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THE discussion on the extension of the Boston fire-limits has reached a rather acute stage. Those who oppose the extension argue that to build of brick is so much more costly than to build of wood that the owners of land in the less thickly settled wards could not afford to improve their property, but must sell at a loss, and the value of land so restricted would be greatly reduced. This notion seems to have produced a certain effect upon the public, but, like a good many other apprehensions which stand in the way of public improvements, it would be hard to tell on what real foundation it rests. Certainly, the prohibition of wooden buildings in Philadelphia has neither ruined the suburban districts nor deprived the poorer citizens of homes. On the contrary, in no great city on this continent are people of small incomes housed so safely and comfortably as in the little brick houses of the outlying parts of Philadelphia. One of the remonstrants against the petition for extension mentioned South Boston as a portion of the city which would suffer greatly in case of extension, and asserted that land there would be rendered "almost useless" unless wooden buildings could be put up on it; yet brick building is at this moment active in South Boston, which is very close to the business centre of the city, and where huge fireproof warehouses, with steel frames, are being erected by a wealthy corporation, and are quickly leased. It is hardly necessary to say that to mix wooden houses with these great buildings is to endanger the latter very seriously, — one might almost say to ensure their destruction, — and it is obvious that, before very long, either the erection of warehouses, or that of wooden houses, must stop in South Boston. We imagine that the owners of South Boston land, however they may dread the "uselessness" of their property, would rather sell it at its value for warehouse purposes than at what it would bring, in competition with Allston and West Roxbury land, for cheap wooden tenements. In Dorchester and Jamaica Plain, the necessity for making an immediate choice between the utilization of the land for first-class buildings, and its permanent abandonment to the most miserable class of structures, is not so plain as it is in South Boston; but the owners of real-estate are the ones who, in the end, will profit most by the proposed restrictions.

A VERY curious case came up before a Chicago court the other day. A certain architect went off on a fishing trip, leaving his rent unpaid. His landlord, in his absence, seized his office furniture, and his plans, the accumulation of twelve years of practice. Before the account was settled, the plans had been lost, or, as was supposed, destroyed; and the architect sued his landlord for their value, which he set at twenty-five thousand dollars. Several architects were called, as expert witnesses, to testify to the value of the plans, but their evidence was so unsatisfactory that the plaintiff is said to have abandoned his case. The counsel for the defendant insisted that the witnesses should estimate in dollars and cents the value of the lost property; and, as in the case of so many other conscientious witnesses, they were hopelessly confused by this ancient legal trick. As the whole profession will agree that such plans have a value, and a very substantial one, in most cases, it might be well to suggest, for a guide in similar affairs, that a cash value can readily and conscientiously be put on documents of the sort by an estimate, on the part of the witness, of the income which he has himself derived from employment based on the alteration or duplication of buildings already completed, and the expense and delay which would have been involved in carrying out such commissions without the original plans to work from. Most architects of twelve years' standing would find that their commissions for work in which old plans were referred to amounted, on an average, to many hundred dollars annually; and the plaintiff's estimate of twenty-five thousand dollars as the value to him, of what might be called a professional investment, of his rolls of drawings, which are said to have represented nearly seven million dollars' worth of buildings, seems to us to have been very moderate. It is to be remembered, too, that the value of such plans increases, to a considerable extent, with age. After a mercantile building is finished, the plans are laid aside, and are, perhaps, not referred to for five or six years. Then the leases begin to run out, and the old tenants want improvements, or new ones want alterations, and the architect is called upon for what may be important service. Five or six years later, the process is repeated; and this time, the owner, very probably, having gained some new ideas about such investments, and having saved up some money, wishes the architect to design another building, changing the scheme in certain points, but retaining other features of the original plans; and here, again, the old plans become very valuable. Although, perhaps, such value is not so strictly defined as to be insurable to its full extent, it is certainly definite enough to form a basis for estimating damages; and architects would do well to reflect occasionally on these aspects of their professional life.

THE engineer of the Brooklyn Dry Dock, Mr. A. G. Menocal, a man of very considerable professional distinction, was, as will be remembered, summoned home from Central America, to be tried by court-martial for neglect of duty, resulting in the defective construction of the dock. The proceedings of the court-martial have been made public, and it appears that he was found guilty of neglect and carelessness, and sentenced to suspension from duty, on furlough pay, for three years; but the court united in a strong recommendation to the authorities of the Navy Department for clemency. The case was a very peculiar one, and certainly calls for careful consideration. It is conceded that the original contractor for the work was inexperienced and unintelligent, that he took the contract at a price far too low, and tried to shirk his responsibility; and the real question is, whether it is reasonable to expect from a supervising engineer or architect such superintendence as will effectually prevent a contractor who wishes to evade his obligations from doing so. It is a common theory among lawyers and laymen that the engineer or architect is bound to furnish such supervision; that is, that he is guarantor for the contractor. Judges generally disagree with the common view on this point, holding that the contractor is the one to be held responsible for carrying out his own agreements; and that the faithfulness of the superintendent is to be ascertained, not by bringing forward evidence of successful fraud on the contractor's part, but by comparing the diligence and professional knowledge which he has shown with the diligence and professional knowledge displayed by other reputable superintendents in relation to similar work.

IN practice, as every architect and engineer knows, and as every intelligent man will acknowledge after a moment's reflection, it is utterly impossible for any man to supervise an important piece of work in such a way that he can be sure that there are no defects in it. If the work could all be done by one mechanic, the superintendent could stand over him constantly, and know that every part was done properly; but no man, however active, can be in two places at once, and, where many men are engaged, the superintendent can only form a general idea, by going from one to the other, of the way in which they do their work. Contractors, particularly the dishonest ones, know this well, and give a hint, which the men are, in many cases, only too ready to act upon, to keep an eye out for the superintendent, and do as he tells them to while he is looking on, and, when his back is turned, to save all the money they can for their employer. In some details of engineering and building operations, tests can be applied to the work after it is done, as by sounding joints in rough masonry with a steel rod, or tapping rivets with a hammer, or filling plumbing pipes with water; but these are exceptional, and in most cases the superintendent can be certain of nothing except that the work done actually in his presence is properly done. Besides this, he can say, perhaps, that other work has the appearance of having been properly done, but here his knowledge necessarily ends. If he is a good judge of workmanship and materials, his opinion, drawn from the appearance of what he has seen, is valuable, and the greater part of his service is necessarily limited to forming this opinion; but it is an opinion merely, and must be taken as such, and should, so far as he is concerned, carry with it only the responsibility involved in forming an opinion with due skill and consideration. To hold the superintendent to greater responsibility, as many persons now seek to do, making him accountable for misdeeds committed by other people, which it is impossible for him to prevent, does much to defeat the object of supervision, by making it the interest of the superintendent to conceal defective work which he may have discovered. It has actually been ruled in a court that an owner, if defective workmanship were discovered in his building, could, at his option, claim damages either from the contractor or the superintending architect; and it is obvious that, under such a view of the law, the architect or engineer, although he might be conscientious in supervision, would be more than human if he did not try, when defects which he could not prevent began to reveal themselves to his experienced eye, to conceal them from the owner's knowledge. Fortunately, both for architects and owners, such jurisprudence is now obsolete, and the superintendent can point out to his employer the evidences, as they begin to appear, of defects in workmanship, suggest to him means of palliating their injurious consequences, and help him to secure indemnity from the contractor who is responsible for them, without fear of being fallen upon himself, and compelled to make good the contractor's frauds out of his own scanty earnings.

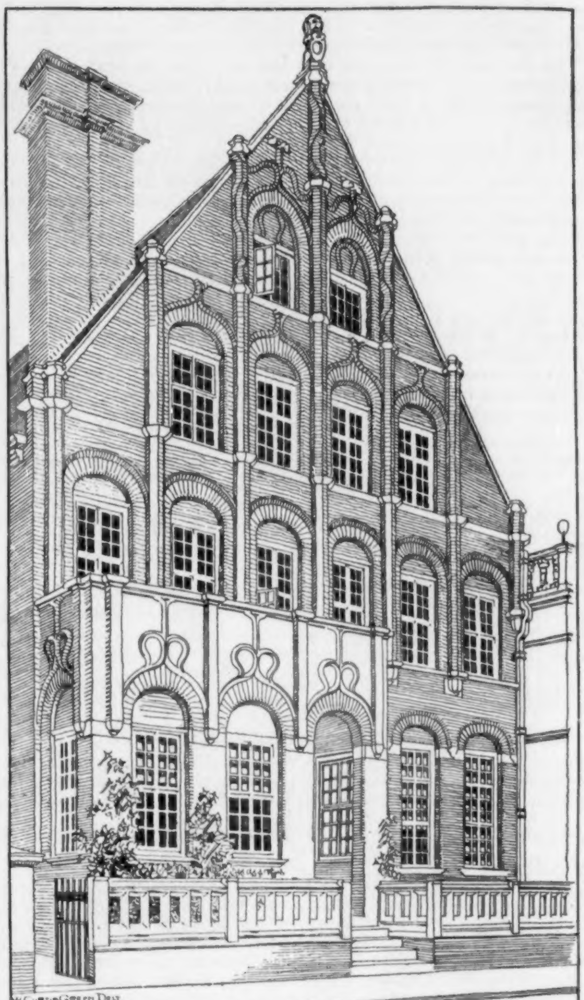
IN no branch of engineering work is thorough supervision so difficult as in concrete building, particularly where the work is to be exposed to water. No matter how strictly the specifications may be drawn, a moment's carelessness, or a little lack of judgment on the part of a foreman, may render the whole work unavailing. Even where the work is done by the day, and the workmen are interested in having it successful, it is almost impossible to make them understand the importance of rigid accuracy, and if an extra dose of sand is spilled from a barrow, or falls from the side of the excavation, into a mixer, or if the foreman turns on the water too freely for a moment, the concrete is nevertheless hurried to its place, and, before the inspector reaches it on his rounds, it will be tamped, or little extra tamping will be done after the water settles away, or, possibly, a surfacing of concrete properly mixed will be put on, and no one, even if he had the eyes of Argus, can discover that anything is wrong; yet, after the work is done, and the water admitted, the pressure inevitably finds out these places, where the tensile strength and solidity have been reduced below the normal, and, sooner or later, they are likely to give rise to leaks, which it is very difficult to cure.

