement of Fiske, Homes & Co., page vii, is one designed by J. H. Ritchie and modeled by Tito Conti, the drawing being by H. F. Briscoe.

SAMUEL READY MEMORIAL LIBRARY, BALTIMORE.
Wyatt & Nölting, Architects.

The New Jersey Terra-Cotta Company illustrate in their advertisement on page viii, the new Ninth Precinct Police Station, New York City; John DuFais, architect.

The Probate Court Building, Cambridge, Mass., Olin W. Cutter, architect, is illustrated in the advertisement of the Fawcett Ventilated Fireproof Building Company, on page xii. The illustration shows the building in course of erection.

The residence of Theodore Hooper, Esq., at Baltimore, Md., of which C. L. Carson is the architect, is shown in the advertisement of the Harbison & Walker Company, on page xxv.

Charles T. Harris, lessee of the Celadon Terra-Cotta Company, begins this month, in his advertising page (xxix), a descriptive series of the various patterns of roofing tiles manufactured by his company. A new series of tiles will be illustrated and described each month, and many valuable directions and suggestions regarding the use of tiles will be given.

"Examples of Bond" is the title of a new series of illustrations begun in this month's advertisement of the Gilbreth Seam-Face Granite Company, page xxxviii. It is the purpose of the company to illustrate a number of styles of bond, employing the various sizes and shapes of their seam-face granite blocks.

PERUZZI'S CAMPANILE AT SIENA.

BY W. P. P. LONGFELLOW.

THE southern part of Tuscany, over which Siena used to rule, is curiously destitute of building stone, considering that it lies between the rocky Apennines and the marble hills that border the Mediterranean. But it is a broken, ridgy land, built of marl and clay, and rising into innumerable hills on which the towns are perched, which almost forbids their inhabitants to use building stone, to be dragged over many miles of hilly roads, up long valleys, or over rough ridges, but which furnishes everywhere good material for brick. In medieval times, when roads were bad, the carriage poor, and when every few leagues of the way brought one into a new country, and usually a hostile one, the transportation of stone to a town so placed was almost prohibited. Siena was, till the days of the Renaissance, almost entirely a town of brick. It was built of brick, walled with brick, paved with brick. The Tolomei Palace of gray sandstone is conspicuous among the buildings of the thirteenth and fourteenth centuries by its unusual material. The Grotanelli Palace and the Marescotti, now the Saracini, have lower stories of stone with brick above; but the Palazzo Pubblico, with its wonderful tower, the Buonsignori and most of the older palaces, the famous old fountains, the great churches of San Domenico, San Francesco, the Carmine, the Osservanza, the Servi, and all the older churches, are of brick. Broad, irregular flagstones have displaced the brick pavements in the streets, which are recorded as late as the seventeenth century, but the great central piazza, the famous Campo, still keeps its funnel-shaped brick flooring seamed with radiating gutters of stone, and looking not unlike a huge cobweb.

The brickwork which suited the pliable Italian Gothic of the fourteenth century did not lend itself so easily to the more rigid style of the Renaissance. It is a characteristic but stubborn material which demands sacrifices from the style that is to be embodied in it, or else insists on its right to generate a style of its own. It is contemptuous of fractions of an inch, and even of inches. When it is called on to adapt itself to a style of minutes and modules in which surfaces and moldings are adjusted to centimeters, and perhaps to millimeters, it refuses, and if the designer persists it makes him no end of trouble, and is apt to spoil his work. The use of terra-cotta, the natural adjunct of plain brickwork, did not develop in Tuscany so luxuriantly as in Lombardy, nor did it prevail much in the later style. By the time the Renaissance was brought in bodily from without, the building of the splendid cathedral in marble, with a richness and delicacy of detail before unknown to the Sienese, had revolutionized their ideas of the elaboration of architecture. The artists who brought it, dainty in their choice of material as of forms, naturally chose to execute their works in stone rather than brick. The Piccolomini Palace, and the Loggia del Papa, built for Pius II., the Sienese pope of the Renaissance, set a new fashion of building in stone, which the nobles or communities that built new buildings after these followed as they might, in the Spannocchi Palace, for instance. But the day of Siena's glory was passed. Not a great deal was added to her architectural beauty after the plague of the middle of the fourteenth century had finished the desolation that ceaseless wars had begun. The religious communities which raised a few great churches when the city had somewhat recovered were not rich enough to build expensively. They made structures of brick, which had to be big to accommodate their worshipers, but were for the most part rather rude, with little attempt at finished architecture, at least on the outside.

There is a marked exception, however, in some of the work of Baldassare Peruzzi, which does not aspire to stone but is built of plain brick, yet with a care in design and a certain distinction in detail that are most characteristic of the man, and set his work apart from the rest. Peruzzi was in reality a Sienese, whether he was born in Siena, as seems probable, or brought there an infant from Volterra, as Vasari tells us. If he came, as Vasari says further, from a noble family of Florence, driven by the quarrels of their fellow-citizens to emigrate to Volterra, this may account for the air of quiet distinction and refinement which characterizes his architectural work, and which, we are told, when all the world was fleeing from Rome after its capture by the Constable de Bourbon, led the Spanish soldiers to take him for some great dignitary in disguise, and to hold him for a high ransom. In Siena he grew up among goldsmiths and painters, in the stimulating atmosphere of the early Renaissance, and by the time he was twenty years old had become a skilful painter. Mural painting was then his work, and having formed his style under the influence of both Sodoma and Pinturicchio he presently drifted to Rome, which had already become the attractive center of all artists. There, falling under the powerful spell of Bramante, he turned to architecture, and became a zealous student of ancient Roman buildings.

Peruzzi belongs to the second generation of Renaissance architects (if we count Brunelleschi, Alberti, and Michelozzo as the representatives of the first, and assume the third to begin with Vignola), among whom are Bramante, the Sangalli, Raphael, Baccio d'Agnolo, Cronaca, and Michael Angelo, and of them all he was perhaps the one who was most thoroughly master of his profession. Whether or not he possessed that power of magnificent conception which enabled Bramante and Michael Angelo to revolutionize the architecture of their day he had no chance to show, for he did not have the great opportunities that fell to them, though his designs, preserved in the gallery of the Uffizi in Florence, and by his disciple Serlio, show power and grandeur as well as skill. He was by his position a successor and follower rather than a leader. His finished works as they remain to us are rather small and simple, excepting the grand but little known Cathedral of Carpi, which, though doubtless his design, was certainly not carried out by him. The Farnesina Villa and the Massimi Palace in Rome are the best known. But there is on them the mark of distinction and of secure control of all the elements of his design that set them apart from the works of his predecessors and contemporaries. Balancing quality against quality, he is deservedly set beside Brunelleschi, Bramante, and Michael Angelo, among the greatest architects of the Renaissance. His works are the first that show a sense of proportion in all their parts, a power of combination, relation, and harmony, and a firmness of profiling and adjustment of detail that make him seem, in comparing him with his fellows, the first thoroughly accomplished architect of the new movement, and one whom in the skill of his profession hardly any of his successors equaled. After he fled back to Siena he was always busy there till he returned to Rome for the last year of his life. The fortunes of Siena had waned, and his work there gave him no great opportunity: so far as it was large in scale it was mostly in modest brickwork. The fortifications of the city occupied him; he planned the convent of the Carmine, and also, it is said, that of the Osservanza outside the city. The charming little courtyard adjoining the house of St. Catharine is his, and various decorative works in the interior of the Cathedral and other churches. The tower which he added to the Church of the Carmine, and which I have to describe here, is a very characteristic example of his qualities, and of his unflagging care even in his most modest work. It is, for all its simplicity, one of the finest of the Renaissance campanili, as it is one of the earliest.

PERUZZI'S TOWER, SIENA.

This tower is a striking piece of really delicate design in brickwork, and bears such marks of Peruzzi's peculiar command of fine proportion in all details as well as in masses, that it would be difficult not to accept the tradition which ascribes it to him. I know of no other piece of brick detail in Siena which can be classed with it. Of the lower part, below the eaves of the nave, I have no photograph, and unfortunately no notes. The upper part, which shows conspicuously above the low roof, consists of two square stories and a low octagonal cupola. Each story is decorated with, or practically consists of an order of pilasters, one at each corner, enclosing on each face a high arched opening, which makes belfry stages of the stories. In the upper openings bells are hung. Every detail is in brick: there is not a line or scrap of stone or of terra-cotta in the whole. Even of molded bricks the forms are few, very simple, and very sparingly used; there are only the cymatiums of the cornices, a quarter-round and a cavetto for their bed moldings, the echinuses of the quasi-Doric capitals, and apparently — I am not quite sure of this — their neck moldings. All the rest is of plain, square-edged brick, yet the design is neither bald nor rude, nor yet inarticulate. All desirable detail is there; the proportion is so finely adjusted, the relief so delicate and yet so firm, the emphasis so well bestowed, that the tower has the effect of a finely treated design in wrought stone, and an air of elegance which it is very rare to find in pure brickwork.

This campanile is worth a careful study in detail; it is to be wished that some trustworthy student would make complete measured drawings of it for the sake of the lessons it has to teach, which can be set forth only by recording with precision the graduated measurements of the detail. The lower story is a little larger in scale than the upper, perhaps a seventh higher, a trifle broader, the pilasters a little heavier, so that it looks more massive, as it ought, while its proportion is in reality somewhat slenderer. The bricks are laid with a precision that would shame most modern bricklayers, and would seem to indicate that Peruzzi carefully watched the building of the tower, as no doubt he did if he was at hand. The upper pilasters are accurately centered over the lower, their shrinkage being just enough to set back their plinths and the dies of the pedestal course into line with the frieze and architrave beneath. The openings in the upper belfry are not perceptibly wider than those below, so that the shortening of the story makes them appear wider, and the upper story looks accordingly more open. An oval bull's-eye set over each end, perforating both frieze and architrave and interrupting the molding that divides them, looks curiously intrusive, but nevertheless adds a touch of lightness to the upper story that could not well be spared.

Comparisons of the details of the two orders show significant differences. The entablatures are higher than the classic proportion, being about a third as high as the pilasters, which are again heavier than the classic,— a marked departure from the habit of Peruzzi's great predecessors. The upper entablature, really a little lower than that below it, is a little higher in proportion, and the cornice, being designed with block modillions while the other has dentils, is more imposing, and fills the office of the principal cornice, though its dimensions are actually less. Moreover, all the detail of the lower entablature, and indeed of the whole lower order, is lighter and finer than that of the upper, notwithstanding the larger scale of the order itself. The moldings of the cornice are subdivided, and so are also those of the caps and bases of the pilasters. This makes the lower order look a little petty, perhaps, but it enhances the importance of the upper. A curious detail is that while the impost band of the lower order is flush with the pilasters, and so breaks their inner lines, that of the upper is withdrawn from the face just enough to keep the lines there, with advantage to the effect. It looks as if Peruzzi, watching the tower as it went up, had noticed the effect below and had seen how to improve on it above; and it is possible that in the same way he got a lesson of simplification for the upper order.

The only unsatisfactory details are the keystones. While the motive of each story is the Roman triumphal arch, the brick orders being made heavier than in Roman examples, the arches are proportionally smaller and drop farther below the architrave. The archivolts, therefore, do not touch the architraves, and the keystones are considerably lengthened; but these last being proportioned in width to the span of the arches, are thin and lank, and are only half redeemed by the bands between the panels which occupy the spandrels.

The cupola is adjusted to the tower with admirable grace. It does not parody on a less scale the proportions or motives of the belfry, or echo its function, as is often done; but is composed of different and simpler elements, and so adapted to the upper story as to ally itself closely with it, forming with it, as it were, a single feature, increasing its predominance, and crowning the tower with a singularly graceful outline. It is a low octagonal cupola, a little less in diameter than the square shaft beneath, with square paneled walls pierced by rectangular windows, crowned by a plain entablature, and bearing an octagonal dome. Small scroll buttresses, set against the diagonal faces, fill the angles of the square below at the junction. They are not of beautiful outline, but make the difficult transition from the octagon to the square with unusual elegance. The curves of the dome are circular, making its section a pointed arch and so considerably higher than a hemisphere, but truncated and terminated at the top by an *amortissement* or bulbous finial of ogee curve which is still of brick, but ends in a ball that may be of metal or stone. The eight faces of the dome are broken by plain panels very slightly relieved, the only relieved panels in the tower.

COURT OF ST. CATHARINE'S HOUSE, SIENA.

The proportion and subordination of the design are almost perfect, the outlines very elegant, the distribution and adjustment of the detail masterly. There is a gathered richness and focusing of detail in the crowning parts, where it is most effective without sacrifice of the pervading simplicity and without crowding, which is more difficult to achieve than many architectural designers imagine. To be sure, the scheme of design lacks that splendid effect of contrast between the tall, plain shaft and the rich belfry that we admire in some of the Italian campanili, both medieval and Renaissance, in the tower of the Palazzo Pubblico, at Siena, for instance, and at Venice in the Campanile of St. Mark, and in Palladio's Tower to San Giorgio Maggiore (in Isola), but of its type there is none better. We seem to see the master hand of Peruzzi in the free and yet consistent way in which the orders are handled, and especially in the sure and fine gradation of all the measures and reliefs, in the scrupulous adjustment of every detail to its own place and to the whole. Finally, it is a rare example of a classical design skilfully adjusted without compromise to simple brickwork, a material which in ordinary hands has shown itself intractable for such a use.

There is another small work of Peruzzi in brick which deserves mention here for the same qualities that we see in the tower of the Carmine,— the façade which was added from his designs to the old cathedral, called the Sagra, at Carpi. The little old Lombard building, outgrown by the town and standing annoyingly in the way of the big palace which the ambitious Alberto Pio had undertaken to build in the new fashion, was yet too sacred to be absolutly displaced; so Alberto had it razed down to its choir, and sent from Rome a design for a simple brick front which he got from Peruzzi, we are told. It is curious to see that it shows the characteristic motive which Palladio employed later at Venice in the churches of the Redentore and San Giorgio Maggiore, and which is usually considered his property,— the use of two interlocking orders, a high one on pedestals for the nave, and a lower one without pedestals for the front of the aisles. This narrow front has but one inter-columniation each for the nave and the aisles, giving three bays and four pilasters taller and shorter. A wall arch of little projection fills the head of each bay; the old marble doorway, piously preserved beneath, an unfinished pediment at the top of the nave, and half pediments on the aisles, and round panels in the tympanums, finish the design.

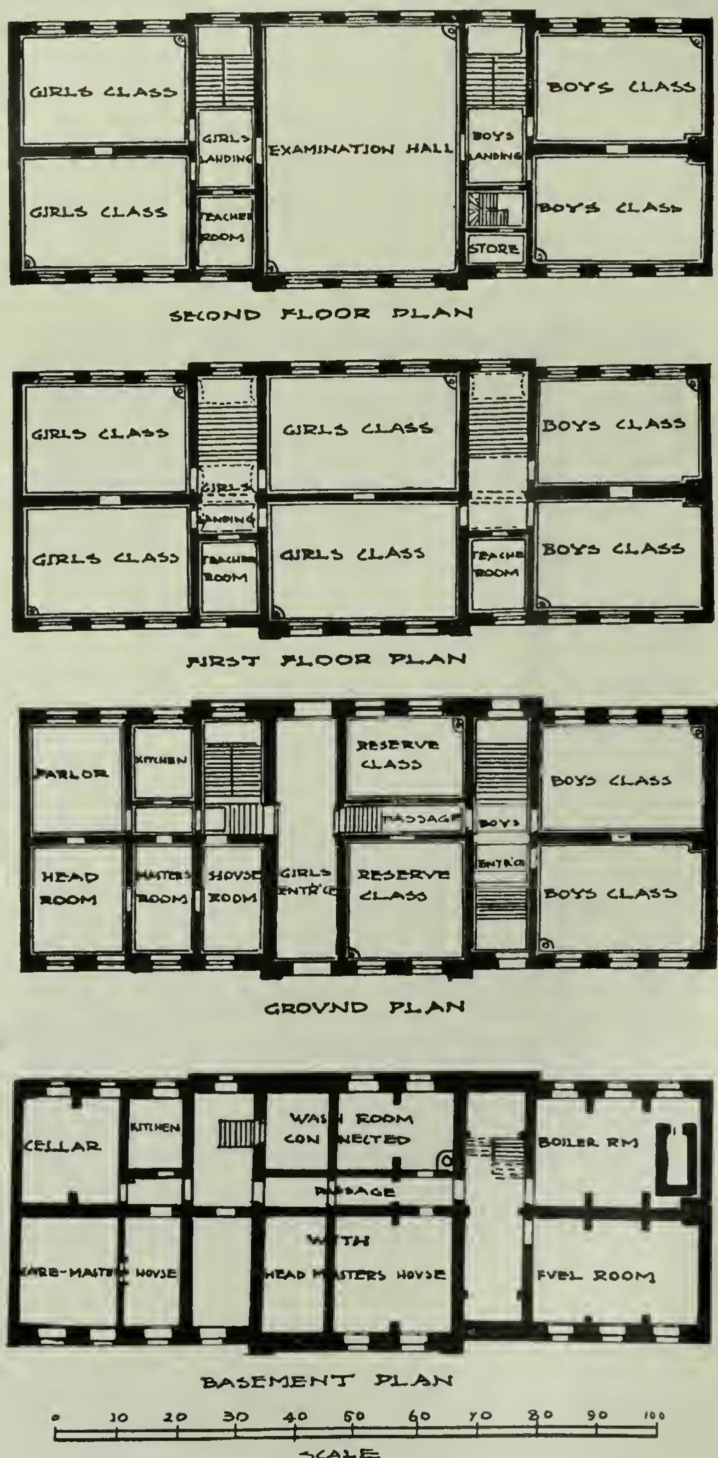
THE AMERICAN SCHOOLHOUSE. I.

BY EDMUND M. WHEELWRIGHT.

As in all matters pertaining to public education, the Germans have made very scientific study of school planning. While certain considerations which are given deservedly careful attention by us are little heeded in Germany, in important points of planning there is much in the plans of German schools which is immediately suggestive for our own needs.

The system of instruction in France and England differs so widely from that generally adopted in this country that, although points of interest and suggestion are not lacking in particular schools, there is in their plans little of important and general suggestion for us.

The German method of instruction in primary and secondary schools is mainly, as with us, by the separate graded class system. Especial instruction in drawing, music, etc., is given in special class rooms assigned for these studies, but no assemblying of a whole school for purpose of collective instruction enters into the German system. There are, therefore, no large Assembly Halls provided in German schoolhouses, as is the case in American and English schools. Although German schoolhouses have fine and richly ornamented halls, they are not used for the regular exercises, but only on state occasions and for examinations. The Assembly Hall, with us, is not the important feature of the school, as it is in England. We use it only as an accessory to the schoolrooms. In our schoolhouse plans the Assembly Hall is usually placed, as is the German Aula, in the upper story of the building, and both are designed to be of ready access from all parts of the schoolhouse. The different uses of these halls in the two countries appear in their decorative treatment. With us the Assembly Hall has commonly but little more architectural pretension in its fittings than have the schoolrooms; indeed, it is practically but a larger schoolroom, while in Germany the Aulas are often given a rich monumental treatment, as if to be representative of the dignity of the State.



PARISH SCHOOL, BERLIN, PRUSSIA.
From Rolson's "School Architecture."

We find, therefore, the German schoolhouse closely resembling in plan the American schoolhouse as it is at present developed; the main consideration of the plan in each being to give conveniently disposed and well-lighted schoolrooms, giving off well-lighted corridors, and a large hall placed in the upper story of the building.

A few points of difference between the customs of the two countries give variations in plan of secondary importance. In Germany, nothing like coeducation of the sexes exists, and consequently in the plans the division between the sexes is made absolute; and this division is not, as with us, almost entirely confined to the basement of the building.

The importance of good ventilation and freedom from bad odors appears to be more generally recognized in this country than in Germany; consequently, we have in our later schools developed more highly than the methods of ventilating, and we have in our best schools excluded the outer garments of the scholars not only from the schoolrooms but from the hallways. American schoolhouses of the first class are now planned with separate rooms called "wardrobes" or "cloak rooms," one for and immediately adjoining each schoolroom. In Germany, the outer garments are hung on pegs in the schoolroom.

On the other hand, possibly on account of the proverbially bad eyesight of the Germans, the subject of proper lighting of schoolrooms is given more careful consideration among them than with us.

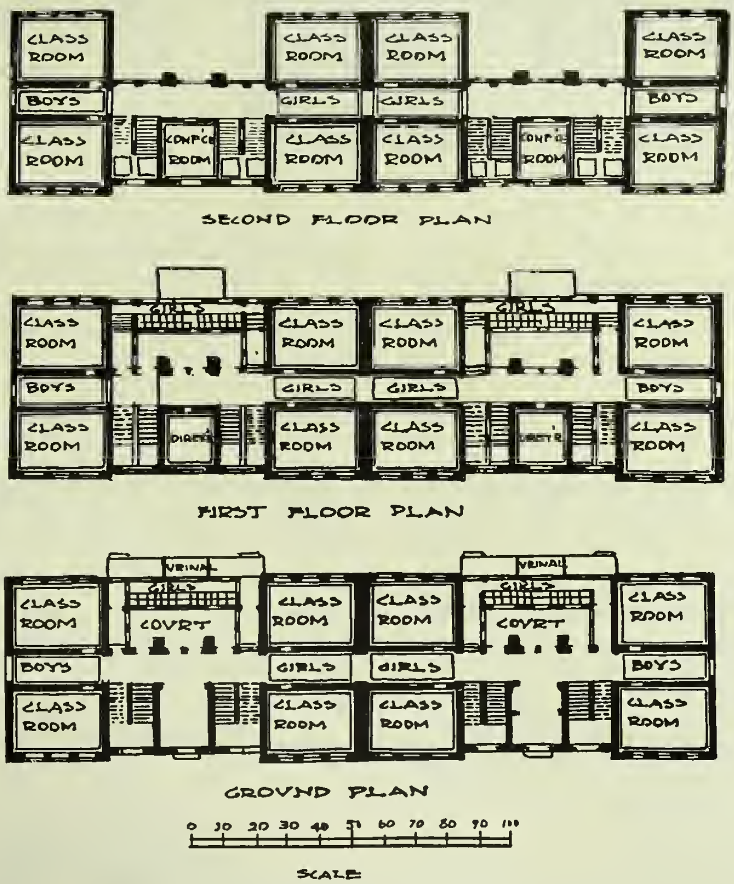
A German schoolroom is either lighted from one side only or from opposite sides. The teachers are not forced to face windows, nor are the pupils subjected to cross light. Schoolrooms are almost invariably arranged so that the principal light comes from the left-hand side of the pupils. But where our classrooms give 12 to 16 sq. ft. of floor surface in a schoolroom to each pupil, in Germany the most liberal area is 10 to 12 sq. ft. for each scholar. This is a consideration immediately associated with the question of proper ventilation, and should not be disregarded in the consideration of the advantages and disadvantages of the schoolroom plans of the two countries.

The schoolroom, 24 ft. (with 12 ft. stud) for primary schools, and 28 ft. (with 13 ft. stud) for grammar schools, generally adopted in this country requires, to give sufficient light to the row of desks next the inside wall, that there should be windows in the wall on the left and in the wall at the back of the pupils. While cross light is disadvantageous for the pupils' eyes, the chief disadvantage of this method of lighting is possible injury thereby to the teacher's eyes. In no well-planned court room are windows placed opposite the bench, and equally valid objections hold in regard to placing a row of windows, except those with northern exposure, opposite a teacher's table.

It is held in Germany that in a schoolroom lighted from one side only, the row of desks furthest from the windows should not be at a greater distance than once and one half the clear height of the room. While this rule is not, however, followed in all cases, in Germany and France 21 to 22 ft. is the customary width of a schoolroom. The maximum length of a schoolroom in these countries is usually 30 ft. This length is the distance to which the average voice can throw with ease, and it places the pupil in the row farthest from the teacher where writing upon the blackboard behind the teacher's desk can be distinctly seen.

Another consideration in the adoption of a narrow width of schoolroom is the economy of construction permitted by this span as compared with the cost of wider spans; but in Germany, as the number of pupils to a schoolroom, except in the upper grades, is no less and sometimes greater than with us, the pupils in a German school are given a smaller allowance of air space, and do not have the advantage of separate desks such as are now almost universally assigned to pupils in our schools. As far as the scholars' wellbeing is concerned, there is disadvantage to them from cross light, but the great width of the schoolrooms required for the diffusion of light from the windows at the back of rooms gives greater air space per pupil than is given in Germany. It is undoubtedly better to have the light from two opposite sides of the room, or, as would commonly be the case, from the left side of the pupils only. The crowding of fifty-six pupils now seated in grammar schools in schoolrooms 28 by 32 ft. into rooms 22 by 30 ft. is inadvisable.

The question of adopting a smaller-sized class room in our schools should be considered as one of economy in its broadest sense. A schoolhouse with schoolrooms 22 or 24 ft. in width can be more economically constructed than can one of 28 ft. wide. The eyesight of teachers and pupils would be better conserved in the narrower rooms.



PRIMARY SCHOOL, DRESDEN, SAXONY.
From Rolson's "School Architecture."

It is for educators to decide whether the lesser number of pupils under each school teacher means greater average progress for each pupil. If so, it is possible that as many pupils per teacher may receive instruction during a term of years under the small class system as under that which now usually maintains. The economy of a system of education would seem to depend not so much upon the number of pupils per teacher receiving instruction upon a given day as upon the average rate of progress of the pupils during a term of years. Smaller classes would admit of greater care in the training of the individual scholar, and under such conditions the rate of progress of the average pupil would probably be considerably increased. Unless the number of pupils per class room in Grammar and High Schools is materially reduced, our schoolrooms cannot be planned according to the most scientific method of lighting, nor can the only weakness of the American schoolhouse plan, as compared with that of Germany, be removed, and consequently no radical improvement can be made in the general plan of our best designed schools. Of course the opportunity for improvement in details of fittings, in beauty of external effect, and in the domestic engineering, is limitless; but as far as general plan is concerned, the module given by the schoolroom for fifty-six grammar grade pupils seated at separate desks prevents no possibility of better combination and arrangement of rooms than have already been made by our best architects.

It is to be hoped that some progressive school board will try the experiment of building a large grammar school designed for classes of forty or forty-eight pupils, and adopt a system which will make rapid promotion in the grades possible. The economy of the small class system can thus be tested on a sufficiently large scale, and for a long enough period to draw reasonable conclusions from the experiment. We should not recede from the system of individual desks and ample volume of air, in which we are superior to the Germans, but we should not rest content with a system of classification which necessitates defective planning as far as light is concerned, if another system is reasonably economical.

If the system of smaller classes should prove to be somewhat more expensive in cost of teacher per pupil per school day, it should be borne in mind that to the credit of the smaller class room is to be placed the interest of the saving on cost of buildings in which the floors, especially in the case of fire-proof construction, are of short span. It would not be surprising if the result of such an experiment would show that the small class system would give as clear gain after duly weighing the other considerations in their economical aspect, the lessened strain on the eyesight of both children and teacher, and the more individual education of the children.

Large primary school buildings for the Elementen Schulen of twelve to fourteen rooms, such as are adopted in Berlin, even if built for small classes, would almost certainly prove to be more economical than the construction of four and six room primary schools. The smaller buildings are more expensive per pupil than larger buildings in cost of land and building, as well as in heating, and, if properly cared for, in janitor service.

Primary schoolrooms, 24 by 32 ft., with a stud of 13 ft. 6 ins., while they would not fully meet the theoretical requirement of width of one and one half times the clear height would be well lighted with windows on one side only and would give seatings for fifty-six scholars. A better lighted primary schoolroom would be one 22 by 32 ft., 13 ft. stud and with desks set six in the width and nine in the depth of the room. This would require aisles as narrow as convenience will admit, say 18 ins. between desks and 2 ft. 4 ins. adjoining outer wall. The loss of two desks necessitated by this arrangement would appear to be a slight objection in comparison with the better lighting acquired.

114.—IMPERIAL GYMNASIUM, VIENNA. THE AULA, OR EXAMINATION HALL.
From Robson's "School Architecture."

A grammar grade schoolroom 24 ft. 6 ins. by 32 ft., 13 ft. 6 in. stud, while not as narrow as the German theory would require, would give seatings for forty-eight pupils, well lighted from one side only. A better width would be 22 ft., with seatings for forty pupils of the grammar grade. The stud of these narrower rooms may be 13 ft.

To illustrate the effect upon school planning of the adoption of the narrower schoolroom lighted from one side, the floor plans of a grammar school recently designed for the city of Boston, with schoolrooms 28 ft. wide, may be compared with that of a plan with the same distribution of rooms, but adapted for improved lighting, with rooms 22 ft. in width.

In the large German schools living apartments are provided for the janitor, and in some cases for the head master. Such arrangements would appear to be objectionable for all concerned; at all events, they do not commend themselves for adoption in this country.

Schoolhouses should, if possible, be provided, in addition to the main entrances, with outside entrances to the basement for each sex, and there should never be less than two entrances on first floor. Where the conditions of the building admit, there should be an ample porch provided at the entrance to shelter the early comers who cannot gain admission to the building. The entrance doors should open outward to prevent possibility of disaster in case of fire or panic. The vestibule doors should be hung with double swing spring butts. The main corridors should be of ample width, not less than 10 and preferably 12 ft. wide, and should be thoroughly lighted. Fire protection by tinned doors, making it possible to shut off the staircases on each floor, is a desirable fire and panic precaution. It is very important that there should be such fire doors to shut off the basement, and that these doors should be fitted with spring butts or door checks.

An entrance with runway and storage room for bicycles is to become a necessity in modern schools.

The staircases should be of iron throughout, the treads fitted with rubber mats, or, better, with some one of the recently introduced combined lead and steel treads. Both rubber mats and lead treads should be set in a sinkage cast in the iron tread. The lead treads need not exceed 5½ ins. in width. The staircase risers for primary schools should be 6 ins. high, and in other schools they should not to exceed 7½ ins.; the balusters and posts of iron of plain pattern, and the hand rails of each of plain round section. There should always be wall rails except at platforms.

Staircases are required in Boston to be at least 5 ft. in width. Some authorities consider that such staircases should not be wider than to admit of the comfortable passage of two files of children, each thus having a hand rail: and therefore that they should be but 3 ft. 6 ins. wide, to prevent the possible crowding between the files in case of panic. The excellence of the discipline of our school children has been proved during alarm of fire, and therefore we may safely retain the comfort and convenience of the 5 ft. stairway. There should not be more than fifteen or less than three risers between landings. Landings should be at least 4 ft. between steps. No schoolhouse should have less than two stairways.

Every primary and grammar schoolroom should have a wardrobe or cloak room adjoining it. The practise of using the corridors for cloak rooms is highly objectionable, as the movement of air in the building is naturally towards the schoolrooms. To say nothing of the danger from disease, the mass of clothing, especially if wet, is one of the main causes of the offensive "schoolhouse smell."

The wardrobes should be carefully heated and ventilated, and should have outside windows.

The hat and coat hooks should be set on side walls only, and the top row should be 4 ft. high in primary schools, and 5 ft. high in grammar schools. There should be at least 30 ft. of hanging space in each wardrobe. Every wardrobe should be fitted with a shelf set above the baseboard, or above the upper row of hooks upon which rubber boots and overshoes may be ranged in orderly manner, and not left upon the floor to be kicked about by careless or mischievous urchins. The wardrobe should have two doors, one from the corridor and one to the schoolroom. Four feet in the clear is the least width for a wardrobe.

Wardrobes adjoining schoolrooms are not absolutely requisite for high schools, and considerable economy may be effected in these

BOWDOIN DISTRICT GRAMMAR SCHOOL, BOSTON.
Edmund M. Wheelwright, City Architect.

buildings by providing well-ventilated and lighted lockers in the basement adjoining the toilet rooms. These lockers should have panels of stout wire netting, top and bottom, in the doors, and may well be provided with floors and top of wire netting.

As noted above, the standard size of a primary schoolroom, to accommodate fifty-six pupils, is 24 by 32 ft. and that for grammar schoolroom is 28 by 32 ft.; the pupils are seated so that the principal light comes from the left, and to give the requisite diffusion of light in such rooms there should be four windows on the long side, and, unless some requirement of design or plan prevents, three on the other side.

When light comes from the north only, it is not held to be objectionable in Germany to place the pupils with their backs to the light.

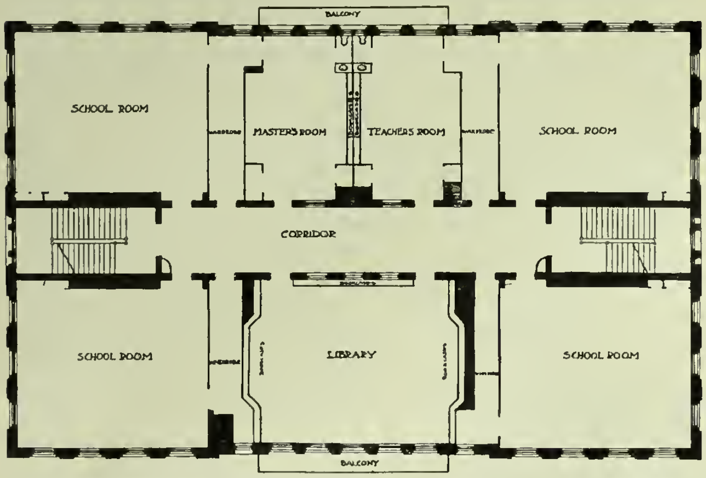
The windows should be 4 ft. between jambs, 3 ft. above finished floor, and carried within 6 ins. of the ceiling. The windows should not have transoms, as the transom bar cuts off most valuable light. Narrow windows with mullions are not as good in a schoolroom as wide windows widely spaced. Arched windows should be sparingly used in schoolrooms, and only those of the upper story; when used, the stud of room and height of window should be increased so as to give at least the minimum glass surface noted above. In primary schoolrooms with 12 ft. stud, 32 sq. ft. of light for each window is the minimum requisite size, and that of grammar schoolrooms is 36 sq. ft.

