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THE English Society of Arts has interested itself to some purpose in the question of improving the dwellings of the very poor, and a rich member having placed at the disposal of the Society the generous sum of six thousand dollars, to be used in obtaining suggestions in regard to the matter, it has been decided to expend the money in prizes, which are now offered for the best essays on the methods for promoting good, wholesome and economical construction for such buildings. The largest single prize, of twenty-five hundred dollars, is offered for the best practical paper on the reconstruction and sanitary improvement of the central portion of London; the others being for essays on less comprehensive subjects of the same general character. The essays are to be submitted on or before December 31, of this year. Particulars of the competition may be obtained from the Secretary of the Society of Arts, London. Perhaps some one of our readers may feel himself competent to treat such subjects with profit to the public, and there is at least ample room for investigation and improvement.

ONE of the greatest difficulties which those who wish to improve the lowest class of houses have to contend with is the dislike of those who are to live in them for the labor necessary to keep their rooms in order, and their resentment at the rules which the tenants of the improved houses are generally obliged to comply with. No beings of the world are more careful of their dignity, or more fearful of being imposed upon, than paupers and tramps, and their haughty stomachs revolt at being subjected to regulations which more intelligent and better trained persons obey with cheerful zeal. Even so respectable an individual as one who attended a meeting of the Society of Arts not long ago, and took part in a discussion on this subject, assured the company that although he and his son lived in one wretched little room in a building in Drury Lane, so crazy that portions of the wall were actually held together with bits of floor-cloth, he would not consent to exchange his miserable dwelling for one in the new model houses, if, by so doing, he must submit to the restrictions which are imposed upon their tenants; and so universal is the abhorrence of the very poor for houses in which they are either obliged to keep their own rooms clean, or to have them cleaned by some one else, that even so sincere a philanthropist as the editor of the *Builder* seriously asserts that the great majority of the inhabitants of the vile London rookeries have either been born in such places, and know nothing better, or have voluntarily abandoned home comforts "from sheer love of drink, of vice, and filth." "They like," he continues, "to herd with the swine," and so far from aspiring after an unattainable cleanliness and comfort, they detest soap and water as much as they do decency and self-control, and would soon make the improved houses, if they were compelled to live in them, as foul as their present habitations.

THERE is undoubtedly much truth in this, and those who are to be the means of conferring upon the world the inestimable blessing of a reform in cheap dwellings must meet this, as well as the other difficulties of the problem, with due consideration. It is, of course, unnecessary to plan buildings with a view to gratifying the filthy inclinations of those who are to live in them, but these filthy inclinations should nevertheless be taken into account, and their exercise guarded against, so far as planning can accomplish that end. It would be too much to expect that the public authority should take upon itself to scrub all tenement-houses, with their inhabitants, regularly every Saturday night, wholesome as such an operation would be; but something of the kind might be done by arranging the new houses so that all public halls and stairways, and all unoccupied rooms, could be thoroughly washed with a hose by the janitor at short intervals; and by closing summarily all tenement-houses which should reach a certain degree of filth; so that the dirtier part of the population should be as it were, pushed bodily along, by imperceptible degrees, out of the mire into sunshine and decency. When it came to choosing between a lodging in the open air or in a house which was occasionally cleaned, even the most unwilling pauper would have to yield, and with many of the younger ones the novel experience might be the starting-point of a life correspondingly purified.

THE recent fire in the St. George apartment-house in New York has caused much discussion among the firemen, as well as among architects and builders in that city, to whom the proper construction of these great tenements is a matter of serious interest. In such cases as this it is only fair to say that the most intelligent criticisms of the circumstances which promote the destructive effect of the fire, and the best suggestions as to the means for guarding against them, almost always come from the firemen, and a member of the New York Fire Department has just called attention to the fact that the present mode of protecting elevator-shafts by brick walls, pierced with openings for doors in each story, and often for windows also, is little better than the old plan of leaving them entirely open. It should be remembered that in any case the elevator-shaft serves as a chimney, into which smoke and flame from a fire in any part of the building are immediately drawn, to distribute themselves again, if they find no other means of escape, through the wide openings into every other part of the structure. This was the result in the St. George building, where a fire starting in the basement broke out almost at the same moment in every story above. If the elevator-shaft had not happened to be the nearest flue for the fire, any one of the numerous dumb-waiters, ash-shoots or light-wells which perforated the building vertically, with openings on each story, would have answered the same purpose, so that the protection necessary for one must be applied to all, if a building so planned is to be made reasonably safe.

THE *Fireman's Journal*, in commenting upon Mr. Bates' letter, remarks that the method of closing elevator-shafts by hatches at every floor, which is still, perhaps through a misconception on the part of the underwriters, applied to many warehouse elevators enclosed in brick walls, serves no good purpose under such circumstances. On the contrary, the hatches, by opposing the fire which rushes upward through the shaft, drive it out through the doors, and as they are generally of mere light wood-work, each resists the flames just about long enough to insure their thorough dispersion through the door below it before it is itself consumed, admitting the fire to a fresh story, where the process is repeated. The most effectual remedy for this, as the *Journal* suggests, is to omit all hatches in shafts surrounded by incombustible material, leaving them clear from top to bottom. The upper walls of the shaft should be carried through the roof of the main building, and a few feet above, so as to make it certain that a fire in the shaft will not be communicated to the roof timbers, and a skylight should be put over the top of the shaft, so that the heat from a fire below, entering the elevator openings, may break the glass, leaving the shaft free to act as a chimney, up which smoke will pass without any tendency to break out into the rooms. An arrangement exactly similar to this is now enforced by law in Boston for elevators, and the same principle might with advantage be applied to all light-wells, dumb-waiters and so on. It is worth remarking that the St. George building was advertised as "fire-proof," in order to attract tenants, and some of the latter, who lost property by the fire, propose to demand indemnity from the owners for the damage which they have sustained in consequence of trusting these false representations. We sincerely hope that they will win their suit, and that all other persons who have suffered in the same way will be encouraged to claim similar reparation. Until it is made impossible for men to build nine-story apartment-houses, or huge storage warehouses, with floors of hollow wood-work filled in, perhaps, with a few cinders, and then to advertise them as "fire-proof," and after collecting by this means the best class of customers at high prices to leave their dupes to bear their losses as best they may when the "fire-proof" building burns up, it is useless to expect much improvement in the construction of such edifices, or in the morality of their owners, and it is quite time that an example should be made of some of these individuals.

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WE are glad to do what we can to give greater publicity to an appeal from the Egypt Exploration Fund Society for money to pay for the excavations now begun at Zoan or Tanis, the most famous city of the Delta of the Nile, the capital of the Shepherd Kings, who held their court there for five hundred years; and, later, when the revolt of Upper Egypt had transferred the seat of government far toward the South, the great frontier town through which most of the traffic between Africa and Asia passed. An attempt at exploration was made here by Mariette Bey, who discovered an extraordinary series of interesting objects; but he was soon obliged to transfer his labors to a different region, and Tanis still remains practically untouched. There can be no doubt that vast treasures of historical and archæological wealth lie buried here, waiting for the spades of M. Naville and his laborers, and a contribution to this work will probably do more to extend the knowledge of antiquity, or, perhaps we might say, of humanity, than any others which could possibly be made. The whole sum needed is a small one, twenty or twenty-five thousand dollars being considered sufficient, under M. Naville's skilful and economical management, to do all that is necessary, and to pay for presenting the report of the results, in print, to the contributors. About half of this amount has been raised by large subscriptions, but for the rest it will be necessary to depend upon contributions of small sums, averaging probably not more than five dollars. Those who are disposed to identify themselves with the undertaking may send their subscriptions to the Reverend William C. Winslow, 429 Beacon Street, Boston.

A CORRESPONDENT of the *Builder* gives a few details of the Italian method of making and using lime mortar which are new to us, and of considerable interest, as are nearly all the particulars of construction as practised by these skilful workmen. In the opinion of the *Builder's* correspondent, most of the modern Italian processes are identical with those practised in the same country by the ancestors of the present inhabitants two thousand years ago; and he believes that the good quality of the Roman mortar, which has been proverbial for centuries, belongs equally to that made every day in Naples or Perugia. As every one knows, the custom among the Italian masons is, on commencing work upon a new building, to dig first a pit, large enough to contain all the mortar required for the work, into which is put lime enough to fill it within a foot or two of the top. Water is then poured in until the pit is filled, and the mixture is left to itself, care being taken only to add water as that first put in is evaporated or absorbed. As mortar is wanted, a portion of the lime is taken from the top of the mass, but the lower portion, which will be used to mix with the plastering mortar, remains undisturbed for years, and acquires a smooth pasty quality much prized by the Italian architects, who place a value upon the lime which they use for such purposes proportionate to the length of time which has elapsed since it was first slaked. The good effect of this mode of preparation is seen in the perfect stability of the mortar, which never swells or cracks, and, when used in brickwork or stone masonry, is never observed to give rise to those disfiguring efflorescences which are almost inevitable with us. On plastering mortar thus made there is no difficulty in laying the fresco colors which are used in Italy with such splendid effect, but which burn out into pale and unsightly patches when laid upon our raw, half-slaked mortar.

WITH lime treated in this way work can be executed which would be impossible with such materials as we employ. As an instance of this the correspondent of the *Builder* quotes the *battuto* roofing which is constantly used to cover costly and important buildings in Southern Italy, and which consists simply in a thick coating of lime mortar, spread over the timber work, and beaten continually with heavy clubs for ten days or two weeks in order to consolidate it. The climate of Southern Italy is rainy, if not cold, but these roofs, which, if made of what we consider good lime mortar, would transmit water like a sponge, serve there to protect for centuries the house beneath. The same kind of work is used for floors, taking the place which would be filled among us by cement concrete, and the beaten lime floors appear to be as hard and smooth as anything that we construct with much more costly materials. That this difference in quality between our own and the Italian mortars is due to the mode of treatment, rather than the original character of the lime used, is indicated by the fact that many different varieties of limestone are employed there, according to circumstances of locality or convenience, without any material variation in the result; the Italian workmen having learned that art which we care so little for, the making the best of poor or indifferent materials. The entire letter is so interesting that we reproduce it at length in another part of the paper.

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*ENGINEERING* gives some interesting facts in regard to the present condition of the manufacture of refined petroleum from the oil obtained at Baku, in South-eastern Russia, near the Caspian Sea. Our readers know already that the Baku wells are very productive, the yield exceeding that of the Pennsylvania wells in their best days, and immense refineries have been built on the spot, for utilizing the oil as it flows from the wells. The largest of these establishments is that of the Nobel Brothers, which, although compactly planned, occupies a tract of ground a mile square, and sends out something like two thousand tons of marketable oil a day. A large portion of this oil is in the form of heavy residue, which is used for fuel by hundreds of steamers on the Caspian Sea and the River Volga, and in most of the locomotives on the railways of South-eastern Russia. The heating effect of the petroleum fuel is said to be three times as great as that of an equal weight of coal; and it is made to burn without smoke in the improved furnaces, while the expenses of hauling and transportation are very much less than those incident to the use of coal. The kerosene, or ordinary illuminating oil, forms a much smaller proportion of the raw Russian petroleum than of the American; our refineries extracting seventy-five per cent of kerosene from the same quantity of crude oil which at Baku yields but twenty-seven per cent. The quality of the Russian kerosene is said, however, to be somewhat superior to that exported from the United States, and the raw material is so abundant and cheap that the Nobel standard kerosene is sold at the works for two cents a gallon. Kerosene being the most rapidly sold of the petroleum products, the smaller distillers, who have not enterprise enough to seek a market for the heavier and lighter portions of the oil, throw them into the sea, reserving only enough of the heavy oil to burn under their distilling retorts and in the furnaces of their steam-pumps; but the largest firms, with the economy characteristic of those who know both how to gain and to use wealth, utilize nearly everything, refining the naphtha, which they sell in Russia for use in various industrial processes and extracting from the heavy portions a very good lubricating oil, which is sold all over Europe. To carry out still farther this economy in manufacture, an attempt has been made to separate vaseline from the oil, and it is intended soon to establish a factory for making paraffine candles, and perhaps also for carrying on such delicate processes as that of extracting aniline, and converting it into the costly dyes so much in use.

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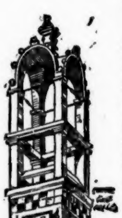
IT is announced that the preliminary competition for the monument to King Victor Emmanuel has resulted in the award of three equal prizes, of ten thousand francs each, to Messrs. Manfredi, Sacconi and Smith, the last-named being an artist of Dusseldorf. Four second prizes, of five thousand francs each, have also been awarded. In accordance with the stipulations of the programme, the recipients of the three first prizes have been requested to present models of their designs, one of which will be selected for execution.

## BUILDING MATERIALS OF CLAY.[1]



CHIMNEY TOP. STRASBURG-ALSACE.

NOT content with being among the leaders in all the arts, the French seek, and deserve, the honor of being generally the first to collect and record, at convenient periods, the improvements and discoveries which all nations are constantly contributing toward the sum of knowledge on each particular subject. The manuals so composed are, as all students of technical processes know, among the most useful of their class, setting forth with clear and comprehensive view the actual state of the art of which they treat at each given period, in a form so condensed, yet with such minute detail in important points, as to serve equally well the general reader, who cares merely for a superficial knowledge of the subject, and the practical manufacturer, who needs a book which he can keep on his office table, for continual reference until another decade or so shall have brought its burden of fresh innovations and improvements, to be duly digested and presented to him in another manual, of a kind similar to the first.

One of the very best among the recent books of this class is certainly M. Foy's "*Céramique des Constructions*." More concise than many of them, it is yet very thorough, containing within the limits of a small book of less than three hundred pages the whole modern art of pottery and baked-clay work, so far as such work is applicable to buildings.

The introductory chapter, very naturally, presents a description of the different varieties of clay, mentioning the sorts most used in France, Germany and Belgium, and giving an analysis of the more important kinds, with an excellent comparison of their qualities. Bricks and roofing-tiles form the subject of the next chapter, which is a long and interesting one. The historical sketch with which it begins, after mentioning the various forms under which the Romans employed burnt clay for construction, speaks particularly of the large, thin bricks employed in Languedoc at all periods, from the time of the Roman domination down to the fifteenth century. During the years following the German invasions the art of making good bricks was lost, and the great mediæval churches of Languedoc are built of materials so badly burnt and spongy that they absorbed the moisture from the mortar in which they were laid, and were consequently set with joints nearly as thick as the bricks themselves.

The manufacture of roofing tiles, which was also introduced by the Romans, seems to have been pursued with greater vigor and success in France than that of bricks, and so early as the eleventh century the tile-makers of the northern provinces, finding the curved "pan-tiles" of the Romans unsuited to their stormy climate, devised an improved form, much resembling that still common in those districts. In the thirteenth century the manufacture had still further advanced, and great quantities of beautiful enamelled tiles were made in Champagne and Burgundy, of such excellent quality that they still remain on some ancient roofs as perfect as when they were first set in place.