THE foreign papers lament the growing exportation of iron from the United States to Europe. So far, the traffic is managed quietly, but it is said that nine thousand tons of American pig-iron per month on an average are brought into Manchester alone, and the iron is reported to cost, delivered in Manchester, five shillings a ton less than the Scotch iron which it replaces. It is true that railway freights in England are very high, and that the cost of ocean transportation, in the case of American iron, is small, as the pigs are used as ballast in cotton-carrying ships; but the land journey from Tennessee or Alabama to Newport News or Galveston is long in comparison with that which the Scotch iron must take, and the inference is unavoidable that the American iron is profitably sold in Great Britain, in competition with British iron, mainly because the American processes produce it more efficiently and economically. The *Engineer*, therefore, calls upon the British manufacturers to improve their processes to the American point, as the only means of saving themselves from the ruin of their trade, and it is to be hoped that the advice will be followed, for nothing is more certain than that cheapness of production does not at all involve reduction of wages, but rather the reverse, while, by putting within reach of a larger number of people the articles produced, it benefits all mankind.

PROFESSOR RICHARDSON writes to the *Evening Post* an enthusiastic letter about the discovery, by the American explorers in Corinth, of the ancient fountain of Pirene, which was fed by aqueducts from the heights of Acrocorinthus, and poured its water through six recessed openings in a two-story façade, erected at the side of the principal street of the city, into a basin. It will be remembered that the party from the American School had uncovered last year enough of the theatre to indicate the general topography, and had intended to devote the present season to a search for the agora, taking the theatre, and the description of Pausanias, as a starting-point; but after a great deal of digging, with little result, around the ruins of the theatre, the director began to be discouraged. Then it was remembered that, two years ago, the foreman of the excavators, a German, had taken it into his head to go down into a well, belonging to a house which stood in a garden a little way from the excavations. On his return, he reported that he had found at the bottom of the well a passageway, which he had investigated, and found that it led to a series of rooms, with architectural decoration, through which, in a channel cut for it, flowed the water which fed the well. As he brought no confirmation of this remarkable discovery except a large quantity of mud on his clothes, his story was attributed to the influence of a powerful imagination on a mind excited by toil, and no attempt was made to follow up his investigation. This year, however, in the absence of interesting results from the digging at the theatre, the German's romantic story came to mind, and a party repeated his exploit of climbing down the well. To their astonishment, they found that his account was not exaggerated, and Professor Richardson immediately recognized in the work the fountain described by Pausanias. Although covered by twenty-three feet of earth, a large portion of it has already been laid bare, and the difficulties of arranging with private owners and public authorities about the changing of the well alone delay the completion of the work of excavation. The well, with the land around it, was purchased outright, but with the stipulation that a new well should be provided for the house, and this has proved not to be easily done, as the rock in the neighborhood is extremely hard.

LA SEMAINE DES CONSTRUCTEURS gives some interesting bits of history relating to the value set upon objects of art by the ancients. We all know how much money they spent on their dinners, but every one, probably, has not heard that a hundred talents, or very nearly one hundred thousand dollars, was paid, in the Augustan period, for a picture of "Venus Anadyomene,"—a damaged picture, too, for it is related that the purchaser tried, unsuccessfully, to find some one capable of restoring the injured portion. Agrippa bought from the inhabitants of Cyzicus a picture of "Ajax and Venus," for forty-five thousand dollars; and Hortensius, the orator, and rival of Cicero, paid a living artist, Cydias, nearly six thousand dollars for a picture of the "Argonauts," and employed the same artist to decorate a little temple in which he placed the picture. Tiberius was given, by bequest, his choice between a picture by Parrhasius, and the sum of a million sesterces, or forty thousand dollars, in cash; and chose the picture; and even copies of celebrated pictures were sold at high prices. Apparently, landscapes were not appreciated, although Virgil, and Cicero, and Horace, at least, were not insensible to the attractions of nature; and Ruskin claims that the art of landscape painting generally is a purely modern invention, dating only from the era of the Renaissance.

SOME INSTANCES OF PILES AND PILE-DRIVING, NEW AND OLD.[1] — II.



43 Harrington-Gardens, London, Eng. Ernest George & Peto, Architects: From the *Builder*.

NEXT is Brevet Lieutenant-Colonel J. L. Mason's memoir on work at Fort Montgomery, Lake Champlain, dated 1850: —

"Fort Montgomery is founded on a timber platform resting on 4,383 piles driven into the ground. These piles were driven in 1844–46, and the grillage laid on them in those years and in 1848. These piles, when the work is completed, will bear an average load of 7 cubic yards of masonry and 1 3-4 cubic yards of earth; or, estimating the masonry at 4,200 pounds and the earth at 2,700 pounds per cubic yard, the weight with which each pile will be loaded will amount to 34,125 pounds in addition to its own weight and that of the grillage.

"These piles were all driven by two steam-engines, one of 6 horse, and the other of 8 horse power, the former requiring generally an engineer and three laborers to serve it, and the latter an engineer and four laborers. The original cost of engines was $4,388.71; the consumption of oil and rope, together with the repairs applied to them, has amounted to $1,982.21; total, $6,370.92. I suppose they could now be sold for $1,000 [not more than what they would cost to-day new], a sum not over one-third their value as pile-drivers if they were further needed at this work for that purpose. Deduct the $1,000 and it leaves the amount actually bestowed on the pile-driving, $5,370 92.

"The following is the itemized cost: —

		PER PILE.
Machinery for 4,383 piles	$5,370.92 or	$1.22
Cost of piles	6,121.42 "	1.40
Driving	1,724.44 "	.40
Measuring, hauling, securing for winter and sharpening	792.24 "	.18
Iron bands to protect the head while driving	439.29 "	.10
Cutting down and levelling the piles with axe and adze to receive grillage	495.21 "	.11
Machinery other than steam pile-drivers	184.10 "	.04
Contingent services and contingencies for this part of the work	1,890.05 "	.43
	$17,017.67	$3.88

"The general arrangement of the piles aimed at was to place their centres under the four angles of a square yard, the double pile-driver having been so constructed as to drive two rows two yards apart, from centre to centre, and on repassing the same track to insert an intermediate one, together with one outside the two already driven; but the distance from pile to pile in each row, resulting generally from dividing a given length into a certain number of spaces, would vary an inch or two from 3 feet.

"The grillage was laid in two courses. The lower, a timber 15 inches wide and 12 inches thick, was generally laid perpendicular to the scarp, thus connecting together rows of piles parallel to the scarp. It was notched down 4 inches onto the piles and pinned. The upper course, at right angles to the lower, was of 12″ x 12″ timber, across the piles, and of 12″ x 8″ between them, the 12″ x 12″ being notched 4 inches down on the lower course, brought its top to the same level as the 12″ x 8″, thus giving a level floor with the masonry.

"The material for the grillage, consisting of 45,610 running feet of timber of the sizes 12″ x 8″, 12″ x 12″ and 12″ x 15″, and of 12,147 hardwood pins, cost $2,277.45; measuring, hauling and securing this timber for the winter, $235.80; preparing, laying and pinning, $2,318.02; machinery, $70; contingent services and contingencies belonging to this part of the work, $612.66. Total cost of grillage, $5,513.93. The difference of level between the highest and lowest water in this part of Lake Champlain is nearly 8 feet; according to our memorandum, 7 feet 10 inches.

"To prevent the decay of the wood it was necessary to place the top of the grillage at least as low as the lowest level of the surface of the water; the piles had to be accurately levelled 1 foot 4 inches below the top of the grillage. It thus became necessary, let the stage of water be what it would, to enclose the area with a coffer-dam and dyke, and to pump out the water.

The cost of the coffer-dam and dyke, together 1,700 feet long and enclosing an area of 2 3-4 acres, was	$1,395.93
Pumping	1,504.21
Excavating for platform for the piles and grillage	1,587.87
Contingent services and contingencies belonging to these last three items	561.00
Total cost	$5,049.01

"We have then

For excavating, pumping and coffer-dam	$5,049.01
Grillage	5,513.93
Piles	17,017.67
	$27,580 61

Then follows the theoretical deduction of the formula already mentioned,

$$L = F \frac{W^2 h}{S\,(W + P)}$$

"The hammer with which these piles were driven weighed 1,630 pounds. The weight of the spruce piles was found to be 39 3-5 pounds to the cubic foot, but the piece weighed was rather more dry than the average of the piles, — they may be assumed to have averaged at least 40 pounds per cubic foot."

An example follows giving an application of the formula, and making $L = 118{,}175$ pounds, claimed to be an average value for piles driven: —

"Each pile supports 28,575 pounds. They have been loaded with 23,800 pounds since the fall of 1846 (three years), and the total now is 28,575 pounds.

"Bastion A, the bastion nearest the channel, was finished in the fall of 1846, with the exception of the parapet-wall surmounting the scarp. In that bastion the piles were longer and heavier and they also went farther under the last blows. The formula applied to those in the neighborhood of the salient would give about 85,000 pounds as the load they could sustain. They have sustained for three years 23,700 pounds each; the parapet-wall will add about 4,000 pounds to each pile.

"Thus, Fort Montgomery gives three years' experience in favor of a coefficient of stability of 3 6-10 when applied to the calculation, under the supposition of a constant force."

In discussing the theory further, he closes as follows: —

"There might be circumstances perhaps to make the intensity of the retarding force greater at some intermediate moment than at the commencement or close of the motion, as, for instance, *a very thin, hard stratum* just below the point of the pile; before the pile should reach it the penetration would be easy; it would be difficult while passing through it, and again become easy. But there were no such circumstances in the cases in question. The borings in Bastion A, down to the depth of 35 feet, gave a mixture of a very fine clay and sand, so fine that, when dried and rubbed between the fingers, it made an almost impalpable powder.

"Many cases occurred in which after a pile had been driven some days another blow was struck, and the result was *invariably* a less motion than was to have been expected if this blow had immediately succeeded the others. One of these cases occurred in which a pile, that on the 18th of September was driven from 4 1-4 to 5 3-4 inches on the last four blows, on being struck again on the 20th of September was driven but two inches.

"In stating the average weight with which the piles are loaded, no deduction has been made for the influence of the water (in the spring months) in reducing the weight of the masonry. In certain seasons, and for a short time, this might reduce the loads from four to five per cent."

[1] A paper by Horace J. Howe, member Boston Society of Civil Engineers, and read before the society, March 30, 1898. Continued from No. 1172, page 84.