It is desirable that schoolrooms should have double run of sash. The heating system where double sash is used is more effectively and more economically run, and both the dust and the noise from the street is lessened. The expense of double sash is considerable, not only on account of the additional sash, but on account of the greater thickness of brick wall required.

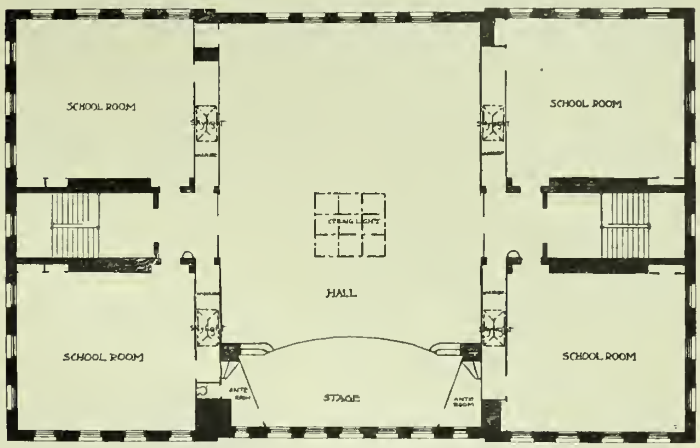
Unless the site is on a steep slope it is requisite that all the basement windows should not be less than 4 ft. 6 ins. high.

In lecture rooms, laboratories, and rooms for manual training and cooking, there is no objection to cross lighting, and windows may be placed without regard to the side lighting advocated above.

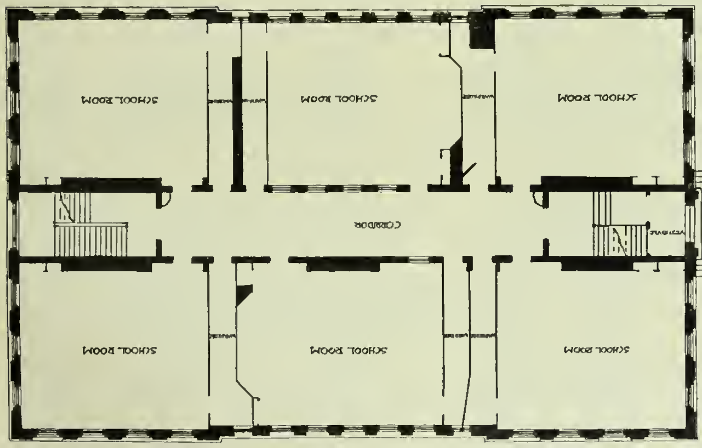
A platform 10 by 5 or 6 ft. should be provided for the teacher; this should be movable, as many teachers prefer not to have an elevated seat. An ample wardrobe for the teacher, and bookcase set with faces flush with the wall where practical, should be placed adjoining the teacher's desk. The wardrobe should be about 1 ft. 4 ins. in depth, the bookcase 12 ins. Both should have doors and should have cornices on line with that of blackboard.



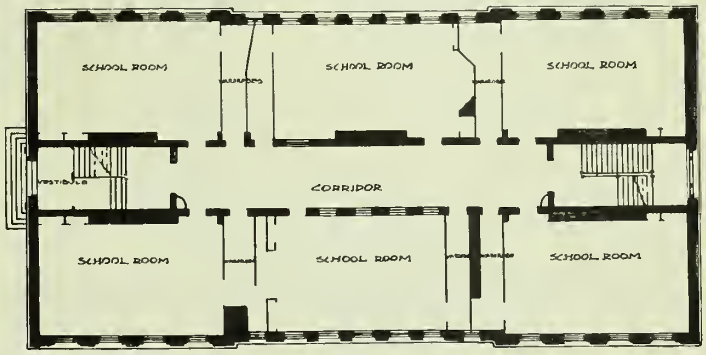
SECOND FLOOR PLAN



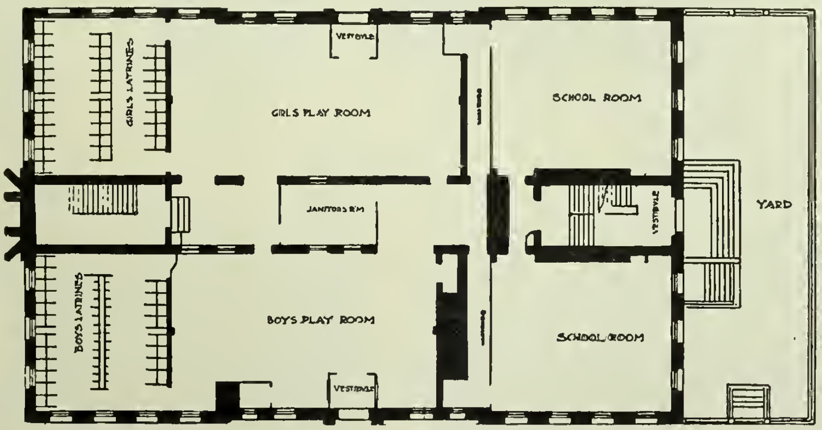
THIRD FLOOR PLAN



FIRST FLOOR PLAN.



PLAN SHOWING NARROW SCHOOLROOM, LIGHTED ON ONE SIDE ONLY.



GROUND FLOOR PLAN.
BOWDOIN DISTRICT GRAMMAR SCHOOL, BOSTON.
Edward M. Wheelwright, City Architect.

Architectural Terra-Cotta.

BY THOMAS CUSACK.

THE four Chicago examples of terra-cotta cornice construction furnished by Mr. W. L. B. Jenney, and published in the June issue of THE BRICKBUILDER, have been studied in the light of the description and directions that accompanied them. Construction and commentary were alike interesting, and will, doubtless, prove useful to those for whose benefit they were prepared; and to that end, given publicity in a duly recognized channel of professional information. As an evidence of this we can state that the chief draughtsman of a leading firm of architects — himself a very capable constructor — makes no secret of having adopted the principle contained in one of these examples, for the construction of similar cornices, one of them on a very important fifteen-story building now in progress in New York. Said cornice has already passed through the hands of the writer, in the ordinary course of business; and though it is not altogether what we should have advised, its execution is simple enough, and the result will be found quite satisfactory. We have, however, profited much during a life of some activity, by the interchange of ideas; and as Mr. Jenney — in common with all other successful members of his profession — appears to set some store on the opinions of practical men, we offer, in return, a short criticism and a few suggestions from their point of view. This we shall try to do frankly, but with the deference due to one who, first in many things, was the first to catch an almost prophetic glimpse of the possibilities of the steel skeleton, which, in little more than a decade, became generally accepted, and gives promise of a yet fuller development. Not shrinking from the crucial test of his theory, he at once set about the practical fulfilment of his own prediction, in the outcome of which it may be said — in this case at least — that the prophet is *not* "without honor in his own country."

His first venture was made in the erection of the Home Life Building, La Salle and Monroe Streets, Chicago, which was begun in 1883, and completed in the following year. In this very building the offices of Messrs. Jenney & Mundy are still situated; and at his desk the venerable pioneer of a successful revolution in the building methods of the world may be found, alert in his movements, quick in his perception, full of interesting reminiscences, and ready to defend the faith that is in him against all comers. We take it for granted that a man such as this will be among the last to deny that as "iron sharpeneth iron, so a man sharpeneth the countenance of his friend."

We would say at the outset that little patience should be wasted on a critic who finds fault with that which *is*, unless he stands prepared to supply the deficiency, and take the risk of showing what he thinks *ought* to have been. This conclusion is reached from a lively appreciation of the fact that: —

> "A man must serve his time to every trade
> Save censure — critics all are ready made."

Acting upon this principle, we take the cornice of the Association Building, La Salle Street, Chicago, and without altering the profile or displacing the girder, rearrange the construction as at Fig. 42. In this way the alteration becomes, to some extent, self-explanatory, and those who wish to follow up the subject will have something tangible to take hold of.

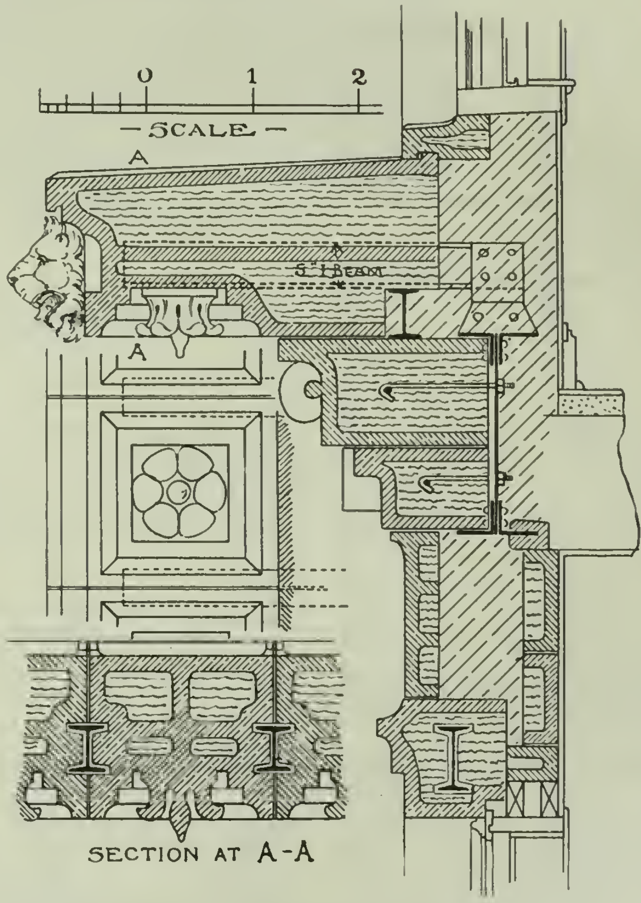


FIG. 42.

Starting with the architrave, the two courses into which it was divided are now made in one; the blocks being of any desired length up to, say, 2 ft. 6 ins. Should radial joints be required, well and good; they would satisfy the eye of a man who did not pause to reflect, but they would not add strength to work which must be otherwise supported over apertures. Of course the *idea* of strength is worth considering, and there are times when it becomes proper to make needful concessions on purely æsthetic grounds. Of these the present may, perhaps, be considered an instance. In either case provision would be made for a 7 in. I beam, its weight depending upon the width of openings. When the work had been set to line, its soffit resting on a suitable center, the whole of the interstices between iron and terra-cotta should be caulked (from the open chambers at back) full of cement concrete, mixed in the manner recommended by Mr. Jenney. That done, no settlement in the arch or displacement of the blocks could occur. The 12 in. channel and the attached angle can now be omitted and the frieze made as in the original. The dental course and the bed molding above are increased in bond, and made to fit in between the flanges of girder, but otherwise anchored as before, except that the anchors take hold of a ½ in. rod passing *through* the blocks, and are tightened up on a good backing of cement by tension nut.

It is in the cornice itself that the most important change would be made, and that change is radical in principle. The use of hangers is often expedient and sometimes indispensable, but wherever it is possible to introduce a more direct support (as distinguished from suspension) the opportunity to do so should not be allowed to slip. Such an opportunity exists here, and it is our first duty to make minor conditions conform to that fundamental one. The first of these would be to make the block in a single piece, plus the slip-sill; and as it would then be but half the size of blocks that have been made without misadventure, the task in this case would not be a difficult one. The 12 in. I beam used as a fulcrum would give place to a 6 in. retained in the same position and for a similar purpose, with this difference: it would be allowed to rest on the top bed of the course below. The occupation of the longitudinal L's being gone, the cantilevers would be lowered to position shown, and their section changed to 5 in. I's. Finally, if square panels in the soffit were deemed a *sine qua non*, that factor would determine the length of the blocks at about 1 ft. 9 ins.; but if oblong panels were permissible the length of the cornice block might be increased to, say, 2 ft. 9 ins., with advantages that are certainly worth considering. These would consist in a saving of cantilevers, and in reducing the vertical joints to little more than half the number indicated on section (Fig. 42). As to the size of the block so increased, it would still remain less than that of those made (without special difficulty) for the Astoria Hotel, and for other buildings which the question of space does not permit us to illustrate. Then the protection of these vertical joints; that may be done in a number of ways, some of which were discussed in articles for July and August. Whatever the method, we think, with Mr. Jenney, that the manner should be thorough, and that for the reasons pointedly stated in his remarks. The ways in which cornice blocks and cantilevers may be assembled will be found in the article for September, to which issue, and to those of preceding months, the reader in search of this and similar data is respectfully referred.

At Fig. 43 is shown a cornice of undoubted simplicity, yet giving, when set, an effect that is highly satisfactory, the chenaeu furnishing a particularly bold skyline. It may be seen on the 12th Street elevation of the S. S. White Dental Manufacturing Company's new premises in Philadelphia (Boyd, Boyd & Roberts, architects). The photo, Fig. 44, though taken under certain disadvantages as to the point of view, gives a fairly correct impression of the work as seen from the opposite sidewalk. To obtain adequate projection — in this case 4 ft. 8 ins. plus the lion's head — without adding unnecessary weight to the structure often becomes the turning point between a terra-cotta and a metal cornice. Such was one of the conditions imposed in the design and construction of the subject under notice, and we think the data now presented will show that a fair attempt has been made towards its fulfilment. In Philadelphia the

not less than 8 ins. on the bed molding, their weight, in any case, being carried by said cantilevers. But a time-honored law, in which the use of terra-cotta had not been contemplated, enacted long before the steel frame had been thought of, was cited and literally enforced, despite all that could be urged in deprecation of such action. Though originally intended as a precaution in the case of stone, when stone was made to balance on thick walls, and without any iron support, it now received a wider interpretation and was made to apply equally to terra-cotta cornices. This called for blocks with a bearing on the wall equal to their projection, quite regardless of the cantilevers which were spaced on 2 ft. 6 in. centers. The absurdity of all this was pointed out to the powers that be, but to them a city ordinance was like unto "the laws of the Medes and Persians that altereth not." Obstacles of a similar kind were denounced with much fervor some years ago by another distinguished Chicago architect, Mr. Dankman Adler, who, in an able argument published in the *Economist* of that city, inveighed against "official conservatism, self-sufficiency, and self-complacency backed by the letter of the law."

In due time blocks of terra-cotta, one dimension of which was nearly 7 ft. were ordered, but the attempt to make and burn them met with indifferent success. Such of them as had not cracked in the drying and remained intact when taken from the kiln were broken

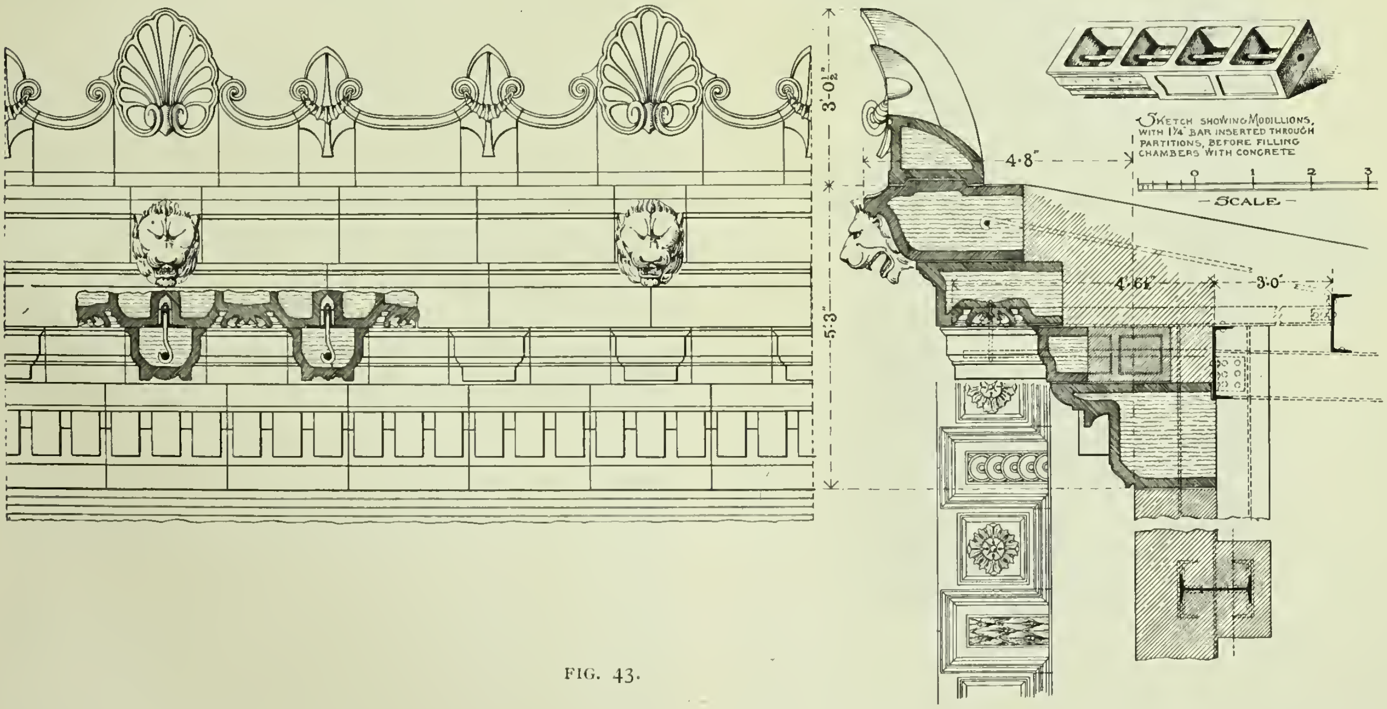


FIG. 43.

building laws are sufficiently abreast of the times to permit of such an attempt being made, without risk of annulment as a foregone conclusion. Had it been in Boston, such a proposal would have been found incapable of execution, by reason of certain belated building laws that have long since outlived their usefulness. Of these, too, we can speak from an unpleasant experience of a few years ago. It is encouraging, however, to know that some concessions have since been made in the manner of their enforcement; but this is not enough: in that respect, at least, they stand in need of a radical revision in the light of progress and advanced practise.

We cannot illustrate the effect of these antiquated ordinances better than by the narration of an incident in connection with a recently erected building in which terra-cotta and brick happened to be the materials used above the first story. The main cornice had a projection of about 3 ft., being supported by steel cantilevers running some distance back into the building and riveted to roof beams. The blocks forming top member of this cornice need not have been more than 2 ft. 6 ins. wide. This would have allowed them a lap of

in transit, yet the farce of reassembling and setting the pieces was carried out as per program. Two thirds of that which was ordered to be made in single blocks of terra cotta was, in reality, altogether superfluous. Indeed, we might go the length of saying that it became positively mischievous. For not only does it lie inert and useless; the space it occupies in the wall is but a series of boxes more or less hollow which otherwise would have been built solid in brick and cement; weight in this case being held of high account for its own sake. This, be it observed, resulted from the misapplication of a law which at one time had a specific meaning, but now calls urgently for intelligent revision, with special reference to altered conditions and prevailing methods of procedure. We doubt whether a more glaring anomaly could be found in the building regulations of any city in the Union; if so, it should have the immediate attention of the city dustman.

We are far from saying that in all cases the best possible scheme of cornice construction is adopted. That would imply a degree of cooperation on the part of architect, engineer, and terra-cotta manufacturer, the necessity for which is only beginning to be recognized. Neither can we assume that the scheme, after it has been fully elaborated (quite apart from its merits as such), is at all times made the most of in the course of execution. Unfortunately, that is not so; nor could we expect anything so idealistic in the outcome of so brief a period of evolution. It is as yet a new problem, and one for which a solution is being rapidly evolved; but like the language itself, in which we have been said to conceal as well as convey our thoughts, it is not altogether complete. In all the wide domain of human progress there can be no finality. Such improvements as have been made thus far are due to the application of mathematical

FIG. 44.

principles, of practical skill, and of knowledge such as comes to its possessor by the slow and sure, though not always agreeable, course of experience. Those engaged in it are represented by the architect, the engineer, the clayworker, and finally, the general contractor. Their ultimate aim is, and, indeed, the results already achieved in the construction of terra-cotta cornices are, economy, simplicity, completeness, and absolute security. That much yet remains to be done in these several directions we are free to admit. None the less, however, do we contend that cornices such as have been illustrated and discussed in recent issues of this journal are the logical outcome as they are the crowning triumph of composite construction.

As to the question whether it be desirable or not to introduce brick at all in ecclesiastical edifices, or generally in public buildings, one might, a few years ago, have been anxious to say, somewhat. I trust, however, that the ignorant prejudice which made many good people regard stone as a sort of sacred material, and brick as one fit only for the commonest and meanest purposes, is fast wearing out.—*Street.*

Fire-proofing Department.

THE PRESENT CONDITION OF THE ART OF FIRE-PROOFING.

BY PETER B. WIGHT.

THE question is often asked, "Why should buildings be fire-proofed when it is cheaper, all things considered, to build them otherwise?" This is one of those questions the answer to which is partly within itself and is impliedly in the negative, with many otherwise sensible people. And as long as it is a question of pure economics viewed solely from the investor's point of view, we should not deride and abuse those who view it in that light. When a man's interest is centered in a single piece of property he has no occasion to be public spirited. It is nothing to him whether his building would be a valuable improvement to the town or not. He is only looking for the best percentage on his investment, and takes his chances of fire with the insurance companies. He estimates the cost of his improvement both ways, and reckons his returns both ways. Then he argues with himself how long his building can be kept in good condition, and concludes that it will anyway last through his natural life if it is not burned down, and if it is he can put up another building and get the benefit of the latest improvements. Therefore he estimates to insure his rents also. But the only thing that troubles him is the 80 per cent. clause in his policies. However, he must take some chances, and this is an indefinite one. In addition to this he introduces some of the cheapest features that produce a modification of his insurance rates, finding that they pay from that point of view, and when his building is completed and rented congratulates himself that he has been more successful than some of his neighbors. There are many examples of this kind of investor, and the circumstances are always in his favor.

It might have been said as one answer to the above question: "Because the building law of the locality says it must be fire-proofed if it exceeds certain dimensions." In this answer is also hidden a deeper fact: that the investor, if he finds that the size of his projected improvement comes within this category, must fire-proof his building, willing or unwilling, and mostly the latter. This new investor surveying the field looks at what his predecessors have done. He finds that there are many ways to comply with the provisions of the building laws concerning fire-proof buildings, and still keep within the law. Perhaps he finds that some great building in which no pains have been spared to get the best results is not on a paying basis, and some other one, which is the result of all the cheap materials and devices obtainable, glossed over with much onyx and mosaic, and replete with every comfort and convenience, is in a flourishing condition. All he wants now is an expert able to get around all the expensive materials with cheaper ones that can be made to pass the inspection of the building department, and he is ready to go on with his building. But knowing that he has sought to evade the spirit of the law, he protects himself with insurance, and gets that also as cheap as he can.

Another and somewhat discouraging element that enters into the discussion of the fire-proof building question is of an architectural nature. How many men have asked themselves the question: "Why should I build for all coming time when my neighbor finds it more profitable to build only for a lifetime? I see around me many substantial structures that I admired in my youth, now degenerate and given over to baser purposes than those for which they were erected, and some being torn down to be replaced by monster bird cages. What will my projected bird cage look like forty years hence to the eyes of my children and grandchildren?" He muses on the fleeting fancies and fashions of the present day, which are overriding and displacing many of the best structures of a quarter of a century ago, and wonders why this will not go on forever. He wonders if invention and improvement will ever cease in our land, and says, "No! The Watchword of Americans is Excelsior!" and then adopts the plan of the most plausible of the many "enterprising" architects who are always thrusting the "latest thing" under his nose. Fashion has conquered his judgment.

This is no fanciful picture. During the last three years a period of financial stagnation prevailing in many of the largest cities of the continent has given those whose energies are usually exerted in projecting public and private improvements, especially in the line of building, much opportunity to mentally speculate on questions which largely concern the architects of the country, and the manufacturers and builders who carry out their plans. They are now criticizing what has been done in years of excitement and occupation which prevented serious thought. They are weighing the results of recent investments in the larger class of buildings, and find many wanting. It is being discovered, or at least asserted, that there has been extravagance. Already some new buildings are projected in which it is sought to depreciate rather than appreciate the quality of materials heretofore used. This is now the general tendency, to which, of course, there are exceptions.

It may be seen in the disposition to cheapen the methods heretofore used in making the interiors of buildings fire-proof. Instead of our past experience resulting in the improvement of old methods, entirely new ones, seeking to supersede the old, seem to find a ready acceptance; and whatever their merits or demerits, they are certainly cheaper methods, and are advocated and accepted largely on that account. The danger of accepting cheaper methods is in the fact that they are generally taken without question as to their quality. They are also taken without being tested by *actual experience*. The only experience to recommend them is found in experimental tests and demonstrations.

The present year has witnessed the only experiences of burned clay when used for fire-proofing purposes on a large scale, and under circumstances calculated to be most disadvantageous to them, that the world has ever seen. Though not unscathed they have done their work, they have fulfilled their purpose. When the crucifiers cried out to the Man of Nazareth, "He has saved others, now let him save himself," they confessed to believe that which they sought to make others think they did not believe. And so the scoffers who can only say that clay fire-proofing has not in a crucial test saved itself are obliged to admit that it has saved the structure of more than one building. It is also a fact that every other pretended system of fire-proofing heretofore used has been an absolute failure when subjected to the ordeal of fire in a large building. Such are the so-called fire-proof buildings erected twenty years ago. Of incipient fires and those that have burned out entire stories without destroying the building the records of clay fire-proofing are a multitude. Many of these have been collected and published in THE BRICKBUILDER, and others remain to be told (see BRICKBUILDER, November and December, 1896). Of buildings with unprotected windows fire-proofed with burned clay, which have resisted the onslaught of fire from adjacent structures that were totally destroyed, may be mentioned the Montauk Block and Schiller Building at Chicago, the latter being of steel skeleton construction, with exterior side walls of hollow tiles.

The experiences of the present year are full of instruction to those concerned in burned clay fire-proofing, and the good result of this will doubtless be seen in the near future. The makers and users have within recent years been too confident in their previous successes, and have neglected to make improvements which are always possible to those who are seeking to make them. There are no defects in the methods of manufacturing and using burned clay that cannot be easily overcome. It is in the selection of the raw materials that there is the greatest field for improvement. After this the most important matter is the method of construction, and the relative quantities to be used for specific purposes.

As far as hollow tiles are concerned, if we have in view the usual systems of many makers which present continuous ceiling surfaces, it is claimed that the chipping off of the bottoms is total destruction of the material from the insurance point of view, even though it has stopped the fire and saved the steel beams. The hollow-tile system thus far used for floor construction is a single system with a double purpose. The systems depending on light metallic supports for concrete or plaster are nearly all double; the floor construction is independent of the ceiling, and the ceiling is stretched below to protect the floor construction. Sometimes it protects the bottoms of the beams, and sometimes they are independently protected. But in all cases it is there to be washed away by water after it has done its work, at which time protection to the floor construction is no longer needed. If the clay system was used on the same principle the results might be different. Up to about seven years ago very many buildings had been constructed with ceilings of fire-clay tiles. In most cases these tiles were attached to wooden floor joists. In many of the fire-proof buildings of Pittsburgh and farther West these tile ceilings were used with steel construction for the highest story. There is only one example east of Pittsburgh, in the American Bank Note Engraving Company's building at New York. In the well-known Horne Department Store, and also in the Horne Office Building at Pittsburg, the highest story was ceiled with clay

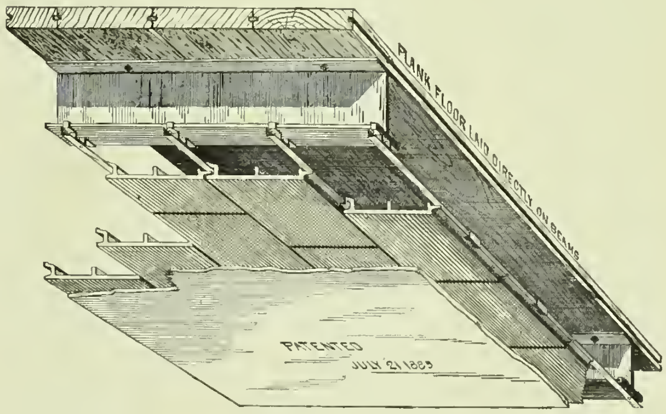


FIG. 1.

tiles, and in each case they were in no way affected by fire from beneath, or by water to which they were also subjected in the Horne Office Building. Another kind of clay tile ceiling was used in one of Ryerson's buildings on Randolph Street, Chicago, where a severe fire raged in the second story two years ago. This has also been described in THE BRICKBUILDER (December, 1896).

In all these cases the tiles were either made in one thickness of material or were hollow tiles that had been split in two after being burned in the kilns. In each the tiles endured the most intense heat and the application of water without falling or cracking. Several methods have been used for making and putting up such tile ceilings with more or less efficiency, but unfortunately they have been driven out of use by cheaper processes. But it has been demonstrated that ceilings of fire-clay tile, and only of tile, will endure tests that no other material will stand, even hollow tile itself. The reason is plain. A hollow tile when it cools in the kiln may still be under a strain in some of its parts, due to shrinkage. This is relieved by splitting it, it having been previously scored for the purpose. These tiles in a ceiling are in a state of rest. Each is independently fastened, and each is free to expand, contract, or move a slight distance. The thinner they are, if of hard tile, the more readily they will respond favorably to the attacks of intense heat or cold water. Everything depends on the way they are fastened; but the difficulties in this respect have been overcome by blind fastenings and overlapping joints. The illustration (Fig. 1) shows a section of one of these ceilings attached to I beams. The brick or tile arches are not shown. Suppose that each I beam was covered on the bottom with heavy porous terra-cotta skew-backs continued under it and a segment tile arch thrown across from skew-back to skew-back. We would have the lightest, most reliable and economical floor construction with hollow tiles. Now, if hangers are inserted through the crown of the arch, a ⊥ iron can be attached to them running parallel with and between the beams, to which the small angle irons can be attached by iron cleats, as shown in the cut. Thus the tile ceiling would be independent of the beams, giving them increased protection in addition to the skew-backs, and furnishing a non-cracking protection to the whole floor construction. Care should be taken to allow for longitudinal expansion in all the ⊥'s and L's.

Such a construction would be the same in principle, as has been said, as those proposed to be cheaply executed with metallic furring, concrete, and plaster; but carried out in a material absolutely indestructible by fire and water, requiring only a new plaster surface to restore it to its original condition. It is not to be expected that it would suit the man who seeks to get around the provisions of the building laws, but it would be demanded for the highest class of buildings wherever the best of everything is sought for.

NAKED STEEL CONSTRUCTION SEVERELY TESTED.

A FIRE of extraordinary severity and destructiveness occurred in Detroit on the 7th of October. It destroyed the Detroit Opera House and five adjacent buildings of ordinary construction, two of them fronting on Gratiot Street in the rear of that on which the opera house fronted. In addition to these last was another building adjoining them and situated only 20 ft. from the rear wall of the opera house, occupied by the H. R. Leonard Furniture Company, and designed by Rogers & McFarlane, architects, of Detroit. This building was 26 by 110 ft., and ten stories high. Besides the street front on Gratiot Street, its side, 110 ft., fronted on a 20 ft. alley, and an alley 20 ft. wide separated it from the opera house. The whole building was of riveted steel construction and had girders and columns through the center. The front was of brick, but the side and rear were covered on the outside only with hollow building tiles. Curiously, while the whole skeleton was steel, all the floors were of mill construction. It was in open lofts and stocked with furniture from top to bottom. The only attempt at fire-proofing was to cover the columns and girders with fire-clay tiles. Everything combustible in it was completely burned out, and it must have made a most intense fire. But the entire steel skeleton remains standing, with the front wall and about half of the tile wall on the alley. The columns and girders are of course standing with the frame. The covering of the columns and girders, which were certainly more exposed than any other part of the frame, may have been the means of preventing a total collapse. The amount of damage to the steel work has not yet been ascertained. The only wonder is that the burning of the combustible floors did not bring down the whole structure. There is nothing remarkable in the falling of a large part of the hollow-tile covering on the exterior, for the unprotected steel must have been greatly expanded and warped by the intense heat on the inside. There were no fire shutters on the rear. This experience only speaks well for riveted steel structures, but the whole may have to be taken down if it is warped out of shape as a whole, or in any of its details.

FIRE-PROOF BUILDINGS.

SINCE the decline within the last few years in the price of iron and steel, accompanied, as it has been, by the breaking up of what was once known as the steel beam trust, the number of fire-proof buildings that have been erected in the large cities of this country has greatly increased. The adoption of the so-called skeleton form of construction is a method which permits of the utilization of space to an extent which would have been found impossible if the old methods of building had been continued. As it is now, it is estimated that a fire-proof building can be put up at about half the price that would have been required to pay for the construction of such a building eighteen or twenty years ago, while, as compared with the ordinary non-fire-proof building, one of these modern fire-proof structures is said to call for an outlay not greater than 10 or 15 per cent. more in amount. This slight margin of increase is more than made good by the increased space obtained, as referred to above, and also by the fact that when once put up a building of this kind requires but a small expenditure in the way of repairs, and possesses the merits of indefinite durability. But beyond this there is also the fact that the insurance rates charged against fire are so much lower in the case of fire-proof structures than those which are not built in that manner, that the saving forms a considerable return in interest upon the extra money spent in the work of construction.