The description which the book gives of the modern manufacture of bricks includes three processes; the first being the ancient one, in which the clay is mixed with water, then moulded, dried and baked. This, although generally acknowledged to be the best, is a long process, since the drying of the little masses of damp clay must be continued in the open air for about a month, before they can be placed in the kiln without danger. Besides time, the operation of drying requires a large extent of ground, since the bricks must be arranged in long, open rows; and it is usually necessary to provide also shelter, in the shape of immense open sheds, to prevent their destruction by heavy rains. For these reasons many attempts have been made, with greater or less success, to employ for the purpose powdered clay, either dry or slightly dampened, and brought to the proper shape and consistency for burning by strong pressure. Under the "half-dry" process, the clay, after the usual operations of pulverizing and mixing, is sprinkled with one-fifth its volume of water, then again thoroughly ground, with a sufficient quantity of sand to moderate the shrinkage as desired, and forced into cast-iron moulds, well oiled, from which it issues in hard, well-formed masses, ready, after a few days' drying, to be exposed to the fires of the kiln. When well made, these "half-dry"-process bricks are superior to any others, the pressure forcing the clay into every part of the mould, and giving it a smooth, polished surface unattainable in hand-moulding. The process of manufacture with clay entirely dry is much the same as with that slightly moistened, but requires still greater care, and machinery of greater power, since the manipulation of the dry mass is much more difficult than that of a soft paste. As the bricks require little or no time for drying, before placing in the kiln, a considerable economy of space and time is secured, and, if well made, the tiles and hollow bricks produced in this way are excellent in quality; but with bricks, according to M. Foy, it is found that the enormous pressure of the moulding machines, amounting to more than a thousand pounds on a square inch, has the effect of forming a stratum of air bubbles, which are forced out of the superficial portions of the clay, and make a place for themselves in the spongy inner mass, half an inch or less beneath the surface. This imprisoned air expands during the process of baking, causing seams, which penetrate deeply into the mass, and render the dry-process bricks usually inferior to those of other kinds.

Next to the composition and mixing of the clay material, the burning is the most important process in the fabrication of bricks and tiles, and many of our readers will be surprised to learn how great are the improvements which have recently been made in this part. Nearly every one knows something of the ordinary method, by which the unburnt bricks are piled up in a cellular mass, through which the smoke and flame from fires kindled in the lower portion are allowed to circulate for several days, until the whole is sufficiently baked, the bricks being then, after cooling, taken down and sorted for sale. This operation, as usually carried on, requires the consumption of about five hundred pounds of coal, or one-third of a cord of wood, for the production of each thousand bricks. It is evident that such a mode of burning occasions a certain loss of heat, and consequent useless expenditure of fuel, since after the bricks have once been brought to the proper temperature for baking, all the warmth radiated from them into the air in cooling is wasted; and many devices are employed for utilizing this heat. In some cases drying-sheds are built on the top of the kilns, which are occasionally made permanent structures, and in others two or three small kilns are superposed, so that the waste heat from the burning of the bricks in the lower ones may serve to dry, and partially burn, those in the upper ones, which need, in consequence, only a small fire of their own, to complete the baking of the contents.

The success of these superposed kilns seems to have led to the greatly improved device known as the Hoffman kiln, in which the ovens, instead of being superposed, are placed side by side, the heated gases, instead of rising vertically, being led from one oven to the next by the draught of a chimney. In place of two or three successive ovens, moreover, the Hoffman kiln contains from twelve to twenty, or even more, the draught of the chimney flue ensuring the passage of the products of combustion through a series of any length. In practice, the successive cells of the Hoffman kiln are arranged in an oval form, each having a pipe to the main flue, or rather, an opening into a main longitudinal flue, which can be closed at pleasure; a movable partition, either of iron or wood, being also provided, by which the communication between any two cells can be interrupted. By inserting the partition between two given cells, leaving the others in free communication, and opening the flue of the cell next the partition on one side into the chimney, closing the rest, a current is established which will draw the smoke of a fire kindled in the cell on the other side of the partition through the entire range. Openings, with covers, are provided in the top of each cell, by which coke, or other combustible matter, can be introduced from above; and each cell communicates with the exterior air by means of a door, which can be tightly closed at pleasure. The operation of the kiln can be understood by imagining one, say, of fourteen compartments, in which, at the time of our first inspection, the movable partition is temporarily placed between the compartments numbered 1 and 14, which, as the kiln is round or oval, adjoin each other. The flue of compartment 14 will then be placed in communication with the chimney, all the other flues being closed; and the outer doors of compartments 1 and 2 will be open. At both of these doors a gang of men will be busy, placing unbaked bricks, fresh from the drying-shed, in No. 1, and taking out from No, 2 the finished bricks, baked and completely cooled, which it contains. The compartments numbered 3, 4, 5, 6 and 7 contain bricks which have been baked, and are in process of cooling, those in No. 3 being the coolest, those in No. 4 a little warmer, and so on, up to No. 7, the bricks in which have just been baked. In cells No. 8 and 9 the baking is actively going on, and men are shovelling fresh coke into them through the openings in the top. The smoke and heated air from the fires are drawn through compartments 10, 11, 12, 13 and 14, each of which contains unbaked bricks, to escape at last from No. 14 into the chimney. As the doors of cells No. 1 and 2 are the only ones open, all the air which passes into the kiln, and supplies the combustion in the eighth and ninth compartment, must enter through them. These cells are entirely cold, but the walls and contents of cell No. 3 still retain a little heat, which is imparted to the air passing over them. In cell No. 4, which is still warmer, the air is further heated, and arrives at No. 8, after passing over the freshly-baked contents of the intermediate cells, so hot as to aid very materially the action of the fire in the two burning compartments. From these, intensely hot, and mixed with smoke and gas, it enters the succeeding range of cells filled with unbaked bricks, losing in each a portion of its heat, which serves to dry and warm the mass, until it reaches the end of its course, retaining by that time just heat enough to enable it to escape by the chimney.

By the time that cell No. 1 has been filled with fresh clay, and cell No. 2 has been emptied of its contents of finished bricks, the calcination in cell 8 will be complete. The stoke-hole in the top of that cell is then closed, and that of No. 10 opened to receive fuel. At the same time, the movable partition is shifted from between cells 14 and 1, and is placed between 1 and 2; the outlet flue of No. 1 being also opened, and that of No. 14 closed. Compartment No. 2, which has just been emptied of its finished bricks, is now refilled with those freshly moulded, and the completed ones in No. 3, which have by this time lost all their heat, are taken out through the door, which is opened at the same time that that of No. 1 is shut. As fast as one cell is filled, and the adjoining one emptied, the shifting of the partitions, with that of the flues and fires, is repeated, the successive

[1] *La Céramique des Constructions*; par Julien Foy. Paris: Ducher & Co., 51 Rue des Ecoles. 1883.

stages of the process thus following each other round and round the kiln indefinitely.

That there must be great economy of fuel and labor in this method of burning bricks or tiles is obvious enough; the extent of the saving effected cannot be fully appreciated without the help of statistics. These show a considerable variation in the results obtained, and probably much depends upon the adaptation of the number of cells in the kiln to the character of the clay and fuel employed; but the average consumption of coal, in those already established in France, is not more than one hundred and seventy pounds of coal to a thousand bricks, or about one-third the average quantity by the old method; and some Hoffman kilns show an economy considerably greater than this.

The main difficulty about the use of the Hoffman kiln is its enormous productiveness, if such a word can be applied to an inert mass. Even the smaller ones, which give an economy relatively less than that offered by larger constructions, need, to keep them in the constant operation for which they are designed, a supply of at least four or five thousand crude bricks a day; and some of the largest can bake with ease from fifteen to twenty thousand, while one, at Vienna, delivers regularly eighty thousand bricks a day. Such a production as this would be likely to overstock the market in all but very populous districts, or perhaps in those places where the brick-making season is short, and operations must be carried on rapidly for a few months.

The Hoffman kiln is now used for burning lime and cement, as well as for baking bricks; and the largest kilns yet constructed are devoted to these purposes; one, which measures nearly four hundred feet in length, and has twenty-eight compartments, turning out seventeen hundred barrels of lime a day; while another, at Boulogne-sur-Mer, produces daily a hundred tons of Portland cement, or nearly six hundred barrels.

A curious variation on the continuous kiln has been devised, which is perhaps capable of application on a smaller scale. The principle of this consists either in moving the fire contained in an iron cage mounted on wheels past a range of bricks; or in placing the bricks themselves on trucks, and moving them successively over the fire. This system, which has not yet been subjected to the test of long experience, has the advantage that the loading of unbaked bricks, and the unloading of finished ones, always take place at the same point, so that there is no shifting of men and tools around the kiln.

It would take too long to mention the other devices for baking clay with economy and rapidity which M. Foy's book describes; the general reader will be satisfied with the simple reference to principles, and will then be glad to take up the second part, which contains an extended study of decorative pottery, including porcelain, as well as tiles. For us, the tiles will be the more interesting subject. According to the author, the oldest paving-tiles found in Europe date from the twelfth century, but the manufacture undoubtedly existed long before, and mosaics of colored clay must have soon succeeded to the marble inlays of the Romans, which the French and English of the time of the Norman Conquest knew, but could not imitate. The earliest floor-tiles were of white clay, enamelled with black, yellow, red and dark green, and were made in the form of triangles, squares, polygons or parts of circles, and put together in geometrical figures. The enamel of these tiles being very quickly worn out, a new process was invented about the end of the twelfth century, for making what we call encaustic tiles, consisting of square or polygonal bits of clay, stamped with a pattern, which was afterwards filled with clay of another color, and the whole baked together. As with us, the main body of the tile was usually of a coarse clay, covered with a veneer of finer material, usually colored in black, or yellow, through which the pattern was stamped or cut, to be filled in to the thickness of the veneered ground. These encaustic tiles were generally glazed, to give them brilliancy, but the pattern remained after the glaze was worn off.

In the thirteenth century the fashionable coloring of pavement tiles changed from black and yellow to red and yellow, the red being that of the coarser clay, which in the preceding age was always concealed by the black or yellow veneer. A few black tiles were still made, but only in plain color, for borders. It is worth remarking, as M. Foy does, that in the eleventh and twelfth centuries, when painted wall-decoration, and the general tone of stained-glass, were light, paving-tiles were dark, black or very dark green predominating; while in the thirteenth century, when the tones of wall-painting and glass had become dark and vigorous, those of tile floors were bright, and almost pale.

During the fourteenth and fifteenth centuries the patterns of tiles became much more complex, and colors were multiplied; and, later, enamelled figures, like those on porcelain, were employed to decorate floors. At the end of the sixteenth century the art died out, and until the revival of thirty years ago floor-tiles of clay were employed in France only for kitchens. Once resuscitated, the new manufacture has increased and improved rapidly, and many different processes are in use, full descriptions of which are contained in the book, to which the curious should be referred.

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**Mediæval Sculpture for Cornell.**—Cornell University has just received a collection of 80 casts reproducing the mediæval sculptures and artistic details of the Angels' Choir in Lincoln Cathedral, London. The collection is the gift of President White.

## ROMAN MORTAR AND THE ITALIAN METHOD OF TREATING LIME CEMENTS.

A CORRESPONDENT of the *Builder* (London) writes as follows: It is stated on page 360 of your number for March 15, in speaking of the way in which the Romans used lime mortar, that the lime was generally burned on the spot, and used fresh before cooling and crystalization set in. Was this really the case? The inquiry is not made by way of cavil at an interesting article, but as a necessary consequence of the comparison of the statement in question with a wide and definite personal experience.

In Southern Italy, at the present day, the work of the mason and of the bricklayer is, as far as it is easy to ascertain, very closely what it was eighteen or nineteen centuries ago. Nor are the dates vague. Pompeii is an instance of indubitable Latin work, of which the latest, though not the earliest, date is certain. At Puteoli, again (or Pozzuoli, as it is now called), work of Roman date is extant. So it is at Capua,—speaking only of spots personally well-known to the writer. Again, in the neighborhood of Pompeii, skirting the romantic line of hills that form the southern bound of the beautiful bay of Naples, exists a tunnel aqueduct about four feet high, now dry, but with a layer of sinter at the bottom that tells of its long continued use. It is held that it supplied Stabiæ and perhaps Pompeii with water. In these and other instances that may be cited, it may be said that it is literary testimony that establishes the antiquity of the work. As far as material goes, in substance, shape, size, and mode of construction the ancient work is indistinguishable from that of the local masons of the present day,—admirable workmen as they are. So again, with regard to the "large size, flat and thin" Roman bricks, of which the article correctly says that they "may be termed tiles, though used for wall building." The use of *mattone*, as it is called, or brickwork, is rare in Southern Italy, as it is more costly than the ordinary tufa work. But it is at times employed,—and then the thin tile is used, precisely as in Roman times. These statements are not made second-hand, or from a hasty tour, but are given from observations made during a residence of more than eight years in Italy, spent in close association with Italian architects.

The upshot of this investigation is, that the whole process of building, so far as can be judged from the comparison of ancient and modern work, being unaltered at least from the time of Pliny, it is fair to presume (in the absence of some very definite proof) that the treatment of lime for mortar is also unchanged. That treatment is the very reverse of being "used fresh." On the contrary, the Italian architects consider that the excellence of their mortar is in proportion to the length of time for which the lime has been slaked before using it.

On proceeding to commence a *palazzo* or other building, the first thing done is to dig a pit of size sufficient to contain the lime which it is anticipated that the building will require. This pit is then filled to within a foot or two of the surface with fresh lime, and the space left is filled with water. The water is, or ought to be, supplied as it evaporates, so as to keep the subjacent lime always in the state of a dense damp paste. It is dug out and mixed up as required, and if the first supply is exhausted more is added, but invariably treated in the same way, and the result is admirable. It is the opinion of persons competent to form conclusions of their own that the ease with which (in a climate that varies so extremely as to its hygrometic condition as does that of Italy, where the usually dry elastic air becomes painfully damp and clinging when the Sirocco blows over the Mediterranean) the walls of houses receive painting *al fresco*, is due to the mode of preparing the mortar; and this is all the more worthy of note because, if such be the case, it may be inferred that the grim and grievous failures which are but too well-known in attempts at *fresco* painting in England, are due, not to our English climate, but to "daubing the wall with untempered mortar."

If it be asked for further testimony as to a method universally in use, at all events in Southern Italy, the inquirer may be referred to a paper on the limes and cements of Casale, Piedmont, and Liguria which is to be found in volume xv. of the Italian Scientific journal, the *Giornale del Genio Civile*. In 1846 the Italian Government instructed Signor G. Signorile to examine the limestones of the above named districts with reference to their use on railways. It had been found that the lime which had been excellent so long as it was calcined with wood, deliquesced when calcined with coal, the coal in question containing pyrites. The experience of thirty years led to the conclusion that for hydraulic lime, perfect calcination has to be effected in kilns of the ordinary construction, heated with wood, and fed from above. The tempering should be effected with the least quantity of water required to effect a stiff argillaceous consistency similar to that required for making bricks when tempered. The lime, the report goes on, should be kept under water, the temperature of which should be between 51° and 70° Fahrenheit, a necessary precaution in the case of experiments some of which lasted from six to twelve months or even more.

It is unnecessary to go into the details of these experiments. Every variety of limestone received attention, and one of the remarkable features of the case was the difference in the quality of the limestones from different beds in the same quarry. But in most cases the slaking was troublesome, as the limes increase in bulk but little when slaked, and, at certain temperatures, commence to soften before removal from the furnace. In these cases the change continues to go on very slowly, so that efflorescence takes place after use in building. It is to avoid chemical changes of this nature that the long process of slaking under a small head of water has in all probability been adopted.