Table showing the circumstances under which some of the piles were driven (77 given in the memoir): —

No. of Pile.	Kind of Wood.	Diameter of Pile in ins.		Length before and after cut off.		Fall of Hammer at the last blow.	Several penetrations of Pile with a few of the last blows in corresponding order. Ins.
		Butt.	Point.	Before.	After.		
1	Spruce.	12½	9¾	32 11	32 0	34 10	5¼-4¼-3⅞-3⅝-3½
2	"	17½	13	33	31 2	33 11	4¼-3⅝-3⅛-2¾-2⅜
3	"	14	11½	32	31 4	35 1	10-6⅞-5½-4⅝-4⅛-3⅝
4	"	14	9¾	33	31 8	34 5	5-4½ 4-3½
5	"	13¾	10¼	32	32 0	36 0	5¼-4¾-4⅜-4⅛-3¾
6	"	14¼	10¼	32	32 0	35 10	5-4⅜-4⅝-4⅛-3⅜
7	"	14¾	10	32	31 10	35 7	4¾ 4¾ 4½-4¼
8	"	14¾	10	33	32 1	34 10	5¼ 4½-4⅛ 4-3⅝
9	"	14¼	10½	32	31 5	35 3	5⅜-5-5-4½
10	"	14	11	33	32 9	35 8	4-3½-3¼-2⅞-2½
11	"	12	9½	33	33 0	35 9	5-4¼-3¾-3½-3⅜-3⅛-3-3
12	Hemlock.	14	11	29	29 2	35 1	11-10¼-9½-9¼-7¾-6½
13	Spruce.	13¾	9	31	30 2	35 1	10·8¾-6⅜-5-4½-3⅞
14	"	14½	12	31	30 2	34 11	6·4¾-3¾-3½-3
15	"	12¾	9¼	31 4	31 0	35 8	9¼ 6½ 5-4¼-3¾-3¾
16	"	13¼	9¾	30 9	30 6	35 9	6-5-4⅛-4-4¾
17	Tamarack.	15	11½	29 11	29 2	35 1	8-7-6-4¾-4¼
18	Spruce.	15½	11¾	32 1	28 7	32 6	5-4-3¾-3½-3¼-3·2¾
19	"	16	14¾	31 9	28 1	32 1	5·3¾-3¼-3-3-3·3¼
20	"	12¾	9¼	31 6	31 1	35 3	17-11-7¾-6¼-5-5¼
21	"	13	9¾	31 0	30 6	35 3	29·27-16-9¾ 6½-5
22	"	14½	10¾	32 0	29 2	33 3	9½-7-5¼ 3¾·3¼-2¾
23	Hemlock.	15¼	10½	31 10	29 10	34 1	6⅛-5¼-4¼-3⅞·3⅜
24	Spruce.	16	11	31 4	29 11	34 5	5⅜ 4¼-3¾-3⅜-3⅛
25	"	13	10	32 5	30 5	33 10	7¾-6¼-5⅛ 4½-3¾
26	"	14¼	10¼	32 0	29 9	33 8	5-4½-4-3¾
27	"	14	10	33 0	31 4	34 5	5½ 4½-4¼-4-3¾
28	"	13½	9½	33 0	31 4	34 4	5¼ 4¾ 4½-4-3¾
29	"	15	9¼	33 0	32 6	35 5	3⅜-3¼-3-3-3-3

From these extracts we see that Colonel Mason did not obtain his formula from ultimate loading. He obtained it from theory and then "tried it on," figuring out a factor-of-safety of 3.6.

It is stated that there has been some settlement since 1850 (Van Nostrand, 1882). Best recent information is that settlement stopped during 1886.

Chief Engineer Jos. G. Totten, United States Army, seems to have inspired his men to do original work; and we come to another example of this in the work of Brevet Major John Sanders.

The following is his well-known paper: —

MAJOR JOHN SANDERS — FORT DELAWARE.

For the *Journal of the Franklin Institute:* "Rule for Calculating the Weight that can be safely trusted upon a Pile which is driven for the Foundation of a Heavy Structure," by John Sanders, Brevet Major United States Engineers.

"A simple empirical rule, derived from an extensive series of experiments in pile-driving, made in establishing the foundation for Fort Delaware, will doubtless prove acceptable to such constructors and builders as may have to resort to the use of piles, without having an opportunity of making similar researches.

"I believe that full confidence may be placed in the correctness of this rule, but I am not at present prepared to offer a statement of the facts and theory upon which it is founded.

"Suppose a pile to be driven, until it meets such a uniform resistance as is indicated by slight and nearly equal penetrations, for several successive blows of the ram, and that this is done with a heavy ram (its weight at least exceeding that of the pile) made to fall from such a height that the force of its blow will not be spent in merely overcoming the inertion of the pile, but at the same time not from so great a height as to generate a force which would expend itself in crushing the fibres of the head of the pile.

"In such a case it will be found that the pile will safely bear, without danger of further subsidence, '*as many times the weight of the ram as the distance which the pile is sunk the last blow is contained in the distance which the ram falls in making that blow, divided by eight.*' For example, let us take a practical case in which the ram weighs one ton and falls six feet, and in which the pile is sunk half an inch in the last blow; then, as half an inch is contained 144 times in 72 inches, the height the ram falls, if we divide 144 by 8, the quotient obtained, 18, gives the number of tons which may be built with perfect safety in the form of a wall upon such a pile.

"Fort Delaware, September 27, 1851."

GENERAL RICHARD DELAFIELD — FORT DELAWARE.

As to the experiments themselves, I will refer to "Foundations on Compressible Soils," 1868, by Richard Delafield, Brevet Major-General. General Delafield is the "Captain Delafield" of the memoir, and was therefore connected with the work at Fort Delaware in 1833 and later. He says: —

"Major Sanders's experiments at Fort Delaware were made with a view of deducing a rule for foundation on compressible soils, without any firm substratum lying within reach of piles, for calculating what weight each pile would bear with safety, by comparing the distance it was sunk at the last blow with the force of the blow, it being understood that the pile has been driven to such an extent that for a number of blows the penetration has been uniform for equal blows.

"To ascertain such a rule two sets of piles, of four each, were driven, and a platform built on their heads; they were then loaded with blocks of stone piled regularly on the platform; and at regular intervals of time the amount of subsidence caused by the weight which was periodically augmented was noticed.

"These piles were 12″ x 12″ x 30′ yellow pine. They were not driven through the alluvial; their points were about 20 feet from the sandy subsoil, so that their stability was due to the accumulated and constantly increasing resistance of the same medium. In one experiment the four piles were driven to a depth of about 24 feet each, with a pile-driver that struck thirty-four blows in a minute, with a ram of 2,000 pounds and a uniform fall of 6 feet. An artesian-well sunk on this island in 1834 found mud continuously to a depth of 46 feet below low-water mark, then 20 feet of sand, then 30 feet of coarse sand containing shells. It then entered and penetrated for 47 feet a bed of marl which contained boulders.

"At the penetration of 24 feet each of the blows of the ram drove them about an inch, or exactly 1-74 of the fall of the ram.

Loads on the 4 piles.	Time. Months.	Total time. Months.	Settlements. Distance in 1-32 ins.	Settlements. Total dist. in 1-32 ins.
60,700	6	6	6	6
75,700	..	..	0	6
94,000	1	7	2	8
94,000	3	10	0	8
107,500	1	11	1	9
121,800	8	19	7	16
121,800	33	52	0	16
134,000 / 147,000 / 160,000 / 174,000	7	59	0	16
189,500	17	76	10	26
189,000	48	124	6	32

"The conclusions that may be derived from it are obvious; that the subsidence had ceased may be safely assumed. It follows that a building on piles, driven in soils exactly of the nature of that in which these experimental piles were placed, will be safe if we do not load them with a greater weight than $\frac{W\,h}{3\,S}$. The coefficient was, however, fixed by Major Sanders for safety at 1-8.

"Conversely, having given the weight of the superstructure, we can by the same rule ascertain the minimum number of piles that will sustain it, if driven to a fixed depth, or the depth to which an approximately fixed number of piles must be driven to effect the same purpose.

"There were two experiments of the kind we have described made at Fort Delaware. The second one continued three and a half years, had similar results and was equally regarded in the determination of the coefficient used in the rule.

"From other experiments made during the same period, Major Sanders ascertained the relation between the living force of the ram and the distance the pile is sunk for *different falls*, by a series of experiments on 64 piles which received 1,900 blows from a ram of 800 pounds. It was found that when the fall was less than 3 feet the useful effect was extremely small; that it gained in a rapidly increasing ratio as the fall was augmented, a foot at a time, to 5 feet; and that at this point the ratio of useful effect to the force expended is at its maximum, and that the piles are driven to distances proportional to the blow; or, in other words, that there is nothing gained by increasing the fall beyond 5 feet. For example, two blows of 5 feet will sink a pile as much as one blow of 10 feet; three blows as much as one of 15 feet; four blows of 5 feet as much as one of 20 feet.

"It was also found that if the 5-foot blows followed each other in rapid succession the useful effect was rather greater than if the interval employed in common hand-power machines for hoisting the ram was allowed to elapse.

"From 1833 to 1838, 11,000 piles of 45 feet in length, 12 inches square at head and not less than 10 inches diameter at the small end, were driven for the foundations of Fort Delaware, under the superintendence of Captain Delafield, of the corps of engineers, with a hammer of 1,800 pounds, by blows in quick succession with steam-power, the maximum fall of the hammer being 45 feet. Since 1850, 4,500 additional piles were driven, under Major Sanders's superintendence; from which experience he has drawn the preceding deductions. Sixty-six hundred of these piles are under the scarps and casements of the present work.

"In 1848 the excavations for the foundations of the work existing at this time (1868) were commenced, and completed in 1849, and the piling by Major Sanders heretofore referred to was finished in 1851. By 1853, 2,000 tons of masonry had been laid on these piled foundations, and in 1859 the walls, arches and other masonry were finished.

"Three bench-marks were established in 1854, reference to which was made in 1859, when it was found that the masonry had not settled in any part. From 1859 to October, 1866, the settlement in reference to the above bench-marks was 4 inches at the maximum point and 2.65 inches at the minimum, and a mean settlement for all the observed points of 3.19 inches. No crack was perceptible in any part of the work in 1866 or in 1868."

Recent observations (1897) show that the fort stands with a single small unimportant crack in one casemate arch.

It is well to note here that Sanders considers the ultimate load as $\frac{W\,h}{3\,S}$. So when he recommends $\frac{W\,h}{8\,S}$ he assumes a factor of 2⅔ only.

Also that his experiments show that the sustaining power varies directly as "h" when the drop is 5 feet or over.

PENSACOLA NAVY YARD, FLORIDA.