But while a building may be classed as fire-proof — and this classification, unfortunately, has been given to a great many structures which do not deserve to be put in such a category — no form of building can offer absolute immunity against the destruction by fire of the inflammable contents which may be stored within it. Our building laws have put no limit upon the area which may be covered by a so-called first-class or fire-proof building, and it is obvious that if such a structure extends over half an acre or an acre of ground, and has each of its floors filled with combustible merchandise, a fire taking place and obtaining great headway on one of these stories may in itself cause a large loss, even though the building itself may not suffer material damage. This was the experience in the conflagration which took place in Pittsburg about a year ago. The fire started in a building of ordinary construction, but the flames were carried by the current of air against the unprotected glass windows of a fire-proof building on the opposite side of the street. The result was that the merchandise on each story of the latter building was set on fire and completely burned up. The structure was in certain ways faulty, a fact which was brought out by the hard test of a hot fire. But the main structure of the building stood firm, although its entire contents were converted into ashes.

A few weeks ago an alleged fire-proof building, a storage warehouse, took fire in Detroit, and in this case the contents were entirely destroyed, while the building itself was damaged to an extent which may require almost entire reconstruction. In this instance, the fire-proof qualities possessed were those of name rather than of fact.

But in view of the presumable loss which might happen to the contents of our fire-proof buildings, when these are used for the storage or sale of inflammable material, it is not unlikely that some restriction should be placed upon the extent of undivided areas. With a building of second-class or ordinary construction the limit of area is 8,000 ft., a space which, if filled with inflammable merchandise, is quite large enough, when on fire, to furnish hard work for a fire department in its efforts to extinguish the flames. In view of the fact that the tendency of the times is in the direction of fire-proof construction in this city, and in view, furthermore, of the circumstance that it is well to take precautions against a known danger in advance, it would be prudent to put some limit in the way of dividing fire walls in fire-proof buildings which will be erected in the future.

So far as office buildings are concerned, no limitation is required, for the reason that these are of necessity divided by fire-proof partitions into relatively small compartments, while the contents of these is hardly ever of a character to offer the materials for a hot fire. The same statement holds true of apartment houses and hotels, which are also cut up by interior fire-proof partitions, so as to impose a check to the quick spread of the flames. But in the modern warehouse it is often thought desirable to have a large undivided area, and these areas are commonly filled with considerable quantities of inflammable merchandise. If the regulations of our building laws were such that these floor areas could not extend over a greater space than 10,000 sq. ft., and where a store of three or four times this area was required, it would need to be divided from the ground upward by solid fire-proof partitions, cutting up the building into sections of not exceeding 10,000 sq. ft. each, it is probable that the convenience of trade would not be greatly interfered with, while the construction would be such as to make it possible for the fire department to hold a fire that occurred within the limits of the floor of a single section, thus making a conflagration impossible.— *Boston Herald*.

Mortar and Concrete.

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

BY CLIFFORD RICHARDSON.

THE ROSENDALE CEMENT INDUSTRY.

PHYSICAL TESTS OF NATURAL CEMENTS.

THE strength, when determined under similar conditions in the laboratory, is a valuable indication of the character of a cement and of the effect upon it of variations in its chemical composition and physical properties. Each kind of cement is made into test pieces in the way most favorable for developing its best qualities, the fineness of grinding, the amount of water necessary to make the mortar, and the time required for setting being observed. At intervals the strength, either tensile or compressive, is determined.

Examinations of this kind have been made by the writer in the last few years of most of the well-known brands of natural cement in use in the concrete base of asphalt pavements over a large portion of the United States. The results are given in the following table, supplemented, where some of the long-time tests are incomplete, by those of other investigators which seem comparable. It is impossible, however, to use the tests of the manufacturers themselves, and of many city engineers as a means of comparison, owing to the methods employed, which are quite different from those in which the test pieces are made with dry mortar and of sufficient density. It has been possible, however, to use some of the results of the excellent tests made in the office of the Inspector of Asphalt and Cements of the District of Columbia, and some of those of the cement testing department of the Board of Public Works of Philadelphia, which are the only ones available which are made under the same conditions as those of the writer, upon which the table is based. The results of some long-time tests of Western cements carried on under the direction of the city engineer of Minneapolis, from 1888 to 1894, are also introduced in parentheses, although only comparable among themselves.

PHYSICAL TESTS OF AMERICAN NATURAL CEMENTS, TENSILE STRENGTH, FINENESS, ETC.

BRAND.	Fineness.			Water in Mortar.		Set.		Neat, tensile strength, pounds per square inch.						Two parts crushed quartz.				
	200	100	50	Neat.	Sand.	Initial.	Hard.	1 day.	7 days.	28 days.	3 mos.	6 mos.	1 year.	7 days.	28 days.	3 mos.	6 mos.	1 year.
Rosendale, best, N. Y.	10.	7.	2.	28.	12.	20′	35′	100	206	400	450	457	500	80	150	250	370	450
Rosendale, average, N. Y.	24.	12.	3.	28.	14.	20′	35′	75	150	300	325	375	460	45	130	210	270	340
Buffalo, N. Y.	32.	24.	6.	26.	12.	18′		80	240	310	(305)	(290)	(346)	80	152	(115)	(103)	(97)
Akron, "Star," N. Y.	12.	7.	2.	26.	12.	8′		112	300	320	(317)	(364)	(369)	108	230	(152)	(149)	(115)
Milwaukee, Wis.	18.	10.	2.	30.	13.	45′	80′	120	160	234	338	(327)	(372)	60	80	(135)	(152)	(156)
Utica, Ill.	24 5	15.	4.	32.	14.	15′	35′	190	249	336	(257)	(242)	(259)	118	140	200	(122)	(134)
Louisville, "Anchor," Ky.		24.	11.	31.5	13.5	22′		110	222	310	(327)	(368)	(416)	98	152	(110)	(144)	(161)
Louisville, "Speed," Ky.	24.	16.	10.	33.5	15.	5′	10′	180	248	394				72	164			
Sellersburg, Ind.		27.	12.	30.	13.5	27′		40	60	320				30	130			
Fort Scott, Kans.	12.	4.	trace.	37.	14.	10′	22′	52	100	160				36	86			
Double Star, Kans.	9.	3.	1.	38.	15.	8′	36′	116	210	305	276			114	256	398		
Mankato, Minn.	31.	9.	1.	30.	14.	45′	65′	188	238	346	(259)	(280)	(319)	112	160	(120)	(126)	153
Union, Penn.		7.		28.	12.	33′		170	230	375				150	250			312
Improved Union, Penn.	30.	15.	3.	28.		16′	43′	140	219	314	324	397		145	231	296	359	400
Round Top, Md.		15.	8.	32.	14.	30′	50′	100	250	300	410	446	526	122	255	342	387	515
Cumberland, Md.		19.		32.	14.	30′		100	300	375	371	393		156	297	356	350	438
Cumberland and Potomac, Md.	30	17.	4.	32.	14.	32′	63′	100	300	315	371	393		188	225	403	397	436
Antietam, Md.		7.		32.	15.	30′		65	146	300				70	124	162	226	232
Shepherdstown, Md.		14.		30.	14.	20′		70	160	300				106	210	265	281	366
Anchor, Penn.		10.	1.5	25.	13.5	75′		150	300					90				
Milroy, Penn.		19.5		30.	13.	20′		50	170	400				70	200			
Utah		13.6	3.5	32.	14.	8′	41′	80	204	280	390			52	230	336		

TESTS OF COMPRESSIVE STRENGTH.

Pounds per square inch.

Brand	Buffalo, N. Y.	Akron, "Star," N. Y.	Louisville, Ky.	Milwaukee, Wis.
Neat: —				
7 days	997	1325	1737	913
28 days	1300	2812	2795	1457
Two parts quartz: —				
7 days	700	700	500	506
28 days	980	1300	1065	822

	Fort Scott, Kans.	Double Star, Kans.	Mankato, Minn.	Utica, Ill.
Neat: —				
7 days	769	1072	1663	1538
28 days	1256	2402	2288	1972
3 months		3155		
Two parts quartz: —				
7 days	417	988	575	1075
28 days	680	1470	834	1450
3 months		2718		

	Average Rosendale.
Neat: —	
28 days	1737
Two parts quartz.	
28 days	614

An examination of the data in the table shows that there are very decided differences to be noted in connection with the fineness of grinding of the samples of the different brands, the amount of water necessary to make the strongest mortar, the set and the tensile and compressive strength at different ages. It would also be found, among a large number of tests of the same cement, that there are often considerable variations in many of the brands themselves from time to time and from year to year, depending on changes in the character of the rock and in the manner of burning. For comparative purposes, however, the results which have been selected are sufficiently illustrative to show what the general differences are in the nature of our natural cements when at their best.

These differences must be considered in the light of our previous information as to the chemical composition and density of the several cements and of our actual experience with them in their practical applications.

Fineness. How fine a cement may be when put on the market is primarily purely a question of the care bestowed on grinding, but under ordinary circumstances it is dependent, to a large degree, on the hardness of the burned stone. The facilities for grinding are much the same at all cement mills, and at but few of them, at least hitherto, has sifting and care in grinding been practised. In the manufacture of the best Hoffman Rosendale of New York scalping or sifting, as well as grinding, is carried on, with the result that this cement is extremely fine, and yet there are some other cements which are softer and as satisfactorily ground without scalping.

The importance of fine grinding appears from comparative tests of sand mortars made of cement from which the coarser particles have been removed, and of that containing a considerable portion of coarse material, which, by itself, has little or no hydraulic activity. These tests show that, other things being equal, the finer the cement the stronger are the sand mortars made with it, at least in the ordinary proportions and at early stages, although in the neat form, the mortar, made with coarse cement, may produce a test piece stronger than that made with the finer material. On this account as our best natural cements are now furnished of such a degree of fineness that less than 10 per cent. is coarser than will pass a 100 mesh sieve, it is important that the coarser cements should not be accepted for use, at least at the same price as the finer.

Fineness is undoubtedly an element of importance, although probably not as much so as in the case of Portland cement, which is used with larger proportions of sand. Fortunately the manufacturers are beginning to appreciate the fact that the improvement that they make in their cements by attention to this detail repays them by the higher test which the finely ground material will give, and the readier sales it will command where they are made to persons who understand the importance of fine grinding and who test their cements carefully before using. Upon those who pay little or no attention to the character of the cement which they employ such a refinement may, no doubt, be thrown away.

Set. Natural cements, when made into mortar with the smallest amount of water, set in from a few minutes to an hour or more. There is a wide difference in this respect, although, as a rule, natural cements are quick setting. The variations are due to the composition of the rock, the extent of its calcination, and the degree to which hydration of the finished cement has been carried. Much high-grade cement may, when first burned and ground, heat when mixed with water and set too rapidly, but when properly hydrated by sprinkling or steaming the burned stone or by storage, it may be made to set slowly and give satisfactory results. The lime cements are usually the quickest in setting unless hydrated, but they are equaled in this respect by many magnesian cements, too rich in carbonates. Very slow setting is unusual when cements are freshly burned. When found it is due to weathering, air slaking, and age, or to deficiency in the proper proportions of lime to silicates.

Normal natural cements, satisfactory for use, when mixed with a small quantity of water, it appears, begin to set in from fifteen to thirty minutes, and are hard set, that is to say, not easily indented by the nail, in about forty-five.

The time required by the same cement, when employed under varying conditions, may vary very much. The more water there is used in making a mortar the slower the set will be. The warmer the water and air the quicker the set; and the more humid the surroundings, and the more excluded the mortar is from the air, the slower it will set.

On this account quick-setting cements must be mixed with more water than slow. They are also frequently in demand where the surroundings have a tendency to delay setting.

Water. The amount of water necessary to make the strongest mortar with each cement for comparative tests is variable. It is commonly expressed in percentages by weight. This is, however, to a certain extent deceptive, as the relation is one of volume.

The variation in the amount of water required is due to several causes,— the degree of fineness to which the cement is ground, the specific gravity of its particles, its volume weight or density, and to its chemical composition. With considerable coarse material the voids in the cement are smaller and the volume of water required for a mortar less. When one cement has a higher specific gravity than another the same volume percentage of water will mean a smaller weight per cent. in the first case. For instance, 300 parts by weight of a cement having a specific gravity 3.00 might require 84 parts by weight of water to make a mortar, while 265 parts by weight of a cement, having a specific gravity of 2.65; but an equal volume with that of 300 parts of a specific gravity of 3.00, would require the same volume of water, or the same amount by weight, 84 grams, but in the first case the per cent. of water by weight would be 28, and in the second, with the light cement, 31.7, although in each case the volume was the same.

The chemical composition of a cement has probably the greatest influence upon the amount of water necessary to make a mortar. Depending upon the quantity of water necessary to hydrate and combine with certain compounds the amount necessary in addition to make the mortar plastic will vary. The cement made at Fort Scott, Kans., requires much more water than any other natural cement to properly temper it. This is due to the fact that on its addition a portion of the water is at once taken up in chemical combination by the cement, leaving only an ordinary amount to act in the physical operation of making a mortar. The magnesian cement of Western New York requires but 26 per cent. of water and the best Rosendales but 28. Here there is not the same immediate demand for water to combine with the cement chemically, and so a smaller volume is sufficient to make a mortar. The quicker setting a natural cement is the more water it requires, as a rule, as the quick set is merely an evidence of active chemical change which requires and ties up additional water.

The difference in the volume of water required by a natural and a Portland cement also illustrates the effect of difference in composition in the amount of water requisite for making a mortar. A good Portland cement of specific gravity 3.15 requires 21 per cent. by weight of water to make a mortar. 315 parts by weight would, therefore, require 66.15 parts by weight of water. The relation of the volume of the particles of cement to that of the water would be as 100 : 66.15. A Rosendale cement of specific gravity 3.00 requires 28 per cent. by weight of water or 84 per cent. by volume of the particles of cement. The Rosendale, therefore, requires over 17 volumes more of water to the 100 of solid cement on account of its different chemical composition and aside from the difference in density.

Another difference in the behavior of cements towards water is the variable amount of working mortar that different kinds of cement require, owing to differences in the speed with which water acts upon them. Some quickly make a smooth and plastic mass, while others require a more prolonged kneading to bring about the proper hydration of certain constituents.

In the practical use of natural cements these peculiarities have their influence and will be noted later.

Strength, Tensile and Compressive. The results of tensile tests of cements given in the preceding table are of representative samples of the best grade of each brand as far as they have come to our attention and for the strongest test pieces which care and experience can make under the most favorable condition. Under these circumstances the tensile strength appears to be, in almost all cases, satisfactory, and it seems that many of the brands attain a strength of over 100 lbs. per square inch in the form of sand mortar, 2 to 1, at the age of seven days, and may be expected to reach this standard at all times. Some brands do not reach this strength at seven days but gain it later, while a few do not continue after some time to increase in strength in the proper ratio. These peculiarities may profitably be examined by comparing the results of the tests with the chemical composition, and what we know of each brand in practical work and other properties of the cements.

Typical Natural Cements. As types of high-grade natural cements of the magnesian and lime classes the Hoffman Rosendale and Round Top cements may be selected. After learning to what their valuable properties are to be attributed it is then of interest to compare the other cements of the country with them, and to learn to what the differences in the latter are due.

Rosendale Cement. Using this term as applied properly to the product of Ulster County, N. Y., alone, we have seen that this cement, of which Hoffman Rosendale has been taken as one of the highest grade brands, is made from a dense rock, that it has a high specific gravity and is finely ground. In tensile strength it does not equal some other cements soon after it has been made up, but with age it increases in strength slowly and continuously without expansion, and is not to be excelled by any of the cements of its class when a year or more old. An examination of its chemical composition shows that its excellent quality must be attributed to the fact that it contains about 15 per cent. of alumina and iron oxides representing an abundant supply of the necessary clay, that the combined silica reaches a satisfactory figure, and that the magnesia is not excessive for a magnesian cement, being about 14 per cent. It appears that the rock is lightly burned, as shown by the uncombined silica and silicates, the cement is very finely ground and, both in the testing laboratory and in construction work, has proved itself for years such a satisfactory article that it may be fairly used as a standard with which to compare other cements. The color of this cement is a deep and dark brown, decreasing in intensity with the decrease in the amount of silicates in the rock from which it is made.

Round Top Cement. Although this cement is known only in the limited markets, reached from the place where it is manufactured in Maryland, it is such a perfect type of a natural cement, nearly free from magnesia, that it has been selected as the standard of its kind. An examination of its physical and chemical properties and a comparison of them with those of the best magnesian brands is instructive and shows to what its valuable properties are due.

It is of only ordinary fineness but of considerable density. It sets in about the same time as many Rosendale cements, but it sets harder and gives much more rapid returns in strength both neat and with sand soon after being made up, both in test pieces and on the work. It is not exceeded in strength by any natural cements after the lapse of considerable periods of time, though equaled, of course, frequently by some other brands of its kind. It is not as plastic as Rosendale cement and requires more water to make a dry mortar and more working to make a smooth one. It does not lose as much in initial strength on addition of excess of water nor is it affected as much by cold, and can be used in winter weather where a magnesian cement would fail. It is particularly suited for concrete work, where centers are to be drawn, owing to its great initial strength and rapid gain. The valuable properties of this cement must be due, as in the case of the best Rosendale cement, to the satisfactory proportions of its various components. The combined silica, in an average sample, reached 21.68 per cent. and the alumina and iron oxide 12.48 per cent., corresponding to very similar proportions in the Hoffman Rosendale, but the magnesia fell to but 2.86 per cent. The absence of the magnesia gives a very different character to the cement, its property of acquiring great initial strength, and one which distinguishes it sharply in its working from most magnesian material.

As taken from the kiln the ground rock or fresh cement is apt to be hot and quick setting, but on sprinkling the burned material with a small amount of water before grinding this difficulty is removed.

In color this cement is a medium between the dark Rosendales and the light Western cements, which may be described as a light brown shading into buff.

SAND CEMENT.

THE engineering public is always interested in the improvement of cement. One of the most likely directions for such improvement at present seems to be the use of sand cement. Concrete is a mass of coarse stone or gravel whose interstices are filled with sand, which in turn has its interstices filled with cement. The finer we grind the cement the more completely is the surface of each sand grain covered with it, and the stronger the resulting mass. Now let us go one step further and we have sand cement. Let us take a mixture of, say, one to one of Portland cement and pure sand (silica sand), and regrind this mixture into an impalpable powder, in which the cement gets ground very fine and the sand itself is as fine as ordinary cement. If we mix this sand cement in the proportion of, say, one sand cement to three ordinary sand, we obtain a mortar nearly as strong, and, indeed, some claim, fully as strong, as an ordinary mixture of one cement, three sand. — *Prof. Cecil B. Smith, in Canadian Engineer.*

The Masons' Department.

THE WAY TO AWARD SOME BUILDING CONTRACTS.

MOST buildings at the present day are planned and constructed on what might be called a mercantile basis, the dominant idea being to obtain the greatest possible results with the least possible expenditure of money; in fact, in a large proportion, if not a majority of cases, it is necessary to cut down the figures which have been obtained in competition, in order to make the two ends meet. But while such is the ordinary and every-day experience, there is, fortunately, a growing demand for well and thoroughly built buildings, particularly in the cases of the best domestic work, where the owner is willing to pay a fair price for what he receives. In such instances, if the architect desires to take advantage of his opportunity, he must certainly adopt a different policy in obtaining estimates and awarding the contract from the method usually pursued.

The unfortunate and inevitable consequences of close competition in awarding building contracts have been already pointed out in these columns, and it naturally follows, if work can be given out on some other basis, the results, all other things being equal, will prove of material benefit to the owner and will place the architect in the best possible position to obtain the most satisfactory results in all directions.

There may be said to be three ways in which work can be figured besides the usual way of obtaining competitive estimates from several parties. First, to have the work done by the day; second, to have the work figured by some one person without letting him know that it is being done without competition; and third, to call in the contractor,— who, all things considered, seems to be the best qualified to execute the work at hand,— and tell him frankly if he can give a satisfactory figure he can have the contract. Whatever advantages the first method may have, there is one serious objection to it for which there is no apparent remedy, and which consequently renders it impracticable except in rare instances; the fatal objection to day work lies in the fact that the journeymen employed on the job always learn in some unaccountable way of the manner in which the job has been let, and work with the idea that it is for their employer's interest as well as their own to make the work last as long as possible. Such inertia it is practically impossible to overcome; and this condition alone, and without various contributing causes, is sufficient reason why day work infallibly overruns the most liberal preliminary estimates. And this is a sufficient reason for not adopting this method except, as has been said, under peculiar or unusual conditions.

The second and third methods are practically the same, except in the first case the true facts are only partially known to the contractor, but it is doubtful if the results justify the mild deception which is practised when the architects pretend that the work is to be figured in competition; in fact, it is quite questionable whether the average builder can be kept in blissful ignorance of the true state of affairs, and if he learns or even surmises the true facts of the case he is much more liable to recognize and improve his chance for liberal profit than if the true conditions were presented for his consideration. It is an indisputable fact that the average man meets the opportunity which has been given him outright much more fairly, squarely, and liberally than he does the one which he has won in rivalry. The spoils of war, even in such mild encounters as the competition for building contracts, seem to carry certain rights, which are unfortunately and unjustly looked upon as inherent, which cannot be easily changed, and which work to the ultimate disadvantage of both the owner and the architect. It is sufficient, in support of this fact, to call attention to the practise of figuring work at cost and depending upon extras and other similar tricks of the trade to acquire a profit, and it can be seen that if a reputable contractor is given the opportunity to include his profit in the original proposition he is in honor bound to do additional work at fair prices.

As plans and specifications near completion, and the architect has mastered the details of the problem, he naturally considers to whom he would award the contract if left free to do so, and instinctively, as a rule, he makes up his mind that, all things considered, there is some one individual or firm who are better fitted to do this given piece of work than any other. Let the architect lay these facts clearly before the owner, and if he is clear sighted enough to realize his opportunity, he will allow the work to be given out without the usual competition, which so often handicaps all concerned at the very start. Another advantage, and by no means an unimportant one, in awarding work in this manner lies in the fact that it is much easier, when proceeding under this plan, to regulate and control the sub-contractors, the importance of which is readily recognized by any one who has had experience in building.

The great objection which is urged against this plan of awarding contracts without competition is the prevalent idea that no client would listen to such a proposition; in fact. we are often given to understand that it would weaken the position of the architect to suggest such a radical proposition. But if the proposed building has been worked out in such a way that sharp competition is not necessary to bring the figures within the limits, it is reasonable to suppose that an intelligent owner can be made to see what will result in a substantial benefit to himself. This method of procedure is at least worth a fair trial in all cases where it promises to bring about improved relations and a better standard of work. And every case which is successfully carried out creates a precedent which makes it easier to accomplish the desired ends in the future.

THE manner in which the huge gasometers on the site of the new South Union Station, Boston, were demolished was certainly novel and interesting. These were built of brick, with very heavy walls so strongly knit that the roof of one of the buildings was blown off with dynamite without weakening the walls in the least, although before the dynamite was used the iron bolts and braces had been removed. In taking down the brickwork an application was made on a gigantic scale of a principle often used in cutting butter and cheese. At intervals of about twenty-five feet about the gasometer were narrow windows extending the greater portion of the height of the wall. A strong wire cable was made fast to the ground at the base of the inside of the wall, carried over the top and down to the ground on the outside on the line of a window, and taken through a pulley block to the drum of a hoisting engine. When all was ready the engine was started, the wire wound up on the drum, and the great strain forced the cable to cut vertically through the bricks and mortar almost as smoothly as it might have passed through an immense cheese. After the brick wall had thus been cut vertically a table was passed around a pier between two windows, the hoisting cable attached to this cable on the inside and thence carried over the top of the wall and directly to the hoisting machine. When the power was gradually applied the immense slice of wall began to reel and totter and finally fall with a crash on the outside of the enclosure. This is about as expeditious a way of removing a large mass of masonry as we have ever heard of, and accomplished the desired result with great satisfaction.

A NUMBER of years ago, when the practise of building operations in Chicago was much cruder than it is at present, one of the basement piers in a large building in process of erection began to show signs of such manifest weakness that the authorities interfered, the superstructure was shored up, and the pier was taken down. Investigation showed that the outside course of brick all around was laid up in admirable manner, but the inside of the pier was a mere mass of bats and a slight sprinkling of mortar. This is an extreme case, but in a very much less scale it is very apt to be duplicated in many buildings. The average brick mason will care enough for appearance to build the outside all right, but there seems to be a tradition among masons that mortar can be slighted on the joints that are hidden, and that if the space is simply filled up with brick, that is sufficient. As a matter of fact, the reverse is just the case. The strength of a pier depends far more upon the mortar than it does upon the brick, and we will venture to assert that a pier of light hard brick laid up in Portland cement mortar will be far stronger than a pier built of the very best quality of hard burned brick which is laid up with indifferent mortar sparingly applied. The only way to build a pier properly is to have the courses run clear through. The practise of grouting was formerly much more prevalent than it is now. If judiciously employed, grouting strengthens a pier immensely; not that the grouting of itself is as good as mortar, but because the chances are the joints will be more thoroughly filled; but at the same time, if the bricks are thoroughly rubbed in at each course, and plenty of mortar used so each brick is surrounded by it, the resulting pier will be a great deal better than one in which less mortar and more grout is used. The secret of all good brickwork is to preserve a thorough bond, and to use plenty of the right kind of mortar.

METHODS OF BEDDING BRICK.

ONE of the papers read before a recent meeting of the Architectural Association of Great Britain dealt with the materials employed by bricklayers and the methods of using them. While the subject is treated from a purely English point of view, many points touched upon are of interest to American readers, and we present the following extracts: I have often found that the quality of the sand used for building purposes does not receive the attention it deserves. A clean, sharp sand is essential to the making of good mortar, whether mixed with lime or cement. The many impurities to be found in sand must act injuriously and tend to detract from the strength of the mortar. The best way to avoid this is to wash the sand, but the expense attached to this process prevents its general adoption. Where a mortar mill is used the "clinkers" from a dust destructor, mixed in reasonable quantities with sand and lime or cement, make a good mortar. But it is always an important point to see that a proper proportion of lime or cement is used, which is not always done.

I think it is essential (except during the winter months) that bricks should be well wetted before being laid. This is all the more necessary where cement mortar is used. The only possible way to secure strong work is to "grout" each course of brickwork, and this is where the advantage of washed or well-screened sharp sand is seen, as it will more readily fill the open joints of the brickwork. The plastering of mortar on the top of each course will not do. But the fact that wet bricks make bricklayers' fingers sore may have something to do with the neglect of wetting bricks. In work that is to be pointed after the building is erected the joints should be raked out one half inch deep and well brushed off with a hard broom, to clear away all loose mortar, and the pointing should be well pressed or "ironed" in the joints. In glazed or enameled work it may be often noticed that after a time the "glaze" flakes off and the defective part appears black. This is very often due to using chipped or defective bricks: but it is also due sometimes to another cause — viz., the mode of bedding them. The bricks having two deep "frogs" and generally being laid in a close joint, care is not always taken that sufficient mortar is spread to insure the frogs of the brick being solidly filled, so that when the weight comes on the wall the pressure is largely on the outer edge of the brick, and causes the "glaze" to fly. One way to obviate this is to fill the frogs before laying the bricks. Another way is to joggle either the end or side of the brick before bedding, and fill or "grout" them up with liquid mortar. The conditions of present day building often compel builders and others to carry on their works in sections. Very often walls are built with a vertical "toothing." If this cannot be avoided, I think the connection or making good to such toothing should be done with cement.—*Carpentry and Building.*

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

NEW YORK.— The election is over, and Robert A. Van Wyck, the Tammany candidate, has been chosen first mayor of Greater New York. A great deal of speculation is being indulged in among architects and builders as to the personnel and conduct of the new Department of Buildings, which will have, after January 1, jurisdiction over a city containing 360 square miles; and as we are confidently looking forward to a busy year, the department will have enough to do, and will need at its head men of more than ordinary skill and resource.

RESIDENCE OF DURBIN HORNE, ESQ., PITTSBURG, PENN.
Peabody & Stearns, Architects.

The official figures of the department, showing the amount of building operations transacted during recent years, are as follows: In 1895 there were 3,206 plans filed, aggregating $72,932,220; and in 1896, 3,848 plans, aggregating $84,068,228. In the first nine months of 1897 there were 2,713 plans filed, aggregating $71,326,605, so that the present year promises to be the most prosperous of all.

Simultaneously two large hotels, one for the accommodation of the wealthy, the other for the reception of the impecunious tradesman and labor, were opened last week. The first, the Astoria, in Fifth Avenue, is the largest and most beautiful hotel in New York. The interior is planned and decorated on a very lavish scale, the magnificent mural paintings being especially attractive. The exterior is a pleasing combination of red brick and Lake Superior red sandstone in the Flemish style, and although it does not join well with the Waldorf next door, it is an impressive building.

The second hotel is known as Mills House, No. 1, and is located on Bleecker Street, in a poor neighborhood. This building was built by Mr. D. O. Mills, from plans drawn by Ernest Flagg. It is a dignified building in the modern French style, with white brick and white stone trimmings. It is a very comfortable, almost luxurious home for the poor man, who can secure a lodging for a night, with bath, etc., for twenty cents, and the owner figures that the enterprise will pay expenses.

A remarkable feat was accomplished recently in New York which no doubt will interest readers of THE BRICKBUILDER.

A five-story brick tenement house, weighing 1,700 tons, was moved a distance of 30 ft. without so much as disturbing a single brick in the entire building.

The undertaking was fraught with many difficulties, but was undertaken and accomplished by W. K. Clynes, a contractor. The actual work of moving the building occupied six hours. Three weeks were spent in getting things ready.

Plans for the new building to be erected by the New York Medical College and Hospital for Women, in 101st Street, east of Manhattan Avenue, have been prepared by Wm. B. Tuthill. They provide for an eight-story fire-proof building, with a front of brick, terra-cotta, and limestone, which it is estimated will cost $90,000.

Plans have just been completed by C. B. J. Snyder, architect of the Board of Education, for two new school buildings. One to be located on 108th and 109th Streets, near Amsterdam Avenue, will be five stories, fire-proof, steel skeleton construction, exterior to be granite, limestone, gray brick, and terra-cotta. It will cost $300,000.

The other will be erected on 89th Street, between Amsterdam and Columbus Avenues. It will be of brick and stone, and will cost $233,000.

F. C. Zobel, architect, has prepared plans for an eight-story brick and stone store and loft building to be built on 19th Street, near Fifth Avenue, at a cost of $150,000.

Neville & Bagge, architects, have planned eight five-story brick and stone flats and stores to be built on Willis Avenue, near 140th Street; cost, $150,000.

James W. Cole, architect, has planned two five-story brick and stone flats and stores to be built on 92d Street, corner Columbus Avenue; cost, $65,000.

RESIDENCE OF DURBIN HORNE, ESQ., PITTSBURG, PENN.
Peabody & Stearns, Architects.

COMMERCIAL CABLE BUILDING, BROAD STREET, NEW YORK CITY. LOOKING FROM COURT OF THE MILLS BUILDING.
Harding & Gooch, Architects.
The white brick used in the façades of the building were manufactured by Sayre, Fisher & Co.

Wm. J. Fryer, architect, is preparing plans for an eight-story fire-proof office building to be built on Greenwich Street, corner Laight Street, taking the place of the building recently destroyed by fire. The cost will be $80,000.

CHICAGO. — The dulness existing in building is emphasized by the eagerness with which important firms seek unimportant work. Small contracts are followed up and courted by concerns who would have thought them not worth looking after three or four years ago. Although every one is anticipating better things just ahead of us, yet the records show for last month only a little improvement over the corresponding month last year when the presidential election was uppermost.

The annual exhibition of paintings at the Art Institute divided honors with the Horse Show lately, though it must be admitted the latter had decidedly the "swellest" crowd in attendance. The exhibition was considered a good one, and it was so overcrowded that a little more weeding might have been indulged. And yet, curiously enough, it is a conspicuous fact that a dozen of the best American artists were entirely unrepresented. Pittsb 'rg held her exhibition at the same time, and her art endowment fund and better field of purchasers proved to offer superior attractions in the way of prizes and sales.

There is a rumor or two of an important building, but no specially interesting news. The government building foundation work, under the direction of General Sooysmith, is making rapid progress. The piling was driven first for the lofty central part, the steam drivers pounding and hissing busily night and day. Now the grillage and the concrete, and finally great pyramids of dimension stones are approaching the street levels, and the pile drivers have worked around toward the circumference of the surrounding groups of lesser foundations. The scene is an unusually interesting one for the student, and classes from the architectural department of the Art Institute make periodical visits under the guidance of an instructor.

The Chicago Architectural Club is promising to be active in its realm this year. It has a competition on now for an architects' club house. Mr. W. A. Otis recently gave a lantern talk on The Development of Architecture, and on another occasion the new president, E. G. Garden, exhibited working drawings of the Public Library Building, which were furnished through the courtesy of Messrs. Shepley, Rutan & Coolidge. The drawings were discussed, also, by Mr. F. M. Garden, who superintended the construction of the building.