In our own use of lime mixed when hot two inconveniences occur. It is, as we have seen, in order to avoid these inconveniences that the preliminary change in the lime, due to slaking, is made to occupy as long a time, and thus to proceed as slowly as possible, by the Italians. Without affecting too much precision of language, we may briefly characterize the evils to which we refer as being the one physical and the other chemical. That is to say, we have to contend with swelling and with deliquescence. As to the swelling it is perhaps not so easy to speak positively in the case of the thin beds of mortar which are commonly used in brickwork. But in concrete the change of bulk is very perceptible. In new brickwork, again, the effect of deliquescence is most painfully apparent. Mr. Robertson, the author of a paper entitled "An Investigation into the Theory and Practice of Hydraulic Mortar," which was read before the Institution of Civil Engineers on 13th April, 1858, said that concrete had a tendency to swell when made of quick-lime. He had tried the experiment and found that the swelling differed in extent in winter and summer. In summer, in a cubic foot, the concrete would swell one thirty-second in bulk; in winter only one forty-eighth. A paper on this subject, by Mr. Burnell, was read at the Royal Institute of British Architects in the session 1857-58, in which the use of quick-lime in concrete was strongly condemned. When the extension of the London and Birmingham Railway from Camden Town to Euston was made, a layer of some 2 feet 6 inches of concrete was placed in the foundations of the retaining-walls. When the footings had been laid on this, and the plinths carried up a few courses, an iron bench-mark was driven in at each pilaster. As the work was of an important nature, great care was taken with these levels, which were read, with a powerful instrument, to the 200th part of a foot, being double the usual degree of accuracy. Time after time, however, on checking the levels after three or four days, they proved wrong. The matter perplexed the resident engineer greatly, until it was found that the error was due to the swelling of the concrete, which lifted the retaining-wall built on it. On going back over the whole series of pilasters, the differences were found to be correct, although there was a general rise of level above the bench-mark from which the levels were started. Again, it was stated in the paper above quoted, that after grinding mortar for one hour, keeping it always at the same stiffness it was observed with surprise that the quantity, instead of wasting, was absolutely beginning to swell, notwithstanding that the lime had been thoroughly slaked, and no increase of bulk from that cause was possible. A number of measurements are added to show that mortar arrives at its greatest density after one hour's grinding; and that when the grinding was carried on for ten hours, the mortar lost half its strength, and gained 14 per cent in bulk. The strong adhesion existing between cement and limestones, especially oolites, has led to the idea, suggested by Mr. Burnell, that carbonic acid is absorbed by the cement from the stone itself. This view was supported by the experiments of Mr. Robertson, who also distinguishes between the hardness acquired by the mortar in the process of setting, and the further induration due to lapse of time.

Mr. Rendle's practice, it was mentioned in the debate, resulted in the rule to slack hydraulic lime with 33 per cent of water, and to keep it for ten days. Roman and other ancient mortars, Mr. Robertson observes, owe much of their excellence to the slow absorption of acid; and it is, he adds, "unreasonable to suppose that the mortar of modern engineers will prove inferior to those, as it is undeniable that the theory is much better understood now." The nature of chemical action is, no doubt, better known now than could be the case before the time of Dalton. But that is quite a different thing from saying that we know better how to make mortar. Nor is it so certain that Time could do so much, unless the start be made in the right way. In some old buildings the mortar is in a very disintegrated condition, while in others it has consolidated into something like a geological rock. It is, at all events, conceivable that the bad mortar was hot slaked, and that the consolidated mortar, as in the case of Roman relics in Italy, and even in England, owes its existence to the new process of the Italian mortar-makers.

At all events, it is clear from the above-cited authorities, that not a few points ordinarily neglected have very great influence on the excellence of mortar. The character of the limestone used has, in the first place, of course to be regarded. But good lime can be made from so many various kinds of limestone that the greatest care in selecting, not only the quarry, but the bed of the quarry, is only one element of the supervision to be exercised by the architect.

Next, attention has to be called to the mode of calcination, and in this it is clear, from the experiments of Signor Signorile, we have to regard not only the kiln, and the mode of firing, but the fuel. Has this been regarded aright with us? To say nothing of wood, is it not the cheapest and thus the least pure coal that is ordinarily employed by the lime-burner? That the excess of sulphur thus rendered possible may be fatal to the excellence of the mortar is not only a theoretic possibility, but, in some cases at least, an established fact.

Then comes the question of slaking, which it is not, perhaps, easy to distinguish from that of grinding. In the case cited, where the continuance of the latter process for ten hours exercised an injurious effect upon the mortar, it is probable that hot slaked lime was used. The experiment thus tells nothing as to the degrees of comminution or of mixing that may be desirable with slowly-slaked lime. As to this, Italian practice and Italian theory are at one. Nor does there seem to be anything irrational in the idea that undue haste in the commencement of a series of chemical processes which are to extend, not only over days, but over years, may be pernicious. To set a brick or a stone in a bed of mortar, and to leave the result to time, is all very well. But even Time himself demands fair play, if he is to be a consolidator rather than a destroyer. A difference has been pointed out between the two processes of "setting" and of indurating, although one of these passes, or ought to pass, insensibly into the other. It is conceivable that the rapidity with which the slaking process has been effected, or the short time given to the slaked lime in which to accommodate itself to its new chemical condition, before it is called upon to enter on a new series of combinations, may have much to do with its subsequent behavior. Such, at all events, is the opinion and such is the practice, of the most ancient and most famous school (save one), of European architecture. Is not this worth the serious attention of the British Architect?

It is suggested that it would be well worthy the reputation of the Royal Institute of British Architects to encourage a thorough and systematic investigation of the subject. Materials exist for forming an opinion. Some of them are above indicated, and their investigation will open the way to yet further facts. It can hardly be said that our knowledge of the practical chemistry of mortars is absolute. It is, perhaps, unnecessary to illustrate this fact. It is certain that the manner in which mortar is used by the Italian builder is very different from that common with ourselves. Is it a difficult matter with us to take up a few courses of newly-set brickwork? When does the adhesion become so perfect that the brick will yield before the mortar? In Italian building adhesion is much more rapid and complete. No doubt much is often due to the presence of that admirable material *pozzuolana*. But this, though a common and valuable, is not a universal, element in Italian mortar. In many cases where hasty building is desirable, as after partial demolition from earthquake, lime taken from such pits as have been described is used pure, or nearly so. It is better not to speak without citing chapter and verse as to the exact proportion of *pozzuolana*, sand, or other materials mixed by the Italian builders with their lime. The proportions differ, from the rudest kind of masonry — which is used in Italy where in England we use wood, as in forming the centre for an arch — to the finest *scagliola*, or the impervious mortar which forms the flat roofs of so many important buildings, a mortar which is beaten with heavy clubs for ten days or a fortnight incessantly, in order to consolidate it. In the *scagliola* with which the interior of churches is often adorned, and in the "*battuto*" work of the terraced roofs, we have examples of the use of lime cements of a nature quite unknown in this country. The plaster of a modern English villa is usually perishable. Not so with these Italian applications of mixtures, alike, or very closely so, in ingredients, but wonderfully different in mode of manipulation from our own lime cements and plasters. What would our English builder think if he was obliged to detail four men to beat a roof or a floor for ten days or a fortnight? But this is an essential part of the erection of a good palace in Southern Italy; and woe to the ears of the neighbors while it goes on! The noise of the beating is bad enough, hour after hour. The men usually sit on very low rush-bottomed chairs, and use a wooden club some 3 feet long, and 4 inches or 5 inches square with a bent handle. A perpetual hammering from three or four of these implements is bad enough; but it is nothing to the fearful howls with which the work is usually accompanied. Evil will be the memory of any one who should introduce into England such an addition to the noise of our cities! But that notwithstanding, the results produced by the Italian treatment of lime are so incontrovertibly superior to those common in England, that it is hard to exaggerate the importance of a thorough investigation of the subject.

F. R. C.

## A FORMULA FOR CALCULATING ARCHITECTS' CHARGES.


THAT the present five-per-cent rule is inadequate is, I think, evident. The problem is to find a rule which is more flexible and, therefore, more easily adhered to and more just.

Other things being equal, the value of an architects' services should vary in some direct ratio with the amount of work in the building. Whether this consists of more elaborate decoration, or of more difficult construction the comparative amount of work in buildings, apart from their size, is more or less closely determined by their cost per cubic foot.

Our first element, then, is this cost, denoted by *R*.

Experiment shows that to determine the ratio we may take the square root of the cost per cubic foot, as follows: —

| Cost per cubic foot. | Square root. | Corresponding Building. |
|---|---|---|
| 10 cents | 3.1 per cent. | Cottage. |
| 15 " | 3.9 " | Country House. |
| 25 " | 5. " | Apartment-House. |
| 35 " | 5.9 " | Town-House. |
| 50 " | 7.1 " | Public Building. |

The column headed "corresponding building" is intended to give a very rough idea only of the class of building that costs about so much.

Putting $C$ for the architect's charge, the formula now stands:

$$C = \sqrt{R.}$$

There is another important factor, however, which must not be lost sight of. The larger the building the less it is worth to do the architectural work. That this is naturally and properly so is obvious. So that besides the direct ratio spoken of we have an inverse ratio with the size of the building.

Experimenting as before, the whole thing is purely empirical, we find that the cube root of the cubic contents of a building gives a proper proportion in which to reduce the charge with the size.

| Cubic feet. | Cube root. | Inverse Proportional per cent. |
|---|---|---|
| 50,000 | 36. | 5.4 |
| 100,000 | 46. | 4.2 |
| 500,000 | 80. | 2.5 |
| 1,000,000 | 100. | 2. |

Introducing this factor of size into the formula, denoting it by $S$, we have:

$$C = A\,\frac{\sqrt{R.}}{\sqrt[3]{S.}}$$

$A$ is a constant which must be arbitrarily determined, perhaps 50 is a fair value for it:

$$C = \frac{50\sqrt{R.}}{\sqrt[3]{S.}}$$

That is, fifty times the square root of the cost per cubic foot in cents divided by the cube root of the cubic contents will give the proper architect's charge for full service, — $C$ being obtained as a percentage on the cost as at present.

EXAMPLES.

I. Country house, 40 x 30 x 40 = 48000 cubic feet; cost, $8,000 = 16.7 cents per cubic foot.

$$C = 50\,\frac{\sqrt{16.7}}{\sqrt[3]{48000}} = 50\,\frac{4.08}{36.} = 5.66 \text{ per cent.}$$

II. Country house, 40 x 60 x 40 = 96000 cubic feet; cost $16,000 = 16.7 cents per cubic foot.

$$C = 50\,\frac{\sqrt{16.7}}{\sqrt[3]{96000}} = 50\,\frac{4.08}{46.} = 4.43 \text{ per cent.}$$

III. Country house, 40 x 30 x 40 = 48000 cubic feet; cost $16,000 = 33.4 cents per cubic foot.

$$C = 50\,\frac{\sqrt{33.4}}{\sqrt[3]{48000}} = 50\,\frac{5.78}{36.} = 8 \text{ per cent.}$$

IV. Town-house, 25 x 70 x 60 = 105000 cubic feet; cost, $35,000 = 33.3 cents per cubic foot.

$$C = 50\,\frac{\sqrt{33.3}}{\sqrt[3]{105000}} = 50\,\frac{5.77}{48.} = 6 \text{ per cent.}$$

V. Public Building, 100 x 100 x 100 = 1000000 cubic feet; cost, $500,000 = 50 cents per cubic foot.

$$C = 50\,\frac{\sqrt{50.}}{\sqrt[3]{1000000}}\,50 = \frac{7.1}{100.}\,3.5 \text{ per cent.}$$

JOHN BEVERLY ROBINSON.

*N. B.* — The cost per foot is intended to include all interior decorations that the architect has anything to do with, the separate ten per cent on such work being abolished.

## THE ILLUSTRATIONS.

HOUSE ON CLARENDON ST., BOSTON, MASS. MR. H. H. RICHARDSON, ARCHITECT, BOSTON, MASS.

HOUSE AT THE CORNER OF COMMONWEALTH AVENUE AND CHESTER PARK, BOSTON, MASS. MR. CARL FELMER, ARCHITECT, BOSTON, MASS.

HOUSE FOR COL. J. F. CLARKE, VALLEY FALLS, R. I. MESSRS. W. R. WALKER & SON, ARCHITECTS, PROVIDENCE, R. I.

DESIGN FOR A HOTEL AT LOS ANGELOS, CAL. MR. FRANZ E. ZERRAHN, ARCHITECT, BOSTON, MASS.

SKETCH FOR A SEASIDE HOUSE. MR. JOHN CALVIN STEVENS, ARCHITECT, PORTLAND, ME.

ENTRANCE HALL OF THE MODEL MUSEUM OF THE UNITED STATES PATENT OFFICE, WASHINGTON, D. C. MESSRS. CHESS & SCHULZE, ARCHITECTS, WASHINGTON, D. C.

THE VOLCANIC ORIGIN OF RED SUNSETS. — Some confirmation of the theory that the recent brilliant sunsets were due to volcanic dust suspended in the higher regions of the atmosphere may be found in a late communication to the French Academy of Science by M. Angot. He called attention to a parallel case which occurred in the year 1831, when there was a violent volcanic eruption, and a new island was thrown up in the Sicilian Sea, together with a quantity of ashes. For some time after the commencement of this outbreak, which lasted altogether for several months, brilliantly colored sunsets were observable at many Continental places. — *N. Y. Evening Post.*

## ROOF COVERINGS.[1]


IN covering buildings for the purpose of preserving them from the weather, the climatic conditions of the locality must always be considered. The first thing to be determined is the pitch or inclination to the horizon to be given to the roof. In hot climates where rain is not frequent but falls in torrents when it occurs, a flat pitch is desirable in order to check the velocity of the rain-water which runs down the roof; but in cold countries where much snow falls during the winter, the pitch should be steep that the snow may easily slide off as it accumulates, and thus prevent damage to the framework of the roof from the superincumbent weight. An ingenious table has been drawn up, showing the increase of pitch that should be given to a roof for every degree of latitude north or south of the equator; but such a table can only be of general application. Several different kinds of materials are in use for forming the outside covering of roofs, and their suitability depends largely upon the pitch, some materials such as copper or lead being used with perfect safety at a very low inclination or even quite flat, while others, such as thatch should never be used at a less slope than 45°. Some materials that were formerly used for roofing have now become quite obsolete; for instance, it is very rare indeed now to find roofs covered with shingles or shides, which were small wedge-shaped pieces of wood about an inch thick at one end, and measuring 9 inches by 5 inches, closely resembling weather-boarding; these were extensively used in some country districts. Again, in Shropshire, Gloucestershire, and other places, thin flags, called tile-stones, were frequently used for roofs, but the facilities of transport are now so great that these have been entirely superseded by the more suitable Welsh slates, or artificial tiles, the manufacture of which has greatly increased and improved of late years. Good roofing materials can now be obtained so cheaply that there is little temptation to builders to supply inferior kinds, and the cause of bad and leaky roofs is to be sought for more in the carelessness or ignorance of the workman than in the badness of the materials.

By far the most important roofing material, and the one in most general use at the present time, is slate. Slate is an argillaceous sedimentary rock which, after being deposited as clay at a very early geological epoch, has been subjected to enormous mechanical pressure, the result of which has been that the beds have been squeezed together and the material rendered very dense and compact, while the original lines of stratification have been almost obliterated, and the particles have been rearranged in fresh planes perpendicular to the direction in which the pressure was exerted; along these planes the rock splits with great ease. The strength of the material has thus no connection with its natural bed, even when the latter can be discovered. This splitting or fissile property makes slate eminently useful as a building material, as, notwithstanding the fact that it is one of the hardest and densest of rocks, it can be obtained in such thin sheets that the weight of a superficial foot is very small indeed, and consequently, when used for covering roofs, a heavy supporting frame-work is not required. Slate absorbs a scarcely perceptible quantity of water, and as it is very hard and close-grained and smooth on surface, it can be laid safely at as low a pitch as 22½ degrees. In consequence of this, the general introduction of slate as a roofing material has had a prejudicial effect upon the architectural character of buildings. The bold, high-pitched, lichen-covered roofs of the Middle Ages — which, with their warm tints, form so picturesque a feature of many an old-fashioned English country town — have given place to the flat, dull, slated roofs, which evidently are so oppressed by their own ugliness that they gladly retire from view behind a parapet, with the result that in most of our modern cities we are confronted with miles and miles of streets whose houses appear to consist of fronts alone, terminating skywards in one dull monotonous straight line. . . . . . . . . . . .