Various authorities give results of tests at Pensacola Navy Yard Dock, built in 1851–52.

The soil is clean white quartz sand to a depth of about 40 feet, resting upon a bed of soft clay. The sand is so open that a cubic foot saturated contained 6 quarts of water.

A space 140′ x 180′ was enclosed by driving yellow-pine piles 12 inches square to a depth of 20 feet in contact with each other, forming a coffer-dam. Within this space the sand was excavated to a depth of 14 feet below tide. Piles, 4 feet centres, driven until a 2,200-pound ram, fall 30 feet, could not move them more than ½ inch.

A series of experiments was made under the direction of a special board of officers. The upward tests are what interest us. The trial pile was about 29 feet long, 16 feet in sand; diameter, 13½ inches; weight, 1,632. Tested two months after it was driven.

TABLE OF TESTS.

POUNDS.		
78,000	no movement.	Rose 2½ ins. in 30 min.
80,000	resisted ½ minute and then rose very slowly.	
82,000	1⅜ min.	
83,000	½ min.	
60,000	18 hours. No movement.	
64,000 / 74,000	Rose 3 ins. in one hour; 6 ins. in all.	
50,000	for 2 days. No movement.	

A single pile used as a fulcrum sustained 39 tons. Tests showed that piles which one day penetrated $\frac{6}{10}$ inch penetrated $\frac{1}{8}$, $\frac{1}{2}$, $\frac{6}{10}$ inch by three successive blows the next day, the blows being given in one minute. "If the pile is allowed to remain undisturbed a short time, the power to move it afterwards *must be greatly increased.*"

This is worth noting, and also the *method of continuous testing.*

A. C. HURTZIG — HULL DOCKS.

Further experiments on pulling piles are given by A. C. Hurtzig, Associate Member Institution of Civil Engineers, in 1881, Albert Dock, Hull.

The material was compact bluish clay. Above it was from 3 to 5 feet of peat, above which again were silt and sand.

The piles were 5 feet apart and formed a dam. It was made in 1874 and piles were drawn in January and February, 1880. That is, they were five years in the ground. The piles may be considered as having been chiefly in the stiff blue clay. Before the piles were drawn the clay puddle between the two rows was removed to as low a point as possible, which was about 13 feet below the level of the quay, or rather under high-water mark of ordinary neap tides. The clay puddle that could not be removed would increase to a small extent the frictional resistance to drawing. A "cat-head" was used to draw the piles, with frame, chain and winch. To the lower pulley-block a heavy sling-chain was attached, and this was slung around the pile to be drawn and secured by wedges. The power exerted by one, two or more men was ascertained by allowing them to lift certain known dead weights with the winch and tackle. Six men could haul up 41.0 tons, five men could haul up 35.5 tons, etc.

It would have been easy with a dynamometer to have had the exact pull taken, but no such instrument was available.

There were 420 piles drawn, upon which 300 observations were taken. The length varied between 20 feet and 49 feet; average length, 40 feet; average scantling, 12½ inches square = 156 square inches, the sizes varying between 12″ x 10″ and 15′ x 14′. The depths to which the piles were driven in the ground ranged between 6 feet and 30 feet; average, 18¼ feet; average superficial area of pile below the ground-line, 76 feet.

The piles were not tongued and grooved, but driven close together, so that only two sides could be taken as frictional area, or 38 square feet. For 300 piles the gross resistance per pile was 33.87 tons. From this must be deducted two items, the weight of the pile and the power required to overcome suction.

The net frictional resistance, 31.82 tons, and this was on an area of 38 superficial feet, gives 1,875 pounds as the friction per square foot in contact with the soil. The piles were of ordinary rough Memel balk timber. With sawn timber there would probably be a slight reduction in the friction.

The piles in the dam were driven by 1 ton ram falling 5 to 6 feet. Penetration, ½ inch to ⅜ inch per blow.

H. LENTZ — CUXHAVEN HARBOR.

We also have a description of the method of pulling piles by simple tidal action, Cuxhaven Harbor, by H. Lentz.[1]

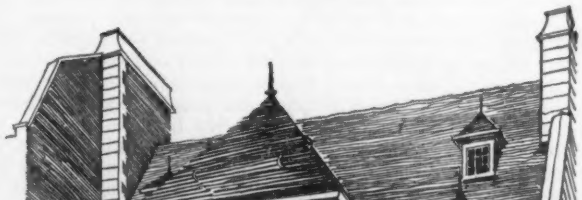
The piles were in fine drift sand, which held them remarkably fast. A trial pile 3.23 feet in circumference, driven to a depth of 15.7 feet, was extracted by a pull of 7 tons 16 cwt. after 23 days in the ground. Numerous piles, on the average 17 inches in diameter, required pulls of from 23.5 tons to 28 tons 15 cwt. after having been embedded from 10 to 20 years at a similar depth.

Having used a rowing barge with windlass, and found it somewhat awkward, the author constructed a large timber box 22′ x 19′ x 6½′ with slit or bay 34 inches wide, reaching from the middle of one of the longer sides to beyond the centre of the box. When totally immersed, the pull was 59 tons. By means of an oak beam laid over the centre-of-gravity of the box and attached by chains to the piles, these latter could be floated out as before. In some cases 50 and 55 tons had to be exerted before the pile could be moved, but in no instance was the full power of the box, 59 tons, brought into requisition.

(To be continued.)

[1] *Deutsche Bauzeitung*, 1879, quoted by Institution of Civil Engineers, 1880.

CHAINED LIBRARIES.



The "Yellow House," Bayswater Road, London, Eng. Ernest George, Architect: From the *Builder*.

IN a paper on the "Libraries of the Middle Ages," recently read by Mr. T. G. Jackson before the Royal Institute of British Architects, the lecturer said that buildings specially to hold their libraries were first erected by the universities and colleges. The oldest structure of the kind in England, perhaps in Europe, is the old library of the University of Oxford, which still retains many features of its original form. This structure, rarely seen by visitors, and even unknown to the majority of Oxford men, is a two-storied building situated on the north side of the choir of St. Mary's Church, adjoining the tower at one end, and separated from the body of the church by a narrow courtyard. Having glanced at the way books were kept, used and lent at Oxford prior to the erection of this building, the lecturer gave a sketch of its foundation by Cobham, Bishop of Worcester, about 1320, and some incidents in its early history, following with a description of the interior, furniture and general arrangements. Long desks were placed at regular intervals at right angles to the walls on which the volumes lay on their sides. A bench was fixed in front for the reader, and a window came between each pair of desks to light that pew or cell. Every volume had a metal clip riveted to the front edge of the board forming one cover, to which was attached a light iron chain of the requisite length, having at the other end a ring. This ring ran upon an iron rod which was carried along the top of the desk, and was secured at the end by a hasp and padlock to prevent the ring being drawn off. The foundation of Bishop Cobham's library was succeeded shortly afterwards by that of the library of Durham College, Oxford, by Richard de Bury, Bishop of Durham (1335–45). The books bequeathed by De Bury to the college were kept for many years in chests, under the custody of scholars deputed for the purpose. At the beginning of the fifteenth century a library was built, and regularly furnished with bookcases or settles enclosing pews or studies between them, where the books were chained. When Durham College came to an end at the Dissolution, its old buildings were utilized by its successor, the present Trinity, and the old library of Durham College still serves as the library of Trinity College. William of Wykeham's New College at Oxford set the fashion for all future collegiate buildings at either University in provision being made for every department, and thenceforward every college had its library as an essential part of its plan. Though books were few, the rooms devoted to them had to be very large, the chaining of the books to the desk making it possible to have only very few on each desk. Soon, as books increased, shelves were formed behind the desks, tier by tier, until at last, in the seventeenth or eighteenth century, they reached the ceiling. The appearance of the fittings before that time could be well seen in the old library of Merton College. Of chained libraries there were at least three extant in England, that belonging to Hereford Cathedral being the most ancient and perfect. Old chains, hasps and staples belonging to Hereford — specimens of the actual fittings of a mediæval chained library — were exhibited by Mr. Jackson, and the method of fixation explained. All Saints Church, Hereford, and Wimborne Minster also possess chained libraries. But the finest in the world is that of San Lorenzo, Florence, the great hall of which was designed by Michael Angelo in 1524, to contain the collection formed by several generations of the Medici. The lecturer then touched on the difficulties of consulting books in the old chained libraries. Shelves for the ever-increasing number of books had been provided, but desk accommodation remained as before. One student occupied on a volume prevented three or four others getting access to the books. This led to the library-rooms being enlarged. Chains were bought for the Bodleian library as late as 1751; it was not till 1757 that this method of securing the books was abolished.

BUILDING LAW.

Fees for Plans and Superintendence. — An architect contracted with a party to furnish plans for a two-story building, and to superintend the construction of same, for 4 per cent of the lowest bid therefor, which was $12,600. After receiving the plans and bids, the party did not erect the building, but afterwards instructed the architect to prepare plans for a three-story building, which was done, and the owner let the contract for construction for $17,000, and requested the architect to superintend the work, which he did until the foundation was nearly completed, when he was discharged. The court held, that if the architect was employed to prepare plans for the first building, with no understanding that a second building might be substituted without pay for the first plans, he was entitled to 2½ per cent (the customary charge) on the $12,000 for the preparation of the plans, etc., and for 4 per cent on the $17,000, the construction price of the second building, provided he was discharged without cause, but if he was properly discharged, he was entitled to only 2½ per cent of the construction price of both houses.

[Hand *vs.* Agen (Sup. Ct. Wis.), 71 *Northwestern Rep.* 899.]

Architect has no Lien for Plans in Massachusetts. — An architect is not entitled to a lien for drawing plans and specifications for a building, under the laws of Massachusetts (Pub. St. c. 191, sec. 1), which gives a lien to any person to whom a debt is due for "labor performed or furnished . . . and actually used in the erection of a building."

[Mitchell *vs.* Packard (Sup. Jud. Ct. Mass.), 47 *Northwestern Rep.* 113.]

Competition on Public Buildings by Architects. — An architect, says the Supreme Court of Pennsylvania, who has violated the terms of a competitive programme under which plans for a public building are submitted has no right of action for damages for violation of the obligations assumed by the commissions under such programme.

[Cope *vs.* Hastings, 38 *Atlantic Reporter*, 717.]

When Architect is not a Public Officer. — An architect employed by commissioners for the construction of a public building to supervise its construction is not incumbent of an office.

[State *vs.* Broome (New Jersey), 38 *Atlantic Rep.* 841.]