BOSTON. — The remarkably open weather which has fallen to the lot of New England this fall has allowed almost uninterrupted work on buildings under process of construction. In consequence, these structures begun in early summer have pushed rapidly ahead, and are now, many of them, nearly roofed in and ready for interior finish. These later additions to the business blocks of the city are, as a rule, full of architectural dignity and grace. As they have approached completion, the old-time buildings in their immediate neighborhood have, by contrast, taken on a shabby aspect indeed.

THE REIBOLD BUILDING, DAYTON, OHIO.
Williams & Andrews, Architects.
The front of this building is of cream-colored terra-cotta. Executed by the Indianapolis Terra-Cotta Company, Brightwood, Ind.

The inevitable result of this will be the gradual rebuilding of the business district. Already many of the adjacent property owners are considering the erection of new structures.

While the building industry in every city suffers periodically to a greater or less extent from the wiles of the speculative builder, yet Boston has been this season particularly afflicted in this respect. To such an extent have material men been victimized by these worthless operators that most of them now refuse to do business with any speculative building whatsoever, unless cash is paid on delivery of material. In some of the other cities the material men have, by combining and refusing to sell other than absolutely responsible parties, succeeded in shutting off this most undesirable class of builders. It would be a wise move on the part of the material men here if they would affect a like combination.

CAPITAL TO PILASTERS, FLANKING ENTRANCE GEORGE GOULD RESIDENCE, LAKEWOOD, N. J.
Bruce Price, Architect.
Executed by the Perth Amboy Terra-Cotta Company.

In spite of the opposition and heated arguments which some of our good citizens have brought to bear against the erection of the new Westminster Apartment Hotel at Copley Square, because of the tendency of its towering height to dwarf the superb architectural proportions of Trinity Church and other adjacent structures, the enterprise has gone rapidly forward, and the foundations are about being laid. The estimated cost of the building is an even million dollars. It will be ten stories in height, of fire-proof construction. Up to the third story the material will be of buff Indiana Bedford stone and granite. The succeeding stories will be of Roman brick and highly sculptured terra-cotta. The roof will have a tile covering. Henry E. Cregier, of Chicago, is the architect; Woodbury & Leighton, of Boston, are the builders.

Among the new buildings now under process of construction or soon to be erected may be mentioned a new building for Jordan & Marsh, located on Avon, Bedford, and Chauncy Streets. This is to be an extension of their present retail store. Winslow & Wetherell, architects. To be constructed of brick and terra-cotta a new structure to be erected at the corner of Purchase and Federal Streets and Atlantic Avenue, on the property recently acquired by Wood, Pollard & Co. Plans for this building are being drawn by Shepley, Rutan & Coolidge, and it is rumored that the building is to be a fine hotel. The site of the property being directly opposite the New Terminal Station, gives some ground for this statment.

TERRA-COTTA PANEL, RESIDENCE, JERSEY CITY, N. J.
Executed in terra-cotta by the Conkling, Armstrong Terra-Cotta Company.

There will be an addition the first of the year to the Homeopathic Hospital, East Concord Street, Boston; H. K. Hilton, architect, Providence, R. I. To be constructed of brick and terra-cotta.

A nine-story business block will be built by the Boston Wharf Company; M. D. Safford, architect. To be constructed of brick and terra-cotta.

Six houses on the Bay State Road, Mr. Geo. W. Wheatland, owner; H. D. Hale, architect. To be constructed of brick and terra-cotta.

New schoolhouse for the city of Haverhill. Plans in competition among Haverhill architects. To be constructed of brick and terra-cotta.

A stable on Troy Street, R. H. White & Co., owner; Peabody & Stearns, architects. To be constructed of brick.

New schoolhouse for the Roxbury district; Andrews, Jaques & Rantoul, architects. To be constructed of brick and terra-cotta.

New schoolhouse for South Boston; H. D. Hale, architect. To be constructed of brick and terra-cotta.

New schoolhouse for East Boston; architect for which has not been appointed.

$100,000 hospital at Attleboro, Mass., Dr. J. M. Solomon, owner. Architect not given out.

$100,000 business block at Hartford, Conn.; Isaac Allen, architect. To be constructed of brick and stone.

New $75,000 dining hall for Harvard College, Cambridge, Mass.; Wheelwright & Haven, architects. To be constructed of brick and stone.

A new hospital at West Newton, Mass.; Rand & Taylor, Kendall & Stevens, architects. To be constructed of brick and stone.

Parochial residence at Woburn, Mass.; W. H. & J. A. Maginty, architects.

$75,000 apartment house at Brookline, Mass.; J. P. & G. H. Smith, architects. To be constructed of brick.

A mammoth apartment hotel on Commonwealth Avenue; Arthur Bowditch, architect; Webb Granite Construction Company, builders. This job was projected last year, but was laid over until the present time. It is now reported that work will shortly be begun on same.

A new apartment house, Springfield, Mass.; H. H. Gridley, architect. To be constructed of brick and stone.

New engine house, Salem, Mass.; Bickford & Graves, architects. To be constructed of brick and stone.

A $200,000 apartment house, Providence, R. I.; Martin & Hall, architects. To be constructed of brick and stone.

Two residences on Commonwealth Avenue; R. C. Sturgis, architect. To be constructed of brick.

A $100,000 combination store and apartment block at Lowell, Mass.; Merrill & Clark, architects. To be constructed of red brick and terra-cotta.

ST. LOUIS. — No small interest has been taken by some of the architects in the competition for the new City Hall that is about to be built by our neighbor across the river, East St. Louis, to replace the one destroyed by the cyclone in May of last year. Some seventeen sets of drawings were submitted, and those of Architect E. Jansen selected by the committee as, in their opinion, being the best suited to the needs of their city. Architects May and Wees, of this city, and Meuller, of East St. Louis, were each awarded prizes. The terms of the competition were much more satisfactory than is usual in such cases, and were such as might be used in competition in the Ecole des Beaux Arts. The design selected is French Renaissance, and provides for the city offices on the first floor and basement, the city court and council chambers, with committee rooms, judge, and jury rooms, etc., on the second, while the third floor is to be used for a large hall. The cost will be about $80,000.

TERRA-COTTA DETAIL.
Executed by the Northwestern Terra-Cotta Company.

Owing to the fact that the enterprising little city has been trying to raise herself out of the mud by raising the streets 8 to 12 ft. above the grade, she found herself without the means to rebuild after the storm, the limit of taxation permitted by law having been reached. To relieve their city of its embarrassment, public-spirited citizens came forward and furnished the money, the city to repay them in an annual rental.

An interesting old landmark, the Wabash Building, which was used for so many years by the Board of Education and Public Library, was destroyed by fire the latter part of last month.

A bill has been introduced into the House of Delegates to give a ninety-nine year lease of the site of our present court house to a syndicate, which proposes to erect thereon a ten-story building, covering the entire block, the building to be arranged for the courts and public offices on the upper floors, and the other floors for offices suitable for lawyers, etc. The scheme has been up for consideration before, but has assumed more tangible form, and has brought forth considerable comment.

There has been no material change in the outlook during the last month, the amount for building, according to the report of the building commissioner, being even less than for the same month last year.

MEMPHIS.— THE BRICKBUILDER has published from time to time the outlook for bi 'lding East, West, and North, but has little to say of the vast amount of work continually going on in the South, where the use of brick and terra-cotta in the construction of buildings large and small justifies at least an occasional item of recognition in its columns.

The new City Hospital Buildings now under way, which will cost when completed $200,000, were designed by Architect Samuel Patton, deceased, of Chattanooga. Mr. Patton lost his life in a Chattanooga, Tenn., fire, and thereby hangs an interesting story. Mr. Patton's rooms were in the Richardson Building, and he could easily have saved himself but for the fact that he made an effort to get his drawings for the proposed new Capitol Building of Mississippi, before leaving the burning building. The Governor of Mississippi had vetoed the bill authorizing the adoption of Architect J. Riley Gordon's plans for the capitol, which had been selected from ten or fifteen competitive sets, Mr. Patton's bei ng among the number. Mr. Patton had gone to much trouble and expense in making a second set of drawings, and his anxiety to save these drawings cost him his life. It might be mentioned here that the State of Mississippi contemplates the erection of a $1,000,000 capitol, which will doubtlessly be thrown open again to competition, as the legislature and Governor could not agree at the last meeting.

The new Memphis Market House and Cold Storage Building, also under way, involves the expenditure of about $75,000 and will be completed in the early spring. The plans were furnished by Alsup & Johnson, architects, of Memphis, who were paid 2½ per cent. for their drawings, and the contract for superintendence given to another firm of architects, Weathers & Weathers, of this city. A councilman attempted a bribe when the contract for plans was first awarded, was sentenced to a heavy fine, and ousted from the city council. The employment of one firm for plans and another for superintendence is certainly an innovation in this part of the country, and shows a few of the peculiar methods of public "jobbing" practised North as well as South.

Few cities can boast of as rapid progress in the building of costly city residences as Memphis. Within the last year at least a dozen homes have been built that would grace the principal thoroughfares of any of the larger cities. A "costly" residence with us means the expenditure of from $50,000 to $75,000 exclusive of lot and furnishings. The majority of these houses are built of brick and stone, and in only one instance has the colonial style been closely followed. Architects Dodd & Cobb, of Louisville, Ky., elaborated their design for the Kentucky Building at the World's Fair, and from these plans has been erected one of the finest and costliest examples of colonial work in the South. I mention the use of colonial work because no other style is so peculiarly adapted to our climate, and with so many beautiful examples all around us it is a wonder that the style should be almost entirely abandoned by Southern architects. What might be termed the "castellated style" has been the theme for most of the "costly" houses, and miniature turreted castles have grown up all about us. The only serious objection to this so-called style is the peculiar appearance that the enormous verandas and uncovered "porches" give to the house.

The much-debated question of licensing architects brings to mind the fact that architects in Memphis, until last year, were required to pay a city and county tax amounting to nearly $100. We are by no means exempt from the combined "contractors and architects," however, and their methods are much the same here as elsewhere; but when it comes to unique methods of advertising, we hold the record. A draftsman for one of the firms of contractors here has branched out for himself with this startling sign,— "Expert, Practical Architect and Scientific Housemover," — displayed on the private residence of the "architect." His own house is only half completed, but in its half-finished state is proudly shown by the possessor as an instance of what can be done toward building a $5,000 house with $1,000. This "scientific housemover" also has his startling "ad" painted in conspicuous letters on his buggy — but, to be more exact, his vehicle.

TERRA-COTTA DETAILS, APARTMENT HOUSE, CHESTNUT STREET, PHILADELPHIA.
Walter Smedley, Architect.
Executed by the Conkling, Armstrong Terra-Cotta Company.

RESIDENCE OF A. B. GARDINER, DOWAGIAC, MICH.
W. K. Johnston, Architect, Chicago.
Roofed with 8 in. Conosera Tile, made by Celadon Terra-Cotta Company.

Not only has Memphis made rapid strides in the way of office buildings and handsome residences, but also Atlanta, Nashville, Louisville, and Chattanooga. In fact, the South offers a field of labor for the architect that allows him scope for nearly every style and class of building, and we are welcoming the extensive and substantial use of materials in clay which until recently played a very small part in the upbuilding of our cities.

THE accompanying cuts show two elevations of residence, and one of stable, designed by Architect W. K. Johnston, Chicago, for Mr. A. B. Gardiner, at Dowagiac, Mich., which are roofed with 8 in. Conosera tile and graduated tower tile, manufactured by Charles T. Harris, lessee of the Celadon Terra-Cotta Co., at Alfred, N. Y.

The walls are of field boulders laid up rough as shown, and the effect in connection with this style of tile roof is very artistic.

But the picture can give no impression of the fine color scheme secured; these broken boulders are of a great variety of color tones, and the roof is a warm red, thus securing a sky line in perfect accord with the building material and its surroundings.

RESIDENCE OF A. B. GARDINER, DOWAGIAC, MICH.
W. K. Johnston, Architect, Chicago.
Roofed with 8 in. Conosera Tile, made by Celadon Terra-Cotta Company.

INTERESTING NEWS ITEMS.

THE DAGUS CLAY MANUFACTURING COMPANY, Daguscahonda, Penn., will furnish the buff brick for the new Warren High School, Warren, Penn.

THE CUMMINGS CEMENT COMPANY, of Akron, N. Y., is furnishing large quantities of Rock and Portland cements for work on the Erie Canal improvements.

THE POWHATAN CLAY MANUFACTURING COMPANY are supplying their gray bricks for the New Smithdeal Business College Building, Richmond, Va.

THE PANCOAST VENTILATOR COMPANY are putting upon the market a handsome new square ventilator for buildings. Also a window ventilator known as the "Common Sense."

STABLE A. B. GARDINER, DOWAGIAC, MICH.

W. S. RAVENSCROFT & Co., brick manufacturers, Daguscahonda, Penn., have changed the company name to the Dagus Clay Manufacturing Company.

CHARLES E. WILLARD has secured the contract to supply the mottled brick on the Vega Society Building, New Britain, Conn.; W. H. Cadwell, architect, New Britain.

THE STANDARD TERRA-COTTA COMPANY, Perth Amboy, N. J., have increased their pressing department by adding a new building 110 by 50 ft.

SAYRE & FISHER COMPANY have the contract to furnish a large quantity of white enamel brick for new residence of George Gould, Lakewood, N. J.; Bruce Price, architect.

The Bolles Sliding and Revolving Sash have been ordered for the Citizens' Bank Building, Norfolk, Va.; Charles E. Cassell, architect, Baltimore, Md. This is a handsome seven-story office building.

The Pancoast Ventilator Company furnished the large copper ventilators for the Astoria Hotel, New York City; also the ventilators for the Manhattan Beach Theater, at Staten Island.

Sayre & Fisher Company are supplying 300,000 gray bricks and 1,500,000 hollow bricks for the new thirty-story Park Row Building, New York City, of which R. H. Robertson is the architect.

The Union Akron Cement Company, Buffalo, are furnishing the Owego Bridge Company with the Star Brand Akron Cement for abutments to bridges at Mt. Morris, N. Y., and at Rockland, N. Y., also for foundation for asphalt pavement at Warren, Ohio.

Fall trade in fancy brick is reported exceedingly good by Messrs. Fiske, Homes & Co. Sales are largely in excess of last year, and future outlook for business in their high-grade specialties is quoted as very good.

G. R. Twichell & Co., Boston, are to supply face brick on the following work: Addition to the Chestnut Hill Pumping Station, Boston; building for fire department headquarters, Worcester, Mass. and Somerset Trust Building, Boston.

H. F. Mayland & Co., New York, representatives of the Burlington Architectural Terra-cotta Company, have secured the contract for furnishing the terra-cotta for a new store building in Brooklyn, of which C. F. Guyler is the architect.

Recent inquiry at Cornell University elicited the information that the Cabot's Brick Preservative used upon several of the most prominent buildings several years ago had proved most satisfactory, thoroughly waterproofing the bricks and retaining its efficacy.

The Excelsior Terra-Cotta Company have secured through their New England representative, Charles Bacon, the contract to supply the terra-cotta for six houses on the Bay State Road. George Wheatland, owner; H. D. Hale, architect; W. D. Vinal, builder.

Mr. George B. F. Maxwell has assumed the sole agency, for Philadelphia, of the products of the American Mason Safety Tread Company, of Boston. Mr. Maxwell is widely known as having been for the past ten years designer and salesman of church and lodge furniture for the firm of S. C. Small & Co., of Boston.

Conkling, Armstrong Terra-Cotta Company have secured through their New England agent, Charles E. Willard, the contract to supply the terra-cotta on the Dedham High School building, Dedham, Mass.; Greenleaf & Cobb, architects, Boston. Also the Sage-Allen Office Building, Hartford, Conn.; Isaac Allen, architect, Hartford.

The Raritan Hollow and Porous Brick Company, New York, are furnishing "Raritan" 12 in. mottled brick in a run of color for a large church in 88th Street, New York City. The molded work in this job is very elaborate, especially the Gothic arches for the cloisters. It is a fine example of the use of brick in church architecture.

The Fawcett Ventilated Fire-proof Construction Company have been awarded the following contracts: Structural steel and fire-proofing for the new Masonic Temple, Boston; structural steel and fire-proofing for the Westminster apartment house, Boston; structural steel and fire-proofing for Mr. Winslow's (Winslow & Wetherell) residence, Boston.

Sayre & Fisher Company have secured through their New England representative, Charles Bacon, the contract to supply the brick for six houses on the Bay State Road. George Wheatland, owner; H. D. Hale, architect; W. D. Vinal, builder. Also the white enameled brick to be used in the Dean Building on India Street. Hartwell, Richardson & Driver, architects; George A. Fuller & Co., contractors.

The American Mason Safety Tread Company is placing strips of its safety material in a granolithic sidewalk on a steep incline on Bowdoin Street, adjoining the State House grounds, Boston, rendering the sidewalk perfectly non-slipping even in the most frosty weather. This use of the safety tread seems likely to become very largely adopted, as it enables the use of granolithic in places where it has been heretofore impracticable.

The Burlington Architectural Terra-Cotta Company, Burlington, N. J., have supplied terra-cotta on the following contracts: New building, Penn Institution for the Blind, Overbrook, Penn.; Cope & Stewardson, architects; residence at Overbrook, Penn.; Kean & Mead, architects; business front, Chestnut Street, Philadelphia; H. E. Fowler, architect; Hospital for Deaf Mutes, Trenton, N. J.; Thomas Stephen, architect; apartment house, Girard Avenue, Philadelphia; S. A. Stoneback, builder.

Meeker, Carter, Booraem & Co., New York, have closed contracts for 150,000 standard buffs, Hotel, 33d Street, near Broadway; H. J. Hardenbergh, architect; C. T. Wills, contractor; 125,000 standard gray bricks, apartment houses, 138th, 139th Streets, and Brook Avenue; Schickel & Ditmars, architects; A. A. Smith, contractor, and are now delivering white semi-glazed bricks and gray bricks to office building, 9–11 Maiden Lane; C. A. Cowen, contractor; R. S. Townsend, architect, all of New York City.

The Hamblin & Russell Manufacturing Company, of Worcester, Mass., have appointed Fiske, Homes & Co., of 164 Devonshire Street, Boston, Mass., as their general agents on Standard Wall Ties, Slate Fasteners, and Wind Guards. Illustrated catalogues setting forth the Standard clinch system and the new method of slate roofing will be forwarded upon application. This system seems to be quite a step in advance of the old methods, and without doubt it will meet with ready approval, and a thorough investigation is invited to all interested in this line.

The Powhatan Clay Manufacturing Company, Richmond, Va. (New York office, Townsend Building), have sent us five sample brick, which are certainly worthy of the highest recommendation as being particularly fine specimens of their latest successes in gray and white brick. The general high reputation which the company's output has acquired among the building profession leaves little more to say of these samples than that they are, if possible, of a finer quality and more perfect shade than any which the company has before placed upon the market.

Fiske, Homes & Co. report a good demand for their special ties, and have booked a large number of orders for fancy brick during the past few weeks. Among the more important are, the Westminster Chambers, Boston; High School, Needham; Fire Station, Dorchester; Richmond Court, Brookline; Pumping Station, Waterworks, Somersworth, N. H.; Warehouses on India Street, city proper, and on A Street, South Boston; Y. M. C. A. Building, Fall River. Smaller orders include mercantile buildings at Salem, Beverly, Springfield, New Haven, Hartford, etc., with numerous apartment houses and private dwellings in and about Boston and throughout New England.

WILLIAM CONNORS, of Troy, N. Y., has purchased for $40,000 the Olympic Mill property, 669, 671, 673, and 675 River Street. This is one of the best manufacturing sites in Troy, and has been owned by Orrs & Co. since 1835. It has two large water wheels of 150 horse power each. Mr. Connors proposes to remodel the present building and equip it especially for the manufacture of American Seal Paint, and erect a separate building, which will be used exclusively for the grinding of dry colors. The machinery to be used in operating this plant will be entirely new, of which Mr. Connors is the sole owner and patentee. His method not only reduces the cost of production, but makes a much better article than can be produced by the present means.

THE HYDRAULIC-PRESS BRICK COMPANIES, through their New York and New England agents, Messrs. Fredenburg & Lounsbury, report the following contracts, pertaining to New England work only, that have recently been secured by them: Hotel, corner Beacon Street and Brookline Avenue, Boston, Mass.; Winslow & Wetherell, architects; Memorial Library, Adams, Mass.; William M. Butterfield, architect; Wellesley Chapel, Wellesley, Mass.; Heins & LaFarge, architects; apartment house, corner Beacon & Carlton Streets, Brookline, Mass.; Winslow & Wetherell, architects; Police Station, Hartford, Conn.; J. J. Dwyer, architect; New Bedford Pumping Station, New Bedford, Mass.; Rice & Evans, engineers; business block, Main Street, Hartford, Conn.; Isaac Allen, Jr., architect; engine house, West Roxbury, Mass.; John A. Fox, architect.

THE CELADON TERRA-COTTA COMPANY, Limited, Charles T. Harris, Lessee, has recently closed contracts for roofing tiles on the following: Seven houses for E. L. Schiller, 81st Street and West End Avenue, New York City; Clarence True, architect; style, 8 in. Conosera; Meter house and Office for Gas Company, Omaha, Neb.; Wilson Brothers & Co., Philadelphia, architects; style, open shingle; water tower at State Hospital, Massilon, Ohio; Yost & Packard, architects; style, graduated Conosera; residence for Isaac D. Fletcher. 813 Fifth Avenue, New York; C. H. P. Gilbert, architect; style, open shingle; two towers for H. C. Rutt, Passaic, N. J.; style, 8 in. Conosera; Y. M. C. A. Building, Mansfield, Ohio; C. H. Martin & Brother, architect; style, 8 in. Conosera; United States Post-Office Building and Court House, Paterson, N. J.; supervising architect; style, Gothic.

WE are in receipt of a very attractive catalogue of some fifty pages from the Eastern Machinery Company, New Haven, Conn., of their Improved Friction Clutches. We would recommend a perusal of this to those of our readers engaged in manufacturing, as being a very interesting little volume, full of information on this subject.

In it the principle on which their Improved Friction Clutches are constructed is described in a clear and concise manner, further explained by sectional cuts, etc. Besides pulleys for regular work, the company make a number of special pulleys, which are also described and illustrated.

The reputation for high-class machinery which this company has won for itself in connection with their line of clay machinery is certainly a guarantee as to the merits of their Friction Clutch Pulleys, and we are glad to recommend parties in need of same to correspond with them. Address, The Eastern Machinery Company, New Haven, Conn.

THE GRUEBY FAIENCE COMPANY have secured the contract to supply the enameled brick to be used on the new Subway station at Haymarket Square. This company have recently equipped their factory with new represses, and are making some new and very attractive designs for tile work. They have recently finished a particularly fine piece of work in special Moorish tile of a dull-finished Alhambra pattern for a bath room in the Moores' residence, in Detroit; A. W. Chittenden, architect. They have also supplied the faience work for an addition to the house of H. C. Warren, of an open loggia roof, supported by brick piers, between which are panels of blue Chinese tile, forming a balustrade. Capitals of these piers are made of gray, dull-finished fawn, to harmonize with the brickwork, the surface between the eaves being blue to match the tiles below. The frieze above is enlivened in color by different shades of tile, set between the consoles. The effectiveness of this combination is most artistic and attractive, and shows the possibilities that may be achieved in this direction by the use of faience in exterior decoration.

ATTENTION is called to what would seem to be a rare opportunity to acquire a most desirable modern brick plant in the heart of the clay-manufacturing district of Ohio. The owner of the plant is obliged to remove to Colorado on account of health, and is willing to dispose of the property at a "great bargain."

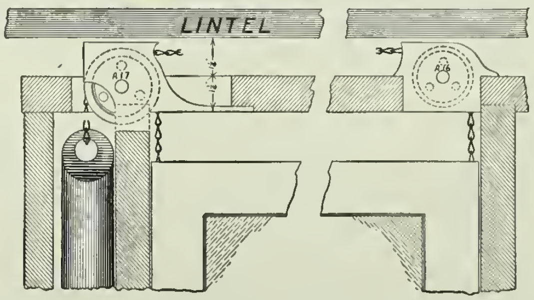
The product of this plant is well and favorably known in the market, and it has facilities for manufacturing and shipping that are particularly favorable. The location is on a belt line of railroad that connects with seven different systems, including the Baltimore & Ohio, and the Pennsylvania. We are informed that there are extensive beds of red and buff clays right at the works, and that the best coal can be obtained delivered at the kilns for $1.00 per ton.

The plant is equipped with six down-draft kilns (holding 800,000 brick) with exhaust fan system attachment, and has a daily capacity of presses of 30,000 brick. There is in stock a very large line of molded dies, claimed to be the most extensive in the State.

Any parties interested in acquiring a property of this kind should not fail to investigate this plant. For further particulars see advertisement on another page.

WHILE the building profession have for a long time recognized the mechanical advantage and economical saving in space of the overhead window pulley in comparison to the old style side pulley, yet in the past it was impossible to use them without making special provisions. This difficulty has been overcome by an ingenious device known as the "Queen" Overhead Pulley, a patent on which was granted last September to U. G. McQueen, Manager of the Queen Sash Balance Company, 150 Nassau Street, New York, N. Y.

The various objections to the old style of overhead pulley have been fully overcome in the "Queen," as may be seen by the accompanying illustrations. Some of the advantages claimed by the company for the Queen pulley are as follows: it can be placed in any window in which the ordinary side pulley can be used, at a gain of a large amount of pocket room, thus doing away with lead weights and reducing cost; no grooving of the sash is necessary, and no extra space for head room need be allowed. No iron or steel work

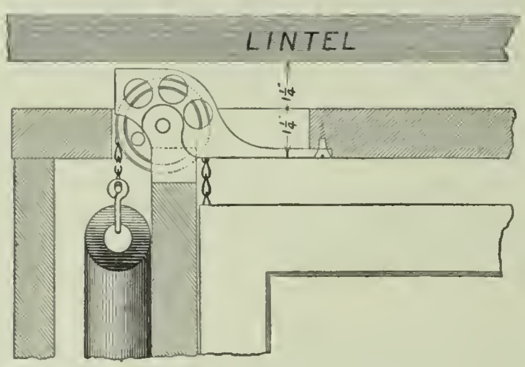


THE "QUEEN" MULLION FRAME PULLEY (ONE WEIGHT BALANCES THE SASH). THIS CUT SHOWS A 2½ IN. PULLEY.

in any building will in any way interfere with its perfect action, and it requires, at least, one inch less head room than any other overhead pulley.

All sizes, styles, and kinds of finish are given in the company's catalogue, and many of the best buildings now being constructed in New York are equipped with these pulleys. It has the endorsement of the leading architects.

The Mullion Frame Pulley, here shown, is designed to do away



THE "QUEEN" SINGLE FRAME PULLEY. THIS CUT SHOWS A 2½ IN. PULLEY.

with the mullion pockets in twin windows. When these pulleys are used, the sashes are operated by one weight with the same result as by using two weights, and from six to eight inches more glass space is given than by ordinary methods.

"The difficulty heretofore experienced in threading overhead pulleys has been overcome by the 'Queen' pulley, and a new style of mouse for use in threading the pulley with cord, tape, or chain is furnished with each order."

The company will be glad to send a working model and catalogue to any architect, on application. All goods specified in the catalogue are kept in stock.

AN ENTRANCE IN TERRA-COTTA, UNION TRUST BUILDING, ST. LOUIS, MO.
LOUIS H. SULLIVAN, ARCHITECT.
TERRA-COTTA EXECUTED BY THE WINKLE TERRA-COTTA CO.

THE WINKLE TERRA-COTTA CO.,

Manufacturers of

Architectural Terra-Cotta

IN ALL COLORS.

WORKS: Cheltenham, St. Louis.

OFFICE: 502-503 Century Building.

ST. LOUIS, MO.

EXCHANGE CLUB BUILDING, Boston, Mass.
BALL & DABNEY, ARCHITECTS.
Fire-proofed by the BOSTON FIRE-PROOFING CO.

Boston Fire-Proofing Company,

D. McINTOSH, Proprietor.

166 DEVONSHIRE STREET,

BOSTON, MASS.

Fire-Proof Building Material.

"Porous Terra-Cotta stands fire and water."

CHARLES T. HARRIS, *President.*
HENRY S. HARRIS, *Vice-President.*

INCORPORATED 1888.

WILLIAM R. CLARKE, *Secy. and Treas.*
ALVORD B. CLARKE, *Superintendent.*

The Celadon Terra-Cotta Co., Ltd.

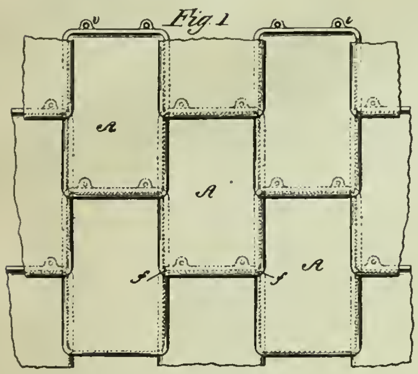
CHARLES T. HARRIS, LESSEE.

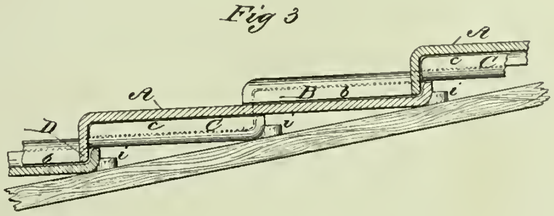
.....Manufacturers of Artistic Roofing Tiles.

(Under Babcock Patents.)

ALFRED, N. Y.

Below we show shapes and give a description of a new form of roofing tile, which is also especially adapted to SHEATHING purposes.





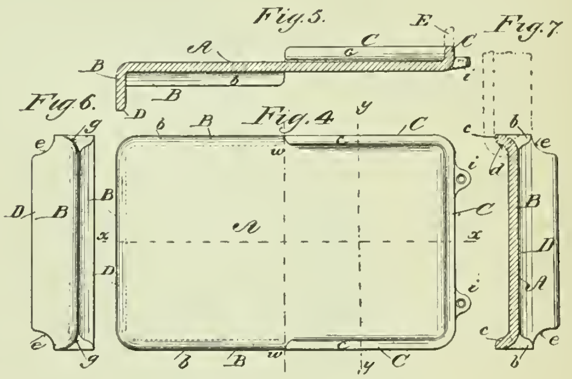


Fig. 1 is a plan view of several tiles arranged as they would be when laid upon a roof; Fig. 3, an enlarged vertical section taken on a line corresponding with xx in Fig. 4; Fig. 4, a plan view of a single tile drawn on the same scale as Fig. 3; Fig. 5, a sectional view of Fig. 4 at xx; Fig. 6 is an elevation of the lower end of the tile in Fig. 4; Fig. 7 is a cross section at yy of Fig. 4.

This invention relates to *clay or any other roofing tiles* of approximately rectangular form; the novelty consists in interlocking the tiles consecutively in vertical succession, composing series which lie in lines perpendicular to the eave and ridge of the roof, and then "breaking" or alternating joints between the adjacent series laterally, so that the members of each overlap at or about the middle of those adjacent.

The invention also includes certain novel features of construction of the interlocking flanges used in carrying out the said arrangement and forming tight joints for the exclusion of rain, snow, wind and dust.

In these tiles, as in those illustrated last month, B is a downward flange on the lower side of the tile extending about one half its perimiter below its axial line ww; C is an upward flange on the upper side of the tile extending in the same way above ww; D is a part of the flange upon the end of the tile deeper than those on the remaining sides.

The extension in depth of the flange at D compensates for the difference in distance or separation between the planes of adjacent tiles of common series and adjacent tiles of different series, enabling them to interlock in vertical as well as lateral succession. This is necessary, also, in order to close the horizontal joints. The said joints may also be the more securely closed by the employment of the upward-extended flange E in conjunction with the downward extension D, as aforesaid.

The parts $bbcc$ of the flanges BC respectively interlock, as indicated at d in Fig. 7 herewith and in Fig. 12 in description of the Conosera shape given last month. The downward flange below the axial line is thereby adapted to overlap and interlock three adjacent tiles, and the upward flange above the axial line to interlock three other overlapping tiles.

The junctions of the corners with the sides at f, Fig. 1, where the flange BC reverse, are sealed by means of the curved edges of the extended flange D, which overlap and fit the rounded exteriors g, Fig. 6, of adjacent tiles.

In the several figures $i.i.$ indicate fastening lugs, by which the tile may be secured to the superstructure.

In the Conosera pattern, illustrated in last issue, we saw that a heightening of the ornamental effect was obtained by the high relief or reveal obtained, the separation of the planes of vertically-adjacent tiles being doubled by the interposition of the edges of laterally-adjacent tiles between their ends.

In the tiles described herewith the same mechanical advantages are fully secured and by the shape a low relief or plain surface, which is especially fit for sheathing purposes.

ALL OUR SHAPES ARE FULLY PROTECTED BY LETTERS PATENT.

The Brickbuilder for 1898.

PROSPECTUS.

CONTINUED ARTICLES FROM 1897.

IN announcing our work for the coming year it should be explained that some of the articles promised for 1897 have been unavoidably delayed, but that nearly all such will be published early in 1898.

The articles that have been begun, and which will be concluded during the early part of the year, are: —

THE AMERICAN SCHOOLHOUSE SERIES, BY EDMUND M. WHEELWRIGHT.

Mr. Wheelwright will furnish at least six more papers upon this subject, which will be published in consecutive issues. The full series will consist of a thorough and comprehensive treatise on schoolhouse designing and planning for the primary, grammar, high, normal, and manual training grades. Heating, ventilation, plumbing, janitor service, an analysis of the cost of schoolhouses, a digest of specifications for a brick grammar school, and the provision for recreation of pupils during recess, in Germany, France, England, and this country, will be fully considered in this series, which will be illustrated from some of the best examples of schoolhouse work in the country.