Slates should always be laid with a certain lap, that is, each course should overhang the next but one below it to a certain extent, and this should not be less than 2 inches. Thus there will be a certain width of slate in each course exposed, and this is called the gauge, its width diminishing as the lap increases. The gauge for any kind of slating is found by deducting the lap from the length of the slate, and then halving the remainder: thus, if Countess slates are laid with a 3-inch lap, the gauge will be $\frac{20-3}{2} = 8\frac{1}{2}$ inches. Each course of slates "breaks joint" with the one below it. The average weight of ordinary slating may be taken as 7 cwt. per square of 100 superficial feet. The valleys of slated roofs are generally laid with lead, turned up under the slates, and the hip rafters are either covered with lead — which is the best plan — or with thick saddle-back slates finished at top with an ornamental roll. Some years ago a system was introduced called patent slating. This consisted in laying large thick slates so that they butted against one another in a vertical line, the joints coming exactly over a rafter to which the slates were firmly screwed. The successive courses overlapped one another a few inches, and when the roof was covered, thin fillets of slate about

[1] A Paper by John Slater, B. A., Fellow of the Royal Institute of British Architects. Published in the *Sanitary Record.*

three inches wide were bedded in putty over the vertical joints tightly screwed down to the rafters, and pointed carefully all round. Slating could be laid in this manner to a very low pitch, and yet remain watertight for a considerable time, but it was found that a slight settlement of the roof was sufficient to injure it, and as the putty also soon perished, the system was abandoned, and it is now never adopted. It gave, however, a distinctly ornamental appearance to a roof.

The prevalence of the use of tiles for the best class of houses at the present time affords a curious example of the change that has occurred in architectural fashion in the last fifty years, for in Nicholson's "Architectural Dictionary," published in 1819, it is stated that "in consequence of the weight and fiery appearance of tiles, slates have almost universally superseded them, and tiles are used only for cottages or small buildings." The "fiery color" spoken of is undoubtedly bad, and if all the tiles were of the brilliant hue that is occasionally met with in country districts, it is probable that their use as a roofing material would have remained restricted. But lately manufacturers have succeeded in producing a warm reddish-brown tint closely approximating to that of old weathered tiles, than which nothing can be more pleasing. Tiles are made from clay in much the same manner as bricks, but as they are thinner, they require a tougher clay, and considerably more care in their manufacture. The clay is dug and weathered, and then ground in a pug-mill, so that it acquires great consistency. It is then formed into the required shape by being pressed into an oak mould, plated with iron. The clay is kept from sticking to the mould by dusting the latter with sand or fine coal dust. The tiles are then dried in the open air, and afterwards baked in a kiln, constructed on much the same principle as a brick kiln, but enclosed in a conical building called a dome. The period of burning depends upon the quality of the clay and the color to which the tiles are to be burnt. This general description applies to nearly all roofing tiles, but of course the moulding processes vary according to the kind of tile that is being made. Till quite recently pantiles and plain tiles were the only kinds made, the former having a double curved surface, on the one side convex and the other concave, which shape is given to the plastic clay by hand. A small hollow in the mould gives the projecting nib by which pantiles are hung on the laths of a roof. The ordinary size of pantiles is $14\frac{1}{2}$ by $10\frac{1}{2}$ inches, and they are generally laid to a gauge of 10 or 11 inches. These tiles are only used for an inferior class of building, as it is difficult to keep a roof covered with them watertight for any length of time, as they can never be made to fit closely over each other at their lower edges, and consequently the rain has a tendency to drift up underneath them. They partially overlap laterally, but not sufficiently to make a watertight joint, and they are consequently frequently pointed with mortar, which forms a thick and ugly joint and soon perishes. The weight per square is about 10 cwt. The Bridgewater tiles are very similar to pantiles, but wider, and formed with a double roll.

Plain tiles are oblong in shape, with a very slightly curved surface, and they are either moulded with nibs for hanging on the laths, or are formed with two holes for nails or pegs. Their size is $10\frac{1}{2}$ by $6\frac{1}{4}$ inches. Many very excellent specimens of plain tiles have been shown at the various building exhibitions which have been held lately, but it would be difficult to find any superior to the best Broseley tiles, which are well burnt, even in texture, and of a very pleasant tint. Plain tiles, of the size mentioned above, should be laid to a $4\frac{1}{2}$-inch gauge, and they are either hung to the laths by their nibs or by pegs driven through the holes in their surface. Some builders are fond of bedding the heading joints in mortar, but it is very doubtful if this is a good plan. Of course it makes the roof somewhat tighter at first, but my own experience is that tile roofs almost always fail in consequence of the laths becoming decayed and allowing the tiles to slip, and the presence of the mortar accelerates this decay. It is, moreover, certain that if mortar be used the tiler will be disposed to depend upon it for keeping the tiles in position, and will not devote so much care to the proper hanging and pegging of each tile, and as all roofs are subject to slight movement due to changes of temperature and to varying wind pressures — have in fact a certain amount of "spring" this will instantly act upon the mortar joint, and will tend to disturb it, and in a very short time the mortar begins to fall away and helps to block up the roof gutters. In some country districts it is the practice to lay the tiles on a bed of hay laid over the laths, and this plan appears to answer very well if proper care be taken, and it adds to the warmth of a building in winter. It is not desirable to give tiled roofs a less pitch than 45°, and 50° is preferable.

With ordinary plain tiles, those in any one course do not overlap laterally; consequently each course must overlap to a certain extent the next but one below it, or the rain would enter between the joints. Of late years many attempts have been made to obviate this necessity, which is the cause of the great weight of this kind of roofing which is nearly a ton per 100 square feet. If tiles can be moulded so that they will fit into one another and form a watertight joint laterally, the successive courses need only overlap sufficiently to prevent the rain driving upwards, and this can be prevented by forming a groove at the upper edge of one tile into which a corresponding projection on the lower edge of the next tile would fit. This method has been adopted with considerable success in Phillips' patent lock-jaw roofing-tiles which interlock with one another on all four sides, and form such closely-fitting joints that nothing can penetrate them; and the patentee claims that by exerting great pressure on the clay during the process of manufacture he is able to ensure uniformity and perfect fit without which the tiles would of course be practically useless. These tiles are of two different kinds: the "Single Grip," and the "Double Grip." The latter are suitable for the most exposed situations, and will stand the roughest usage. Half tiles are made for hanging next to a gable in alternate courses, in order to secure a perfect bond, in the same way that closers are used in brickwork. No mortar is required with them, nor any special skill in laying them. The difference between these tiles and the ordinary kind in the weight per square, $5\frac{1}{2}$ cwt., and the number required, 150, is very striking, the weight being less than one-third that of ordinary tiles. Taylor's patent tiles are moulded with a different kind of lateral overlapping arrangement. All these patent tiles give a decidedly ornamental appearance to roofs, as they break up the plain surface into a series of elevations and depressions.

It is curious to notice how closely some of the new patent systems of tiling resemble those in use among the Romans and in the early part of the Middle Ages. Tiles were used at a very early period for roof coverings, and were first formed with rims on each side, and under the rims were notches forming a lap laterally; and hollow tiles, similar to common hip and ridge tiles, were laid over the vertical joints, themselves overlapping each other. An improvement was effected by making the tiles trapezoidal in shape, instead of rectangular, and thus the narrow end of one tile was pushed down till it closely fitted between the rims of the one below it; the notches under the rims were then discontinued, but the vertical joints were covered as before.

In the thirteenth and fourteenth centuries, in the old French province of Champagne, tiling was carried to very great perfection; and it is probable that no better tiles have ever been made than those which can be still seen in many buildings in Troyes and its neighborhood. The tiles are very like the modern Broseleys, but were made with one nib for hanging on the laths and one hole for nailing; and to show the extreme care which was taken with them, the position of the nib and the whole was reversed in each alternate course of tiles. This was done in order that, as the alternate courses were laid "breaking joint," the nail-hole should always come over the centre line of each rafter, and the nib always midway between the rafters. The rafters were of course fixed in the proper position for the tiles, which were laid to a gauge of about $4\frac{1}{2}$ inches; and as the length was $12\frac{3}{4}$ inches, there was always a lap of nearly 4 inches. In some of the tiles of this period the exposed portion of each tile was glazed, and thus rendered non-porous. This would be an excellent plan to adopt with modern tiles, but it would render them too expensive for general use. There is, however, another peculiarity in the best of these old French tiles which might easily be adopted by modern manufacturers, and which would be a great improvement, and that is the chamfering of the lower edge of the tile. The mould could easily be made of the shape requisite to form this chamfer, which would greatly diminish the risk of the tiles being ripped up by the action of a strong wind. The tiles of this period are frequently found in as good condition now as when first burnt.

The great objection to all tiles is their porosity which causes them to absorb a considerable quantity of water, and this tends to rot the wood-work underneath. This wooden sub-structure consists in the case of both slates and tiles, either of fillets of wood nailed on the rafters at intervals corresponding to the gauge required, or of close boarding similarly nailed to the rafters. For slates these fillets are generally $2\frac{1}{2}$ inches or 3 inches wide and 1 inch thick, called slating battens, and the slates are nailed to them by nails — two to each slate — passing through small holes pierced in the slate itself. For tiles, which are much heavier, stouter fillets are required, and the tiles are hung on to these by pegs passing through the holes in the tiles, or by the projecting nibs which have been already described. Close boarding is far preferable for either kind of covering, as it keeps the roof tighter and warmer, and in case it should be necessary for workmen to pass over the roof for any purpose after its completion there is much less danger of the slates or tiles being broken than with battens. The risk of damage from high winds is also much less, but this point will be referred to more in detail farther on.

In country districts the roofs of cottages and out-buildings are frequently covered with thatch. This consists of layers of straw — wheaten straw is the best, lasting twice as long as oaten — about 15 inches in thickness, tied down to laths with withes of straw or with string. Thatch is an excellent non-conductor of heat, and consequently buildings thus roofed are both cooler in summer and warmer in winter than others, and no better roof-covering for a dairy can be found. Thatch is, however, highly combustible, and as it harbors vermin and is soon damaged it is not really an economical material, though the first cost is of course small. A load of straw will do a square and a half of roofing, that is, 150 superficial feet.

Felt is often used for covering roofs of outbuildings. It should be nailed down to close boarding, the edges of the sheets overlapping, and if a double layer be applied, with a coating of tar on each, and the top layer to be sprinkled over with sand it forms a good and cheap covering for a time. It requires, however, a fresh application of tar and sand every two or three years. In Germany a material closely resembling felt, called "*Dachpappe*," is frequently employed for covering roofs of manufacturing premises. This is a species of pasteboard or *carton-pierre*, two layers of which are nailed to close boarding and tarred and sanded. Roofs covered with this material are laid to a very flat pitch not more than sufficient to throw the water off in one direction, and instead of fixing a gutter at the eaves, small fillets of wood are nailed to the boarding, sloping in two directions upwards and meeting at the bottom where an outlet for the water is formed. These fillets are completely covered with the *dachpappe*. These roofs are extremely light, and if the material is carefully laid they remain water-tight for a considerable period.

The structural arrangement of a building frequently renders it impossible to form a sloping roof over all parts of it, and hence flats are necessary. When this is the case metal coverings are the best that can be adopted. Formerly it was not uncommon in buildings where cost was not a consideration to use sheet-copper for covering flats or slight slopes, and a large portion of the roof of the British Museum galleries is laid with this material. Copper forms a very light covering, as it may be safely used in sheets not more than .03 inches thick, which would weigh about 20 ozs. per foot super. Copper slowly oxidizes when exposed to the air, but the oxide does not eat into the substance of the metal as is the case with iron; it seems rather to form a protective coat. The cost of copper renders its use very limited, and zinc has to a large extent taken its place.

Zinc is also a very light covering, in fact its specific gravity is slightly less than that of copper, but it has not a good reputation, owing to the fact that on its first introduction it was used in very thin sheets and sufficient care was not taken in laying it. Its expansion is greater than that of any other metal, and therefore it should always be laid with ample play, or it will soon buckle and crack. The Vieille Montagne Company have greatly improved the methods of laying zinc, and they have also introduced thicker sheets than could previously be obtained, and if zinc is used at all it should never be less than No. 16 gauge, which weighs about 24 oz. to the foot super, and is as nearly as possible 1-24 of an inch thick. Zinc resembles copper in the fact it oxidizes on the surface only, but in smoky districts it will not last at all, as sulphuric acid completely destroys it.

The surface oxidation only of zinc when exposed to ordinary atmospheric influences, suggested the attempt to prevent the rusting of iron by giving it a thin coating of zinc. This led to the production of galvanized iron for roofing purposes. The galvanizing process consists in first precipitating tin upon sheets of iron by means of weak galvanic action, and then placing the plates in a bath of liquid zinc. Iron thus treated will last, under favorable circumstances, for a long time, but when used for roofing it is almost impossible to avoid nailing the sheets in some places, and where the nail-holes occur, moisture invariably makes its way to the iron itself, which rusts internally, and the thin zinc coating then comes off in flakes. What was previously stated as to the action of sulphuric acid upon zinc will show the utter uselessness of galvanized iron in smoky districts.

The most durable metal covering for roofs is milled lead. This is lead which, after being cast, is passed through a mill between rollers adjusted so as to give the requisite thickness to the sheets which are rolled out. This thickness varies from .075 inches to .236 inches, the weight of these qualities being 4 lbs. and 14 lbs. respectively per superficial foot. The qualities chiefly used for roofing are the 5, 6, and 7 lb. lead, the latter being the lightest that should be used for flats or gutters. In laying lead on flats they should be close boarded, and care must be taken to allow for the due expansion and contraction of the metal; consequently the joints of two adjacent sheets must not be soldered together. In order to prevent the water from penetrating at the joints, fillets of wood, $2\frac{1}{2}'' \times 2''$, rounded at the top, called rolls, are nailed to the boards, and one sheet of lead is dressed close up to and half way over the roll, while the next sheet is brought up to the opposite side of the roll, and lapped completely over the roll and the turned-up portion of the first sheet. If the lead is closely hammered down with wooden mallets no nails are required, and they are better omitted. When it is necessary to nail the lead around skylights or in other positions copper nails should always be used.

There is one very interesting question connected with roof coverings which can only be briefly alluded to here; and that is the actual effect upon them of wind-pressure. A gale of wind never passes over a city without blowing down into the streets a number of tiles and slates, to the imminent danger of passers-by. The cause of the slates being blown off is not quite so simple as might at first be imagined. Where loose ridge tiles or broken slates occur these are blown off as a matter of course, but it frequently happens that roofs which were perfectly sound are seriously damaged. As the direction in which the force of the wind acts is horizontal, there would seem to be no tendency to rip up or break off materials lying so closely upon one another as slates. The true explanation is probably this: any exceptionally strong gust of wind is succeeded by a momentary vacuum, and as under ordinary circumstances the atmospheric pressure inside and outside a roof is equal, it follows that during the brief continuance of the vacuum outside the pressure inside is considerably in excess, and the weakest points of the roof covering will have a tendency to be pushed outwards. Now in roofs covered with battens, to which the top only of the slates are nailed, the lower portions of the slates would be much less able to resist any such outward pressure, and would be forced upwards, and if at such a moment another gust of wind were to occur it would find its way under the slate and break it. If the rafters were covered with close boarding instead of battens this would offer a far more even resistance, and for this reason close boarded roofs are much less liable to damage from wind. The whole question of the action of wind upon sloping roofs has not received the attention from professional men that its importance demands.