Expert Testimony. — Persons who have made special study of the strength of materials and the proper mode of building structures to sustain weights may testify whether a structure has been built sufficiently strong to withstand the strain which would be put upon it in using it for the purpose for which it was intended.

[Fox *vs.* Buffalo Park, 47 *N. Y. Supp. Rep.* 321.]

BOOKS AND PAPERS.

TEN years ago, a veritable flood of books on sewerage and sewage disposal poured from the English and American press, much to the edification, as we sincerely believe, of the public. Perhaps the publishers received less profit than the public from them, for the stream soon abated, and for some time has flowed only at a very moderate rate. Meanwhile, the science of sewage disposal has advanced greatly. Not only have biological investigations shown the principles on which it must be based, but innumerable experiments, on the largest scale, as well as the smallest, have enabled engineers to carry into practice, with economy and certainty, their new theoretical knowledge. Although various popular books have given the outlines of the recent discoveries in regard to nitrification, none, so far as we know, have reduced them to such definite statements, and accompanied them with so many useful data for practical engineers, as Mr. Robinson's work.[1] Of course, many of his data, such as those for the flow of water in sewers, and the analyses of sewage, are old, but they are not the less valuable and necessary in a book which is intended to assist in laying out actual plans of sewage disposal. Perhaps the professional reader will regret that most of the statistics are at least three years older than the book, while some of them date back to 1879 or 1880, a period which is, so to speak, remote antiquity in sewerage science. However, the information is recent enough to give a rational account of the electrical precipitation processes, including the mysterious Hermite process, which was one of the wonders of science a few years ago; the Ferrozone and Polarite processes, and others, besides some most useful statistics in regard to the economic results of sewage precipitation and filtration on a large scale at Berlin, London, Birmingham, Frankfort, Glasgow and several other places. The engineer will, we think, draw the inference from what he reads that the electrical treatment promises to reward further experiment; while the layman who studies Professor Robinson's book will arrive at the conclusion which engineers have already reached, that the profitable utilization of the sewage of large towns by irrigation or precipitation of any sort is practically out of the question, and that city people must be content to pay a small sum out of their own pockets for the sake of having their wastes efficiently purified, and prevented from polluting streams or coast waters, comforting themselves for their expenditure by reflecting upon the immense indirect benefit that they gain in the way of health.

To show how nature recuperates after unfavorable conditions are removed, Professor Robinson describes the change which has taken place in the Thames within the few years which have elapsed since the installation of the great precipitation-works of the London sewerage system at Barking. Nearly all our readers will remember the terrible "sewage section" which was said, in the last decade, to haunt the Thames, passing back and forth with the tide through the heart of London, and polluting the water of the river to such an extent that the victims of the "*Princess Alice*" disaster were said to have been asphyxiated as soon as they were immersed in the river, and to have been unable to swim or otherwise help themselves. Now, the "sewage section" has practically disappeared. No fresh sewage enters the river, and the deep deposit of foul mud at the bottom is being gradually scoured away, so that the water has become again tenanted by fish of many kinds; gulls now ascend the river every winter as far as Westminster Bridge, and a seal was caught not long ago at Richmond.

EVERY student, and, still more, every practitioner, needs to have constantly at hand some reliable compendium of architectural forms of Classic architecture, at least, even if it be nothing more than a condensation of Vignola's famous work. It is impossible for any one to carry in his head an accurate remembrance of all the multifarious and multitudinous details of accepted and established form, proportion and arrangement, without due observance of which a designer's work must have an illiterate and ungrammatical air. So long as the student has directly at hand his school or college library, or so long as a practitioner is established in a large city where he can have access to a good public library, it is not a very grievous disadvantage that his own book-shelves do not bear some one of the many works that record the grammatical elements of Classic architecture. Just how many such works there are, we do not know, and a recent brief inspection of the overflowing shelves of the Avery Architectural Library compels the feeling that it would be wholly immodest to advance a guess as to the total number of such published works and still more improper to advance the opinion that some one amongst them was superior to all the others.

However, enough is as good as a feast, and student and practitioner will find in Bühlmann's "*Architecture of Classical Antiquity and the Renaissance*"[2] a work that shows with admirable clearness and with enough of the desirable completeness the answers to the many self-imposed conundrums that the designer using Classic or Renaissance forms has to answer.

As works can but imperfectly convey to the understanding what the eye can do more perfectly at a glance, our readers are afforded the opportunity of making their own appreciation of the value, to them, of the book we speak of by turning to the (reduced) sample illustrations taken at random from the collection which may be found elsewhere in this issue.

[1] "*Sewerage and Sewage Disposal.*" By Henry Robinson, M. Inst. C. E. London: E. & F. N. Spon; New York: Spon & Chamberlain, 12 Cortlandt Street. 1896. Price $4.50.

[2] "*The Architecture of Classical Antiquity and the Renaissance.*" By L. Bühlmann. Seventy-eight steel-engravings in portfolio, with descriptive text translated by G. A. Greene. Price $18. Or, separately, Part I, Orders of the Columns, 28 plates. Price $6.50. Part II, Façade, Arches, Doors and Windows, 25 plates. Price $6. Part III, Development and Decoration of Rooms, 28 plates. Price $7.50.

SOCIETIES

SKETCH-CLUB OF NEW YORK.

THE New York Sketch-Club visited the new buildings and grounds of Columbia College on Morningside Heights on Saturday afternoon, June 4th. An enjoyable part of the afternoon was the visit to the Avery Architectural Library, Mr. Smith, the librarian, in expectation of the visit, having arranged on the various tables many of his most valuable books.

After dinner, in the lecture-room of Havemeyer Hall Mr. Chamberlain delivered a lecture on "Old Ravenna," which was very interesting, being composed of reminiscences of a trip the object of which was a study of the Byzantine architecture in Italy.

During the evening was had an opportunity of examining the exhibit of the Architectural Department.

The time being too short for the programme provided, it was necessary to postpone the election for Treasurer and the Chairman of the Current Work Committee. That the work of the Club may not be impeded, the President has appointed as temporary chairman of the committee George Stirratt, who, with the Executive Committee, will make arrangements for the sketching-trips during the summer.

N. Hausman, *Recording Secretary.*

WASHINGTON ARCHITECTURAL CLUB.

The Club held its annual meeting Saturday, June 4th, and elected the following officers for the ensuing year: —

President, Edward W. Donn; *Secretary*, Arthur B. Heaton; *Treasurer*, W. D. Windom; *Directors* for two years, T. F. Laist and W. S. Marsh; for one year (to fill unexpired term), T. J. D. Fuller.

After the election, the constitution of the "Fine-Arts Society of the District of Columbia" was accepted and the following delegates to that body were elected: T. F. Laist, W. D. Wood, T. J. D. Fuller, and as alternates, P. C. Adams and E. R. Crane. Frank Upman and Harry Dodge Jenkins, of the Chicago Architectural Club, were admitted to the Club.

This was the last meeting of the Club for the season. Several bicycle runs are being arranged, also a summer sketch problem to be ready for the fall.

Arthur B. Heaton, *Secretary.*

THE ILLUSTRATIONS

[*Contributors of drawings are requested to send also plans and a full and adequate description of the buildings, including a statement of cost.*]

THE ASTOR GALLERY: HOTEL WALDORF-ASTORIA, NEW YORK, N. Y. MR. H. J. HARDENBERGH, ARCHITECT, NEW YORK, N. Y.

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

CENTRAL DOORWAY, ABBAYE DE ST. DENIS, FRANCE.

NORTH DOORWAY, ABBAYE DE ST. DENIS, FRANCE.

DORMITORY, CAMBRIDGE, MASS. MR. C. H. BLACKALL, ARCHITECT, BOSTON, MASS.

THE WITHINGTON APARTMENTS, CHICAGO, ILL. MR. HENRY J. ROSS, ARCHITECT, CHICAGO, ILL.

THE BELFRY, NANTES, FRANCE.

This plate is copied from Baron Taylor's "*Voyages pittoresques.*"

TWO STORE FRONTS, INDIANAPOLIS, IND. MESSRS. VONNEGUT & BOHM, ARCHITECTS, INDIANAPOLIS, IND.

[The following named illustrations may be found by reference to our advertising pages.]

THE PALAZZO FARNESE, ROME. — THE VILLA SACCHETTI AND THE VILLA PAPA GIULIO, ROME.

TUSCAN AND DORIC ORDER OF THE RENAISSANCE. — THE MONUMENT OF LYSICRATES, ATHENS.

These and the preceding plates are copied reductions from Bühlmann's "*Architecture of Classical Antiquity and the Renaissance.*"

CHURCH AND PRESBYTERY FOR ST. PATRICK'S, DUNDEE. MR. T. M. CAPPON, ARCHITECT.

This plate is copied from the *Builder.*

[Additional Illustrations in the International Edition.]

THE WEST FOYER: HOTEL WALDORF-ASTORIA, NEW YORK, N. Y. MR. H. J. HARDENBERGH, ARCHITECT, NEW YORK, N. Y.

[Gelatine Print.]

THE BANK OF SCOTLAND, BISHOPSGATE STREET, LONDON, ENG. MR. W. W. GWYTHER, ARCHITECT.

NEW PREMISES, DRURY LANE, LONDON, ENG. MR. C. F. HAYWARD, ARCHITECT.

NO. 28 AUSTIN FRIARS, LONDON, ENG. MR. C. REILLY, ARCHITECT.

MOUNT STREET, PARK LANE, LONDON, ENG. MR. F. B. WADE, ARCHITECT.

COMMUNICATIONS

[*The editors cannot pay attention to demands of correspondents who forget to give their names and addresses as guaranty of good faith; nor do they hold themselves responsible for opinions expressed by their correspondents.*]

FOLDING-DOORS IN ENGLAND.

To the Editors of the American Architect: —

Dear Sirs, — In your issue of May 14th you give a leader upon a paper read before the Royal Institute of British Architects on "Domestic Architecture in the Eastern States of America." May I crave a little space to say that multitudes of persons agree with Mr. Paterson as regards sliding-doors and heating houses, although in the new villas which crop up everywhere they are doomed to live in small rooms? All the older houses in England had folding-doors in the reception-rooms, by which means the air-space could be doubled if necessary. Why they have been given up, I know not; but most probably because good doors are more costly than a one brick or lath-and-plaster wall; or because of the gain in wall-space, or the craze for having two sides of a room (in suburban villas) occupied by bay-windows. As to heating houses, I should say that in these days the only persons who do not have stoves in their halls are those whose means do not allow them such comforts.