IMPORTANT PROBLEMS IN CONSTRUCTION BY WM. W. CRE-HORE, C. E.

Although bearing the same title, this practical and interesting series consists of independent articles, of which there remains possibly two to be published, and these will appear in the early numbers of the year.

ARCHITECTURAL TERRA-COTTA SERIES, BY THOMAS CUSACK.

Under this title, but in independent articles, Mr. Cusack will review the relationship existing between architect, engineer, and terra-cotta manufacturer; with reference to the latest phases of composite construction. In this he will have occasion to offer some suggestions, on which a common understanding may be effected, that would lead to a discontinuance of present anomalies. The illustrations will be taken from the best current work in which terra-cotta has been employed, and include drawings showing constructive details.

COLOR AS APPLIED TO ARCHITECTURE, BY E. E. GARNSEY.

Mr. Garnsey, who has spent a part of the past year in Europe studying the best examples of the use of color in architecture, will have one more paper upon this subject.

THE BRICK ARCHITECTURE OF ITALY.

Mr. W. P. P. Longfellow will contribute two more papers, each of which will consist of a description (with illustrations) of some notable examples of brick architecture in Italy.

The paper by Mr. Frank Miles Day, promised for 1897, and which will treat of Italian Brickwork, suggesting modern application, will be published during the year.

In connection with this subject it may be here stated that during the year the reprint of Street's Brick and Marble in the Middle Ages will be resumed.

While this work is taken up, owing largely to the existing obligations to our older subscribers, it will be done in a manner that will not fail to interest new subscribers. To this end a large quantity of photographs of Italian work, many of them heretofore unpublished, have been purchased from the latest collection of Valentine & Co., London, and these, with measured drawings made by draughtsmen holding Travelling Scholarships, will be used to further illustrate, and give added interest to this work.

PLATE FORM OF SCALE DRAWINGS.

The Plate Form for the coming year will be made the leading feature of our work. Carefully selected scale drawings of elevations and details of the very best work that is being done in this country will be reproduced in this form, and in addition to these there will be reproduced measured drawings of some of the best examples of colonial brickwork, especially prepared for the purpose.

New Announcements for the Year.

SUBURBAN RESIDENCE TO COST $10,000.00.

There will be begun this year a most valuable series of contributions by well-known architects, on the designing, in brick and terra-cotta, of a popular class of buildings which will include RESIDENCES, APARTMENT HOUSES, LIBRARIES, CHAPELS, CHURCHES, etc. (one of these buildings will form the basis of a series each year). It is the intention that each of these subjects shall be treated in at least two sets of articles (six articles to a set) in which the cost and conditions are varied. Each article will be suitably illustrated by elevations and plans.

The subject chosen for this year's work is a

SUBURBAN RESIDENCE TO COST $10,000.00.

The contributors will be

Walter Cope	(Cope & Stewardson)	Philadelphia.
Ralph Adams Cram	(Cram, Wentworth & Goodhue)	Boston.
Edward B. Green	(Green & Wicks)	Buffalo.
Alfred B. Harlow	(Alden & Harlow)	Pittsburgh.
Charles A. Rich	(Lamb & Rich)	New York.
C. F. Schweinfurth		Cleveland.

OTHER LEADING ARTICLES FOR THE YEAR.

APARTMENT HOUSE ARCHITECTURE (Illustrated), by Irving K. Pond (Pond & Pond), Chicago.

THE BONDING OF BRICKWORK, by Ernest Flagg, New York.

A SERIES OF PAPERS ON MASONRY, CEMENT, AND MORTAR, by Prof. Ira O. Baker, Champaign, Ill.

DESCRIPTION, WITH SERIES OF STANDARD DRAWINGS OF DETAILS FOR BUILDING CONSTRUCTION, by C. C. Schneider, C. E. Chief Engineer Construction Department Pencoyd Iron Works.

ESTIMATING THE COST OF BRICKWORK, based on the actual time and quantities of material used in different buildings, and

DIFFERENT WAYS OF ESTIMATING, by F. E. Kidder, Denver, Col.

FIRE-PROOFING.

In this department, which is conducted in a manner consistent with the policy of our journal, we shall furnish a series of articles by the ablest of writers, which shall treat of the advanced methods of fire-proof construction with materials of clay.

Among the writers who will contribute during the year are: —

Dankmar Adler	Chicago.
W. L. B. Jenney	Chicago.
F. C. Moore (Pres. Continental Insurance Co.)	New York.
C. T. Purdy, C. E.	New York.
Peter B. Wight	Chicago.

MASON CONTRACTOR.

In this department there will be published that class of articles which shall be alike of interest to architects and contractors.

A special effort will be made, beginning with this year, to make this department of vastly more value to this class of our readers, and to this end important questions arising from the relationship between architect and contractor will be discussed by those who have given such questions careful study.

Suggestions from our subscribers as to important questions needing practical discussion are solicited, and all such will be given due consideration.

MORTARS AND CONCRETES.

This department is maintained for the purpose of furnishing that class of material which shall be an aid to architects and builders who recognize the necessity of care in successfully employing cements. Contributors to this department will include many of the leading authorities on the subject.

RECENT BRICK AND TERRA-COTTA WORK IN AMERICAN CITIES.

We shall publish in this department letters from the larger cities which shall present in a concise and interesting manner the more important happenings in matters architectural. These letters will be illustrated from the best current work in brick and terra-cotta. That this department may become a more potent factor in our work we have recently reorganized our correspondents' corps.

EDITORIALS AND CURRENT TOPICS.

Our editorials are contributed by a staff of able writers, and by them current topics of interest will be discussed.

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Publication Office, 85 Water Street.

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THE BRICKBVILDER

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THE BRICKBUILDER.

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

PUBLISHED BY

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HONOR TO WHOM HONOR IS DUE.

BETWEEN the financial necessity of making himself known, and the unwritten ethical code which forbids him to advertise his wares, the architect is not uncommonly squeezed out of a proper recognition of himself as a factor of his work. Now there is a right and a wrong use to make of an architect's name in connection with building operations. To parade the fact in print that so and so has done so and so, when his achievements are of little public interest or real merit, is certainly reprehensible. On the other hand, the architect has a perfect right to an acknowledgment of what he has done, and he is entitled to this recognition as publicly as the circumstances will warrant. When we read in the news columns a report of the dedication of some church or of some proposed public building, with a dozen or more names of committee men unknown to fame, we fail to see who, beyond a very narrow circle of personal friends, would be interested in such names; while the name of the architect, which is very apt to be lacking, is of deep business interest as well as of artistic importance to a great many. This is a principle which the public as represented by the utterances of the daily press is very apt to neglect, not with the idea of depriving the architect of what might be considered an advertisement, but because the desirability of coupling the man and his work does not appeal to the average news editor. When it is remembered that in a large building direct employment is given to many thousand craftsmen and artists, and that each one of these looks to the architect of ten for direct employment and always for possibilities of gain, it will readily be seen that the omission of the architect's name considered simply as a matter of news is a mistake, and that the thousands of manufacturers, mechanics, and contractors who have to do with the building have quite as much interest in knowing who is to do it as they have in knowing what is to be done. In connection with a large structure recently completed, it was estimated as a result of pretty careful investigation that the building had directly and indirectly interested something over three thousand people in its construction, each one of whom received his instructions and final approval of work from the architect. Surely in a case of that kind the mention of an architect's name, no matter how publicly brought forward, could hardly be called illegitimate advertising.

The association of the name with the work may properly be carried even further. When a painter signs his canvas, or a sculptor carves his name on the pedestal of a statue, no one considers that he is exploiting himself before the public. It is expected as a matter of course, quite as naturally as that an author shall sign his writings. There has recently been considerable discussion as to the advisability of an architect's signing his buildings in precisely the same manner, not at all as a matter of advertisement, but purely as a matter of responsible identification, of properly locating the credit or the blame. While the species of advertising which some of the members of the profession are willing to resort to is anything but self-respecting or desirable, an architect's name should never be disassociated from the work he has produced, and as a matter of justice as well as of news, when the building is mentioned in print the architect's name belongs with it.

BRICKS WITHOUT STRAW.

THE inadequacy of means to desired results is one of the discouraging phases of all the arts and sciences, and no less is the insufficiency in the burnt clay industries apparent to-day than it was in the time of Moses, with the difference that in the light of modern experience, for straw we must read dollars and cents. Or, to drop the simile, there is no difficulty in having good brick and terra-cotta work made. There are plenty of manufacturers to-day who can turn out what is wanted. The lack is not in the brains of the manufacturers nor in the processes of making, but in the amount of money which is available to pay for the product when completed. When an architect or an owner says he is discontented with terra-cotta as a building material, or feels that it is not sufficiently dignified to serve as a medium for his ideas, we will venture the broad statement that in nine cases out of ten the difficulty is rather that he is not willing to pay the price of a thoroughly good article. If our constructors were willing to pay for terra-cotta at the rate they do for stone, the resulting product would be equal to any artistic emergency. It is not fair to the product to put forward as one of its merits that it is cheaper than stone. Certainly most terra-cotta is cheaper than some stone, but burnt clay at its best, fresh from the hand of the artist, with every touch and feeling translated into permanent shape, should be measured for itself entirely irrespective of what it costs, and in planning for specific effects the cost of itself should be the last thing to be considered. Rather, let us try to get first the best effects in the most natural and straightforward manner. Terra-cotta when rightly used is never cheap, either figuratively or literally. The amount of thought and work which can be expended upon the modeling of a single ornament places it entirely above the category of ordinary work. We are appreciating this more and more fully every day in our country; but if one wishes to appreciate that we are trying to get good effects in terra-cotta without paying the price, and that it is very largely the lack of adequate financial resources which prevents us from elevating terra-cotta to its proper level, one has only to compare the best of our work with buildings like the South Kensington Museum, or the London Natural History Museum. In our American work there is every evidence that our manufacturers know how to make the terra cotta: but there is also, unfortunately, the evidence that terra-cotta is still suffering from the stigma of being a cheap material, and that in only too many instances our constructors and designers are not willing to give it the same chance that they would without question accord to stone.

WE have received the reprint of a paper upon the subject "Can Buildings be Made Fireproof?" which was presented to the American Society of Civil Engineers by Mr. C. T. Purdy, who is so well known for his excellent work in the lines of architectural engineering that his conclusions have very considerable value. The Pittsburgh fire is the text of the paper, which is very fully illustrated with diagrams and photographs showing the construction of the various buildings involved. Mr. Purdy's opinion is that, limiting the definition of fire-proof building to denote one which will not burn, no matter how great a fire it may be exposed to from without, and which will confine an internal fire to any room in which it occurs without material injury to the rest of the room, the Pittsburgh fire confirms the opinion that buildings can be made fire-proof; but that it is quite essential in making a fire-proof structure which can be depended upon in any emergency, that the best design, the best specification, and the best workmanship in every detail of the construction should be insisted upon. He also concludes that, as now manufactured, porous tile or terra-cotta fire-proofing can be relied upon to protect the steel construction, while the hard-burned material cannot be depended upon with the same certainty. Woodwork covered with wire lathing and plastering is not fire-proof construction, and the efficiency of concrete in floors was not tested by this fire.

WITH this number the translation, by Mr. Dillon, of Choisy's "The Art of Building Among the Romans" is completed. Of this work there remains four plates that have not been published. Subscribers who so desire may have these plates sent with the February number of THE BRICKBUILDER by sending notice to that effect to this office.

PERSONAL AND CLUB NEWS.

FRANK F. WARD and Herbert E. Davis have formed a copartnership under the firm name of Ward & Davis, for the practise of architecture, with offices at 203 Broadway, New York City.

AT the invitation of Mr. Frank Lloyd Wright the members of the Chicago Architectural Club met on the evening of November 29, in a discussion of the "Arts and Crafts."

THE St. Louis Architectural Club held its regular monthly meeting on Saturday night, December 4. President Ittner presided for the first time since the club's vacation. The names of Messrs. E. G. Garden and W. S. Eames were proposed as honorary members. The classes in architecture under R. M. Milligan, and the pen and ink class of Mr. Enders are showing considerable interest in their work. The other classes have not become thoroughly organized yet.

THE regular monthly meeting of the New Jersey Society of Architects was held on Friday, December 3, at Board of Trade rooms, 764 Broad Street, Newark, N. J.

THE chairman of the committee appointed to confer with the Master Mason's Association of the city of Newark, which association requested a conference with a like committee from the society to adjust in general misunderstandings between the architects and builders, reported that the agreement that had been drafted at the last meeting had been finally adopted after minor changes were made.

A REGULAR meeting of the T Square Club was held on Wednesday evening, December 1, the subject for competition being "An Arrangement of Terraces and Steps." Mr. Wilson Eyre was the critic for the evening. First mention was awarded to David K. Boyd, second mention to Wm. C. Hays, and third mention to John Molitor. The award of medal and mentions for the second annual redesigning competition was also announced at this meeting, the drawings having previously been sent to New York, where they were judged by Messrs. John Galen Howard, Bruce Price, and Henry Bacon, who had consented to act as jury for this competition, and made the awards as follows: Gold medal to Horace H. Burrell; second mention to Samuel R. Davis, and third mention to Charles Z. Klauder.

ILLUSTRATED ADVERTISEMENTS.

THE accompanying illustration is of the Brewers Exchange Baltimore, Md., of which Mr. J. E. Sperry, of that city, is the architect. This building is executed in terra-cotta and brick from sidewalk to flag-pole, including a very neat entrance and vestibule, in which the former material is used throughout with highly creditable results.

The terra-cotta was executed by the New York Architectural Terra-Cotta Company.

Another beautiful fireplace mantel designed in brick and terra-cotta is shown in the advertisement of Fiske, Homes & Co., page vii.

In the advertisement of R. Guastavino, page xiv, a group illustration is made which shows the roof over St. Anthony's Chapel, at Washington, D. C., in process of construction. Heins & La Farge are the architects.

Harbison & Walker Company illustrate in their advertisement, page xxv, the Y. M. C. A. Building at Cleveland, Ohio; C. F. Schweinfurth, architect.

Number two of the descriptive series of the roofing tiles made by the Celadon Terra-Cotta Company, Charles T. Harris, Lessee, is given in the company's advertisement, page xxix.

The Philadelphia and Boston Face Brick Company illustrate one of their artistically designed brick mantels in their advertisement, page xxxi.

Examples of bond, showing blocks of the Gilbreth Seam-Face Granite laid up in two styles of bond, is illustrated in the company's advertisement, page xxxviii.

The American Schoolhouse. II.

BY EDMUND M. WHEELWRIGHT.

SLATE blackboards are the most economical in the long run, and, when of proper quality and color, are preferable to any other blackboard. All blackboards should be 4 ft. 6 ins. high. In primary schools they should be set 2 ft. 4 ins. above floor; in grammar and high schools they should be 3 ft. 0 ins. above floor. The chalk receiver should have a receptacle 2¾ ins. wide. It is desirable to have blackboards on all available wall surfaces of schoolrooms and recitation rooms.

Sheathed dadoes should never be used in schoolhouses. They give lodgment for dust, and when removed have often been found to be infested with vermin. The best dado for a schoolhouse is of gauged mortar, with wooden chair rail, where blackboards are not set, and with a plainly molded ogee base run out of 2 in. or 3 in. plank, or better, a like mold of Keene's cement may be used. To facilitate the cleaning of the building, it is advisable that the angles of walls and the junction of walls and ceilings of schoolrooms should be concaved on a radius, as is customary in good hospital construction.

As in a hospital ward, and for the same reasons, as little wood as possible should be used in the finish of a schoolroom. Inaccessible ledges on which dust may collect should be avoided. Jambs of windows and doors may well be finished with round corners in Keene's cement. The floors should be of rift Georgia pine or maple. Schoolhouse floors are not usually finished, although two coats of linseed oil for Georgia pine floors would appear as desirable here as in a private house for the floors that are to be scrubbed. School boards are usually very economical in expenditures for this purpose, a method of saving public funds not conducive to the health of the community. In Germany great pains are taken during construction to thoroughly oil the floors of schoolrooms, and the surface is carefully maintained in use. In Boston ash is found to be the most satisfactory of the inexpensive woods for the interior finish of schoolhouses.

The doors should have transom lights over them, and should have a glass panel set with bottom 4 ft. above floor. Doors should open towards the corridors. There should be a picture molding run around the walls of all schoolrooms, recitation rooms, and assembly halls.

A soft shade of light green is a good color for the walls of schoolrooms of the present standard size with southern exposure, while light shades of buff are desirable for rooms with other exposures. No "hot" colors should be used on schoolroom walls. The ceilings should be tinted in light shades of buff. Water color may be used for all plaster above top of blackboard. If the narrower schoolrooms lighted from the left or from the left and right side are ever adopted, it would be possible to paint the walls of the rooms in a lower key than is now advisable where the rooms depend upon the general diffusion of light for their sufficient lighting.

BROOKLINE HIGH SCHOOL, BROOKLINE, MASS.
Andrews, Jaques & Rantoul, Architects.

Schoolhouses should have one or more teachers' rooms with toilet room adjoining, and in large schools there should be, in addition, a master's office.

The uses to which a basement may be put depends upon the size of the school. In every school, in addition to the boiler room, coal room, etc., there should be well-lighted play rooms for both sexes, with lavatories adjoining, shut off by fly doors with spring butts. Where sufficient size permits, manual training and cooking class rooms and gymnasiums for both sexes, and where possible, ample bathing facilities may well be provided. Where there is space there should be a well-lighted janitor's closet.

The best flooring for basement, corridors, play rooms, and lavatories is asphalt of the best brands. Where wooden floors are used, they should be laid on screeds bedded in concrete with waterproof paper under upper floor and with no air space. If the site is damp, it is advisable to lay on top of the bottom bed of concrete a thick coating of hot asphalt or tar concrete before setting the floor screeds.

BRIGHTON HIGH SCHOOL, BOSTON.
Edmund M. Wheelwright, City Architect.

It is a wise precaution to build schoolhouses of four or more stories in height wholly of indestructible materials, that is, they should be of "fire-proof" construction.

It would appear unnecessary under ordinary conditions to use such expensive construction in buildings of three stories or less in height.

The first floor of all schoolhouses should be of "mill" or "fire-proof" construction. With the present low cost of structural steel, a steel and arch construction of the floors is preferable to that of heavy timbers and plank, as the latter construction, though less expensive, is liable to cause considerable annoyance from shrinkage, as practically the market does not afford seasoned stock of large dimensions.

With the first floor constructed of incombustible or slow-burning materials, all interior partitions solid, the plastering laid directly on brick walls, ceilings wire-lathed and the basement staircase protected by fire doors, even if the floors above the first story and the roof are constructed of the ordinary narrow joists with ⅞ in. floor boarding, there is practically no danger from a fire started in the interior of a schoolhouse. If the roof is flat and protected by a battlement wall of ample height, under ordinary surroundings, a fire outside of such a schoolhouse would be a practical danger to the lives of the occupants. In a building constructed as above described, and in the isolated position of most schoolhouses, the scholars would be led to the street before there could be any dangerous condition of the building. There is, however, danger from panic. To avoid this danger by giving the greater sense of security to teachers and pupils, which goes with a solid construction, it would appear advisable to have the floors of fire-proof construction in primary schoolhouses in excess of two stories in height, when in closely built localities.

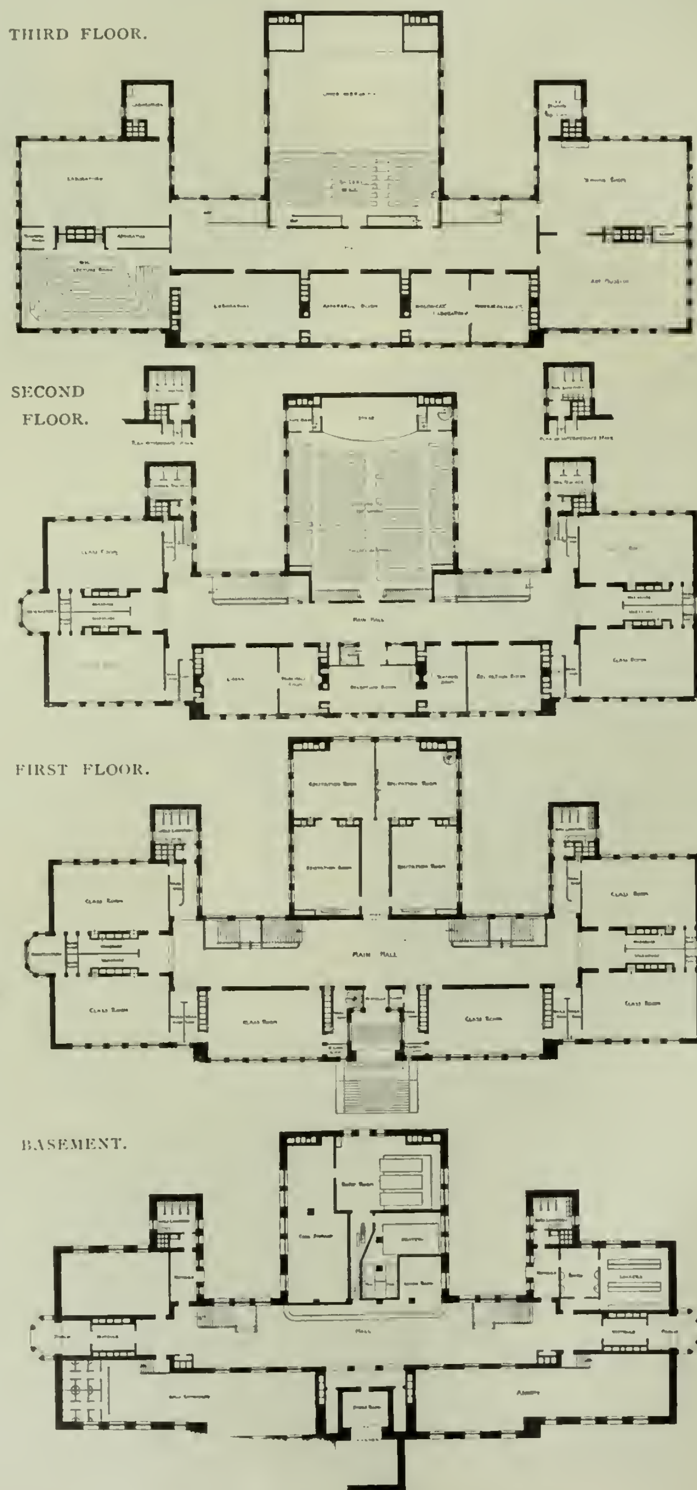
The inner lining of outer brick walls should be of hard-burned hollow brick, with soft brick set to receive nailings for finish. The interior partitions should either be of brick, terra-cotta lumber, or thin partitions of metal lathing on angle irons. The advantage of such solidity of construction and absence of wood furring is not only to protect from fire, but from vermin.

In the matter of schoolhouse construction the question of cost is an all-important consideration, and should be at least touched upon in a paper of this kind. An attempt at exhaustive analysis of the subject would be a task disproportionate to the value of the result. General conclusions drawn from data gathered in my own practise, and from that of others, may, however, prove serviceable to architects and school committees. This data should be used with judgment and with careful consideration of the conditions governing each particular case. Estimates based upon cost per square or per cubic foot can never be as safely relied upon as those based upon a survey of quantities, and reckoned according to the prices which maintain at a given time in each locality; but none the less a fairly close approximation of the probable cost of a building can be made by estimates based upon the cost per square or per cubic foot. The basis of cost per schoolroom is the fairest method of comparing roughly the cost of grammar or primary schoolhouses.

To come to a closer judgment of such comparative costs that per cubic foot has often to be taken into account, while, as their plans present less constant characteristics than do those of the schoolhouses for the lower grades, the cost per cubic appears the fairest basis of comparison of costs of high schools.

The architects of the Brookline High School have allowed me to examine the drawings, specifications, contract prices of that building for purpose of comparison with the cost of the Brighton High School, built for the city of Boston. The two buildings were built at about the same time. Reckoned from the top of basement floor to top of cornice, the Brookline High School contains 1,193,880 cu. ft., and cost, without grading and without laboratory, or other similar fittings, $185,000, *i. e.*, close to 15½ cents per cubic foot. The Brighton High School contains 746,854, and cost upon the same basis in round numbers $122,000, or about 16⅓ cents per cubic foot, *i. e.*, the proportionate cost of the Brighton High School was 6.6 per cent. more than that of the Brookline High School.

By actual computation 4½ per cent. of this additional cost is explained by the extra thickness of walls and strength of floors required by the Boston Building Laws. As the Brookline school was an admirably constructed building, it will be seen that if the building laws of Boston had permitted, the Brighton school



BROOKLINE HIGH SCHOOL, BROOKLINE, MASS.

might have cost between $5,000 and $6,000 less than it did. The Brighton school had slate blackboards, Keene's cement door and window finish, double run of sash above basement, asphalt floor, or equivalent, throughout basement.

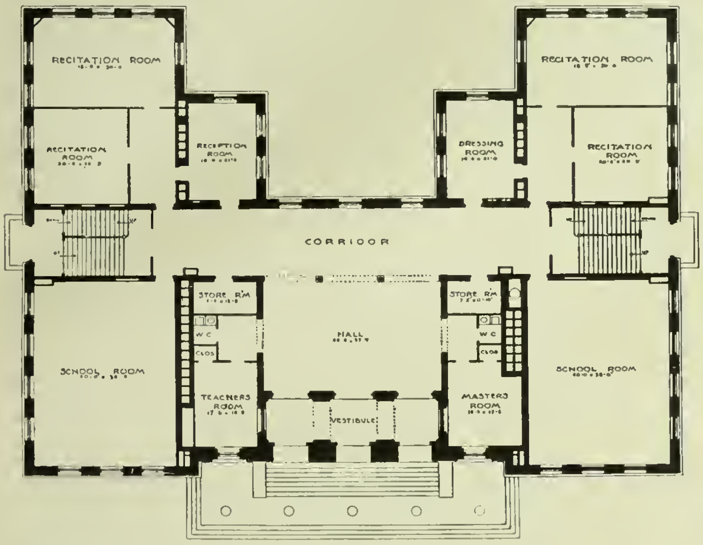
The Brookline school had composition blackboards, oak door and window finish, single run of sash throughout, basement floors of concrete or Georgia pine on concrete.

If the Brighton school had been finished as was the Brookline school, the following savings could have been made in the former building: —

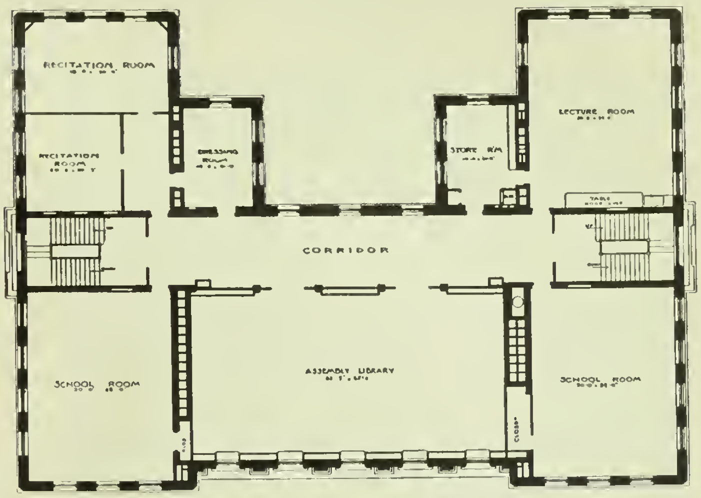
Wire lathed ceilings	$1,328.00
Terra-cotta lumber partitions	606.00
Hospital base	252.00
	$2,186.00

This is 1.8 per cent. of cost of the building.

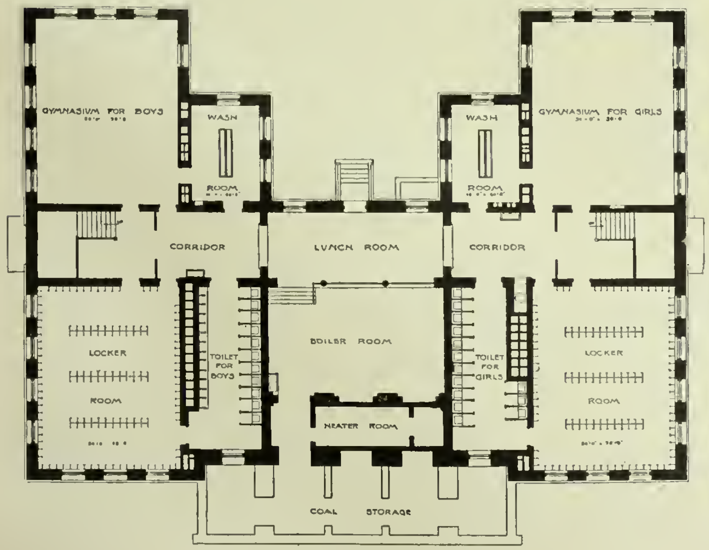
A careful computation of the cost of the Brighton High School shows that if the building had been built as a purely utilitarian structure of the factory type, a saving of 8 per cent. of the cost, or between nine and ten thousand dollars could have been made.



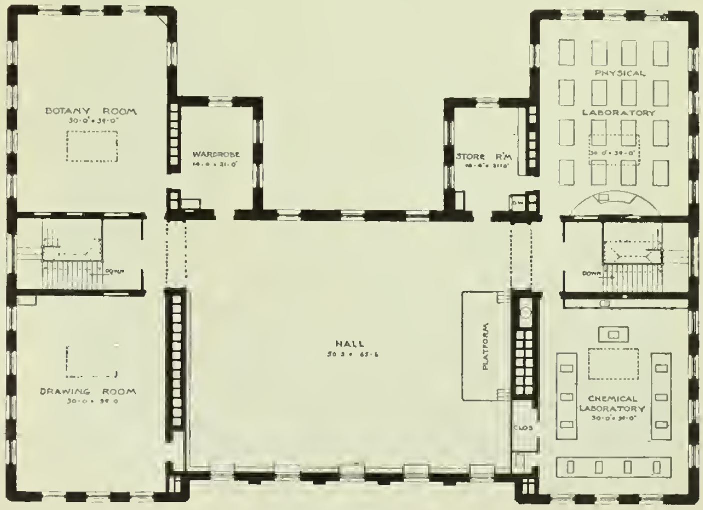
FIRST FLOOR.



SECOND FLOOR.



BASEMENT.



THIRD FLOOR.

Composition in place of slate blackboards	$537.50
Oak instead of Keene's cement finish	226.80
Single in place of double run sash	1,090.00
Concrete and Georgia pine basement floors in place of asphalt	654.00
	$2,508.30

This amount is a trifle more than 2 per cent. of the cost of the Brighton school. The features noted above were originally contemplated by the architects of the Brookline school; they were omitted to bring the cost of the building within its strictly limited appropriation.

The Brookline and Brighton schools had in common certain features not found in less well-constructed buildings, which cost, in the Brighton school, as follows: —

The architects of the Brookline school reckon the cost of tower above cornice line as being between $8,000 and $10,000, or about 5 per cent. of cost of the building. There are other architectural features in the Brookline school which increase its cost above that of a purely utilitarian structure. It is probable that a closer analysis of the cost of the two buildings would be about the same proportionate expense for architectural effect.

We may, therefore, safely set the cost of a first-class high school building at 15½ cents per cubic foot. This should apparently be the normal cost of such a building provided with domestic engineering systems of requisite excellence, if built in a locality where the requirements of the building laws involve no needless expense, and where the cost of labor and materials is as high as it is in the neighborhood of Boston.

Important Problems in Construction.

BY WILLIAM W. CREHORE, ASSOC. M. AM. SOC. C. E.

PROBABLY the greatest inconsistencies are found in the details of wooden construction. Girders and beams of ample carrying capacity often have insufficient bearing or rest on improper material. Framed joints between headers and trimmers are weakening at best, and are seldom made to develop the full strength of either member. Frequently these joints are so made as almost to incapacitate one of the members entirely. It is safe to say that architects, as a rule, pay little attention to the design of joints and connections in their wooden construction, but leave this important work to the boss carpenter, trusting largely to his experience. The scarcity of accidents in this kind of construction shows that the carpenter's experience is a valuable guide, but the inconsistencies remain, and much material is absolutely wasted, because it is used where its full strength cannot be developed. The use of iron stirrups in wood framing is becoming more general and ought to be encouraged: it does away with mortising, and thus not only preserves the full value of the timbers intact, but also saves time and labor in erection. The additional first cost is slight.

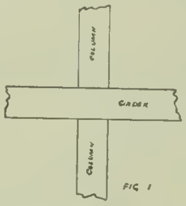


FIG 1

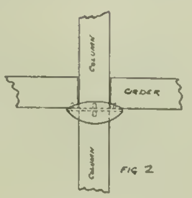


FIG 2

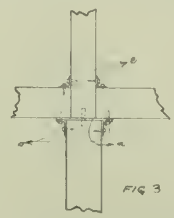


FIG 3

It has long been customary in wooden construction to rest the posts directly on the girders which pass over the tops of the posts in the story below, as in Fig. 1. By this construction the direct column load crushes the girders across the grain where the timber has only about one fifth the resistance that it has against crushing longitudinally. Consequently, when the posts are figured to their full capacity only one fifth of it can be developed in any arrangement such as this. As a chain is no stronger than its weakest link, so it must be remembered the capacity of a structural system is determined by the weakest spot in the system. There are several devices in use for making these wooden post and girder connections; for example, see Fig. 2, where the post above rests on a kind of cast cap between it and the post below, the sides of this casting being extended to receive the girders. These connections are very loose and do not bind the adjacent members together in any way, their avowed purpose being to "let go" easily in case of fire or accident.