## CONCRETE FLOORS AND PAVINGS.

BETWEEN concrete for foundations and concrete for floors and pavings there is a wide margin of difference. In the former case the material is buried and forgotten, and probably depends to a great extent upon the surrounding ground to keep it from yielding, whereas in pavings, any serious defects mean irremediable failure, necessitating entire reconstruction; while in floors it may, in addition, be the primary cause, not only of the downfall of the floors themselves, but of the collapse of the entire building, and possibly serious injury to life and property.

It is, therefore, not at all surprising that while we have never heard nor are likely to hear of patent concrete for foundations, yet for floors and systems of flooring, and for pavings and similar purposes, concrete has been the subject-matter of numerous patents. It is passing strange that although the population of large towns has increased year after year for centuries past, that detached houses have gradually become linked together as streets, and that advantage is taken to fill up every nook and corner of vacant land with buildings, with the result that a fire is oftentimes the cause of immense destruction of property, yet we still make veritable tinder-boxes of nearly every house erected, by employing timber joists laid in grid-iron fashion, so as to feed the flames that may possibly attack them; while the destruction of wood plates built in the brickwork to support the joists, provides ways and means for the walls to topple over and complete the wreck.

On sanitary grounds, also, wood floors ought to be as far as practicable in new buildings condemned. The cavity between floor-boards and the ceiling beneath often serves as the receptacle for the dust of ages, which finds its way between the shrunken floor-boards, and is of such an impalpable character that the least vibration of the floor-joists sets it in motion, while dry-rot is another element of unwholesomeness possibly existing to some extent within a few feet of where we work, sleep, or pass our leisure hours, but which, to the naked eye, is incapable of detection.

Previous generations (many, at least) had better reasons for continuing the time-honored system of floor construction than we have at the present day, with these two materials combined, which give us nearly all we require for fire-proof and sanitary floors, and whose period of existence shall be determined only by the life of the walls which carry them.

The time, however, has not yet arrived when concrete, or iron and concrete combined, can reasonably compete in cost with timber for floor construction, but the difference is not so great as might be imagined in many instances, especially where great weight has to be supported, or where the area to be covered is of considerable size. With the prospect of foreign timber becoming dearer before many years, from the rapid manner in which forest trees, within reasonable distance of the shipping ports, are being cut down, and, on the other hand, the lowering in cost of Portland cement and rolled-iron, it is fair to assume that concrete floors will make their way ere long.

Should the sanitation craze, after it has exhausted all that can be possibly said about the ventilation of sewers and drains, intercepting-traps, exhaust-cowls and Tobin tubes, reach the subject of healthy floors, some impetus will possibly be given to their construction. What is needed, however, is to place the knowledge of making ordinary but reliable concrete floors within the reach of every practical builder, for the necessity of employing specialists must be attended in many cases (where, for instance, the requirements are for a small building, or in remote districts) with a much larger outlay than circumstances will, as a rule, permit, and it cannot be obviated in cases where highly-paid employés and special materials have to be sent long distances.

There are necessarily many descriptions of concrete floors; there is the concrete floor, pure and simple, merely a slab resting upon the walls only, and which, if made from the proper materials, is to all intents and purposes fire-proof. But the construction of a floor of this kind is conditional upon the means of support beneath, and not applicable where the latter do not exist at moderate distances apart. There is also the same kind of floor, but with this difference, that it is supported at intervals between the walls by iron beams, which are exposed to view. This latter is an easy method of construction, but is not fire-proof, as the application of great heat to the exposed surfaces of the iron girders would distort and twist them and inevitably end in a total collapse. An improvement is to encase the girders in concrete of a certain thickness, which gives them an appearance of solidity, and serves the purpose of rendering them proof against any ordinary conflagration.

Then we come to "composite floors," or those in which iron in some form or another is embedded, with a view of acquiring the necessary strength.

The many patented systems of floor construction apply, as a rule, to some peculiar shape or arrangement of the iron embedded in the concrete, and not to the latter *per se*, no vested rights, in fact, existing with regard to the use of Portland cement, with the most fitting aggregates, as previously named.

With regard to the materials suitable for floor construction, it is apparent that the aggregate should not be of too heavy a character, and therefore, granite and broken stone generally have to give way to aggregates of less density. Probably there is nothing better than broken fire-bricks or hard-burnt building bricks. Slag from iron ore is an excellent material for the purpose, and ordinary coke from gas-coal is also suitable, although necessarily not of so strong a nature in itself as either of the other three. When coke is used, however, care should be taken that no fragments of coal are mixed therewith, as their expansion, consequent upon the liberation of the gas they contain, causes a rupture of the concrete, in the same way that pieces of unslaked lime affect building mortar. If possible, the aggregate should be crushed by a machine, as no hand-breaking can possibly reduce it to the irregular shapes and forms peculiar to crushing.

The maximum size of the aggregate, also, when ready for use, should be considerably less than can be advantageously employed for foundations, especially for floors of modest proportions where their average thickness is not more than five or six inches, in which case the largest portions should be able to pass easily through a ring 1¾″ in diameter. With porous aggregates, like coke and broken building bricks, it is a good plan to saturate them well with water, previous to use, with the view of retarding the setting energies of the cement; for the longer, in reason, the concrete is in hardening, the greater the ultimate strength.

The necessary thickness of self-supporting concrete floors, *i. e.*, those without iron in any form being introduced in their construction, is a question dependent very much upon circumstances; for instance, the distance between supports, the proportion of cement, the load the floor has to carry, and the description of aggregate, are all factors bearing more or less upon the point. For a sound floor, probably the best proportion of aggregate and matrix, assuming the latter to be the best Portland cement, would be four or five of the former to one of the latter.

One disadvantage of a concrete floor is its tendency to slight change of form, resulting, perhaps, in occasional minute cracks.

Whether these cracks very much affect the strength of the floor is doubtful, but they are at any rate unsightly, and create an uneasy feeling of weakness. For this reason and likewise on economical grounds, ten to eleven feet ought to be the maximum span or bearing of a simple concrete slab floor.

For spans of these dimensions, assuming the materials to be of the best, and the live load to be carried is not more than usual for any ordinary building, that is, excepting warehouses, granaries, and similar erections, six inches thick would be ample; and a fairly safe rule to apply would be to allow five-eighths of an inch in thickness for every foot between bearings, so that, assuming the distance between supports to be 8′, we should get 8′ x ⅝″ = 5″. Of course the distance at right-angles to the span does not enter into this calculation, nor would it affect the application of the rule, whether it be more or less.

Some years since Lieutenant-Colonel Seddon, R. E., made a series of experiments as to the fitness of concrete for an independent floor material, and these experiments go far to prove its value for the purpose.

The first test made was of a floor or slab of concrete, 17′ 6″ long, and 9′ 9″ wide, resting on all four sides on 18″ walls, leaving, therefore, an area 14′ 6″ x 6′ 9″ unsupported.

This floor was 6″ thick, and made of one part of Portland cement to four parts of broken brick ballast, screened or guaged to an inch mesh, well beaten when deposited in place, and ultimately covered with water for seven days. At the end of this time layers of brick were piled over the entire surface of the unsupported area, until a load of about eleven tons, or 2.22 cwts. per foot super, exclusive of its own weight, was applied. At this point the edges of the slab began to rise along the sides, and when loaded with fifteen tons, or 3.06 cwts. per foot super, it suddenly gave way. This was decidedly a successful result, as far as it went, and a second experiment was made on a slab similar in all respects, and the conditions also equal, except that an interval of fourteen days instead of seven was allowed it to mature. This slab broke down with about 13½ tons, or 2.75 cwts. per foot super, distributed in the same manner as previously.

Considering that neat Portland cement tests usually give about 20 per cent increase of strength in fourteen days, as compared with those of seven days old, this result is somewhat unexplainable, but it at any rate goes to show that a very large factor of safety should always be allowed in concrete floor construction.

The next test was with a similar slab, and the conditions still the same, except that twenty-one days were substituted for seven and fourteen days. A party of forty-five men marched on to it, marked time at quick and double, then jumped. This having no visible effect, it was loaded with bricks as before, and when 15 tons, or 3.06 cwts. per foot super had been applied, it commenced rising off outside edges; with 32 tons, or 6.53 cwts. per foot super, it cracked slightly, and was then loaded up to 43½ tons, or 8.88 cwts. per foot super, without any appearance of the crack altering. At that time it had tilted up about ¾″ at outer edges. No further attempt appears to have been made to break down this slab, and the experiment certainly gives some curious results. Not only does it appear to have attained three times the strength of a similar slab fourteen days old, but after cracking it supported a very large increased strain without losing its strength.

Apparently this entirely negatives the theories generally accepted with regard to concrete: first, that it is capable of no sensible deflection without rupture; secondly, that when once rupture has occurred, or cracks are visible, the end is not far off, and it loses its capabilities of sustaining a heavy load.

Two further experiments were also made, all conditions being the same as before, except that fourteen and twenty-one days respectively intervened between the making and testing of the slabs, and instead of one part of cement and three parts of broken brick ballast, the aggregate was composed of twelve of broken brick, four of cement, and three of sand, and the effect was that 12 tons 6 cwt., or 2.51 cwts. per foot super, broke down the fourteen days old floor, and 13 tons 18 cwt., or 2.84 cwts. per foot super, the twenty-one day floor, conclusively proving the remarks made in "Concrete in Foundations," with regard to the weakening effect of "diluting" the aggregate with too great a proportion of sand.

Experiment No. 6 was made with a slab of concrete 6″ in thickness, 17′ 6″ long, and 16′ 6″ wide, out to out, resting on 18″ walls, thus leaving a clear bearing of 13′ 6″ x 13′ 6″, the materials being the same as in Nos. 1, 2 and 3 experiments, and the test made when twenty-one days old.

A party of eighty men marched on to it, marked time at quick and double, then jumped; it was afterwards loaded with bricks as before. There was no result from the jumping, but the slab broke suddenly and without any warning, under a weight of 10½ tons, or 1.07 cwt. per foot super.

In this case the result of eighty men jumping simultaneously might have been expected to produce what the dead weight of 10½ tons accomplished, as the shock of a sudden impact of this nature would be very severe, and the sudden collapse of the floor rather tends to prove that the larger the slab the less deflection it is capable of. Being free on all four sides, also, the slab had a better chance of expanding or contracting, without risk of cracking. In an actual building this freedom of action could not well be accomplished.

Experiment No. 7 represented a landing supported on three sides, the concrete being 5½″ in thickness, and composed of one part of Portland cement, two of broken Charlbury stone (oolitic limestone), and two of broken bricks and Broomhall tiles. Some of the stone would only have passed through a 1½″ mesh. The test was made at fifty days old (and this case appears to have been a piece of work intended to remain), when a concrete beam, weighing 270 lbs., was dropped from a height of 4′ 6″, and fell on one corner in centre of landing, the result being a dent ⅛″ deep, the floor seemed to quiver, and two or three small flakes fell off the under side, which was rough (and would account for this), and the beam broke in two. Another beam, 329 lbs. in weight, was dropped from the same height, and fell along one edge about the centre of the landing, causing a slight line about ⅛″ deep to be cut in the landing, and a flake or two to drop from the under side as before, but with no other result.

The form of concrete, as shown on section, was weakened by being reduced in thickness near to the bearings, but after these tests the landing was allowed to remain, and has presumably been in use since that time (about 1876).

These tests go to prove that concrete slab floors of 6″ in thickness, and up to, say, 10′ bearing, even if only supported on three sides, would be available for almost any ordinary purpose, provided the cement and aggregate were of the best description, the work was executed in a proper manner, and the necessary time was allowed for setting.

It must be remembered that since the date of these experiments the quality of Portland cement has been greatly improved, and that the gain of strength, had the trial slabs been six months old instead of from seven to twenty-one days (with one exception), would undoubtedly have been at least fifty per cent.

## CALCULATING IRON COLUMNS.

JACKONSVILLE, ILL., April 21, 1884.

TO THE EDITORS OF THE AMERICAN ARCHITECT: —

*Gentlemen,* — In making out a bill of materials for a building which was planned by my employer, it recently fell upon me to determine the size of certain cast-iron columns intended for floor supports.

After determining the weight each column must carry I consulted a table, which I have used for some time, and which I got from what I have always considered good authority, and from this table I determined the diameter of the columns and thickness of the iron. My employer, however, in looking over the bill remarked that the columns were too small, and proceeded to demonstrate that he was correct by a formula which he considered reliable.

Being of an inquiring disposition I consulted all the authorities in my reach, and the result was somewhat perplexing, for with half a dozen tables and formulæ at my disposal I could not get the same result from any two, and between the extremes there was quite a remarkable discrepancy. For instance: Take a column 14′ long, 8″ external diameter, ¾″ iron, and one gives, as the safe load, 62.5 tons; another gives for the same column 37.5 tons, a difference of 25 tons or 50,000 pounds. Or, suppose I have a load of 133 tons, which must be carried by one column 10′ long. One says that I must use a column 10″ in external diameter, and with a thickness of iron 1½″, while another allows me to use a column 9″ in external diameter, and with the iron only 1″ thick.

The rules are all for "hollow cylindrical cast-iron columns having ends turned at right angles to the axis."

In the case of which I speak it was more of an object to be safe than saving, but surely there is either a shameful waste of material in the one case, or a shameless disregard of safety in the other, and it seems to me that with such widely-varying rules in common use among our builders it should not surprise us to hear of accidents caused by the giving way of columns.

Will you kindly tell me what or whose rule or formula is accepted by the best authorities as reliable and trustworthy in making such calculations?

Hoping I have not trespassed too much on your time, I am,

Yours, Daniel E. Pierson.

[The difference in the results given in the tables probably depends upon the factor of safety assumed by the computer, the breaking-weight in all cases being generally deduced from Hodgkinson's formula. Francis, who is usually considered the best authority, takes the ultimate strength as given by Hodgkinson's formula, and divides it by five for the safe load on columns with perfectly accurate ends. For columns with ends turned with only the precision usual in building work he divides the first safe load by two, and for columns with ends roughly dressed by three, so that for ordinary foundry columns he would take the Hodgkinson's breaking-weight divided by ten, as the safe load. Cooper, Hewitt & Co.'s tables follow those of Mr. Francis. Trautwine gives breaking-loads only, by Hodgkinson's formula, with the remark that "it is not safe in practice to use more than one-fourth to one-eighth of these loads," which is anything but a satisfactory mode of disposing of the question. The New York Building Law demands that the relation between the load imposed on a column and the breaking-load shall be as one to six, but gives no further particulars. Hodgkinson's formula, as quoted by Trautwine, is for long, hollow cylindrical columns, with truly planed ends, firmly fixed.

Breaking load in tons =

$$\frac{(\text{Outer diameter in inches})^{3.5} - (\text{Inner diameter in inches})^{3.5}}{(\text{Length in feet})^{1.63}} \times 42.3.$$

With a table of logarithms the calculations for breaking-load can be easily made, and a factor of safety taken to suit the circumstances, but considering the carelessness with which such castings are made, we should be very reluctant to make the difference between the actual and the breaking load smaller than Mr. Francis' rules would give it. — Eds. American Architect.]