Yours faithfully, S. Beale.

NOTES AND CLIPPINGS

Bridging the English Channel. — The annual meeting of the already rather old Channel Bridge Company recently took place in Paris, under the presidency of Comte de Chaudordy. The scheme which is now in favor with his rather unfortunate company is incontestably original. The minutes of the recent meeting contain the following explanation: "M. Thevenet le Boul, chief engineer of the Points et Chaussées, member of the technical committee of the company, explained that the new method proposed for crossing the Channel consists in rolling on a bridge submerged to the depth of fifteen metres below low-water mark, an immense platform emerging above the water. It is to be propelled by electricity, and capable of carrying four railway trains. The rails on the platform join the rails on land at the departure and arrival, so that the trains will simply steam on to the platform, and steam off it when the platform reaches the opposite coast. It is the amplification on a vast scale of the little platform which is used to convey foot-passengers between St. Malo and St. Servan. The new project has just formed the subject of careful study by the Compagnie de Fives-Lille, whose high reputation is a guaranty for success. That study has shown the practicability, the facility of execution and the relative economy of that method of transit by rail between France and England. This scheme has the advantage over its predecessors of being very simple, and of possessing absolute safety both during its execution and in its working. That solution has also the advantage of escaping the principal international objections raised against the project of the bridge above the water. No obstacle to navigation would be created by it, and the insular situation of England would remain intact. This new work could be completed in five years. The total cost would not exceed 350,000,000 francs, or three times less than the bridge above the water. Three rolling platforms, working simultaneously, and only during the day, would suffice for a traffic of

3,000,000 tons of merchandise and 2,000,000 passengers, which would produce an annual income of over 60,000,000 francs, or a net income of 50,000,000 francs. Considering the facility of brilliantly illuminating the platforms with electricity, they could also travel at night. The great English company, the Thames Iron Works and Ship-building Company, Limited, is in accord with the French Compagnie de Fives-Lille for the grouping around this project of the principal iron working firms and companies of the two countries into a vast international consortium, which, with the present Channel Bridge Company, will demand the concession and secure the execution of the work." M. Thevenet le Boul's communication was applauded unanimously by the meeting. The platform on which it is proposed that the trains should stand while being conveyed across the Channel would be 150 metres long and about 15 metres broad. It would be supported by five iron pillars on each side. These pillars, braced together in pairs by iron girders, and supported by iron stays, would rest on a submerged platform provided with wheels rolling on rails fixed on the bridge. This submerged platform would be 30 metres wide, so that the pillars supporting the platform above the water would incline inward, since that upward platform would be only about 15 metres wide. The motive power, which it is proposed should be electricity, would be generated by steam-engines and dynamos installed on the upper platform, and transmitted directly and separately to each of the fifteen pairs of wheels with which the submerged platform is to be provided. — *London Standard.*

MECHANICAL FILTRATION. — Although the efficiency of open sand filters is readily admitted in the United States, other methods of filtration appear to be more commonly adopted, mainly for financial reasons. It has, of course, to be borne in mind that the supply per head is much larger than is usual in this country, so that for towns of equal size the area of filter-beds required would be much in excess of that necessary here. These considerations have accordingly led to a very extensive use in America of the so-called mechanical filters in which the water, with or without the addition of small supply of alum, is passed rapidly through a filter of very moderate dimensions, the flow being reversed at stated intervals so as to clean the filtering material. It thus becomes of interest to compare the purifying effect of this cheap and rapid method of working with that attained by the costly filter-beds constituting the standard practice in this country. An investigation of this character was undertaken some time back by Mr. A. Hazen on behalf of the Ohio State Board of Health, and his report, published in *Engineering News*, deals very fully with this system of mechanical filtration, and shows that on the whole it gives a satisfactory degree of purification. The inquiry extended over five weeks, the filters in question being used for the water-supply of Lorain, a town on the shores of Lake Erie, from which the supply was drawn. The filters were six in number, each being 17 feet in diameter, and had an aggregate effective filtering area of 1,356 square feet. The filtering material is a layer of sand 4 feet deep. In working, each filter was washed rather oftener than twice daily, the average number of washings for the plant of six being 14 per diem. The time needed to wash a filter was 8 1-2 minutes, and the wash-water was 5.5 per cent of the supply to the town. Sulphate of alumina was added to the water before filtration, the amount ranging from 3.9 to as little as 0.8 grains per U. S. gallons, the average being 1.83. The quantity of water passing the filters during the five weeks over which the observation extended was 77,960,000 U. S. gallons, the corresponding rate of filtration being 1.14 U. S. gallons per square foot of filter per minute, or 71,500,000 U. S. gallons per acre per day. Bacteriological examination showed that in practice the number of organisms removed in the filter was about 98 per cent of those in the untreated lake water. The alum added was entirely decomposed, and did not appear in the effluent. From the observations made, it was concluded that the purifying effect was satisfactory if the filters were not worked at a greater rate than 100,000,000 gallons per acre per day, and that 2.5 grains of alum were added per U. S. gallon of water filtered. — *Engineering.*

PAVEMENTS IN BERLIN — Consul-General Goldschmidt, of Berlin, under date of March 30, 1898, says that he has received a number of communications inquiring into the progress of street paving in that city, and desires to state that the area of carriage pavements is 6,500,405 square yards. Of this area, a fraction less than 74 per cent has stone pavement, about 25 per cent asphalt, and a fraction over 1 per cent wood pavement. The proportion of asphalt is steadily increasing. The soil, continues Mr. Goldschmidt, consists of coarse, gritty sand, forming apparently an excellent foundation for the heavy 8-inch layer of gravel and cement, over which the 2-inch covering of asphalt is spread, making a strong and durable pavement. The average price of asphalt pavement in Berlin is $2.80 per square yard. The city government grants the contracts for laying the pavements, and also for keeping them in repair for twenty years, the first five years without extra compensation and after that for an annual compensation of 10 cents per yard.

STONE-CUTTING BY CABLE IN THE PIT. — In the French quarries of St. Triphon stone is sawed with steel wire cables moistened with wet sand, and passing in an endless rope over a series of pulleys. The wire, which runs from 1,000 to 1,200 feet per minute, is charged as it enters the cut with a jet of water and siliceous sand, which forms the cutting material. A running cable of 500 feet can make a cut 100 feet long. To remove a ledge, pits 3 feet in diameter are dug to the depth of the desired cut and the stone sawed vertically in slabs to the bottom, being then easily split off by wedges. The slabs are removed by an electric travelling crane and sawed to any desired size. — *Invention.*

FORMER DELHIS. — Near Delhi there is a lofty building whence, so some say, the ruins of sixteen distinct Delhis can be viewed, each city having been wiped out in turn by pestilence. And yet the Delhi of to-day is a plague-spot on the map of India. — *Philadelphia Press.*

THE POTOCKI PALACE, PARIS. — The French Government is negotiating for the purchase of the Potocki Palace, on the Avenue Friedland, with a view of utilizing it as a residence for France's royal guests during the exhibition there. This residence, which was built in 1882 by M. Jules Reboul, the distinguished architect, is one of the most magnificent in Paris. Before drawing the plans he passed two years in Italy studying the great Italian palaces. The style is Louis XIV, and from the fact that the bronze door cost $80,000 and the staircase $120,000, the splendor of the interior may be imagined. There are accommodations in the stables for forty horses, and all the stalls are of marble with silver fittings. The garden, which is very large, is laid out in English style. Ismail Pasha offered $5,000,000 for this palace ten years ago, but his offer was indignantly declined. — *Marquise de Fontenoy in Philadelphia Press.*

WINDMILL-RUN DYNAMOS. — If we mistake not, Dr. Fridtjof Nansen, in his last attempt to reach the North Pole, had the "*Fram*" equipped with a specially designed windmill, which, when operating, drove a dynamo and furnished the necessary current for lighting purposes. An aërmotor erected on the roof of a building in Park Place, in this city, has been for some time successfully driving a dynamo in connection with a storage-battery plant, the current from which has been utilized for incandescent lighting. From this it will be seen that there is nothing very new in the application of windmills to the driving of dynamos. There are probably several reasons why the windmill or aërmotor has not been more universally adopted for the above purpose: In the first place, such a motive power is always more or less uncertain, and cannot always be depended upon. There may be a calm just at the time it is found necessary to recharge the batteries, or the batteries may be in use when a breeze springs up. This would necessitate having two sets of batteries at a considerable cost. Another reason why aërmotors have not been more extensively adopted is probably due to the fact that currents can now be generated with steam as a motive power very economically, especially in large quantities. The erecting of an aërmotor and the installation of a number of storage-batteries with a dynamo mean a considerable outlay of money, especially when the cost of maintenance and renewal is taken into account. — *Electricity.*

THE OLDEST DWELLING IN ENGLAND. — In the town of St. Albans, within easy distance of London, is the oldest inhabited house in Great Britain. The town itself has had a splendid history. It was occupied by Cæsar and made a municipium; later, it was attacked by Boadicea with great slaughter. Here, too, St. Alban was martyred in 286, and the legends of his death are told, with every variety of mythic addition, by the caretakers of the Abbey, a magnificent pile, 580 feet long, of Roman brick and flint, which contains the shrine of the saint and many wonderful brasses. But what should particularly interest Americans is a little cottage by the river Ver, which lies out of the general ken, and might very well be missed by the tourist. This is the oldest inhabited house in England. It is now an inn, the Fighting Cocks, but it stands as it did 1100 years ago, when it was built as a fishing pavilion for the monks of the neighboring monastery. It used to be called the Old Round House, and the name was only changed a century ago, when it became a favorite resort for cock-fighting. It lies about two hundred yards below the Abbey, on the banks of the river, from which it is now separated by some ten or fifteen yards of road. Originally, it is held, the water came into the door, where on the summit of a flight of steps the monks would practise the gentle craft of angling. The house is octagonal in shape, and has foundations of immense thickness, built of flint and Roman brick, like the Abbey. From its basement there is a subterranean passage running straight for the Abbey, but now blocked up. There is just such another passage in the Somersetshire village of Street, near Glastonbury, which runs from the stable to the Grange there, in the direction of the Tor. The upper part of the Fighting Cocks is of brick, and oak, and the beams are so hard that they resist any nail. From the little garden you get a fine view of the walls of the old Roman town of Verulam, which lies on the other side of the river. The line of the fortification is quite perceptible in the open fields. Inside the little house the rooms are small and very low. The kitchen has a settle and a handsome outside chimney of brick. There is fine oak panelling on the walls. Altogether, the cottage realizes its character, and it is interesting to know that, though it was at one time fortified as St. Germaine's Gate, it has never lacked a tenant since it was built, by King Offa of Mercia, in 795. — *Boston Transcript.*