The connection shown in Fig. 3, however, possesses superior advantages to the cast cap. A steel plate, *a*, is placed between the columns and may be extended in two or more directions to receive girders. A pair of angle knees, *b*, is placed under the girders and made fast to the lower column by lagscrews. Lagscrews also pass up through the angles and the plate into the girders, thus securing the whole system from shifting in either direction. The upper column is held laterally by the ends of the girders in one direction, and to prevent motion the other way a wooden peg is let into the lower column and passes up through a hole in the plate into the upper column; to increase the rigidity of this connection a pair of angles may be used at *c* also, with lagscrews into the column and girders. By properly proportioning the size of the steel plate and angles, this simple connection can be made to fit any combination of wooden girders and posts imaginable. The writer has used it with 12 by 12 girders connecting to 8 by 8 posts with no difficulty whatever. Then, too, each girder and post has a square cut end, and no side straps are required to hold the girders in place. Heavy wooden construction might be safely used with this style of connection, if properly proportioned, in many cases where cast-iron columns are now used with wooden girders.

In determining the extent of bearing to give to wall or column footings on different kinds of soil, careful attention should be paid to the old rule about keeping the center of gravity over the middle third, and on soil of a yielding nature still greater accuracy than this is required. If a rigid slab of any kind be laid on a plastic or yielding surface, and a pressure be exerted at some point outside the middle third, the slab will be observed to take a permanent set in an inclined position, lower at the loaded end than at the other, as illustrated in Fig. 4. Similarly, then, but on a larger scale, when a wall is so built and stepped off that the center of gravity of its section falls outside the middle third of its footing course (see Fig. 5) the same phenomenon must be expected, if the footing course is rigid; otherwise the footing course must crack off on or near the line, *b*, which separates the working portion from the idle portion.

FIG 4

FIG 6.

FIG 5.

This emphasizes the point that a portion of every such footing is idle, and of no effect, or rather, that its effect is bad in proportion to its rigidity, because its tendency is then to assume an inclined position, like the experiment in Fig. 4, and thus cause cracking in the back of the wall at some point about *a* (see Fig. 5); whereas if the footing course could crack, the loaded portion would move on down vertically and the idle portion stay where it was. Besides this "middle third" principle, there is the "sixty-degree" principle, which requires that a straight line, *c*, inclined so as to touch the corner of each step shall make an angle with the horizontal of not less than sixty degrees. This limit of inclination has been established from theoretical considerations as well as by experience, and its observance is a prerequisite to stability in construction. "Problems in construction are all simple enough if you keep in mind two things,—bracing at forty-five degrees, and brickwork at sixty," was a remark made not long ago by an architect who is better known for his artistic ability than for his knowledge of construction. As emphasizing fundamental principles the remark is worth recording and remembering.

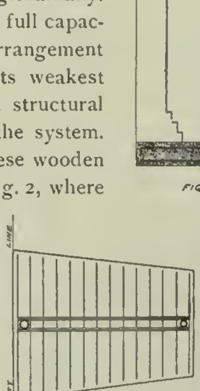


FIG 7.

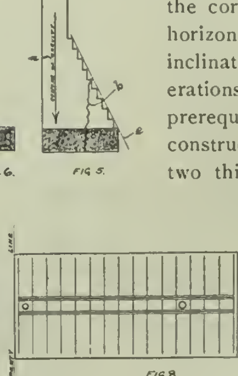


FIG 8.

The writer may be pardoned for this digression into the realm of first principles, in view of the surprising number of violations of these principles which have been observed to exist in actual work and in plans for proposed new work. The advent of higher buildings and the novelty of all problems connected with their construction, has led some designers to try experiments with first principles to a remarkable extent. To illustrate from an actual case, take Fig. 6. The designer found the side wall loads would require wider footings than he could obtain by stepping up in the usual manner on one side of the wall only, and being reminded of the universal efficacy of steel beams for an emergency decided to imbed a series of them in the concrete under his footings (as shown to scale in Fig. 6), and thus distribute the wall load over the required amount of ground without destroying his interior with stepped-up footings. In effect he simply had a perfectly rigid footing, part of it loaded (rather overloaded) and part of it idle, so that in case of settlement the condition in Fig. 4 will prevail, eventually producing a horizontal crack in the back of the wall.

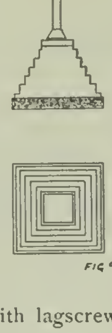


FIG 9.

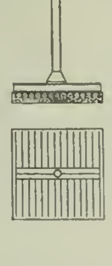


FIG 10.

A large part of the difficulty experienced by designers is due to the necessity for providing for isolated heavy loads at or near the property line. If it is not possible to arrange the footing so that the load's center of gravity will fall within the middle third of the ground area covered, then it may be tied to another in one rigid bed of steel beams encased in concrete, spreading over enough ground to carry both the loads, and occasionally one bed is made to receive three or four or more loads. In designing one of these grillage beds it is important (1) to shape it so that the center of gravity of all the superimposed loads shall coincide nearly with the center of pressure of the ground area covered, and (2) so to design the grillage itself that it will distribute the imposed loads equitably over every square foot of the ground area. To bring about these results is not as simple a problem as it might at first appear, especially if there are more than two loads, and if their relative positions and magnitudes are irregular.

In the case of two loads on one grillage bed, if the interior load is lighter than that on the property line, the bed should be trapezoidal in shape (see Fig. 7), but if the interior load is heavier, the bed may be rectangular (as in Fig. 8). These requirements arise from the necessity of keeping the center of gravity of the loads coincident with the center of pressure of the area covered by the grillage bed.

The simple square grillage bed (see Fig. 10) for a single interior heavy or moderately heavy load possesses advantages over the stepped-up masonry footing (see Fig. 9) covering the same ground area in that there is much space saved about the column near its base which is lost in the stepped-up footing, or else the latter has to be lower in the ground. At the present prices of steel beams the slight difference in cost is offset by the saving in brickwork and by this gain in space or saving in excavation.

In order to distribute an isolated load or loads over the grillage bed an upper course of steel beams or girders is usually necessary. In the lower course or grillage course proper the beams are laid not more than 12 or 15 ins. center to center, and the concrete between them is depended on to complete the distribution on the ground. In the upper course the problem is to receive the loads from the columns and to distribute them as economically as possible over the lower grillage beams. For this purpose deep beams, or plate girders if more economical, are placed close together directly under the load or loads and extended across all the beams of the lower course. The total bending moment having been figured, it will be found much more economical to make it up by using a few deep beams concentrated under the load than to use many shallow beams spread out over the lower grillage, even though the projecting portion (and therefore the moment) of the lower beams is thereby made somewhat less. In the lower course it would also be more economical to use the deeper beams if they could be spaced further apart, but the close spacing is necessary here to make the distribution of the loads complete.

In the writer's opinion this whole subject of load distribution should receive more attention from designers than is now customary. It is not a feature of high building construction only, but should also be thought of in designing footings for lighter loads as ordinary dwellings. These footings are too often specified arbitrarily without any calculation, and made like some other case where the conditions are supposed to be similar. There are very few kinds of soil that will not bear *some* weight without yielding; it is merely necessary to find out how much or how little the soil will bear on each superficial foot and then to design accordingly with a fair factor of safety. In building a frame house on more or less spongy ground stability will be gained by spreading the footings over an increased area sooner than by sinking them deep, unless solid ground is to be found near at hand. The architect or builder of your suburban residence tells you that it will take a year or two for your house to settle, and that you must expect ceilings and walls to crack, windows to bind, and door jambs to be distorted from rectangles to parallelograms, necessitating frequent visits of the carpenter and the locksmith. This, on the contrary, is not necessary, and a very slight extra expense in the footings to begin with would prevent all the above and similar annoyances which were not directly due to the use of green lumber in constructing the building.

Architectural Terra-Cotta.

BY THOMAS CUSACK.

(Continued.)

THE recently erected Bank of Commerce, Cedar and Nassau Streets, New York, of which Mr. James B. Baker is the architect, has been appropriately named; for it certainly is a commercial building *par excellence*. This is indicated, not only by its location and the avocation of its occupants; the design itself would seem to have been suggested by a full and frank acceptance of these underlying facts, as the fundamental conditions on which the embodiment of that idea should be based. So, too, with the detail, which has been worked out on really sensible business principles, enlivened

FIG. 45. BANK OF COMMERCE BUILDING, NEW YORK CITY.
J. B. Baker, Architect.

on the one hand, and held in due subjection on the other by good architectural maxims. It is legible, and on the whole, effective, when viewed from any point of accessibility in a neighborhood where tall buildings now "do congregate." There is a commendable absence of unnecessary fripperies, as also of finical bedizenment, and there is reason to doubt whether the designer cares two cents for triglyphs. Judging not merely by what has been done, but quite as much by what has been wisely left *undone*, in the way of detailing here, we think that common sense has prevailed over pedantry, for which we are disposed to feel thankful. The legibility, and much of the effectiveness just referred to, is accomplished chiefly by a systematic gradation in the size of the various members. They increase in size, just as the ornament increases in boldness of relief, in proportion to its approximate distance from the spectator. In that respect, at least, we have in this building a timely reminder of an oft-forgotten and in some instances, apparently unknown art, which should not be allowed to pass unimproved.

It is matter for regret that as much cannot be said in behalf of the color scheme, more especially so in regard to the combination

FIG. 46.

of color as between terra-cotta and brick walling. The three lower stories are granite of a bluish cast, for which the terra-cotta throughout is a remarkably good match. This is so, not only in color, but in the quality of surface texture, which it is more difficult — and, beyond a certain point, obviously impossible — to produce. The constituents of that unstratified rock, quartz, feldspar, and mica, though in itself of volcanic origin, cannot be reconstructed by fire without the admixture of other and more fusible ingredients. In combination with silica and alumina, etc, they may be rendered more time resisting than the original rock, but they no longer retain their crystalline formation.

The word match is used here out of deference to those who prefer to regard it as such; but *imitation* is the more correct word, and it, like Banquo's ghost, will dog our steps at all hours, whatever we may do to down or disguise it. The more general question of imitating stone will not be shirked when the time comes to discuss it, but in passing let this much suffice for the present. It is done by manufacturers in response to a demand that is well-nigh irresistible, because usually urgent, sometimes peremptory, and not infrequently a condition precedent to the closing of a contract. When that demand ceases or abates in its insistence, so will the supply, but not, we fear, until then. The root of this abnormal growth was exposed not many days ago by a prominent architect, who, in reply to a mild remonstrance on the point by the present writer, remarked in a tone of unavailing regret," Your argument is all right in theory, but the tide is against you; I have found it so in my own practise." The remark, no less than the confession, showed that he, too, though an architect, was content to remain a creature of circumstance. Nevertheless, in the present instance, as in others just like it, we cannot help thinking that a solid body color in a gray burning clay, adjusted to about the required shade by an admixture of a small percentage of manganese, would have been preferable to the one selected. It would, at all events, have avoided the appearance, and left never a foothold for the charge, of artificiality.

The brick used from the fourth to the fourteenth story (inclusive) are a light buff with a yellowish tinge. This, with the horizontal bands of dark terra-cotta, destroys the idea of vertical homogeneity which is (or, we think, ought to be) the dominant characteristic of a high building. The contrast is also more pronounced than agreeable. There is such a thing as a harmony of contrast, and though that was the thing evidently aimed at here, we leave it for higher authorities on color to say whether the mark has not been missed by several points. Instead of harmony, it appears to approach the margin of that neutral territory, beyond which discord begins.

In Fig. 45 we have a view of such portions of the Bank of Commerce as rise above the Equitable Life Building on the left, and the Mutual Life on the right, with a rear view of Mr. Post's twenty-five-story bantling in the distance. The lower stories disappear from view in the depths of the Nassau Street Canyon, where our lens, by reason of physical limitations, was unable to penetrate. We know for a fact, however, that they rest on a secure foundation of steel, buried in a monolith of cement the size of the entire site, and many feet in thickness. With this assurance, we can now give undivided attention to the four upper stories, on which may be noticed an excellent example of engaged columns of the banded variety, a style that is invariably successful in terra-cotta. Losing sight of all that is below, these four stories and the main cornice, Fig. 46, undergo a favorable transformation, and that because their continuity is not so much broken up by the intrusion of harshly contrasting brickwork. The bluish-gray monotone, however, remains; and whether viewed from the harbor or from adjacent housetops, we

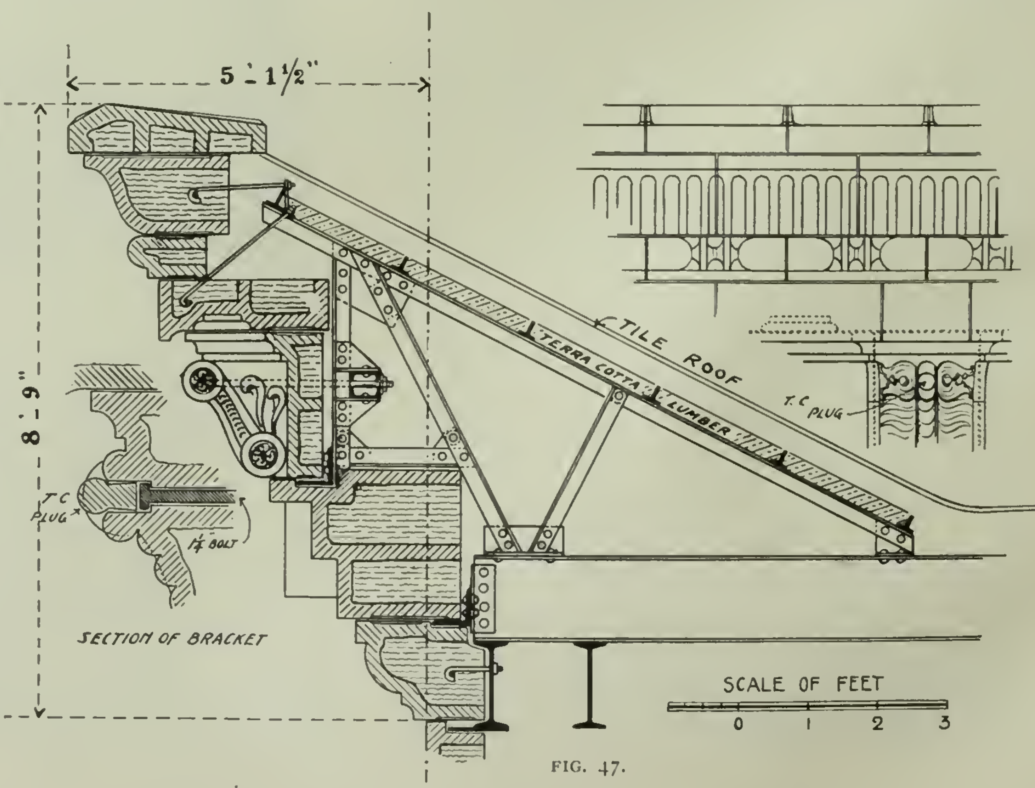


FIG. 47.

think it must be admitted that the color is more than one shade too dark. A lighter color would have yielded a greater proportion of high lights, between which and the deepest shadows there would have been a blending of half-tones to unite the two extremes and preserve an even balance. The absence of this scintillant transition is not felt so much in a strong light when tinted by "that silent architect, the sun"; but under a leaden sky, or when the shades of evening begin to fall, the general effect leans too much to the side of monotony and gloom.

The main cornice, Fig. 47, has a height of 8 ft. 9 ins., and a total projection of 5 ft. 1 in. from wall line; and, as little of its weight rested directly on the wall, it had to be transmitted to the structural framing and to the roof beams. This is done by a series of steel trusses, framed out of 3 by 3 L sections and spaced on about 5 ft. centers. The direct weight of the first course has a partial bearing of about 10 ins. on the wall below, and besides fitting into the flanges of the 15 in. I beam, it likewise rests on the projecting bottom cover-plate. It is also anchored back by a ¾ in. bolt, one end of which takes hold of a ¾ in. rod that passes through the block, the other having a tension nut, by means of which the desired alignment is made, thus overcoming any trifling variation that might occur in the ironwork.

The dental course rests, in part, on a continuous 6 by 6 L section attached to floor beams. On the top bed of these blocks a recess is molded, into which another continuous 6 by 6 channel is bedded, and then riveted to the triangular bracket forming part of the main truss. It will be seen from this that the whole course is held in position in a simple, practicable way, and beyond the possibility of escape. Into the seat thus prepared the modillions are set on about 2 ft. 8 in. centers, and they, in turn, are secured by a 1¼ in. bolt, which, passing through the block, is fastened to the two channels in the manner shown in section. The flat head of this bolt is countersunk, the hole being then filled by a terra-cotta plug, set in cement, the outer end of which becomes one of the balls called for in design of modillion baluster.

The modillions being thus secured beyond peradventure, and the panels between them locked in position, they are made to act as corbels, with sufficient strength to carry the four courses above, and yet leave a wide margin of safety. In these last courses, as with the first one already described, a hole is provided for a ¾ rod to pass clear through the block, from which it may be anchored at convenient intervals, without reference to positions of joints. The coping is set on a liberal bed of cement, which, passing up between the partitions of the cellular bottom bed, grips it in such way as to make anchors unnecessary. The sloping roof is formed of fire-proofing, on which is laid a waterproof covering, to be again protected by a tile pavement laid in cement. The risks of fire and water reduced to a minimum, the damage from incessant friction is rendered practically non-existent.

The construction and execution of this cornice has been spoken highly of by men well qualified to judge of its merits. From their conclusions we see no reason to dissent in any particular. It is a good example of its kind, with a projection in due proportion to its height, and quite sufficient as the crowning member of a twenty-story building. Most important of all, we think it is safe, which is more than can be said in the case of all the terra cotta cornices of recent erection, with which we are acquainted. There may be things in this world about which "ignorance is bliss," but the security of overhanging members, suspended at heights varying from one to three hundred feet, in a city's most crowded thoroughfares, finds no place in that category. Some day, we fear, there may be a tale to tell on this subject, in regard to which those who had furnished the sensational features would be cited as involuntary listeners. The meritorious examples that have been selected for discussion may, in some measure, help to encourage and promote the construction of others equally good. In this, the one thing required is an intelligent application of the same (or similar) principles, honestly applied and modified to meet the exigencies of the subject in hand.

The Art of Building among the Romans.

Translated from the French of AUGUSTE CHOISY by Arthur J. Dillon.

PART III.

CHAPTER II.

THE ART OF BUILDING AND THE ORGANIZATION OF THE WORKING CLASSES.—(*Concluded*).

THE number of monuments built by the Roman troops was considerable. It was one of the Roman principles that the soldiers should never, under any circumstances, remain idle; and, as must be confessed, it was principally to avoid dangerous inactivity that they were employed on the buildings, and frequently they were thus employed, the Roman writers tell us, on buildings which were otherwise superfluous. When Vitellius had the amphitheaters of Bologna and Cremona built by the soldiers, he thought less of bestowing on the cities these useful buildings than of controlling for the moment the turbulent spirit of the legionaries. In Africa we again find the Roman soldiers building amphitheaters; in Brittany, fortifications; in Egypt, tombs, bridges, temples, porticos, basilicas; in Italy, the great roads, and everywhere the mention of their work is accompanied by the curious observation that "the monuments were undertaken in order to occupy their leisure."

It was not only the soldiers that were thus transformed into workmen, for such was the simplicity of the Roman methods that even the prisoners that the Romans held and the convicts from the lowest ranks of the people could be used for the same purpose. Condemnation to labor on the public works was a recognized legal penalty. It is cited by Paulus, and may be read on every page of the Theodosian legislation.

The work was principally in extracting the material for buildings, and it was from among the prisoners, principally the Christian prisoners, that the workmen were recruited who quarried the stone and dug sand for the Baths of Diocletian; and long before, all the prisoners of the empire had, under different pretenses, been put to work on the canal of Avernus, as well as on that colossal assemblage of palaces called the House of Gold. "To complete them," says Suetonius, "all who were in the State prisons were brought to Rome by the order of the emperor, and he did not allow those convicted of crimes to be sentenced to any punishment except labor on the public works."[1]

The Romans even went still farther. Not satisfied in placing prisoners and soldiers side by side with the workmen, they even called to the work of construction free citizens and men most unused to work, demanding of the one, materials, of the others the aid of their arms. This unusual but systematic imposition was particularly developed toward the seventh century along with the rise of despotism, and it was continued under varying names until long after the fall of the empire. But in order to see things from the proper point of view it is necessary to go farther back.

The Roman idea of taxation was entirely different from that held to-day. People were then divided into two distinct parts; one was the urban population, who as a whole had the benefit of the rights of the cities and of the municipal franchises; it was composed of descendants of the ancient Roman colonists, men of the race of conquerors, as could be seen by their liberties and privileges. Beneath this class was the taxable population, the remains of the indigenous race, which was constrained to provide for the other half

[1] The texts establishing this participation in public works by prisoners are these: —

Paul., Sentent., Lib. V., tit. de Poenis; Cod. Theod., Lib. XIV., tit. X., l. 4; Digest., Lib XLVIII., tit. XIV., l. 34, l. 8, § 7, etc.

On the construction of the Baths of Diocletian with the aid of convicts: Annales eccles. Baronii, ann. 298, act. Sta. Marcelli.

Construction of the House of Gold and of the canal of Avernus: Suet., Nero, Cap. XXXI.

of the empire by its labor. The imposts they paid were not only taxes to cover the cost of the government; they were also, in fact above all, tribute paid to the luxury and subsistance of the great cities. This fact alone establishes the great difference between the social economy of antiquity and that of to-day. The difference is, however, not only in the destination of the results of taxation, for it is even more apparent when the elements which made up the public revenue and the manner of its collection are examined.

This tribute, which was imposed on the vanquished, should have been redeemable, as with us, in money, which could then be exchanged for the necessities of the conquerors: but the interposition of money seemed a useless complication to the Romans, and instead of obtaining the products of the soil and of labor by the use of money exacted from their tributaries, they preferred to suppress all such intermediaries and collect the debts of the provinces in such shape that they could be immediately utilized; so a large part of the taxation was collected not in money, but in kind, and those who were responsible for the provisioning of Rome were, in most cases, the collectors of these curious taxes.[1]

Building materials were among the taxes in kind which the Romans thus collected. For example, the curiales of Etruria paid annually to Rome 900 cartloads of lime; the city of Terracina had a similar impost to pay, and the product of these taxes was reserved exclusively for public works, lighthouses, wharves, etc. Such and such a country sent the Romans building stone, another a tribute of bricks. These materials were a percentage of the products of various industries, just as in certain provinces (among others Bruttium and Calabria) a part of their flocks and herds, and from Egypt and Sicily a portion of their wheat was taken. Distinct regulations, moreover, prohibited the acceptance of an equivalent in money, and thus guaranteed to the public works supplies of material whose amount was limited only by the moderation of the Romans.[2]

It was in this manner that the owners of the soil assisted, by contributions of taxes in kind, in the establishment of public edifices. As for the lower classes, whose almost total lack of property sheltered them from taxes either in kind or in money, they owed to the public works a tribute of another sort, forced labor.

The corvée played an important rôle in the public works of the last centuries. The Romans disdainfully called this form of tax "sordida munera," and counted among the services that could be demanded of that part of the population subject to forced labor, the proportion of the lime for public works and personal concurrence in "the construction of the public monuments, the sacred buildings, and the great roads of the empire." The people[3] who took part in these works were in principle all the inhabitants of the empire, except the officers of the government, and the dignitaries of the church, and the army. Nevertheless, the exceptions should have been greater in practise; and judging from appearances, it is probable that the Roman authority excepted all the population of the great cities from whom they provided provisions and pleasures, and from whom, it would seem, they were far from exacting onerous assistance or useful services.

It remains to say how these taxes were imposed, what recourse there was against their exaction, and what laws determined their extent and tempered their rigors. But, with a remarkable gap, the Code leaves these serious questions in the most absolute vagueness. More than twenty[5] constitutions relate to the "sordida munera," and among so many laws there is not one which defines the rights and obligations of the subjects of the empire, who came within the scope of these onerous regulations; all treat of the exceptions, the only thing which they neglect to define is the extent of the obligations which they impose. Thus is seen, even in the silence of the law, the spirit of a system which was based entirely on exceptions and privileges. This gap in the laws left open an unlimited field for arbitrary and oppressive measures, and the frequencies of the corvées under the rule of the emperors shows the strangest forgetfulness of equity in the distribution of the public burdens. Taxes in the form of personal labor have, among other wrongs, that of being imposed exclusively on those taxpayers who, by chance, happen to be in the vicinity. But the Roman emperors hesitated but little over principles when it was a question of a tax that fell on a class of the people who had been reduced, by centuries of servitude, to passive instruments. These general levies were a sure and swift means of attaining their object, and this advantage was sufficient for them. They had frequent recourse to it during the despotic times that preceded the dismemberment of the Roman world. It was by this means that Diocletian was able to execute, in so few years, the embellishment of Nicomedia, of which he wished to make a second capital of the empire, and a rival of ancient Rome. Basilicas, palaces, a circus, a mint, an arsenal, were raised in the new city by the unaided arms of the inhabitants of the city. They were compelled to transport the materials at their own expense, to furnish all the necessary engines and machinery, and even to cede to the emperor the sites of their own houses. These requisitions, of which Lactantius has left us so striking a picture,[6] were so unexceptional in the eyes of the Romans that one of their historians eulogizes Vespasian for having constructed buildings in the provinces "without having taken laborers from the fields."[7] The whole spirit of antiquity is shown by this single remark, which becomes even more characteristic when it is considered that it relates to one of the most prosperous periods of Rome and to one of the best princes that ever ruled the empire.

To sum up: Rome took its unskilled labor from the population subject to the corvée, and its skilled workmen from the local corporations; the corvée and the corporations were the two elements which supplied the labor for the construction of those monuments whose ruins we admire; to unite them was to unite material power and the strength of tradition and to furnish the empire with resources sufficient for the most colossal undertakings. But as they owed their existence to a false organization of society, these resources were rapidly dissipated, and the empire finally experienced the fatal results of an economic system founded on disregard of individual right and private liberty; the country supported during three centuries the painful laws which compelled it to construct for the cities buildings of a purely municipal character; the small towns themselves were put

[1] The details preserved in the Theodosian Code, Lib. XIV., tit. IV., on the organization of the "Suarii" should be examined in this connection. I chose this example because these tax collectors, who were also counted among the principal contractors, are perhaps those whose functions were most clearly defined; and from this point of view, a study of their organization should precede any general research on the method of collecting the taxes in kind among the ancients.

[2] Tributes of lime paid by Etruria and Terracina: Cod. Theod., Lib. XIV., tit. VI., l. 3: Symmach., lib. X., cap. 53.

Tributes paid in building stone: Cod. Theod., lib. XIV., tit. VI., l. 4.

Tributes paid in brick. See the notice published by Nardini at the end of his "Roma Antica," designated "Lettera d'Ott. Falconieri sopra l'iscrizione d'un mattone," etc.

Rule against the acceptance of money in place of tributes in kind: Cod. Theod., Lib. XV., tit. I., l. 17.

No part of these materials was conceded to individuals unless the portions paid by the tributaries exceeded the limit of the public needs: Cod. Theod., Lib. XIV., tit. VI., l. 4.

[3] Cod. Theod., Lib. XI., tit. XVI., l. 15. 18. The list of the taxes varies greatly. To show this it is sufficient to compare the enumeration of the fifth century in the Theodosian Code with that in the Justinian Code of the sixth century (Lib. X., Cap. XLVII., l. 12). There is a direct proof of these variations; for example, that the care of the great roads ceased to be placed among the "sordida munera" under Theodosius the younger. But these fluctuations of the Roman law are of little importance, for we are more concerned with the general idea than with the details of its application.

[4] Cod. Theod., Lib. XI., tit. XVI., l. 15, etc.

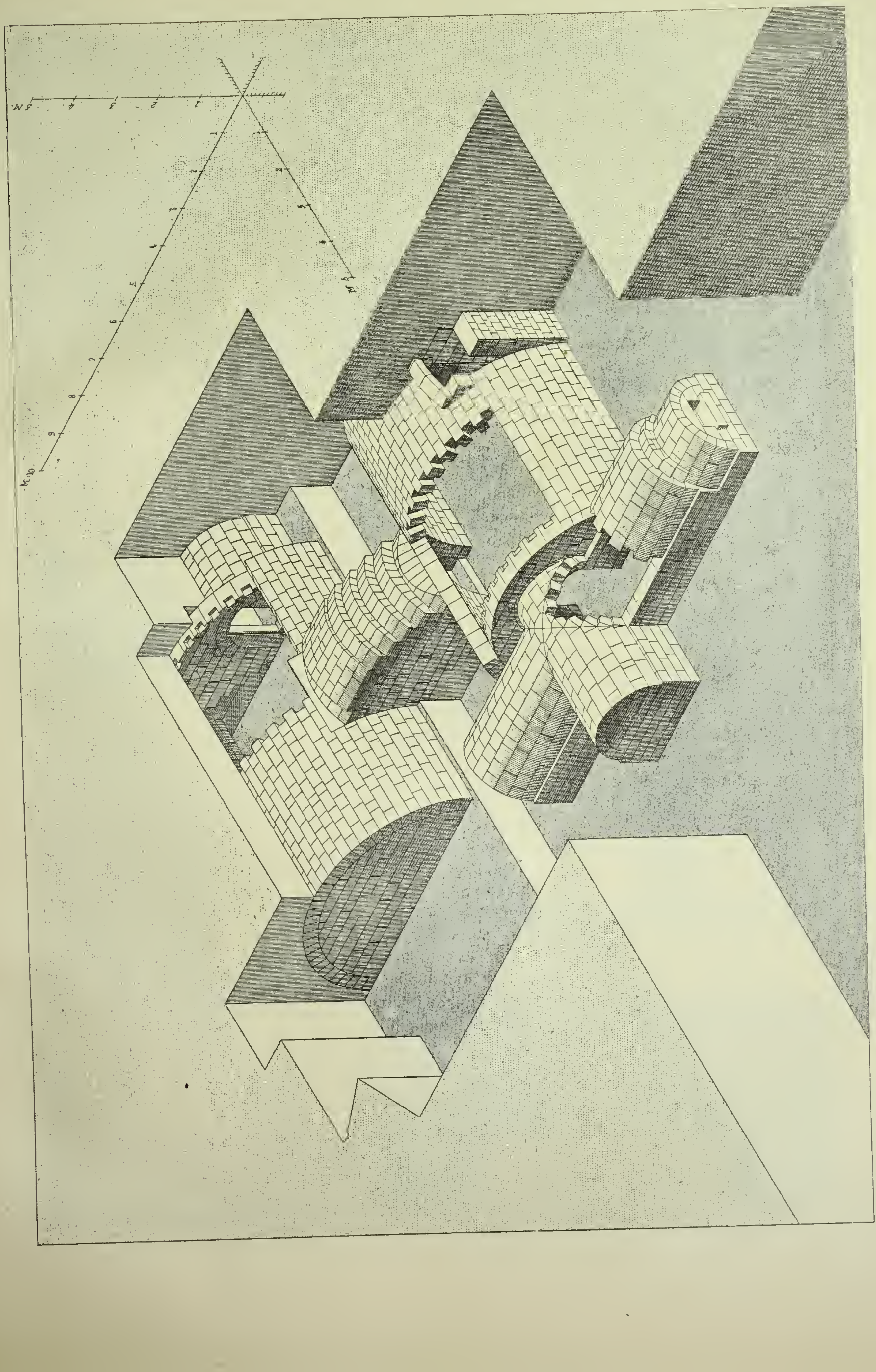
[5] It is necessary to make a careful distinction between the "sordida munera" and the "extraordinaria munera." The two kinds of contributions, although the juridical texts frequently connect them, were, by their nature, profoundly distinct. The Theodosian Code never confounds them and sometimes it even opposes them, as can be seen in Lib. XI., tit. XVI., l. 15. "Sane rerum extraordinariarum munus ab omnib. omnino Magnif. tua sciat esse poscendum . . . . Sordidorum vero munerum talis exceptio sit, ut . . ."

The "sordida munerum" were the corvées, the "extraordinaria munera" were simply increases of taxation. It will be remarked that there were much fewer exceptions to the "extraordinaria muneria" than to the "sordida muneria", but, on the other hand, their imposition was guarded by a host of guarantees, none of which extended to the "sordida munera." See, in support of this observation, the following constitutions where the "sordida munera" appears, and whose character is defined by their assemblage.

Cod. Theod., Lib. VI., tit. XXIII., 3, 4; tit. XXVI., 14; tit. XXXIV., 1, 4; Lib. XI., tit. XVI., 5, 15, 16, 18, 19, 20, 21, 22, 23; Lib. XIII., tit. III., 12; Lib. XIV., tit. IV., 6; Cod. Just., Lib. X., tit. XLVII.