## THE CINCINNATI COURT-HOUSE.

To the Editors of the American Architect: —

*Dear Sirs,* — The Court-House Commissioners appointed under a recent act of the Legislature, organized and at once proceeded to business by electing Mr. H. C. Urner, president. According to their decision the present Court-House is to be rebuilt; a new building entirely is hardly among the possibilities. The Board consists of the following gentlemen: John L. Stentenius, Henry C. Urner, Judge Wm. Worthington and Wesley M. Cameron. The last named is a retired contractor. These gentlemen are from among our best citizens, two Democrats and two Republicans. There will be no chance for any jobbery at the hands of this Commission. Mr. James W. McLaughlin was appointed architect, and will at once proceed to prepare plans for rebuilding the structure. Of course it is too soon to say what will be done in the way of alterations, but it is certain that not much in the way of additions can be done, as the expenditure is limited to $300,000.

It is well for the tax-payers and for the profession that the matter has thus been settled without the intervention of any political jobbery.

The County Commissioners (who from this time forward have nothing to do with the matter) in the meantime go on asking for "bids" for the lowest cash price for plans, specification, bill of quantities, etc. C.

## "A FAIRLY GOOD TRUSS."

Boston, April 23, 1884.

To the Editors of the American Architect: —

*Gentlemen,* — In reply to your comments upon my note of the 1st inst., I ask space for a few more remarks relative to the "Fairly Good Truss."

"Subscriber" sent a sketch of a truss which has actually been constructed, — giving *in figures* the rise and span of the truss, and also the sectional dimensions of the various members. He does not give the details of the joints, but his sketch is clear enough as to the *relative positions* of the members, — showing that the ties intersect the principals at ⅔ their height, and that from these joints of intersection the pieces designated B on the original sketch are let fall *at right angles* to the *ties;* also, that the struts C rest upon the ties D midway between the *plates* and the foot of the piece A, and are *at right angles* to the *principals.* These data enable us to construct a skeleton on such a scale that the *lengths* of the members may be measured with fair accuracy. We thus find that the length of the principal, from the plate to the head of the piece B, is 21.6 feet; that the length of the half tie is 29 feet; and that the pieces B and C are 7.5 feet apart at their heads and 6.4 feet apart at their feet.

A calculation of the strains in the truss may readily be made from these data, and will clearly demonstrate its weakness.

The cross strain upon the principal is, as you observe, "one constantly imposed with safety," but only when the member is properly proportioned and of suitable sectional dimensions to *sustain both a transverse and a compressive stress,* which is far from being the case in this instance. L. Frederick Rice, C. E., Architect.

[It seems that Mr. Rice criticised the truss in question as shown in the printed diagram, and in that case we can assure him that we agree with him. Our own criticism was based upon the rough manuscript sketch, — a very rough one, which was sent us, and which not only showed no exact division of any member, and no right angles, but showed the two sides differently. One side was represented as having the feet of the strut and tie nearly together; as it seemed to us so nearly together that the transverse strain would be easily resisted; and we formed our opinion from this part of the diagram, which might or might not have been the most correct representation but which at least showed how such a truss would generally be constructed by a person with any knowledge of framing. In redrawing it for publication after our criticism had been penned, our draughtsman introduced a symmetry into the diagram which it did not originally possess, arranging the parts as he thought most appropriate to this result. The consequence was that Mr. Rice studied one drawing, and we another, neither of us having ever seen, before our criticisms were printed, the diagram which formed the subject of the other's remarks. If the drawings had been just alike, we cannot imagine that there would have been any difference between Mr. Rice's conclusions and our own, since we undoubtedly analyzed them in the same way. — Eds. American Architect.]

## HAND-BOOK ON GLASS-MAKING.

Utica, New York, April 19, 1884.

To the Editors of the American Architect: —

*Gentlemen,* — In your issue of April 12th, on Colored-Glass (From a lecture by Mr. G. Aitchison, A. R. A., delivered at the Royal Academy, February 25th) he refers the reader to a Technological Handbook, "The Principles of Glass-Making, 1883." If you will kindly, inform me where I can get the book, if it can be got in this country, whom it is by, and the price of it, you will confer a great favor.

Your Subscriber,

A. H. R.

As we have no knowledge of the book in question we must ask some one of our readers to give "A. H. R." the information he desires. — Eds. American Architect.]

## PAPIER MACHÉ.

Brooklyn, April 28, 1884.

To the Editors of the American Architect: —

*Gentlemen,* — Is there any manufacture of *papier maché* work to be used for panels, etc., on outside work.

Respectfully,

M. Thomas, Architect,

[Henry C. Carter, 367 Washington Street, Wm. Gibson's Sons, 143 East 33d St., and Henry Ordenstein, 57 Franklin St., New York, all do a certain amount of *papier maché* work. — Eds. American Architect.]

## NOTES AND CLIPPINGS.

The Statue of Charles I. at Charing-Cross. — Its story is singular—almost as singular as that of the statue of the Merry Monarch himself, which loyal Sir Robert Viner, "Alderman, Knight, and Baronet," put up in the old Stocks Market. It appears to have been executed about 1633, by Hubert Le Sœur, a pupil of John of Bologna, for the Lord High Treasurer Weston, who intended it to embellish his garden at Roehampton. By the terms of the commission, it was to be of brass, a foot larger than life, and the sculptor "was to take advise of his Maj. (Charles I.) riders of greate horses, as well for the shape of the horse and action as for the graceful shape and action of his Maj. figure on the same." Before the beginning of the Civil War, according to Walpole, the statue, cast but not erected, was sold by the Parliament to John Rivett, Brazier, living at the Dial near Holbrook Conduit, who was strictly enjoined to break it up. Rivett, whose "faith was large in time," carefully buried it instead, and ingeniously exhibited some broken brass in earnest of its destruction. Report further says that, making capital out of both parties, he turned these mythic fragments into knife and fork handles, which the Royalists bought eagerly as relics, and the Puritans as tokens of the downfall of a despot. In any case there is evidence to show that the statue was still in Rivett's possession in 1660, and it is assumed that it passed from him or his family to the second Charles. Styrpe says that he presented it to the king, which is not unlikely. — *English Illustrated Magazine.*

Concrete Water-Pipes.—In a late number of the *Annales des Ponts et Chaussées* a cheap method of making water-pipes of small diameter is described. The pipes were formed of concrete in the trench itself. The mould into which the concrete was stamped was of sheet-iron about two yards in length. The several pipes were not specially joined to each other, the joints being simply set with mortar. The concrete consisted of three parts of slow setting cement and three parts of river sand, mixed with five parts of limestone débris. The inner diameter of the pipes was nine inches; their thickness three inches. The average fall is given at one in five hundred; the lowest speed of the current at one foot nine inches per second. To facilitate the cleaning of the pipes, man-holes are constructed every one hundred yards or so, the sides of which are also made of concrete. The trenches are about five feet deep. The work was done by four men, who laid down nearly two hundred feet of pipes in a working day; the cost was about ninety-three cents per running yard. It is claimed as an advantage for the new method that the pipes adhere closely to the inequalities of the trench, and thus lie firmly on the ground. The works were carried out by M. Thanneur for the water-mains of the town of Coulommiers. It may here also be mentioned that in the course of the Canal du Verdon, which supplies the town of Aix-en-Provence and the neighborhood with water, several mains were carried in a similar manner. But the concrete pipes which are submitted to great pressure have not proved effective. The method, consequently is only suitable for pipes in which there is no pressure, or only a very trifling one.

# BUILDING INTELLIGENCE.

(Reported for The American Architect and Building News.)

*[Although a large portion of the building intelligence is provided by their regular correspondents, the editors greatly desire to receive voluntary information, especially from the smaller and outlying towns.]*

## BUILDING PATENTS.

*[Printed specifications of any patents herementioned, together with full detail illustrations, may be obtained of the Commissioner of Patents, at Washington, for twenty-five cents.]*

297,117. HASP-LOCK. — David H. Donaldson, Buffalo, N. Y.
297,118. SHUTTER-FASTENER. — Wm. E. Doolittle and D. Edward Doolittle, New Britain, Conn.
297,126. PORTABLE FIRE-ESCAPE. — Francis Ingersoll Freeman, Warren, O.
297,139. LIQUID PAINT. — George T. Lewis, Philadelphia, Pa.
297,145. BLIND-STOP. — Thomas Massey, Pawtucket, R. I.
297,151. LOCK. — Frank W. Mix, New Britain, Conn.
297,164. SURVEYOR'S LEVEL. — Theodore F. Randolph, Cincinnati, O.
297,171. RATCHET-DRILL. — Caspar Schumacher, Kalk, Germany.
297,187. SASH-HOLDER. — William O. Smith, Norwalk, O.
297,189. MEANS OF VENTILATION. — Marshall B. Stafford, New York, N. Y.
297,204. BLIND-SLAT LOCK AND OPERATOR. — Izaak Van Kersen, Kalamazoo, Mich.
297,209. WRENCH. — Thos. Foster White, Salem, Kans.
297,210. RATCHET-DRILL. — Pardon A. Whitney, Cleveland, O.
297,218. BRICK-MACHINE. — William Andrus, Keokuk, Iowa.
297,227. LEVELLING AND PLUMBING INSTRUMENT. — Oliver H. P. Brown, Clarksville, Ark.
297,228. SASH-FASTENER. — Francis M. Case, Denver, Col.
297,229. DISINFECTING SEWERS. — Edward Z. Collings, Camden, N. J., and Charles F. Pike, Philadelphia, Pa.
297,239. LOCK FOR SLIDING-DOORS. — James Henry Dougherty, Whistler, Ala.
297,282. CARPENTER'S VISE. — John F. Miller, Pittsburgh, Pa.
297,290. COUPLING FOR LIGHTNING-RODS. — Theodorus H. Patee, Greencastle, Ind.
297,296. APPARATUS FOR VENTILATING WATER-CLOSETS, URINALS, DRAINS, SEWERS AND THE LIKE. — Thos. Rowan, London, Eng.
297,308. BUILDING-BLOCK. — Walter Stranders, New York, N. Y.
297,310. FAN-BLOWER. — James E. Studley, Oshkosh, Wis.
297,311. BURGLAR-ALARM. — Henry E. Taber, Watkins, N. Y.
297,321. WATER-CLOSET CONNECTION. — Henry C. Weden, Boston, Mass.
297,325. STEAM-RADIATOR. — Corydon Wheat, Geneva, N. Y.
297,331. SKELETON TOWER. — John S. Adams, Elgin, Ill.
297,332-333. ELECTRIC-LIGHT TOWER. — John S. Adams, Elgin, Ill.
297,360. VISE-ATTACHMENT. — Charles H. Eddy, Auburn, N. Y.
297,374. ROOFING-COMPOUND. — Jas. T. Fretwell, Atlanta, Ga.
297,392. ROTARY-BLOWER. — Ralph E. Harris, Macomb, Ill.
297,395. LUMBER-TRIMMING MACHINE. — Edward Heyde, East Saginaw, Mich.
297,402. LATCH-KNOB ATTACHMENT. — Geo. Lewis Howland, Topsham, Me.
297,404. SINK OR ANALOGOUS ARTICLE. — Henry L. Jacobs, Columbus, O.
297,410. EXCAVATING-ELEVATOR. — Geo. H. Kanmacher, Columbus, O.
297,423. BRICK-KILN. — James S. Lester, Atlanta, Ga.
297,432. AUTOMATIC FIRE-EXTINGUISHER. — Wm. Neracher, Cleveland, O.
297,434. HEATING AND VENTILATING APPARATUS. — Patrick W. Nolan, New York, N. Y.
297,449. FIRE-PROOF BUILDING. — Gustavus W. Rader, New York, N. Y.
297,455. VALVE FOR WATER-CLOSETS, ETC. — William Scott, Malden, Mass.
297,465. DOOR-SECURER. — Wm. Starrett, North Manchester, Ind.
297,485. LUMBER-RACK. — Joseph Amis Aycock, Whitesburg, Ga.
297,491. CONSTRUCTING AND FASTENING TILES. — Walter Booth, Tarrytown, N. Y.
297,492. CALIPERS. — Charley Bovensiep, Detroit, Mich.
297,499-500. FASTENER FOR MEETING-RAILS OF SASHES. — Louis J. Church, Washington, D. C.
297,505. PNEUMATIC TUBE. — Wilbur G. Davis, Syracuse, N. Y.
297,530. METALLIC SHINGLE. — John Mott, New York, N. Y.
297,548. FIRE-GRATE. — Georges Alexis-Godillot, Paris, France.

## SUMMARY OF THE WEEK.

### Baltimore.

ADDITION. — Francis White and others are about to make an addition of a mansard story to the five-st'y property s e cor. Baltimore and Liberty Sts., to cost about $3,500, from designs by George Archer, architect.

BUILDING PERMITS. — Since our last report forty-one permits have been granted, the more important of which are the following: —

St. Charles Catholic Church, brick church, w s Gilmor St., s of Baker St.

Chas. P. Logue, three-st'y brick stable and dwell., rear w s Pearl St., between Mulberry and Saratoga Sts.

Alonzo Radcliffe, three-st'y brick building, n w cor. O'Donnell and Canton Sts.

S. D. Price, 4 two st'y brick buildings, w s Peabody St., s of John St.

Brigham & Hopkins, six-st'y brick building, s e cor. German and Paca Sts.

Jos. M. Johnson, three-st'y brick building, n s Baltimore St., e of Schroeder St.

Hy. Smith, three-st'y brick building, w s Regester St., between Lombard and Pratt Sts.

Chas. Bonaparte, 6 three-st'y brick buildings, s s Baltimore St., commencing s e cor. Patterson Park Ave.; and 3 three-st'y brick buildings, w s Patterson Park Ave., rear above.

Levi Straus, three-st'y brick buildings (square), and two-st'y brick stable, s e cor. Eutaw Pl. and Mosher St.

M. A. Caldwell, 5 two-st'y brick buildings, e s Wilcox St., s of Chase St.

Louis C. Smith, 3 two-st'y brick buildings, n s Heath St., between Hanover St. and Goodman Alley.

E. J. McMullen, 8 three-st'y brick buildings, s s Dolphin St., between Myrtle Ave. and Shield Alley.

John G. Foster & Co., 4 two-st'y brick buildings, e s Chesapeake St., between O'Donnell and Elliott Sts.

L. H. Robinson, three-st'y brick building, w s Fulton Ave., n of Mosher St.

There is no change in the Labor Quotations.

### Boston.

BUILDING PERMITS. — *Brick. — Athens St., No.* 138, Ward 13, for Timothy Hourihan, dwell., 25' x 35', three-st'y flat.

*West Chester Park*, Ward 11, for N. H. Chadwick and O. L. Stillings, 9 dwells., 23' x 45', two-st'y mansard; ell, 14' x 20'; O. L. Stillings, builder.

*Adams Pl., No.* 28, Ward 19, for Mrs. Prudence E. Libby, tenement, 40' x 56', three-st'y flat; Simon Gaul, builder.

*Highland St., Nos.* 84-88, Ward 21, for Daniel Stamford Heirs, 3 dwells., 30' x 35', two-st'y mansard; W. H. Sayward, builder.

*Bismarck St.*, near Boylston St., Ward 23, for F. W. Dahl, currying-shop, 40' x 126', three-st'y flat; ell, 33' x 88'; Dady & Flint, builders.

*Newbury St., No.* 245, Ward 11, for W. C. Nast Estate, dwell., 25' x 58', four-st'y mansard; John R. Briggs, builder.

*West Cottage St., Nos.* 62-68, Ward 20, for Silas Potter, 4 dwells., 21' 3" x 36' 6", three-st'y flat; Sampson, Clarke & Co., builders.

*Wood. — Norfolk St.*, rear, near Withington St., Ward 24, for Mrs. Caroline Jackson, storage, 14' x 50' and 53', one-st'y pitch; John H. Burt & Co., builders.