HEAT FROM ALUMINUM. — Aluminum is a source of stored energy whose use, as described by Herr Goldschmidt to the German Electro-Mechanical Society, has given astonishing results. When mixed in a sand-lined wooden bucket with an oxygen compound, such as iron oxide, the aluminum can be ignited with a match, after which it burns quietly, giving forth an intense heat, which may reach 3,000 degrees centigrade. This supplies an economical furnace for brazing or hard soldering. It can be used also for welding, for producing pure wrought-iron, for making a variety of alloys and for obtaining certain pure metals free from carbon that have been hitherto almost impossible to produce. A mass of metallic chromium weighing fifty-five pounds has been obtained in this way. The slag is of interest, being artificial corundum of extraordinary hardness and containing minute artificial rubies. — *Boston Transcript.*

THE LARGEST MAP IN THE WORLD. — The largest map in the world is the ordinance survey map of England, containing over 108,000 sheets, and costing $1,000,000 a year for twenty years. The scale varies from ten feet to one-eighth of an inch to the mile. The details are so minute that maps having a scale of twenty-five inches "show every hedge, fence, wall, building and even every isolated tree in the country. The plans show not only the exact shape of every building, but every porch, area, doorstep, lamp-post, railway and fire-plug." — *San Francisco Chronicle.*

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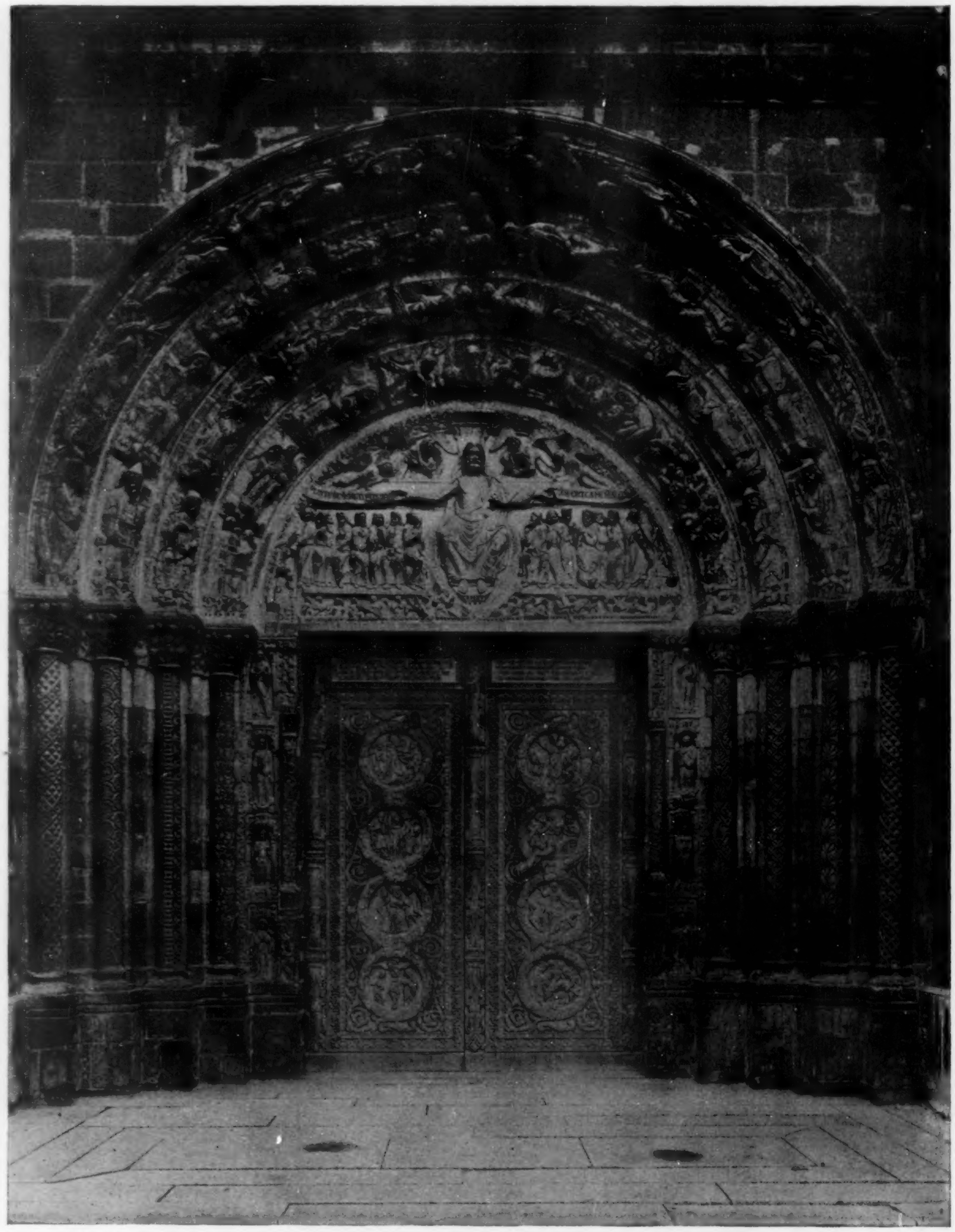
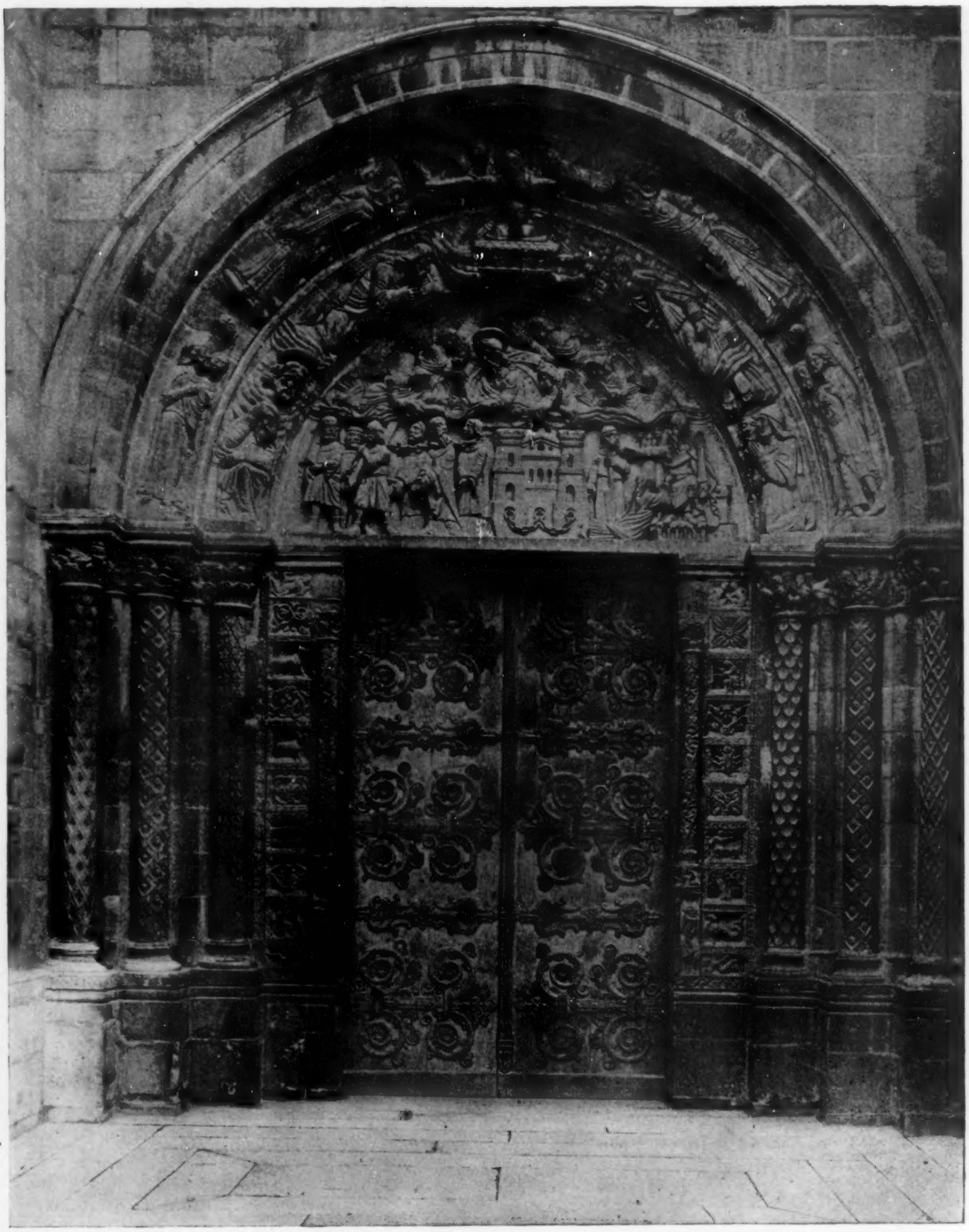
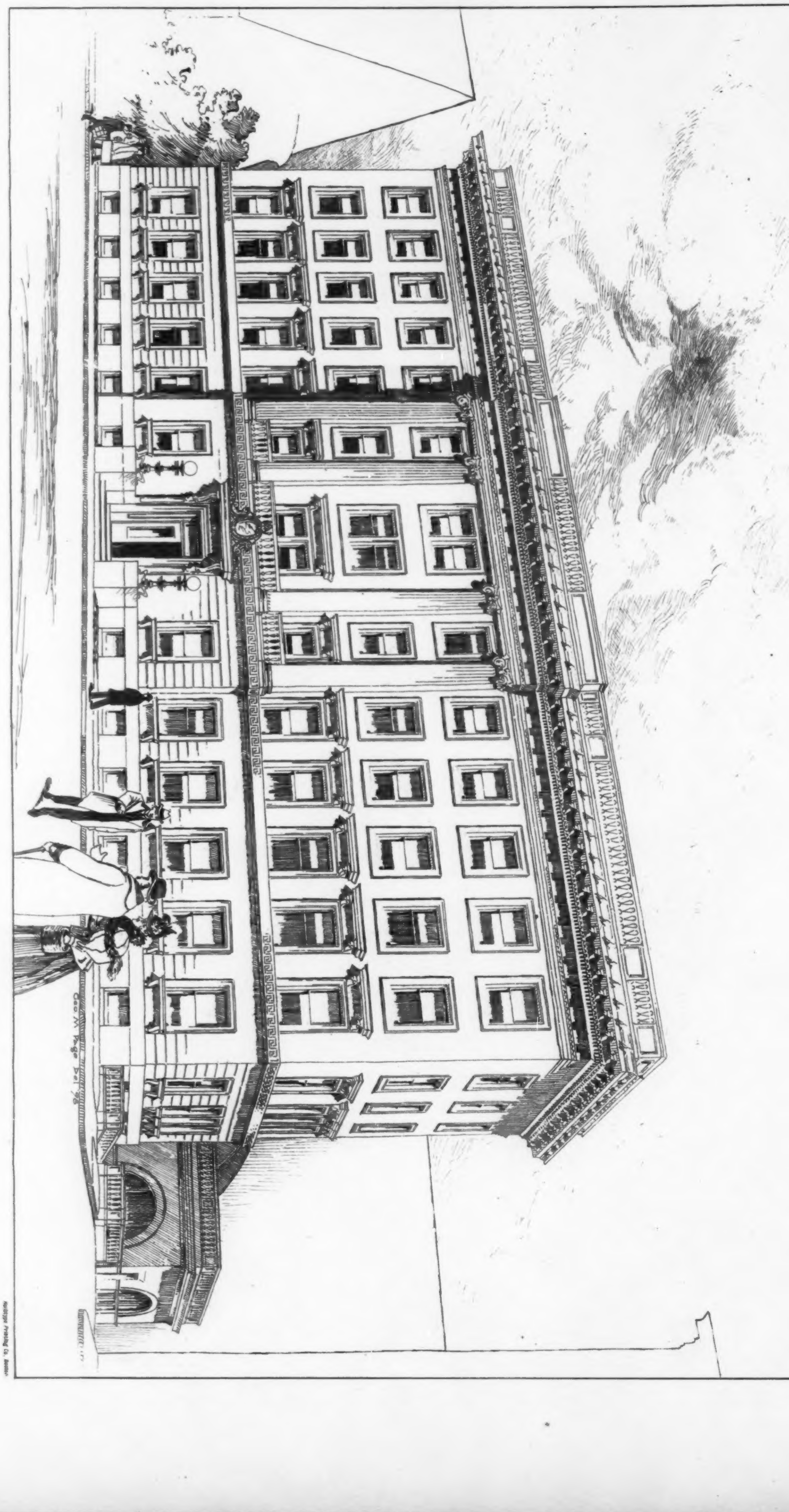