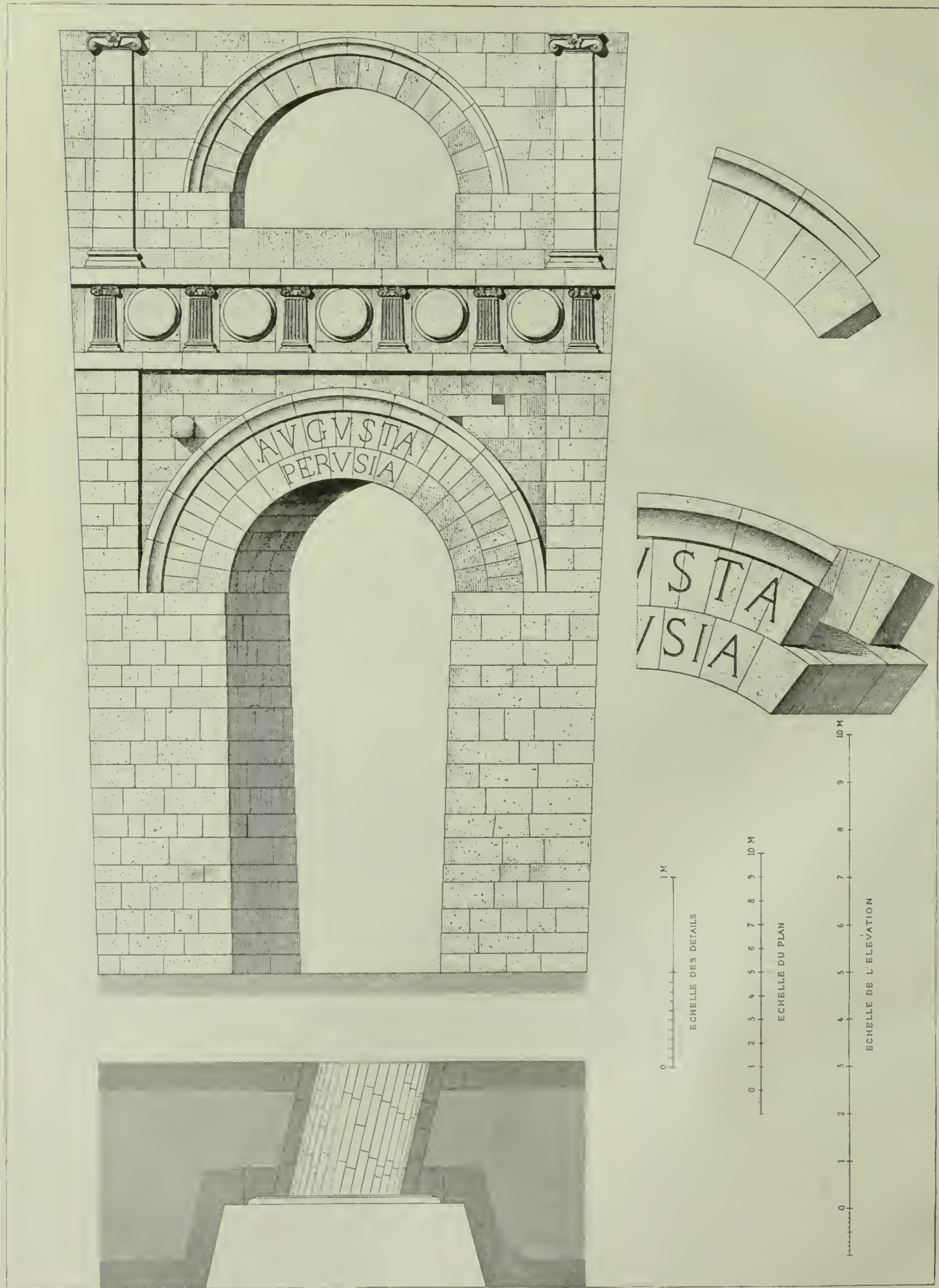
[6] Lact., de Mortib. persec., Cap. VII.

[7] Aurel. Vict., de Cæsarib., Cap. IX. I take this observation from the work of M. Naudet, "des Changements opérés dans toutes les parties de l'Empire romain," etc.



VIVIERES.

PLATE XIX. THE ART OF BUILDING AMONG THE ROMANS.



PEROUSE.

PLATE XX. THE ART OF BUILDING AMONG THE ROMANS.

under the obligation of contributing to the expenses of the great cities.[1] But finally, incapable of meeting the exigencies of the imperial tyranny, the inhabitants of the country, as, for example, in Gaul, profited by the relaxation of the bonds which tied them to the empire to arm themselves against it and ceased to be its auxiliaries in order to become its enemies.

In their turn the corporations had their period of decline; their members, ruined by a system of tariffs and statutes that legally de prived them of part of the payment due for their services, came finally to seek asylum outside of the cities by taking refuge in the colonies, or even going beyond the frontiers; they sought to find a larger and more liberal life among the barbarians. This was the signal for the abandonment of the old methods; they had declined with the increase of public misery, but they fell definitely with the fall of the corporations that were the depositories of their secrets. The first constitutions opposed to the dissolution of the corporations date from the immediate successors of Constantine. They attempted to stop the evil by reviving the traditional methods; but the fall was irremediable, the sequence of the traditions was broken, and architecture existed only in the memory of the past and in the monuments of the Roman greatness.

It is hardly necessary to point out the differences which should distinguish the methods of the architecture of the empire and that which is suitable to modern nations. They lie in the differences of the two civilizations themselves, and they arise from the double picture we have shown of the methods of building, and the institutions that explain them. Knowing how the methods of the art of building of former days satisfied the needs of the Roman civilization, one can easily see the reasons that should prohibit them to-day, or at least modify their form and limit their use; it can be understood that these gigantic constructions, where the simplicity of the methods is compensated by an immense increase of labor, properly belong to the days of slavery and forced labor. The affranchisement of the laboring classes, putting a price on all work, imposes on the builder the necessity of taking the material difficulties more into account, of measuring with greater care the amount of time and effort he must spend. The Roman methods are possible only under a great empire whose resources are concentrated under an absolute government; and this is so certain that the Romans themselves, as soon as they built for private purposes, as soon as they had to pay for labor, either in salaries to the members of the corporations, or in buying the slaves who worked for them, renounced the luxury of solidity. The vestiges of Pompeii, and the ruins of the villas scattered about the Campagna of Rome show this fundamental distinction most clearly; their construction is essentially slight, and they are less like the official works of the contemporary epochs than like the buildings of the Lower Empire, whose construction is recalled by the Christian basilicas. Moreover, the work to be expected from slaves is different than that from free workmen exercising without constraint their chosen trades. Intelligence develops with the amelioration of physical conditions, and we may ask more from logical combinations and less from physical force; in a word, we may leave a greater field for the personal initiative of each artisan. This is one of the first causes of the changes in the art of building, but still other reasons oblige us to give our architecture a new aspect, and apply different methods to our construction.

There are, in fact, two methods of construction appropriate to two clearly distinct conditions of society; either buildings are constructed as a whole of a solidity that protects them from the chances of destruction for centuries, or else, accepting the conditions of maintenance, and the chances of a proximate reconstruction, buildings are erected whose existence must be prolonged from day to day, whose preservation is a constant expense. It is the last method that tends to prevail among modern nations. Given up to the preoccupation of production, they seek to reserve for creative enterprises a part of the resources which the Romans devoted to the monuments of the empire; and when the income of the amount so saved exceeds the cost of maintenance and reconstruction, the difference is regarded as an increase of the public wealth. The Romans would have difficulty in comprehending such a calculation. Accustomed to live by the labor and tribute of conquered nations, they regarded their personal interests as the end and aim of all the energy of the peoples whom conquest had made their slaves, and they found in this resource all that was necessary to give their works a solidity which it would be wrong to seek in modern times. Our buildings will have but a short existence; many of them will scarcely survive us. It is not sure that the needs to which they owe their existence will last after us; and the ruin of these frail edifices is a small matter if the economy in building them as they are built is sufficient to replace them by others more in accord with the new generations.

Unceasing transformation; this, in a word, is the condition of modern architecture. The constant movement of society forces architecture into a series of changes whose result it is useless to predict and whose end is impossible to foresee. But whatever make be its variations, our architecture is bound to the past with unbreakable bonds; its origin carries us back, in spite of ourselves, to ancient Rome, and for a yet long time will it be necessary to seek the principles of its methods and the hidden end to which it is tending.

THE END.

[1] Cod. Theod., Lib. XV., l. 18 et 26: Laws cited by M. Serrigny in his work on "Le Droit publique et Administratif des Romains."

ENAMELED BRICKS FOR THE FRONTS OF BUILDINGS.

AT the time that the American "glazed" bricks failed, English enameled bricks were imported at a much higher price, and were used for facing the interior courts of most of our large office buildings. One of the most recent, however, the Marquette, has been faced in its courts with the new-made American enameled bricks. Thus far these inner courts have afforded the principal places for their use; but in England they are extensively employed on the interior of buildings, in the lining of kitchens, vestibules, and latrines, and for manufacturing buildings and laboratories, in which they effectually resist the action of the acids in the air.

In cities of the interior of this country, where much bituminous coal is consumed, the *bête noire* (almost literally) of the architect is the disfigurement of the exterior of buildings with the condensations from soot. These are of a gummy nature, contain creosote, adhere with obstinacy to every building material, and after a few years they cannot be removed, even with soap. Red bricks were found to turn to a dirty chocolate color, and were not free from disfigurement. The only remedy that house owners could find (and that an expensive one) was to paint stone and brick alike, so that to-day more than half of the best buildings of Chicago and other cities are painted.

The architects of the Rookery saw their opportunity to avoid this in one fine building when the dark semi-glazed "obsidian" brick came on the market. This was a frank acceptance of the situation and a surrender to what was then thought to be the inevitable. They made the exterior the exact color of smoke-dirt, and so it has remained ever since; but we now see the dirt and not the bricks, which are completely covered. The owners have avoided the expense of repeated painting, and have been the gainers thereby. Many other buildings have been similarly faced since then.

But since reliable American enameled bricks have been on the market, architects and owners have been able to face their buildings with bricks that can be kept clean if washed periodically; for even the best enameled bricks will not keep themselves clean, and the hardest rains will not wash off soot condensations. But washing is cheaper than painting. —*Inland Architect.*

THE falling of a piece of cornice, from the eleventh story of the Times Building on Park Row, New York, illustrates the danger of using stone for projecting construction in cities. Sandstone was employed in this case, and the Building Department stated that frost was the active agent in causing the accident.—*Eng. News.*

Fire-proofing Department.

TEST OF FIRE-PROOFING MATERIAL.

WHEN one considers the immense interests involved and the terrible consequences of the failure of any vital portion of a large building, the reasons for frequent and thorough testing of all kinds of building material is readily appreciated. Even with the utmost care unexpected weaknesses may be developed. While such conditions might not be entirely obviated by proper tests, it is quite certain that preliminary investigations would be apt to reveal indications of possible failure, and a wise constructor would give a questionable material the benefit of the doubt by avoiding its use altogether. Tests are quite as desirable for ascertaining what to avoid as for affording a measure of possibilities, and our constructive literature is full of reports of both public and private tests of all sorts of materials. It is, however, with the more recently adopted materials of construction that tests have been most numerous, and especially with fire-proofing in its various forms, a construction which has struggled out of an experimental stage, and from which, as has been admirably shown by Mr. Wight's articles in these columns, very definite, and on the whole extremely satisfactory conclusions have been reached, and there have been in recent years many exhaustive and satisfactory tests made with a view to determining the reliability of the various fire-proofing mediums. Any one who has compared reports of the various tests cannot, however, but be struck with one fact which is very prominent, namely, that the large majority of them have been devoted to an investigation of the material itself, independently of the method of use; thus there have been experiments in Denver, New York, Boston, in fact in nearly every large city, which have shown conclusively that terra-cotta can be depended upon to resist a high degree of heat, and to properly protect a concealed steel construction. The results of most of these investigations are permanently on record, and are readily available to the student or the constructor, and the tests have been so thorough and impartial that it would seem as if, after the years which were taken to develop the fire-proofing industries and the numerous opportunities for showing the resisting powers, we ought to be pretty well down to a basis from which we can start in laying out any species of construction depending for its protection upon the qualities of burnt clay. We believe in tests. They not only keep alive an interest in scientific reasoning, but they serve to keep up the standard of the manufacturer, and yet we have been sometimes led to question whether the more recent tests of fire-proof buildings have not been in the nature of thrashing old wheat, whether the time has not come to stop questioning whether terra-cotta will stand fire or whether something else is better, and to confine our tests to a more practical demonstration of how to do rather than what to do with, admitting at the very start the results of investigations which are too manifestly decisive to admit of a great deal of argument.

Theoretically and practically it has been established that terra-cotta, if properly applied, does protect. The theoretical demonstration has been made in numerous private and semi-public tests of small sections of flooring, column protection, etc. The practical tests have been applied in such conflagrations as the Pittsburgh fire, Western Telegraph Building in New York, the Athletic Club in Chicago. Though opinions may differ as to the economic advisability of using one material or another, or a different form, terra-cotta itself is no longer an experiment, it is a scientific fact, the records of which are open to any one who reads.

But what we do need tests upon is the details of construction. No one is ready yet to admit that the last word has been uttered or the final solution achieved in the application of burnt clay to purposes of fire-proofing. There is a great deal of clumsiness in manipulation which must be obviated. There is weight to be reduced, there are shapes to be improved, and there are systems of application which would bear a great deal of study. Along these lines tests are of value, and a great many of them can be made to follow new and unsolved paths. The material itself, however, with all the variations of the different manufacturers in the different parts of the country, is practically the same throughout. It is not like steel, every melt of which may be different, and which, consequently, requires tests at frequent intervals. The extremes of hard and porous terra-cotta are perfectly understood, and can be scientifically analyzed and applied.

An absolutely fire-proof building is, of course, an impossibility, for no structure has yet been devised which could not be affected to some extent by heat if the combination of conditions were favorable. We cannot fire-proof the contents of any structure by merely enclosing the supports in a fire-resisting envelope. But we can vastly improve not only the details of construction, the methods of applying the brick and terra-cotta, the manner in which the protecting envelope is applied to the beams and the columns, the precise arrangement of supports, ties, etc., but we can also, to advantage, make very decided and radical changes in the arrangement of so-called fire-proof buildings, by which their resisting powers can be greatly increased. Fire-proof construction is not merely a question of floor and column protection, but one of the essential requirements is that the structure shall be so arranged that fire cannot readily spread from one part to another; consequently we need to devote more study than is usually allowed to the arrangement of corridors and partitions, as well as to the window openings and the construction of elevator wells and light shafts. It may be open to argument whether an elevator well is safer from a fire standpoint if it is enclosed in brick walls than if it is entirely open. In the former case it can easily become a huge blast chimney. In the latter case the fire enters it more readily. But certainly the partitions and elevator arrangements are not usually conspicuous for the amount of study which has been expended upon them, and we could well afford to expend some of our test money upon the determination of the best kind of construction to answer for partitions, to resist not only heat, but also the air pressure, which sometimes is quite considerable in a building, as well as the even more disastrous effects of the fireman's hose. One of our correspondents has said quite truly that in one of the notable instances in which a fire-proof building was exposed to the effect of a conflagra tion from an adjoining structure far more damage was done by the firemen than by the fire; that if the building had been left alone the waves of fire would have beat against it impotently, but the combination of water and fire was too much for it. All of which simply shows that we must consider all possibilities in designing a fire-proof construction.

Then there is opportunity for considerable investigation in devising a fire-proof window. It has been suggested that wire glass could be used in metal frames, and that wire glass when properly set will melt before it will let the heat through. So far as we know, this has never been tried, and we should suppose that, even assuming the glass stood the heat, a few drops of water might change conditions considerably. Window frames and staff beads are almost invariably built of wood. In the fire in the Potter Building, New York, some time ago, if we are correctly informed, fire was communicated from story to story through an interior well by means of the wood finish around the windows. If instead of exposed wood the frames were to be set flush with the jambs or with a projecting terra-cotta molding to cover the frame, and the sashes themselves were of sheet metal on a wood foundation, similar to the construction of tinned wooden shutters, the danger of ignition would be reduced to an insignificant minimum. Here again is another chance for a long series of valuable fire-proofing tests. In fact, the possibilities of improvement in even the best of our fire-proof structures are so manifest, there is so much remaining to be done which can be accomplished only through the direct agency of carefully conducted scientific experiments and tests, that we can well afford to admit the results of previous investigations, and can with great profit continue our investigations along the line of the unknown, having already so much firm ground to tread on.

A COMPETITIVE (?) TEST.

New York, Dec. 20, 1897.

To the Editor The Brickbuilder: —

Dear Sir: — The impression seeming to prevail among those not familiar with the details, that we were participants in an attempted joint test of our end-construction, porous hollow-tile arch, and one of the Roebling concrete method, which occurred on November 19, last, at 68th Street and Avenue A, this city, we ask that you kindly grant us the use of your columns for a dispassionate statement regarding it, from its inception to its final merited miscarriage.

We do not dispute the fact that portions of the tile used in the construction of this arch were procured by John A. Roebling's Sons Company in a near-by city, but aside from that we had no voice in the matter of detail or the manner of construction.

Under the administration of Stevenson Constable, Superintendent of Buildings, New York City, and the supervision of his brother, Howard, there have been no less than fourteen tests made of different systems of fire-proofing, all governed by the following conditions: — 5 to 6 hours' firing, followed by water applied under a pressure of 60 lbs. to the square inch. A full report of these various tests was furnished *The Engineering Record* (see Vol. 36, Nos. 16–19) by Stevenson Constable.

Deeming the fire period — 5 to 6 hours — which had governed these fourteen tests inadequate to determine the resistance to intense heat of fire-proofing material, we, in March last, at the request of Mr. Constable, threw down a challenge to all, for a joint test of *24 hours' continuous fire*, of 10 in. porous end-construction flat arches, followed by water applied under a pressure of 60 lbs. to the square inch. On September 7, the John A. Roebling's Sons Company, in a letter addressed to Constable, purport to accept our challenge; but instead of a fire test of 24 hours' continuous duration — the main purpose of our challenge — propose one of 4 hours only, which is to be followed by cooling, then application of water, and so repeated; and further providing: "The Roebling arch to be constructed in the same manner — material, quality, and proportion — as they will guarantee to construct their floor systems *in the future* in the city of New York." "The material for the hollow brick arch to be purchased at some building in course of construction, where such material has been delivered by Henry Maurer & Son, without special selection as to quality, and to be the regular 8 in. hard-burnt clay or porous terra-cotta side or end construction."

These conditions not confirming to those of our challenge, we declined the proposition and considered the whole matter settled; at which conclusion it seems the Roebling Company also arrived.

The John A. Roebling's Sons Company, however, instigated by Mr. Constable, determined to proceed with the test — under conditions imposed by themselves, and presumably the most favorable for their method — and with the material procured at considerable trouble and expense, with additional tile from other manufacturers, they proceed to erect an end-construction arch of 5 ft. span, in a structure adjoining a concrete arch prepared, superintended, and constructed by them.

We quote: "The Roebling arch in the test structure was identical as to proportions, manipulation, etc., with the fire-proof arches erected by the John A. Roebling's Sons Company, and represents the standard construction of that company.

"The hollow-tile arch is a modern pattern, end-construction type, of flat arch erected with care" (sic) "so as to represent as nearly as possible the usual workmanship, as found in fire-proof buildings now in the course of construction in New York City."

It did not require deep penetration to discern the result — sure to follow — when a hollow-tile arch, constructed, as we see, under the fostering (?) care of a rival concrete interest, came to be tested, and that test under the sole control of such interest; the result we had foreseen followed. The end-construction arch, after 3 hours' firing, loaded with but 150 lbs. to the square foot, fell in; but in falling disclosed the secret of its fall: glaring defects of construction!

A study of the results of other tests, both of hollow-tile and the Roebling concrete arch, which we collate below, will convincingly show that the test, of which this letter treats, was simply a farce.

TESTS OF HOLLOW-TILE ARCHES.

Denver, Col., Dec. 20, 1893.

"An end-construction, porous terra-cotta arch of 5 ft. span, after undergoing a continuous fire test for 24 hours, was practically uninjured, as it afterward supported a weight of bricks of 12,500 lbs. in a space 3 ft. wide in the middle of the arch."

Pittsburg, Pa., May 3, 1897.

"The report of S. Albert Reed to the New York Tariff Association shows that the end construction, porous tile arches were superior to the side-construction, hard-burned tile arches; that all floors of either method were practically uninjured."

But our concrete friends claim that these tests were too far from New York to be conclusive, so we quote Stevenson Constable himself: —

New York, Sept. 29, 1896.

(See *Engineering Record*, No. 19, pp. 402, 403.)

"An end-construction, porous terra-cotta arch, loaded with 150 lbs. per square foot, was subjected to a fire test of 6 hours' duration, uninjured. Nearly 20 days thereafter the load was increased to 1,960 lbs. per square foot, and the arch still declining to fall, the test was discontinued.

Maximum deflection . . . . 3.41 ins."

May 20, 1897, *Engineering Record*, No. 19, p. 405: —

"A side-construction, hard-burned tile arch loaded with 150 lbs. to the square foot was tested under 5 hours' firing, uninjured. On May 22, 1897, load was increased to 600 lbs. per square foot without injury.

Maximum deflection . . . . 1.84 ins.

Maximum temperature . . 2,050 degs."

Our concrete friends now claim: that an end-construction arch, of our material, but built under their direction, loaded with but 150 lbs. to the square foot, after firing for less than 3 hours, fell in.

Maximum temperature, 2,300 degs.

Maximum deflection, 3.65 ins.

It is an undisputed fact that in the preparation of hollow tile, the raw material (clay, etc.) is subjected in burning to a heat of fully 2,800 degs., sustained for from *6 to 7 days*.

TESTS OF ROEBLING CONCRETE ARCHES.

From report of Stevenson Constable, New York, Sept. 25, 1896, *Engineering Record*, No. 359.

"A Roebling concrete arch, which we are justified in presuming 'represented the standard construction of that Company,' loaded with 150 lbs. per square foot, was subjected to firing for 5 hours. Upon reopening doors before putting water on it was seen that all the plaster and wire netting had burned off except in the extreme corners.

Maximum temperature . . 2,300 degs.

Maximum deflection . . . . 4.485 ins.

Mr. Constable being restrained from interference, we can only quote from report in *Engineering Record*, p. 556, — source unknown to us: —

"The Roebling arch remains intact, with shreds of the skin coat hanging to the ceiling, the brown coat remaining intact.

"2,300 degs. maximum temperature.

"1.4 in. maximum deflection."

Yours truly,

HENRY MAURER & SON.

New York City, Dec. 20, 1897.

Mortar and Concrete.

CHARACTERISTICS OF VARIOUS BRANDS OF AMERICAN NATURAL CEMENTS.

BY CLIFFORD RICHARDSON.

COMPARED with the typical high-grade lime and magnesian cements, which have been described, very considerable variations are found in numerous other brands of the East and West.

Rosendale Brands. The many brands of Rosendale cement from Ulster County, which are on the market, while in general, very similar and of excellent quality, still show very decided differences in certain directions. Some give much stronger mortars, both in initial and eventual strength, than others, and display very considerable variations in their time of setting and density. They show corresponding physical and chemical differences. This is due to the variations in the rock from which they are made. It has been shown to differ in composition in the two principal strata found in Ulster County, and again in different exposures of the same stratum. Along the several miles of outcropping where Rosendale cement is made, extending from Rondout to High Falls, very varied rock is found. In most cases where a deficiency exists, it is in the amount of clay in the limestone. It carries too little, and the cement made from it is hot and lacking in strength. An examination of the analyses of five samples of Rosendale cement, given in a previous table, shows that from 8.68 per cent. of oxides of iron and alumina to 15.20 per cent. is found. This alone would produce a marked difference in the several cements. Further, the magnesia is as high as 19 and as low as 14 per cent., the silica reaches 24 and falls as low as 11. It is easy to see, therefore, that different brands of Rosendale cement, or the same brand at different times, may vary, although the material as a whole is of one general character, and that individual brands can only be expected to be uniform when the greatest care is exercised. The best cement plainly contains, within limits, of course, the most silicates and the least magnesia. It will then be the least fiery and give the greatest returns in the strength for the mortar prepared with it.

Depending upon its origin, Rosendale cement may vary so that tests of sand mortar, 2 to 1, may fall as low as 30 lbs. at the age of seven days and reach 100 lbs. The cement may set slowly or too quickly. It will, eventually, in almost every case, yield results which are satisfactory in so far as that the mortar is dense and not brittle and continues to gain in strength with age, not deterioriating after long periods of time. Mortar of Rosendale cement is particularly desirable for laying up masonry, as it is plastic and trowels well. In concrete it is satisfactory only in the best brands or where a considerable time can elapse awaiting the acquisition of strength. Where centers are to be drawn rapid work cannot be done with Rosendale cements, so that when the Potomac Valley cements are available but little Rosendale is used, while in such work as fortifications and gun emplacements, where slowness of setting is no objection, it is a most desirable material.

Rosendale cement mortar will not withstand frost as well as the lime cements, but is superior in this respect to that made with many other magnesian cements. The greater the amount of magnesia in a cement the less it is able to resist cold weather. Rosendale cement suffers more in strength at an early period from the use of an excessive amount of water in mortar than lime cements and some magnesian brands, but eventually recovers quite or nearly the same strength as when less water is used. A test of a Rosendale cement, initiated in 1892, illustrates this in the following figures:—

	Tensile strength per sq. in. Dry Mortar.	Moist Mortar.
2 parts quartz, 1 part cement.		
7 days	38	20
28 „	68	48
3 months	200	140
6 „	220	198
1 year	246	236
2 years	242	232

It appears that the deficiency in strength of the moist mortar at the age of three months has disappeared when it is one and two years old.

Western New York Cements. The cements made at Buffalo and Akron, in Erie County, New York, are magnesian like the Rosendales, but they differ from the Ulster County cement very decidedly. They often have a greater initial strength, both in neat and sand mortars, but after the lapse of time fail to show the same increase and at times fall below some other cements at the age of a year. To what this is due may be seen on examining their composition. They contain a very much larger amount of magnesia, nearly 26 per cent. as compared to 14 in the best Rosendale, and the amount of alumina and iron oxide is reduced to between 7 and 10 per cent., as compared with 11 to 15. The peculiar differences between the Erie and Ulster County cements is plainly due to this difference in composition, and more especially to the larger amount of magnesia. This has been known to eventually cause some brands of this cement to expand sufficiently to reduce its strength, and in some cases to show a deficiency in strength without apparent expansion. The amount of expansion which takes place with these cements may be seen in the concrete base of asphalt pavements in some cities, which at times are raised into waves several inches high, crossing the streets at intervals. These ridges are so marked that from time to time they must be cut out and the surfaces lowered.

Where the amount of concrete is not extensive, and expansion insufficient to produce heaving, the cements have, in most cases, given sufficiently satisfactory results. Their greater strength, when first used, gives them a certain advantage over other slower cements, but they are plainly not entirely well balanced in composition. The presence of so much magnesia necessitates great care in burning, and considerable variations will be found in the product, depending on the extent to which calcination is carried, and the way in which it is done. Hydration of the burned stone before grinding has, however, improved these cements in recent years. They are in color a very light buff, and are not nearly as dense as the Rosendales. They require less water for working than any other cements, and are very plastic. Their use has extended over a large field of engineering work.

Potomac Magnesian Cements. Several cements are made in the Potomac Valley, not far from where the Round Top lime cement, already spoken of, is burned, which are magnesian in character. They are of local importance only, but are interesting from a technical point of view in comparison with others of the same class. They contain about the same amount of magnesia as the Rosendale cements, and in their best form, nearly as much alumina and iron oxide, but often are deficient in this respect. They are not burned as hard, and so show a greater loss of carbonic acid on ignition. They are distinguished by their color, which is a pale-yellowish buff, from the dark colored cements of Ulster County. They resemble, in the practical results obtained with them, the best forms of Rosendale, and often excel them, troweling well and acquiring strength slowly. In concrete they harden to an extremely tough mass, and with the exception of having a very slow set in cold weather, like all magnesian cements, and acquiring little strength soon after use, are equal to any of the natural cements, especially in their final results. They vary considerably, and should always be carefully tested and watched, but are quite as reliable, as a whole, as any of our magnesian cements. The writer has never seen more satisfactory concrete than has been made with these cements, both in the arches of concrete sewers and in the base of pavements in Washington, D. C.

(*Continued.*)

SAND CEMENT.

EDITOR BRICKBUILDER: —

Dear Sir: — The advent of a new building material will always be received with curiosity and criticism. At first, no doubt, the former will prevail, but soon the latter will assert itself.

It is probable that this is the present state of affairs regarding the use of Silica Portland, or more commonly called "sand cement."

Its use in Europe, especially in Denmark, is an assured fact, and, I believe, success.

In the United States I understand that progress is satisfactory, but probably retarded by the abundance of a high class of Rosendale and other natural cements, as well as high-grade Portlands.

In Canada, the Rathbun Company, of Deseronto, have control of the output of this product for the whole Dominion, and have tube mills producing it not only at their works at Napanee Mills, but have established also a branch in Montreal. I believe they are crowded with orders for months ahead, and certainly, if the enclosed tests are fair indications of the average quality, it is not to be wondered at.

It would appear that the distinctive quality of *high early strength* so prominent in Portland cements is still present, and if this strength maintains itself indefinitely, which there does not seem any reason to doubt, then there is a distinct advantage gained.

Whether "sand cements" of a sliding scale of proportions of sand and cement ground together will be able to meet the various requirements of trade the future alone can decide, but much will depend on the frankness and honesty of the makers. The brand labels of this product should, I believe, state plainly what proportions of the two materials are in each package, or else large avenues of fraud will be open of which the manufacturers are innocent.

TESTS ON "SAND CEMENT."

MADE IN THE MCGILL UNIVERSITY CEMENT LABORATORY.

(*a*) "*Citadel*" *Brand* (1 cement to 1 sand).
Residues on No. 100 Sieve, $\frac{2}{10}$ of 1%.
on No. 180 Sieve, ½ of 1%.
Neat tensile strength, 1 week, 332 lbs. per square inch.
4 weeks, 475 " " "
Neat compressive strength, 4 weeks, 3,837 lbs. per square inch.
1 Sand Cement, 3 Standard Sand } Tensile strength, 1 week, 135 lbs. per square inch.
4 weeks, 141 " " "
2 months, 135 " " "
1 Sand Cement, 3 Standard Sand } Compressive strength, 1 week, 470 lbs. per sq. in.
4 weeks, 687 " "

(*b*) "Ensign" brand (1 cement to 1 sand).
Residues on No. 100 Sieve, $\frac{6}{100}$ of 1%.
No. 120 Sieve, $\frac{1}{10}$ of 1%.
Neat tensile strength, 4 months, 810 lbs. per square inch.
6 " 780 " " "
1 Sand Cement, 3 Standard Sand } Tensile strength, 1 week, 189 lbs. per square inch.
2 weeks, 201 " " "
1 Sand Cement, 3 Standard Sand } Compressive strength, 1 week, 900 lbs. per sq. in.

(*c*) "Jubilee" Brand (1 cement to 6 sand).
Residues on No. 100 Sieve, $\frac{3}{100}$ of 1%.
No. 120 Sieve, $\frac{13}{100}$ of 1%.
Neat tensile strength, 4 months, 340 lbs. per square inch.
6 " 540 " " "
1 Sand Cement, 1 Standard Sand } Tensile strength, 1 week, 300 lbs. per square inch.
2 weeks, 379 " " "
1 Sand Cement, 1 Standard Sand } Compressive, 1 week, 2,800 " " "
1 Sand Cement, 2 Standard Sand } Tensile strength, 1 week, 184 " " "
2 weeks, 215 " " "
Compressive strength, 1 week, 1,225 lbs. per sq. in.

CECIL B. SMITH.

MONTREAL, CAN., Dec. 6, 1897.

The Masons' Department.

THE LICENSING OF CRAFTSMEN.

NOT the least of the beneficial improvements which we owe to organized labor and the trades unions is that which has resulted in the licensing of some of the specialized mechanical occupations. In most of our cities a plumber, a gas fitter, or a steam fitter has to obtain a license from the authorities to follow his trade, and we believe it is generally felt that such municipal regulation is a wise one. Agitations have been made from time to time looking towards the further extension of the licensing system. We are heartily in favor of requiring all master mechanics to pass some sort of examination before being allowed to practise a trade. The interests are too vital and the welfare of the public might be too seriously threatened by neglect or bad workmanship to warrant a disregard of possibilities of control, and we have recently had instances in several of our cities of the results of entrusting building operations to uneducated mechanics. Illinois is the only State so far who has gone even further and has required the architects to be licensed. When such a measure is proposed there is immediately a cry raised of close corporation and a desire to squeeze out the humbler members of the profession who have not had opportunities; but looked at aright, it is not at all a question of the individual, but rather of the community, and there is every reason why an architect should be required to thoroughly understand his business in a constructive sense before he can place himself before the public in a professional capacity. The time has long gone by when mere rules of thumb are sufficient in architecture. In the good old colonial days they built by guesswork. The fact that many of the colonial structures are standing in excellent condition to-day is due to the very large factor of safety, possibly more correctly termed a factor of ignorance, which sometimes entered into the work; but if any one thinks mere judgment or experience without a substantial backing of positive scientific knowledge is sufficient to erect a modern commercial structure, he will be sadly disappointed with his first practical experience. Architecture is preeminently one of the educated professions, and wholly aside from any question of artistic license, which, to be sure, is quite as desirable as constructive restriction, though more intangible and less readily formulated, the architect cannot be trusted to depend upon the good-wlil of mechanics who might calculate his strains for him and provide against the possibilities of his own ignorance. Architecture ought to be a close profession, entrance to it being closely guarded by legal restrictions which would insure to the community that the man who has a license knows at least the constructive details of his business.