*Gibbs Ct.*, near Main St., Ward 4, for Patrick Monohan, 2 dwells., 11' x 18' and 22' x 32', four-st'y flat; Wm. Carter, builder.

*Blue Hill Ave., No.* 18, Ward 20, for J. W. Laming, store, 18' x 37', one-st'y flat; Laming & Drisko; builders.

*Hichborn St.*, near Herrick St., Ward 25, for John H. Walch, 8 dwells., 12' 9" x 14' 3" and 18' x 27', two-st'y hip; J. W. Berry, builder.

*Unnamed St.*, near Wilton St., Ward 25, for H. W. Longfellow, dwell. and skating-rink, 21' x 32' and 32' x 43', two-st'y mansard; H. M. Perry, builder.

*North Beacon St.*, near Everett St., Ward 25, for A. F. Sinclair and L. S. Marston, 4 dwells., 14' 9" and 20' x 52', two-st'y pitch; Stephen Ellis, builder.

*Sycamore St.*, rear, near Mt. Hope Station, Ward 23, for John Richardson, stable, 24' x 45', one-st'y pitch.

*Union St.*, rear, near Shepard St., Ward 25, for John Kelley, dwell., 23' x 33', two-st'y pitch; Michael Mahon, builder.

*East Third St., No.* 531, Ward 14, for John Dargan, dwell. and store, 27' 6" x 45' 4", three-st'y flat; Wm. T. Eaton, builder.

*East Third St., No.* 533, for John Dagan, dwell., 13' x 21' and 42' 8", three-st'y flat; Wm. T. Eaton, builder.

*Washington St.*, near Keyes St., Ward 23, for John Dowling, dwell., 15' x 20' and 21' and 23' 6" x 32', two-st'y pitch; McDonald & Tobin, builders.

*Canterbury St.*, near Ashland St., Ward 23, for Thomas McManus, dwell., 22' x 30', two-st'y pitch; D. McDonald, builder.

*Tuckerman St.*, e s, Ward 15, for H. Gove & Co., stable, 20' and 24' x 80', two-st'y flat; C. E. Snow, builder.

*A St.*, near Boylston St., Ward 23, for F. W. Listman, dwell., 12' x 22' and 22' x 32' and 38', two-st'y pitch; Jacob Luippold, builder.

*Myrtle St., No.* 23, rear, Ward 23, for Edward G. Norcross, dwell., 20' and 28' x 28', two-st'y pitch; Melvin D. Ayers, builder.

*Unnamed St.*, near Chester St., Ward 23, for John Egan, dwell., 23' x 31' two-st'y pitch; Melvin D. Ayers, builder.

*Rockland St.*, cor. Unnamed St., Ward 21, for Thos. Closby, 2 dwells., 27' 10" x 36' 6", three-st'y flat; John D. Wester, builder.

*Sumner St., No.* 293, Ward 2, for Thos. Boardman, dwell. and store, 19' x 55', two-st'y mansard.

*School-street Pl.*, rear of 41 School St., Ward 23, for Thos. Harris, stable, 18' x 20', one-st'y pitch; Harris Bros., builders.

*Longwood Ave., No.* 78, rear, Ward 22, for Daniel Vetter, 2 dwells., 20' x 28', three-st'y flat; Jacob Luippold, builder.

*Allston St.*, near Allston Pl., Ward 25, dwell., 14' x 15' and 22' x 29', two-st'y pitch; R. E. Abbott, owner; W. B. & M. Farrow, builders.

### Brooklyn.

BUILDING PERMITS. — *Delmonico Pl.*, n e cor. Ellery St., three-st'y frame store and tenement, tin roof; cost, $4,600; owner, Wm. Kolb, 186 Hopkins St.; architect, F. Holmberg; builder, J. Rueger.

*Delmonico Pl.*, e s, 30' 6" n Ellery St., three-st'y frame tenement, tin roof; cost, $4,000; owner, architect and builder, same as last.

*Fourth St.*, w s, about 75' s South Fifth St., four-st'y brick tenement and store, tin roof; cost, $12,000; builders, W. & T. Lamb.

*Penn St.*, s s, about 150' e Bedford Ave., two-st'y brick dwell., tin roof; cost, $5,400; owner, Wm. E. Andariese, 85 Broadway; architect, E. F. Gaylor; builders, M. Smith and R. & B. Ferguson.

*Bergen St.*, n s, 90' e Albany Ave., 2 one-st'y frame buildings for car-house and stable, gravel roof; cost, $15,000; owner, South Brooklyn & Central R. R. Co.; builders, M. J. Reynolds and P. Brady.

*Union St.*, s s, 125' w Clinton St., 3 three-st'y brown-stone dwells., tin roofs; cost, each, $6,500; owner, Julius Wadsworth, New York; architect and carpenter, Geo. Lowber; mason, W. L. Rountree.

*Richards St.*, n e cor. Bowne St., two-st'y brick shop, slate and tin roof, brick and iron cornice; cost, about $8,000; owner, J. H. Williams, 293 Henry St.; architects, Norris & Son.

*Kent Ave.*, n w cor. Park Ave., 2 four-st'y brick stores and tenements, tin roofs, wooden cornices; cost, $12,000; owner, A. Phillips, Jr.; architect and carpenter, J. T. Hanlon; mason, J. Collins.

*Scholes St.*, s s, 78' w Lorimer St., four-st'y frame store and dwell., tin roof; cost, $6,000; owner, Anton Muller, 30 St. Mark's Pl.; architect, J. Platte; builder, F. Herte.

*Court St.*, s w cor. Luquer St., 3 four and three-st'y brick stores and dwells., tin roofs; cost, corner, $8,000, and others, each $5,500; owner and builder, Thomas Keogh, 149½ Nelson St.

*Saratoga Ave.*, s w cor. Herkimer St., two-st'y brick dwell., tin roof; cost, $3,500; owner, Pauline Hartung, 148 Saratoga Ave.; architect, L. R. Hartung; mason, C. Bauer.

*Marcy Ave., No.* 241, e s, 75' s Wallabout St., three-st'y brick dwell., tin roof; owners, Moller & Schumann, Marcy Ave., cor. Gerry St.; architect, Th. Engelhardt; builders, S. Burrows and Jos. Frisse.

*Penn St.*, n s, 104' e Lee Ave., two-st'y and three-st'y brown-stone dwells., tin roofs; cost, each, $6,000; owner, Daniel Scully, 220 Penn St.; architect and builder, M. Browne.

*Leonard St.*, n e cor. Vann Cott Ave., four-st'y frame store and tenement, gravel roof; cost, $8,000; owner, Fred. Isermann, New York; architect, —— Webber; builders, Jno. Haffer and Randall & Miller.

*Withers St.*, n e cor. Lorimer St., three-st'y frame store and tenement; cost, $5,000; owner, Geo. Thocode, 334 Lorimer St.; architect, A. Herbert; builder, J. Schoch.

ALTERATIONS. — *South Eighth St.*, s s, 25' w Second St., three-st'y brick extension, tin roof, etc.; cost. $7,400; owner, Loftus Wood, 1145 Broadway; architect, E. F. Gaylor; builders, M. Smith and S. L. Hough.

*Second St.*, e s, 51' n North Tenth St., add one st'y, also three-st'y brick extension, etc., gravel roof; cost, $9,000; owner, The Tuttle & Bailey Manufacturing Co., 83 Beekman St., New York; architect, A. Namur.

*Pacific St., No.* 1134, two-st'y brick extension on east of building, and two-st'y brick extension on rear, interior alterations; cost, $8,000; owner, W. L. Butler, on premises; architects, Rossiter & Wright; builders, T. A. Hamblin and J. C. Sawkins.

### Chicago.

OFFICE-BUILDING. — Burnham & Root are architects of the twelve-st'y office-building to be erected for P. C. & S. L. Brooks, of Boston.

SEMINARY. — Plans are completed for the Western Theological Seminary, to be built by the Episcopal Church, on Washington Boulevard, near California Ave. This structure and dormitory attached will cost $75,000, and will occupy a lot 200' on the Boulevard by 194' deep. Treat & Foltz, who have on hand at present over $400,000 worth of work, drew the plans.

BUILDING PERMITS. — S. Weise, 2 two-st'y dwells., 3124 and 3126 Vernon Ave.; cost, $8,500; architect, C. C. Mueller.

C. J. Hess, 2 two-st'y buildings, 2973 and 2975 Prairie Ave.; cost, $12,000; architect, L. B. Dixon; builder, J. Phillips.

J. M. Kralove, two-st'y dwell.; cost, $3,500.

J. Reifort, two-st'y dwell., 3839 Dearborn St.; cost, $3,000; builder, E. Hamlin.

Geo. Allis, three-st'y store and dwell., 430 Division St.; cost, $7,000; architect, Furman; builder, L. Koble.

C. Groshauser, two-st'y dwell., 611 Twenty-first St.; cost, $3,000; architect, Beasley.

H. Gerber, two-st'y dwell., 3633 Halsted St.; cost, $3,500; architect, Ruehl.

P. C. & S. L. Brooks, twelve-st'y office-building, Lasalle St., cor. Jackson St.; cost, $250,000; architects, Burnham & Root.

M. D. Kerfoot, 2 one-and-one-half-st'y cottages, Rice St., cor. Leavitt St.; cost, $3,000.

H. Morgen, 2 three-st'y dwells., 3504 and 3506 State St.; cost, $10,000; architect, Geo. Edbrooke.

Three-st'y flats, 76 South Sangamon St.; cost, $6,500; architects, Furst & Rudolph.

H. Lehmann, three-st'y flats, 283 West Ohio St.; cost, $8,000; architect, E. Stende.

Jacob Alt, 2 three-st'y flats, 464 and 466 West Congress St.; cost, $11,000; architect, R. Besler.

Mrs. A. Boland, three-st'y flats, 140 Eugenie St.; cost, $7,000; architect, J. Otter.

G. Hesterman, two-st'y flats, 69 Huron St.; cost, $2,500; architect, C. C. Hanson.

M. Pasantt, 4 two-st'y flats, 1162-1166 Harrison St.; cost, $12,000; architect, W. A. Furber.

J. S. Kirk & Co., one-st'y boiler-house; cost, $5,000; builder, Nicholson.

V. Heller, two-st'y dwell., 314 and 316 Jefferson St.; cost, $2,500.

E. Hink, three-st'y dwell., 593 North Clark St.; cost, $10,000; architects, Froman & Jepson.

C. Burke, two-st'y store and dwell., South Park Ave.; cost, $4,000.

F. A. Kennedy Co., six-st'y bakery, 44-50 South Desplaines St.; cost, $50,000; architects, Adler & Sullivan.

Ulick, 2 two-st'y dwells., 2326 and 2328 Dearborn St.; cost, $10,000; architect, William Strippelman; builders, Geo. Lehman & Son.

Norton Bros., two-st'y barn, 17 Depuyster St.; cost, $5,000; builder, Jas. McGraw.

H. J. Christoph, 2 two-st'y dwells., 769 and 771 Larrabee St.; cost, $10,000; architect, W. Arend.

M. Mitchell, three-st'y and attic store and dwell., 520 West Eighteenth St.; cost, $5,000; architect, P. Besler.

J. Lala, two-st'y dwell., 259 West Twentieth St.; cost, $3,500; architect, J. Witner.

Vopeska & Kubrin, two-st'y dwell., 202 Taylor St.; cost, $3,700; architect, J. Witner.

G. Snydacker, three-st'y dwell., 2522 Michigan St.; cost, $25,000; architect, J. C. Cochran.

M. B. Clancy, two-st'y dwell., 3142 Vernon Ave.; cost, $5,000; architect, C. M. Palmer.

W. B. Snow, two-st'y dwell., 3140 Calumet Ave.; cost, $5,800; architect, C. M. Palmer.

Dearborn Foundry Co., three-st'y foundry; cost, $5,200; architect, L. Smith.

J. P. McAsse, two-st'y dwell., 478 Taylor St.; cost, $3,000.

Western Theological Seminary, three-st'y seminary and dormitory, Washington Boulevard; cost, $75,000; Treat & Foltz, architects.

F. H. Hedrich, three-st'y store and dwell., 127 Chicago Ave.; cost, $5,500; architect, Otto.

H. Feldman, 2 two-st'y dwells., 781 Ogden Ave.; cost, $8,000; architect, F. Keltenich; builder, A. Kaiser.

Dr. Matthei, 6 three-st'y dwells., 307 to 317 Van Buren St.; cost, $30,000; architects, Treat & Foltz; builder, A. Kaiser.

Chas. Keefer, three-st'y dwell., 540 Division St.; cost, $7,000; Theo. Karls.

P. Schoenhofen Brewing Co., two-st'y barn, ice-house, and rear addition; cost, $5,000; architect, Otto Matz.

J. S. Norton, 2 three-st'y dwells., 613 Division St.; cost, $15,000; architects, Treat & Foltz.

Mrs. E. Montgomery, two-st'y dwell., 2825 South Park Ave.; cost, $5,000.

### Cincinnati.

BUILDING PERMITS.—Dr. Schmuck, four-st'y brick dwell., Main St.; cost, $7,000; Geo. W. Rapp, architect.

Mrs. E. Roberts, two-st'y brick dwell., Spring St.; cost, $3,500.

J. G. Grote, four-st'y brick store, Court St.; cost, $7,500.

Geo. Cornelius, three-st'y brick building, 61 Fourteenth St.; cost, $6,500.

Krebs Lithographing Co., five-st'y brick building, Sycamore St., near Sixth St.; cost, $20,000; Jas. W. McLaughlin, architect.

C. Eichenbusch, two-st'y brick dwell., Tremont St., near Oak St.; cost, $3,000.

Mrs. A. Best, three-st'y brick dwell., McMicken Ave.; cost, $4,000.

M. L. Elston, 2 two-st'y frame dwells., Chapel St., e of Walnut Hills; cost, $4,500.

B. Gerbel, two-st'y frame dwell., Ohio Ave., near Parker St.; cost, $3,000.

Wm. Packer, two-st'y brick building, 130 East Second St.; cost, $2,500.

F. L. Lumke, three-st'y brick building; cost, $6,000.

Jos. Seiber, two-st'y frame dwell., Hackberry St., near Madisonville Pike; cost, $3,500.

P. D. Roe, two-st'y brick dwell., Dosey St., near Sycamore St.; cost, $4,000.

Mrs. Mary Walter, two-st'y frame dwell., Church Ave.; cost, $3,000.

F. M. Zumstein, three-st'y brick stable, Lodge Alley, cor. Sixth St.; cost, $4,000.

Mt. Auburn Baptist Church, Auburn Ave., near Church St.; cost, $21,000; Chas. Crapsey, architect.

F. Burdeck, four-st'y brick building, cor. Twelfth and Breman Sts.; cost, $7,000.

A. Lucas, two-st'y brick dwell., Addison St., near Spring Grove Ave.; cost, $5,000.

H. Mantel, three-st'y brick dwell., Woodward St., near Franklin St.; cost, $5,000.

H. Berens, three-st'y brick building, Plum St., near Front St.; cost, $3,600.

M. Clements, two-st'y brick building, Hathaway St., near Baymiller St.; cost, $5,000.

L. B. Harrison, five-st'y brick store, Race St., between Fourth and Fifth Sts.; cost, $30,000; Jas. W. McLaughlin, architect.

J. D. Rumeir, three-st'y brick building, Clifton Ave.; cost, $6,000.

J. Schilenburger, two-st'y brick building, Vine St., near Boone St.; cost, $6,000.

Mrs. Lahman, two-st'y brick building, Linn St.; cost, $6,500.