Abbaye, St. Denis, France, Central Doorway, XII Century.



ABBAYE, ST. DENIS, FRANCE—NORTH AISLE DOORWAY.



DORMITORY AT CAMBRIDGE, MASS.
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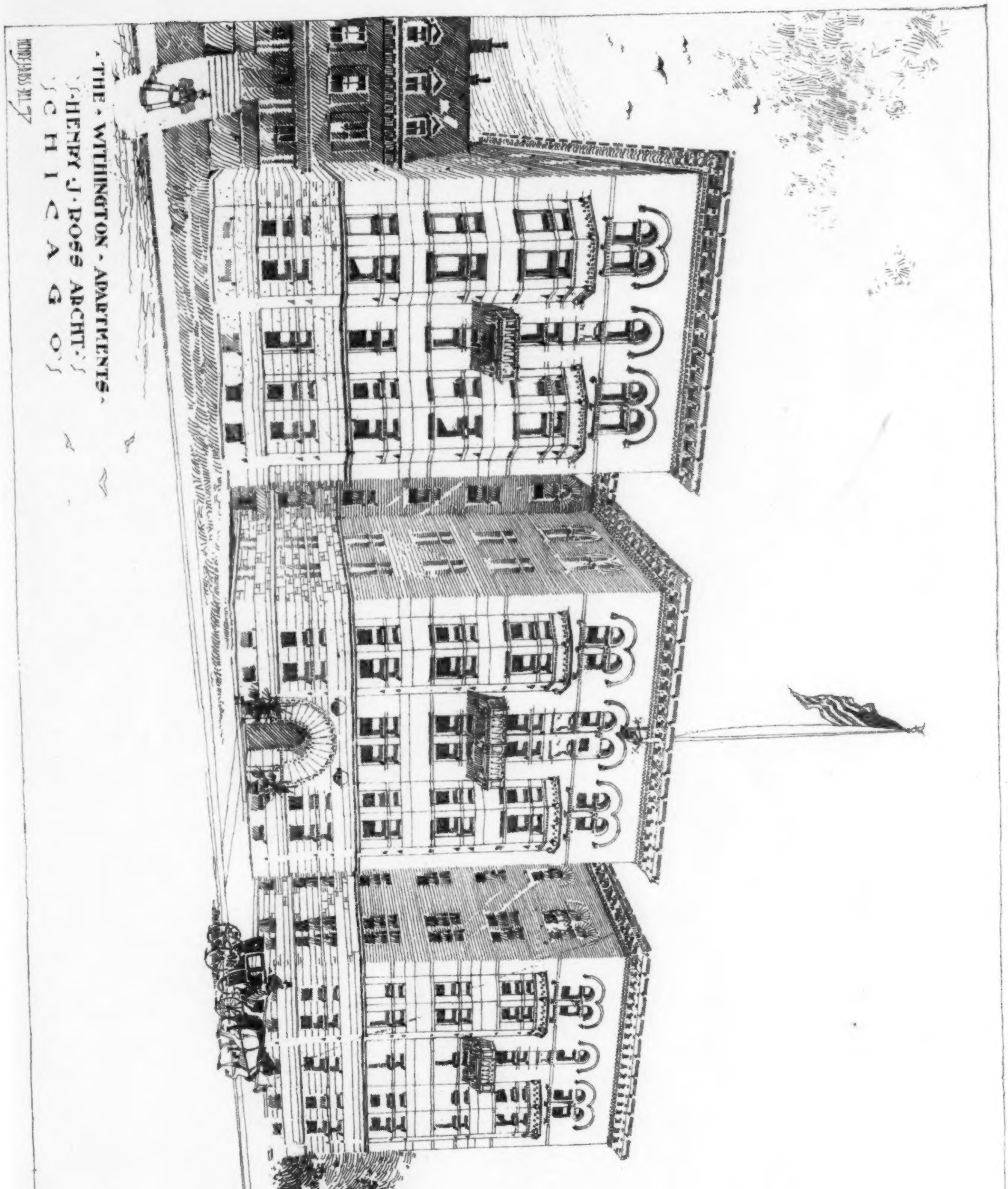

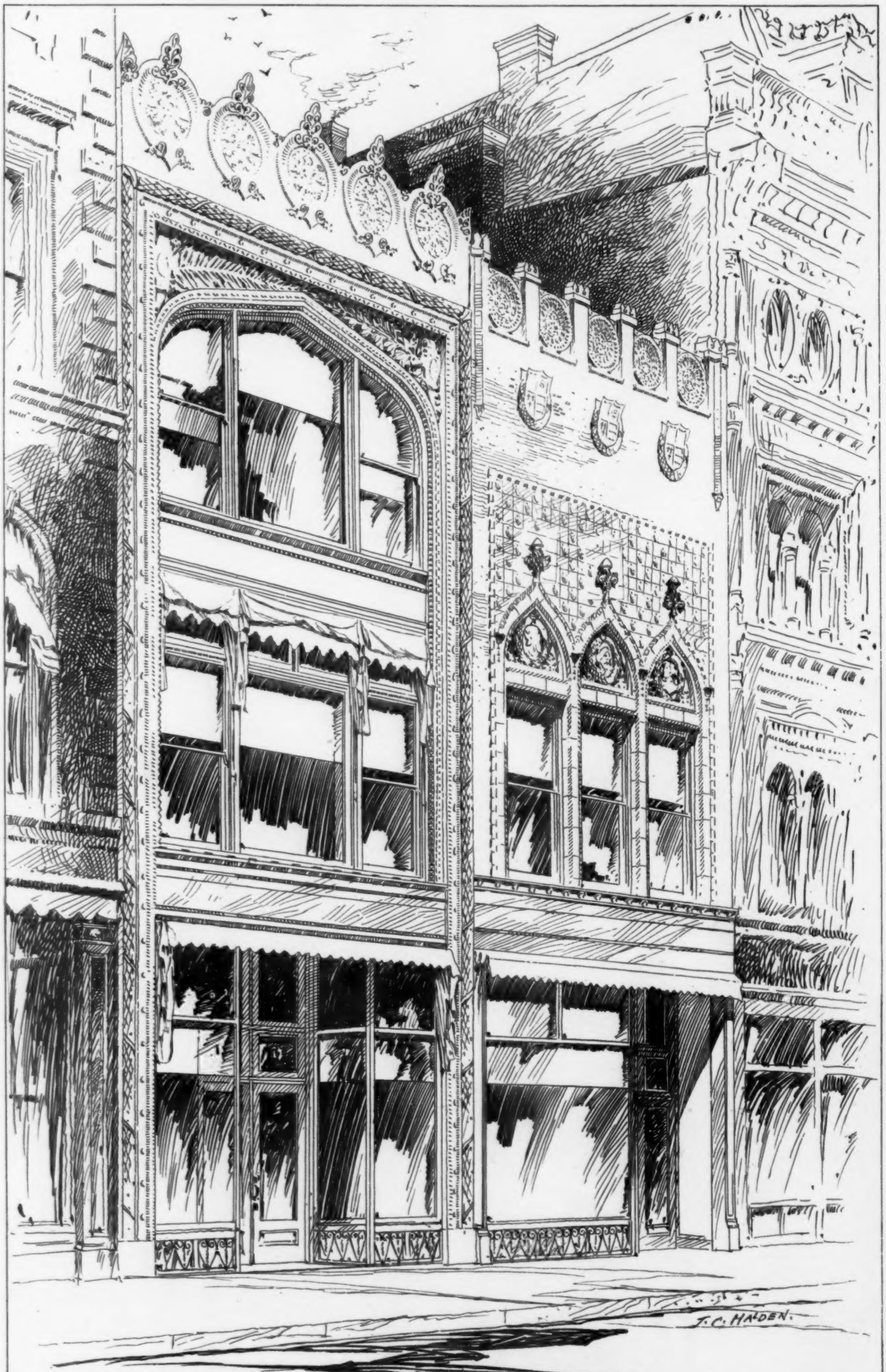

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