But licensing the architects, obliging them to know their business, does not relieve the builder from a responsibility. It can truly be said that all the architects in Christendom cannot make a good builder out of a poor one, and that if he does not know his business no architect can teach it to him. The two callings are correlated and interdependent, while at the same time there are distinctive features of each that must be mastered. And besides, the fact is that most buildings are not put up under the supervision of an architect. We will go even further, and venture the statement that a large majority of the poorly constructed buildings are put up without any intelligent forethought from either architect or builder. An owner wishes to economize, and not only dispenses with architectural services, but takes the lowest bidder who will assure him that he knows how to do it. Of course we blame the owner for such shortsightedness, which, however, is more often due to ignorance than to the intent to build poorly; and right there is where the city has a perfect right to step in and insist that the builder shall know his business, shall be competent to decide on all general points of construction, and that before he can be called in to put up even the humblest structure he must receive approval and a license from the community. We hope the work of municipal regulation may go on and extend, for if properly regulated it cannot but be of value to the community, besides elevating and improving the condition of the mechanic and the architect.

HIGHER TECHNICAL EDUCATION.

THE subject of licensing of craftsmen is naturally associated with provision for a higher technical education in the mechanic arts. As we survey the situation, the organization of our building trades, as relates to the craftsmen themselves, is on the whole not as favorable for individual development as it was a few generations ago, when the apprentice system, with all its defects and limitations, did manage to turn out a very fair quality of workman, who at least understood his tools, and had had experience under the eye of a master who knew more than he did. The apprentice system to-day is a theory rather than a fact in most of our cities. For it the best substitute is afforded by the mechanic schools, which, in their possibilities, are undoubtedly far superior to any apprentice system, but which need to be largely broadened in their scope, and brought more closely in harmony with actual handicraft to be of the immediate value which those who are interested in them believe they should be. A good bricklayer need not possess a knowledge of integral calculus. We question even if he need a very special knowledge of even the lower forms of mathematics. But an intelligent appreciation of the material which he uses, the way in which it acts, and why it is used as it is, is quite as essential as a mere manual dexterity in the use of a trowel and cold chisel. There are some ideas which die hard with the average mechanic, such as the theory, for instance, that putting lime in cement mortar in cold weather improves the quality of the mixture and keeps it from freezing. If our manual trained bricklayer were properly instructed he would know better, and would, we venture to say, feel a keener interest in building his wall properly and using mortar in a logical as well as scientific manner. Now every one, even in this enlightened age, cannot have a technical education, and yet every one in our free country aspires to a higher position than the one he is born to; and in proportion as the intelligence of the individual craftsman is raised, it goes almost without saying that the resulting work is going to be better because of the possibilities of growth which it puts within the reach of the mechanic himself. Intelligent work is always more economical, even if the price per hour is greater. In the Southwest the saying is that it takes two Indians to do the work of one Mexican, and two Mexicans to do the work of one Eastern laborer. It isn't because there is more muscle in one case than in the other, but it is because of the intelligence which directs the hand, so that the trained mechanic is cheaper at five dollars a day than an unthinking laborer at one dollar.

UNDERPINNING HEAVY BUILDINGS.

SOME one has aptly characterized the difference between medieval construction and the more recent methods as being typified by the use of the nail and the screw, our modern construction being put up so it can be taken apart, whereas the medieval work was put in place to stay. An even more striking development of modern work is in the line of adding to a building in its vital constructive features after it is all done and occupied, a feat which would presumably have been undreamed of in the building periods of the past; but with our rapid modern growth it is every year found more and more desirable to make radical changes in existing structures, and the partial reconstruction of buildings has developed into a very interesting and quite exact science, notably in as far as relates to the underpinning or extending downward of the foundations of a building. This is a department of building which is intensely fascinating to even the most unprofessional observer, and one appreciates the capabilities of modern science more fully by following in detail some of the devices which have been forced upon constructors in our attempts to obviate the existing weaknesses of foundations, or to provide suitable supports for increased loads. The time was when foundations were put in to stay, and the thought of sinking them deep and making them broad implied a permanence which would never be disturbed. But with our modern scientific agencies we can pick up a building, hoist it in the air, build under it to almost any extent, or move it bodily for a considerable distance, not only with perfect safety and surety of results, but with an ease of operation which is a constant source of surprise even to those who are intimately associated with this kind of work. The subject forms a distinct chapter in the development of our national constructive architecture, and merits so much more than a passing note that it is our intention at an early date to take it up in detail and illustrate the subject by a series of articles which shall show what has been done in notable instances. It has special relevancy to our own peculiar field, brick having been found peculiarly adapted for the underpinning of heavy buildings, inasmuch as limitations of space usually forbid the employment of a bulky material, and brick has naturally been adopted because it affords an opportunity for thorough construction even when applied under most disadvantageous conditions. A number of the heaviest buildings in the world rest upon brick foundations, which were put in place under conditions which would have been prohibitory for any other material.

STAINING BRICKS.

IT frequently happens that a builder has to build an addition to some brick building already up; and it also happens that he cannot procure bricks to match the old bricks in color. To get over this difficulty he is compelled to use bricks available and render them the color of the old bricks by staining, or staining the old bricks to correspond with the new. There are several methods — all good — of staining bricks, and for the benefit of those builders who may require to employ one or other of the methods we submit the following: To make a good durable red stain, mix Indian red, or Venetian red, with a solution of good Portland cement, regulating the color by adding a little Spanish brown if necessary. Mix with this fine sand, washed clean and dried, before being added to the solution. Cement and sand may be used in equal proportions. The mixture is to be a little thinner than ordinary paint. It must be stirred while being used, and applied with a brush. Another red stain, which is easily applied, looks better than the first, but lacks durability. Take as follows and in proportion to amount required: One ounce of glue melted in one gallon of water, add a piece of alum the size of an egg, then a half pound of Venetian red, and one pound of Spanish brown. Try the color and mix more light or dark to suit. For a buff or cream color, use any yellow mineral paint, such as yellow ochre, adding a mineral white to make it light if necessary. For black, use asphaltum heated to a fluid state before applying. Bricks should be stained black before being laid, and the best way is to make the brick moderately hot, then dip them about one inch in the melted asphaltum, and leave them to dry before being used. This makes a good, durable job, if they are held in the mixture for a moment or two in order that the color may have an opportunity of being absorbed to the depth of a sixteenth of an inch. Another method of staining bricks black is to mix together asphaltum and linseed oil, and heat the mixture until it will mix together well. Heat the bricks and dip them in the mixture, where they should remain for a short time. The best way to stain black is to have a flat pan over a fire; fill the pan until it has about an inch in depth of the mixture. Place in the pan as many bricks as it will hold, then take out the first brick and replace it with another. Put the stained brick on a board or a clean spot to dry; then take out the second brick and put another in its place; and continue this operation until brick enough are stained, minding to keep up the supply of asphalt and oil. — *Canadian Architect.*

RIGHTS OF PURCHASER OF EFFECTS OF INSOLVENT CONTRACTOR: Where one buys at sheriff's sale the property of a contractor who has failed, and assumes the place of the contractor, under a partially performed building contract, and completes the work for him, he is entitled only to the amount which would have been due the contractor who had been overpaid for the work already done by him.— *Superior Court of Pennsylvania.*

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

NEW YORK. — As would naturally be expected, the month of November was quiet in regard to real estate and building transactions as compared with the many active months preceding, but the records show a healthy improvement over the corresponding month of '96. The most important event of the month was the decision of the competition for the New York Public Library and the award of the contract to Carrere & Hastings, architects; an award

TERRA-COTTA FIGURE, HARTFORD TIMES BUILDING, HARTFORD, CONN.
A. W. Scoville, Architect.
Executed by the Conkling, Armstrong Terra-Cotta Company.

received with great satisfaction by all; and from the illustrations published, we can predict that New York will become the possessor of a beautiful building of which we can be justly proud. The building will be erected on the site of the old reservoir at 42d Street and Fifth Avenue. Nearly $3,000,000 will be expended, and the time occupied in building will probably be at least three years. The competition for this building was the most important since the Episcopal Cathe-

HOUSE AT WASHINGTON, D. C.
A. S. Bell, New York, Architect.

dral, and we may safely say that no competition was ever more successfully or honorably conducted.

Soon after the decision of this competition the same architects were awarded the new building for the Academy of Design, another large and important work which will cost $400,000. The plans of Arthur A. Stoughton, architect, for the new Army and Navy Memorial Building in Central Park, have been accepted.

HAMILTON SCHOOLHOUSE, TRENTON, N. J.
W. A. Poland, Architect.
Front brick made by Oliphant & Pope Company.

TERRA-COTTA DETAIL, JEWELERS' EXCHANGE BUILDING, BOSTON.

Three five-story brick public school buildings, cost aggregating $750,000, are to be built at once. They will be located on 104th Street, near Second Avenue, 111th Street, near Lenox Avenue, and 104th Street, near Fifth Avenue. Frederick C. Zobel, architect, has prepared plans for a ten-story brick and stone fire-proof store and office building 75 by 100 ft., to be erected on 23d Street, near Lexington Avenue. Cost, $250,000.

Neville & Bagge, architects, have planned four five-story brick and stone flats and stores to be built on 112th Street, corner Fifth Avenue. Cost, $100,000.

BOSTON. — The two closing months of the year are seldom active ones in the building industry in the way of the giving out of new work for estimates. While these months of the present year have developed no extraordinary exceptions to this general rule, yet they have certainly shown a decided improvement over the corresponding months of 1895 and 1896: not only in Boston, but in New England generally. Considerable work projected last year and the year before, which was "pigeon-holed" pending improvement in general business conditions, has now gone ahead, and the plans for same given out for estimates or the contracts awarded.

TERRA-COTTA DETAIL, JEWELERS' EXCHANGE BUILDING, BOSTON.

One feature in connection with the stations of the Subway now open to the public is certainly open to criticism, and points to a moral distinctly favorable to the using of enameled brick or glazed terra-cotta as a covering for the iron columns or posts in public buildings in which a hurrying, crowded mass of people congregate. The posts which support the roofs of these stations are of iron encased in cement, square in form, and of about 20 ins. in diameter. When new, these posts were painted with some preparation which gave them a white, smooth surface, which did not last long, however, when they were exposed to the wear and friction of the passengers coming in contact with them. At the present time, although the stations have been in use but little over three months, these posts present a soiled, dingy aspect, but little in harmony with the glistening white of the enameled brick walls. Had the posts been encased with enameled or glazed tile they would have preserved a clean, attractive appearance, indefinitely. We are confident that the comparatively small increase in the cost of thus encasing these columns in tile, instead of cement, would be more than offset by the permanent character of the finish, which would require no attention

JEWELERS' EXCHANGE BUILDING, BOSTON.
Winslow & Wetherell, Architects.
The exterior is built entirely of cream-colored terra-cotta, executed by the Perth Amboy Terra-Cotta Company, and furnished through their New England agents, Waldo Bros., Boston.

and care beyond, perhaps, an occasional washing in soap and water; whereas, with the cement surface, there must be frequent repainting, at some expense, and at inconvenience to the traveling public.

It is to be hoped that in the stations now under process of construction in the sections of the Subway not yet completed, that the columns will be treated in the way suggested. This has been done most successfully in the Subway Station of the Illinois Central Railroad, Chicago, where all the columns supporting the roof are enclosed in glazed terra-cotta tiling.

Work on the New South Terminal Station continues to advance rapidly, and it is estimated by the engineers that about one third of the entire undertaking has been completed, showing that progress on the same has been fully up to contract time. The walls of that portion of the station technically known as the head house are now up to the second story, leaving three stories yet to be built according to the present plans. It is expected that the work of setting up the frame for the train shed will begin during January.

TERRA-COTTA DETAIL, JEWELER'S EXCHANGE BUILDING, BOSTON.

Among the new buildings now under process of construction or soon to be erected may be mentioned a $75,000 apartment house at Brookline; J. F. & G. H. Smith, architects; to be built of gray brick.

RESIDENCE AT PITTSBURGH, PA.
George S. Orth, Architect.
Front brick made by the Harbison & Walker Company, Pittsburgh, Pa.

Two residences for Francis Morton on Sutherland Road; Cabot, Everett & Mead, architects; to be constructed of brick. A mercantile building for John T. Morse, Jr., on the corner of India Street and Atlantic Avenue; W. T. Sears, architect. A brewery for the Star Brewing Company, at Roxbury, Otto C. Wolfe & Son, architects, Philadelphia; to be constructed of brick. A $50,000 business block in Malden; Tristram Griffin, architect; to be constructed of brick. A $40,000 schoolhouse at Watertown, plans for same being open to competition for architects residing in Watertown; to be constructed of brick. An insane asylum, to cost $150,000, at Cranston, R. I.; E. T. Banning, architect, Providence; to be constructed of brick and stone. New Court House at Chelsea, to cost $50,000; Wilson & Weber, architects, Boston; to be constructed of brick. New chapel at Providence, R. I., to cost $100,000; Martin & Hall, architects, Providence; to be constructed of brick and stone. Church at Hartford for the Pearl Street Congregational Society, to cost $100,000; Flagg & Bartlett, New York City, architects; to be constructed of brick and stone. A physical laboratory for Dartmouth College, Hanover, N. H., to cost $50,000; Lamb & Rich, architects, New York City; to be constructed of brick. A new jail at Fall River for Bristol County; Lewis M. Destramps, Fall River, and Nat. C. Smith, New Bedford, architects; to be constructed of brick and stone. A new Court House at Worcester, to cost $375,000; Andrews, Jaques & Rantoul, architects. A society building, to cost $18,000, at Derby, N. H., for the I. O. O. F. Society; Geo. G. Adams, architect; to be constructed of brick. A new combination store and office building at Providence, R. I.; Wm. R. Walker & Son, architects; to be constructed of buff brick and terra-cotta. The Phœnix Hall at Brockton (steel frame fire-proof building); Fuller, Delano & Frost, architects, Worcester; to be constructed of brick and stone. A new $30,000 dormitory for Smith's College, Northampton, Mass.; W. C. Brocklesby, architect, Hartford. Home for Aged Couples at Manchester, N. H.; William N. Butterfield, architect, Manchester; to be constructed of brick. A $25,000 cold storage plant at Waterbury, Conn.; A. B. Pinkham, architect, Boston; to be constructed of brick and terra-cotta. A new school-house, to cost $25,000, at Mattapoisett, Mass.; Charles Brigham, architect, Boston; to be constructed of brick. The high school at East Boston, for which plans were in competition, has been awarded to John Lyman Faxon, and is to be constructed of brick and stone. The schoolhouse for Haverhill, Mass., has been awarded

MT. ALOYSIUS ACADEMY, CRESSON, PA.
Alden & Harlow, Architects.

to C. Willis Damon, architect, Haverhill; to be constructed of brick and stone. A new $60,000 schoolhouse at Malden, Mass. Plans in competition: to be constructed of brick. A new combination store and office building at Worcester, to cost $75,000; Earle & Fisher, architects, Worcester; to be constructed of brick and stone.

CLEVELAND. — The second annual exhibition of the Cleveland Architectural Club closed November 27, after a successful run of two weeks, on the tenth floor of the New England Building, where ten large rooms and the corridor were completely filled with between 700 and 800 different drawings, photographs, water and oil colors, statuary, and the advertising exhibit.

The exhibition was divided into two parts: the regular architectural work and the exhibits by advertisers.

In the latter, interesting and artistic exhibits were made by all who took space in the catalogue. Three of the rooms were devoted to this feature.

The memorial collection of the life work of Richard Morris Hunt, loaned by Mrs. Hunt and Mr. R. H. Hunt, was given the place of honor, being located opposite the main entrance. It proved of much interest to all patrons of the exhibition.

The work of the architectural schools attracted much attention, and many questions were asked regarding methods and courses of study of these institutions; Harvard, Columbia, Atelier Masquery, University of Pennsylvania, Philadelphia School of Industrial Art, and Cornell being represented. The drawings by students of the Eçole des Beaux Arts, Paris, exhibited by, and the property of Cornell University, were most carefully and critically examined for their wonderful technical value. They were twelve-hour problems.

The government exhibit of post-offices and custom houses, recently exhibited at the Nashville Exposition, was also of interest, because of the advance shown in the design of many of the buildings. Especially interesting were the two designs rendered by Messrs. D. A. Gregg and C. D. Maginnis.

Boston was well represented by the work of Messrs. Blackall, Freethy, Gregg, Le Boutillier, Little & Browne, Schweinfurth, Peabody & Stearns, and Winslow & Wetherell.

The design for the new Cleveland Chamber of Commerce, by Peabody & Stearns, was very much admired.

The exhibition possessed one feature of merit which popularized it with the public, *i. e.*, its many exquisite water colors. So many and varied were they that every room was given a goodly quota. Of these, the work shown by Messrs. Ross Turner, J. A. Schweinfurth, Geo. P. Fernald, A. Kahn, Emil Lorch, Chas. S. Schneider, W. M. Hall, W. D. Benes, Frank A. Hays, Jamieson, and A. C. Mûnoz, and Misses Reade and Burgess deserves prominent mention.

GOODRICH HOUSE, CLEVELAND, OHIO.
Coburn, Barnum, Benes & Hubbell, Architects.

In interior decorations many pleasing designs were shown; those by Messrs. W. T. Supplee, Nicola d'Ascenzo, and G. Ketterer, of Philadelphia; Louis Rohrheimer, Cleveland; and Misses Christia M. Reade and Ida J. Burgess, of Chicago, being the most meritorious.

The work of the Cleveland Club consisted of the competition drawings of the year past, and that of its individual members. Coburn & Barnum exhibited two views of a residence now building for Mr. W. H. Lawrence, at Dover Bay Park. This house is of brick and terra-cotta, with tile roof, with interior construction of steel and fire-proofing.

Coburn, Barnum, Benes & Hubbell (firm now dissolved) exhibited views of the Goodrich House and Western Reserve Historical

ENTRANCE, GOODRICH HOUSE.

Society Building, both brick and terra-cotta buildings, the latter being absolutely fire-proof.

Knox & Elliot made a very interesting show of their work Granger & Meade occupied a goodly space with residence work, in which they have become so successful. Willard Hirsh's design for one of Cleveland's branch libraries attracted deserved attention. The building is in Roman brick and is well executed. Chas. W. Hopkinson made a goodly showing of executed work. Hubbell & Benes showed a number of clever designs of proposed buildings. Lehman & Schmitt's designs for an office building and residence of F. W. Bruch commanded attention. Arthur N. Oviatt's views of the Century Club were much admired. These club rooms are located on the fifteenth floor of the New England Building and are the finest in the city. W. W. Sabin's design for Eldred Hall at W. R. U., and Wm. R. Watterson's competitive design for the Cleveland Chamber of Commerce were carefully inspected.

The catalogue issued for the exhibition has received many flattering comments, and such a demand has been made for it that the issue is nearly exhausted.

PITTSBURGH. — There has been considerable activity in the building line during the fall. Many of our architects are now engaged on competitive drawings or laying out new work for next season, which would indicate considerable business for the coming spring. The Washington county commissioners have invited six architects to compete for the new court house plans; among those of this city are W. Kaufman, F. J. Osterling, and F. C. Sauer. The Pennsylvania Railroad Company will soon have plans ready for a new Union Depot to be erected on the site of the present structure. The Daughters of the Revolution have authorized Architect Miss E. Mercur to prepare plans for a custodian building which will be erected on the old Block House property at the Point. The school directors of the Third Ward, Allegheny, have adopted the plans submitted by Architect F. C. Sauer, for their new school building. Architect Joseph Anglin will prepare plans for a three-story brick and stone hall building, 60 by 120, for the Fraternal Hall Association, to be erected at McKee's Rocks. Architects George Orth & Brother are preparing plans for a three-story brick warehouse for Jacob Graff, to be erected on Penn Avenue, East End. Architect Sidney Heckert has prepared plans for a large residence, to be built of Pompeian brick and stone, for Harry Robins, and to cost $45,000.

INTERESTING NEWS ITEMS.

THE CUMMINGS CEMENT COMPANY have secured another large contract to furnish their Obelisk (Natural) and Storm King (Portland) brands for canal work. This will necessitate running the works most of the winter.

THE Bolles Sliding and Revolving Sash have been specified for the new twelve-story office building corner Charles and Fayette Streets, Baltimore, Md.; Winslow & Wetherell, architects, Boston, Mass.

O. W. PETERSON & CO., Boston, have removed their office from 611 to 505 John Hancock Building. They now have a fine exhibit room, in which is shown a full line of dry pressed and stiff mud-clay products.

WALDO BROTHERS have secured the contract for furnishing Atlas Portland cement to B. T. O'Connell, for approach of new Charlestown (Boston) bridge. The price was considerably in excess of other American Portlands, but Atlas was the only brand submitted that passed the test.

THE HYDRAULIC-PRESS BRICK COMPANY, of St. Louis, have closed contract with Drainage Commission, of New Orleans, La., for 100,000 enamel brick for various pumping stations; work to commence at once. They are now putting on the market a white brick with an impervious non-absorbent face and without a glaze. On

MAIN ENTRANCE, GOODRICH HOUSE.

PORTION OF FRONT OF BUILDING FOR EVANS ESTATE, BUFFALO.
E. A. Kent, Architect.
Terra-Cotta executed by the Northwestern Terra-Cotta Company.
(The whole front of this building is of terra-cotta.)

account of the increased demand for enamel brick they have been compelled to add to their already large kiln capacity.

THE winding iron stairs in the building of the Boston Art Club, on Dartmouth Street, have been covered with their protective device by the American Mason Safety Tread Company, constituting a safeguard which will be much appreciated by members and guests of the club.

WALDO BROTHERS will supply Atlas Portland cement to Joseph Ross for work at foot of Summer Street, Boston, part of Terminal Station improvement, the cement being approved by Wm. Jackson, city engineer, after careful tests.

HOLBROOK, CABOT & DALY have purchased of Waldo Brothers Atlas Portland and Hoffman Rosendale for their contracts for city of Boston abutments at Back Bay Fens, also for New York, New Haven & Hartford Railroad work at Readville, Mass.

THE CELADON TERRA-COTTA COMPANY, LIMITED, Charles T. Harris, Lessee, has closed contracts for roofing tile for Emerson Hall, Beloit College, Beloit, Wis., wave pattern; Patton & Fisher, architects, Chicago. Residence for Wm. Guernsey, Chicago, 8 in. Conosera, Geo. L. Harvey, architect. Residence for Nathan Herzog, Chicago, open shingle; Handy & Cady, architects.

THE architectural terra-cotta for "The Westminster," Copley Square, Boston, H. E. Cregier, architect, Woodbury & Leighton, builders, will be furnished by Waldo Brothers, who are agents for the Perth Amboy Terra-Cotta Company. This is the largest contract for terra-cotta which has been awarded in Boston in a long time.

THE DAGUS CLAY MANUFACTURING COMPANY, manufacturers of front brick, report a business that keeps their plant running on full time. They have recently opened a new clay bank, located on their premises, which yields a clay that makes a very handsome shade of buff brick. Among the contracts recently closed by this company is one for 40,000 pink Roman brick for a residence at Buffalo.

MR. JAMES R. PITCAIRN, of 337 Fifth Avenue, Pittsburgh, Pa., is now the Pittsburgh agent of the Ridgway Press Brick Company, of Ridgway, Pa. Mr. Pitcairn, although having had the agency of the "Ridgway" product for but a few months, has already furnished their mottled grays for two very creditable operations, and their stiff mud buffs for two more, and has now orders in at the factory for four large operations to be built of mottled gray Roman brick.

ANTHONY ITTNER, the well-known brick manufacturer of St. Louis, reports a decided improvement in his business. The demand for his pressed and ornamental bricks for shipment to distant points has been a conspicuous feature of his business for the year. One of these orders called for 100,000 bricks to be shipped to Dallas, Texas, for the St. Paul's Sanitarium, and another for a shipment to Fort Cook, Neb.

POWHATAN CREAM-WHITE BRICKS have been used in the following operations in New York City: Apartment house, 107th Street, near Amsterdam Avenue; W. J. Casey, builder. Apartment house, northwest corner 86th Street and Central Park West; James

ST. FRANCIS CHURCH, COLUMBUS, OHIO.
Yost & Packard, Architects.
Built of rock-faced and plain bricks, made by the Columbus Brick & Terra-Cotta Company.

Livingston, builder. Business building, 590 Broadway; J. A. Zimmermann, builder. Light Courts St. James Building, Broadway and 26th Street; S. E. Moore, contractor.

THE CENTRAL FIRE-PROOFING COMPANY have recently taken contract to furnish and set in place, the terra-cotta fire-proofing for Bellefield Hotel near Pittsburgh. They are now furnishing and setting fire-proofing for the Land Title & Trust Building, Philadelphia, and Arbuckle Sugar Refinery, Brooklyn. They are also furnishing material for Pavilion Building, Boston, Astoria Hotel, Syndicate Building, Park Row, Columbia College Building, New York University Buildings, and many others in New York city.

THE RIDGWAY PRESS BRICK COMPANY, through their Pittsburgh agent, Mr. Jas. R. Pitcairn, are furnishing the mottled gray Roman brick for Joseph Horne & Co.'s new six-story store building at Pittsburgh.

Joseph Horne & Co. are the largest wholesale and retail dry goods, etc., dealers in Western Pennsylvania, and this store, when completed, will make a notable addition to Pittsburgh's already long list of fine buildings. Peabody & Stearns, of Boston, are the architects; Henry Shenk & Sons, general contractors; and C. B. Lovatt & Bro. are the bricklaying contractors.

A CITY RESIDENCE.
Hobart A. Walker, New York, Architect.

WE are in receipt of a very attractive pamphlet of some ten pages from the Illinois Steel Company, Chicago, describing the character and merits of their steel cement. This cement is manufactured mainly from the blast furnace slag obtained from the smelting of iron ores. It is ground to the greatest possible degree of fineness and is claimed to be particularly desirable for heavy concrete work where high strength is required. In the pamphlet is also recorded a number of tests of steel cement. Accompanying these tests there are some very flattering testimonials from prominent concerns who have used the cement and endorse it as being entirely satisfactory.

STORE BUILDING, DETROIT, MICH.
Gustav A. Mueller, Architect.

A NEW candidate for honors in the way of enamel brick is the Pennsylvania Buff Brick and Tile Company. Office, Trenton, N. J.; works at Saylorsville, Pa. For the past two years the company have been conducting a line of experiments on enamel bricks in an extensive way, and are now turning out a most desirable article. During the last six months they have made many alterations and additions to their already extensive plant in order to be fully equipped to handle to the best advantage the large business they anticipate on this branch of their output. The conservative, methodical progress which the company has made in the production of satisfactory enamels would indicate that they are upon a proper basis to satisfactorily supply the demand for a good enameled brick.

THE PANCOAST VENTILATOR COMPANY has bought out the interest of Mr. R. M. Pancoast, who has resigned the vice-presidency and withdrawn from all connection with the company. They report a very gratifying increase in their business. Beside the contract for supplying the ventilators for the Astoria Hotel and a ten-foot ventilator for the Manhattan Beach Theater, they have had them specified for the new Liberty Silk Mills, at 57th Street, New York, and a 66 in. one for the Purdue University, of Lafayette, Ind. In addition to their regular line of ventilators, they have a new Common Sense ventilator, which is much appreciated by those in offices and sleeping rooms.

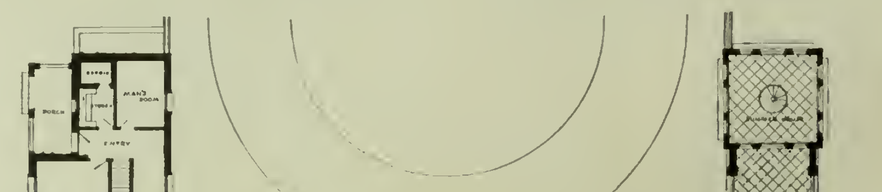
THE COLUMBUS BRICK AND TERRA-COTTA COMPANY have closed the following contracts to supply their bricks in New York City: Two flats, 112th Street, light-gray standards; Edward Wenz, architect. Four flats, 119th Street, light-buff standards; John Brandt, architect. Flats, 116th Street, dark gray Romans; G. A. Shellinger, architect. Grammar School No. 13, Huston Street, light-buff standards; C. B. J. Snider, architect. Stable and dwellings, 77th Street, terra-cotta Romans; A. M. Welch, architect. Two flats, 103d Street, dark-gray Romans; G. F. Pelham, architect. Office building, Broadway and 19th Street, gray speckled Roman. The following list of buildings in other localities are being supplied with their bricks: Arnold Building, Knoxville, Tenn., light-gray standards; Baumann Bros., architects. Stores and offices Napoleon, Ohio, gray standards; E. O. Fallis, architect, Toledo, Ohio. "Majestic" apartment. Atlanta, Ga,. light-buff standards; Willis F. Denny, architect. Chapel, Soldiers' Home, Dayton, Ohio; dark-buff standards. Residence, R. H. Morrison, Charleston, W. Va., terra-cotta Romans; Harrison Albright, architect. Bank, Tarrytown, N. Y., light-buff standards; Robertson & Manning, architects. Store, Elder & Tuttle, Springfield, Ohio, terra-cotta and gray. Burt's Theater, Toledo, Ohio, light-buff and dark-gray standards; Mills & Wachter, architects.

COURT, HOUSE FOR H. H. COOK, ESQ., LENOX, MASS.
Peabody & Stearns, Architects.

WE have recently had our attention called to the Standard System of Slate Fastening as being one which combines many good points in the fastening of slate shingles and obviates many bad ones, and we are glad to bring the same to the further notice of our readers. This system is known as the Standard Slate Fastener, and is a simple yet most practical device for the securing of slates to the roof in an absolutely rigid manner. The fastener is made from galvanized steel wire cut in lengths from 4 to 5 ins., bent at one end in the form of a crook, and at the other, so as to make a sharp angle at about 1½ ins. from its termination. This end is made with a sharp point and is to be driven to the depth of its elbow into the roof proper, which brings the main shank of the fastener flush with the roof, and allows the crook to project to its own height (½ in.).

The end of the slate at about its center is then slipped into the crook and held there in a secure manner. As the fastener is from 2 to 3 ins. in length from the elbow to the crook, it allows the next layer of slate to overlap the preceding one just that distance, and as each fastener is driven between the joints, there is no punching of holes in the slate. The fastener comes also with snow-guard attachment if desired. It is claimed by the company that 50 per cent. is saved in time of laying slate by the use of this system over any other.

Parties interested may obtain full information by writing the manufacturers, Hamblin & Russell Manufacturing Company, Worcester, Mass.



FIRST FLOOR PLAN.

SCALE DRAWINGS OF ELEVATIONS SHOWN IN PLATE FORM.

HOUSE FOR H. H. COOK, ESQ., LENOX, MASS.
Peabody & Stearns, Architects.

WE are in receipt of the new illustrated catalogue issued by Henry Maurer & Son, New York City. This is a particularly interesting work of about one hundred pages, and shows every evidence of great painstaking in its compilation; while primarily its object is to describe the particular products of the above-named company, yet there is incorporated in its pages much general information regarding the practical use of burnt-clay fire-proofing. Several pages are devoted to the enumeration of a list of over three hundred large buildings, located in various parts of the country, for which the company furnished the fire-proofing. Following this are some sixty pages devoted to a full and comprehensive description of the various fire-proof arches, partitions, furring, column covering, roof and ceiling tiles, etc., which the company manufactures. These are further explained by twenty-two colored plates, illustrating their various purposes. In connection with this portion of the catalogue there are introduced a number of interesting extracts from articles written by various authorities pertinent to the subject of proper fire-proof construction, also a review and criticism of some public tests of fire-proofing made at different times in New York City and elsewhere.

In the closing pages of the catalogue there are twenty-nine full-page half-tone illustrations of prominent buildings recently constructed in New York and Philadelphia, for which this company supplied the fire-proofing. The general excellence evinced in the arrangement of the catalogue, and the real value of the matter encompassed in its pages makes it a volume to be desired by all interested in the subject of fire-proof construction.

RESIDENCE OF H. H. COOK, ESQ., LENOX, MASS.
Peabody & Stearns, Architects.

The New York and Rosendale Cement Company furnished 65,000 barrels of cement for the New York Croton Aqueduct during 1897.

The tests of Portland cement usually made as to fineness, tensile strength, at one and four weeks' setting, etc., do not afford an opportunity to ascertain if the cement under test possesses other qualities which for practical purposes are equally if not more valuable. The customary tests of cement give no evidence regarding its strength when mixed with a larger proportion of sand, regarding its uniformity, constancy of volume, durability, adhesiveness, impermeability, resistance to violent changes of the atmosphere, and to abrasion by wear. Information as to these qualities can only be obtained by the observation of long-time tests, the results of the employment of the cement in practise, which must be taken into consideration, together with the results of the usual tests, to form a judgment of the relative value of several cements.

The Dyckerhoff Portland Cement will pass the requirements of all tests compatible with the best quality, and the well-known results of its employment for more than thirty years have demonstrated that it possesses in the highest degree all the qualities desirable in a Portland cement, and justify the reputation that the Dyckerhoff is the best Portland cement made.

Mr. E. Thiele, 78 William Street, New York, is the sole agent for the United States for the Dyckerhoff Portland cement, and will be pleased, on application, to forward a pamphlet describing this cement more fully, and containing directions for tests, employment, and testimonials.

The Dyckerhoff Portland cement is for sale by Messrs. Ham & Carter, 560 Albany Street, Boston, and all the leading dealers in building materials throughout the country.

The Union Akron Cement Company, Buffalo, are supplying the cement for the new brewery building at Washington, Pa.; also large quantities of cement for work on the Erie Canal.