A. Liks, three-st'y brick dwell., 202 Western Ave.; cost, $5,000.

Mrs. R. Behman, three-st'y brick building, Mulberry St.; cost, $5,000.

C. Simons, 3 one-st'y frame buildings, 17, 19 and 21 Central Ave.; cost, $4,000.

J. Boen, two-st'y brick building, Calhoun St.; cost, $6,000.

J. B. Lucas, two-st'y brick building, Wheeler St.; cost, $4,000.

W. Harrison, two-st'y brick dwell., s e cor. Highland Ave. and Oak Sts.; cost, $7,000.

P. Lane, three-st'y brick building, Warner St.; cost, $4,100.

T. Soelter, three-st'y brick dwell., Euclid Ave.; cost, $5,000.

John Ridder, three-st'y brick building, Lick Run Pike; cost, $3,500.

Ed. Stevens, two-st'y brick dwell., Crown St., opposite Home St.; cost, $8,500.

Dr. Rendigs, four-st'y brick building, Woodward St., cor. Pendleton St.; cost, $12,000.

Thirty-nine permits for repairs; cost, $35,100.
Seventy-five permits; cost, $273,800.
Total permits to date, 244.
Total cost to date, $923,350.

### New York.

CHAPEL. — On the n s of One Hundred and Twelfth St., near Second Ave., a brick chapel, 25' x 90', is to be built for the Church of the Holy Trinity.

CITY PRISON. — It is proposed to enlarge the City Prison on the Leonard Street side; $90,000 has been appropriated for the purpose. Messrs. N. Le Brun & Son have the plans on the boards.

STORES. — At No. 5 East Nineteenth St., a five-st'y store-building, 25' x 97', of Philadelphia brick with Ohio-stone finish, is to be built for Mr. M. Garcia, at a cost of $30,000, from designs of Mr. Robert Mook.

At No. 2191 Third Ave., a four-st'y brick store and warehouse, 31' x 120', is to be built for Mr. John Lynch, at a cost of $20,000, from designs of Mr. B. Walther.

TENEMENTS.—For Mr. Henry Bornkamp, Messrs. McClay & Davis have drawn plans for 14 five-st'y brick tenements, 25' x 70' each, to be built on Ninth Ave., near Ninety-fifth St., at a cost of $210,000.

BUILDING PERMITS.—*One Hundred and Twenty-sixth St.*, s s, 250' e Eighth Ave., 2 five-st'y brown-stone tenements, tin roofs; cost, each, $20,000; owner, Frederick Aldhous, 24 East One Hundred and Twenty-eighth St.; architect, F. T. Camp.

*Forty-fifth St.*, n s, 150' w Eleventh Ave., two-st'y brick stable, gravel roof; cost, $7,500; owner, Standard Oil Company, 44 Broadway; architect, R. G. Ewen.

*Twenty-first St.*, n s, 225' e Eighth Ave., 3 five-st'y brown-stone tenements, tin roofs; cost, each, $35,000; owner, Henry R. Mount, 359 Pearl St.; architect, A. B. Ogden; builders, Geo. Whitfield and O'Keeffe & Co.

*Eighty-fourth St.*, s s, 255' 6" w Third Ave., five-st'y brick and brown-stone tenement, gravel roof; cost, $13,000; owner, Gideon Fountain, 153 East Sixty-second St.; architect, A. B. Ogden.

*Fifty-first St.*, n s, about 300' e Tenth Ave., two-st'y brick and stone church, tin roof; cost, $100,000; owner, Rev. M. J. Brophy, 247 West Fifty-first St.; architects, N. Le Brun & Son.

*Eighty-third St.*, s s, 300' e Ninth Ave., 7 four-st'y brick and brown-stone dwells., tin roofs; cost, each, average, $20,000; owner, Wm. Noble, Seventh Ave., s w cor. Fifty-seventh St.; architect, G. W. da Cunha.

*Eighty-fourth St.*, n s, 175' e Fifth Ave., 2 four-st'y and basement Connecticut brown-stone dwells., tin roofs; cost, $35,000 and $37,000; owner, Philip Braender, Ave. B, between Eighty-fourth and Eighty-fifth Sts.; architect, J. Brandt.

*East Thirty-second St., Nos.* 16, 18 *and* 10, 3 five-st'y brick tenements; tin roofs; cost, each, $17,000; owner, Jacob Schlosser, 364 East Fiftieth St.; architect, Jobst Hoffmann.

*Madison Ave.*, n w cor. One Hundred and Seventy-third St., two and-one-half-st'y frame dwell., shingle roof; cost, $3,300; owner, Henry C. Mandeville, 1760 Washington Ave.; architect, F. F. Ward.

*West Eighty-fourth St., Nos.* 360, 362 *and* 364, 3 four-st'y Connecticut brown-stone dwells., tin roofs; cost, each, $15,000; owner, Mrs. Margaret A. Brennan, 73 West Sixty-ninth St.; architect, F. F. Ward.

*Forty-ninth St.*, s s, 81' 6" e Tenth Ave., and *Forty-eighth St.*, n s, 81' 6" e Tenth Ave., 2 five-st'y brown-stone tenements, tin roofs; cost, each, $17,000; owner, William Rankin, 338 West Forty-seventh St.; architect, M. L. Ungrich.

*Forty-seventh St.*, s s, 310' e Tenth Ave., 2 five-st'y brown-stone tenements, tin roofs; cost, each, $22,000; owners, Mr. and Mrs. Hugh McKee, 114 Washington St., Hoboken; architect, M. L. Ungrich.

*Forty-seventh St.*, s s, 209' e Tenth Ave., 2 five-st'y brown-stone tenements, tin roofs; cost, each, $22,000; owner, Philip Hauseman, 889 Tenth Ave.; architect, M. L. Ungrich.

*Second Ave., Nos.* 467 *and* 469, 2 five-st'y brick tenements, tin roofs; cost, each, $12,000; owners, Josephine Anderson and others, by E. Ellery Anderson, agent, 165 Madison Ave.; architect, J. Boekell.

*East Seventy-first St., No.* 427, four-st'y brick tenement, tin roof; cost, $9,500; owner, Henry Rollmann; architects and builders, Wm. Fernschild & Son.

*Sixty-eighth St.*, s s, 50' e Ave. B, three-st'y brick dwell., tin roof; cost, $4,000; owner, A. J. Port, 27 Mount Morris Ave.; architect, A. J. Miller; builder, Thos. Wilson, superintendent.

*Eighth Ave.*, e s, One Hundred and Thirty-second St., to One Hundred and Thirty-third St., 7 five-st'y brick flats and stores, tin roofs; cost, each, $16,000; owner, Henry Weil, Mansion House, Brooklyn; architects, Babcock & McAvoy.

*Third Ave.*, e s, 59' 9" s One Hundred and Fourth St., 2 five-st'y brown-stone front tenements and stores, tin roofs; cost, each, $18,500; owner, Patrick McManus, 110 East Ninety-first St.; architect, John Brandt.

*One Hundred and Twenty-third St.*, s s, 85' e Lexington Ave., five-st'y brick flat, tin roof; cost, $16,000; owner, Wm. C. Lesster, 232 West Fifty-second St.; architect, Geo. B. Pelham.

*Sixth St.*, n s, 40' w Ave. B, five-st'y brick tenement, tin roof; owner, Esther Marks, 101 Ave. B; architect, Edward Kenny.

*Eighty-first St.*, n s, 200' e Tenth Ave., 7 three-st'y brown-stone front dwells., tin roofs; cost, each, $12,000; owner, Daniel Herbert, 215 East Forty-eighth St.; architect, H. J. Hardenbergh; builders, D. & E. Herbert and O. T. Mackey.

*West Thirty-ninth St., Nos.* 107, 109, 111 *and* 113, seven-st'y brick fire-proof apartment-house; cost, $160,000; owner, Jas. D. Fish, 78 Wall St.; architect, Ed. H. Kendall; builders, W. A. & F. E. Conover and A. G. Bogert & Bro.

*West Thirty-ninth St., Nos.* 113, 115, 117 *and* 119, eight-st'y brick fire-proof apartment-house, fire-proof roof; cost, $185,000; owner, architect and builders, same as last.

*Fifty-ninth St.*, n s, 200' w Tenth Ave., five-st'y brick and stone flat, tin roof; cost, $18,000; owner, Henry Richl, 118 East Ninety-first St.; architect, Aug. Hatfield.

*Chrystie St., No.* 58, five-st'y brick tenement, tin roof; cost, $16,000; owner, H. W. Miles, 55 Chrystie St.; architect, Wm. B. Tubby.

*One Hundred and Nineteenth St.*, n s, 473' e Pleasant Ave., frame coal-pocket; cost, $15,000; owner, Robert Murray, 221 West One Hundred and Thirtieth St.; architect, G. W. Walgrove.

*One Hundred and Fifty-ninth St.*, s s, 300' e Courtland Ave., three-st'y frame tenement, tin roof; cost, $5,000; owner, Chas. Nuendorff, 24½ Christopher St.; builder, Adam Jansen.

*Worth St., No.* 105, five-st'y brick and iron store, tin roof; cost, $36,000; owner, Clinton Ogilvie, 55 West Fifty-fifth St.; architect, Richard Berger.

*West Forty-eighth St., No.* 435, four-st'y brick tenement, tin roof; cost, $15,000; owner, James Mullen, West Forty-eighth St.; architect, W. F. Simonds.

*West Forty-fifth St., No.* 126, five-st'y stone and brick flat, tin roof; cost $80,000; owner, Anna Gillies, 126 West Forty-fifth St.; architect, A. W. Cordes.

*East Seventy-eighth St., Nos.* 164, 166, 168 *and* 170, two-st'y brick stable, tin roof; cost, $3,000; owner, Elijah B. Middlebrook, 121 East Seventy-eighth St.; architect, F. B. Sewell.

ALTERATIONS. — *Ave. B, No.* 311, repair damage by fire; cost, $3,750; owners, Alcott & Wehrum, on premises; builder, Henry Wallace.

*West Fifty-eighth St., No.* 44, three-st'y brick extension, tin roof; cost, $5,000; owner, E. J. Donnell, on premises; builder, L. N. Crow.

*Jacob St., Nos.* 11 to 17, one-st'y brick extension, gravel roof; cost, $3,000; owner, Ambrose K. Ely, 132 East Twenty-third St.; architect, John McIntyre; builders, Robinson & Wallace and Wm. J. O'Connor.

*Bathgate Ave.*, n w cor. One Hundred and Seventy-fifth St., interior alterations; cost, $3,500; owner, Hugh N. Camp, Fordham Ridge, Twenty-fourth Ward; architect, John E. Kerby.

*Park Row, Nos.* 17 *and* 19, new first-st'y front, iron-work, condemned walls rebuilt; cost, $10,000; lessee, Joshua Von Brummer, on premises; Isaac Greenwood, Jr., principal owner and representative for heirs, 416 West Fourteenth St.; architect, G. E. Harding.

*West Tenth St., No.* 12, four-st'y frame extension, tin roof, interior alterations; cost, $15,000; Bruce Price, 28 West Twenty-third St., agent for Josephine L. Price.

### Philadelphia.

BANK BUILDING. — At the s e cor. Fifth and Chestnut Sts., Drexel & Co. will erect a new bank building, 55' x 105', 58' high; to be built of white marble, the banking-room to be finished in Indiana limestone; plans by Wilson Bros. & Co., architects.

HOUSE.—Residence for Theo. Engel, Esq., at Sixteenth and Jefferson Sts., from plans by Wilson Bros. & Co., architects.

BUILDING PERMITS.—*Arlington St.*, cor. Monument St., bet. Seventeenth and Eighteenth Sts., 17 two-st'y dwells., 13' and 14' x 38'; and 14' and 15' x 42'; D. C. Cleaver, owner.

*Thirty-third St.*, s Spring Garden St., 6 three-st'y dwells., 48' 6" x 53'; J. H. McIlvain.

*Thirtieth St.*, cor. Fletcher St., 4 two-st'y dwells., 14' x 29'; Samuel Stewart, contractor.

*Grape St.*, n e Wood St., 2 three st'y dwells., 13' x 32'; Frank Elliot, contractor.

*Crams Ave.*, bet. Mitchell St. and Ridge Ave., 2 three-st'y dwells., 16' x 32'; Frank Elliot, contractor.

*Green St.*, s Queen St., 2 two-st'y dwells., 19' and 20' x 60'; Wm. Garvier, contractor.

*Vine St.*, e Twenty-fifth St., 2 two-st'y dwells., 17' x 58'; W. T. B. Roberts, sup't.

*Long Lane*, n Reed St., two-st'y factory, 32' x 56'; M. M. McCuen, owner.

*Gerret St.*, e Nineteenth St., two-st'y dwell., 14' x 39'; M. McManes, contractor.

*Cambridge St., No.* 1624, three-st'y dwell; 16' x 45'; Chas. O'Krouglowicsz, contractor.

*McKean St.*, bet. Eleventh and Twelfth St., two-st'y dwell., 16' x 28'; W. H. Messick, contractor.

*Southampton Ave.*, e Twenty-seventh St., two-st'y dwell., 24' x 32'; C. McDowell, owner.

*Cumberland St.*, w Amber St., three-st'y dwell., 18' x 62'; Geo. Kessler, contractor.

*Catherine St.*, w Broad St., 2 two-st'y dwells., 18' x 60'; Jno. Loughran, owner.

*Ward St.*, s Wharton St., two-st'y dwell., 16' x 28'; Lewis Simpson, owner.

*Bringhurst St., No.* 206, two-st'y dwell., 18' x 42'; Thos. McCarty, contractor.

*Twentieth St.*, cor. Reed St., two-st'y dwell. and stable, 16' x 45'; J. P. Leonard, owner.

*Perkiomen St.*, w Vineyard St., three-st'y dwell., 16' x 42'; Carlhoffer & Co., owners.

### St. Louis.

BUILDING PERMITS. — Fifty-six permits have been issued since our last report, twenty-four of which are for unimportant frame houses. Of the rest those worth $2,500 and over are as follows: —

Mrs. C. Minke, 2 adjacent two-st'y dwells.; cost, $6,500; Marko & Sons, contractors.

Charles Wunderlich, 4 adjacent two-st'y dwells.; cost, $13,900; C. F. May, architect; Bierman & Ahring, contractors.

St. Louis M. H. B'l'dg Co. No. 3, 2 adjacent two-st'y dwells., cost, $5,000; E. Mortimer, architect; J. B. Major & Co.; contractors.

Sam. Cupples & Co., one-st'y storage-house; cost, $3,000; J. B. Legg, architect; F. C. Bonsack, contractor.

Marlett & Johnson, two-st'y dwell.; cost, $3,000; E. Mortimer, architect.

Fred. Netzeband, two-st'y dwell.; cost, $7,000; F. H. Torrence, contractor.

St. Joseph's Parish, three-st'y schoolhouse; cost, $6,000; B. J. Goesse, architect; Goesse & Remmers, contractors.

Christ. H. Grote, 2 adjacent two-st'y dwells.; cost, $10,000; B. J. Goesse, architect; Goesse & Remmers, contractors.

Henry Meyer, two-st'y dwell.; cost, $5,000; A. Beinke, architect; Goesse & Remmers, contractors.

E. Cavanaugh, two-st'y dwell.; cost, $4,500; J. Cairns, architect; Morris, contractor.

Henry Hoberg, two-st'y dwell.; cost, $4,000; C. F. May, architect; Fred. Hoberg, contractor.

W. M. Horton, two-st'y dwell.; cost, $12,000; A Beinke & Co., architects.