THE AMERICAN ARCHITECT AND BUILDING NEWS.

VOL. XXXIX. Copyright, 1893, by TICKNOR & COMPANY, Boston, Mass. No. 889.

Entered at the Post-Office at Boston as second-class matter.

JANUARY 7, 1893.

CONTENTS

A NEW sort of conduit for carrying letters is to be tried between New York and Brooklyn. For many years mail-pouches have been transported between the main post-office and the up-town branches by means of pneumatic tubes, laid under the streets, but there are difficulties in the way of carrying pneumatic tubes across the East River, and, until now, the mails have been transported between the two cities only by means of wagons. It is now proposed to improve the service by the ingenious process of laying a pipe over the East River bridge, with its approaches, and constructing within the tube a tiny electric railway, in which are to run cylindrical cars, large enough to take a mail-pouch, and each furnished with a small electric motor, taking current by means of a trolley. It is estimated that a speed of a hundred miles an hour can be attained, which would be sufficient to take a mail-pouch from New York to the Brooklyn post-office in less than a minute. The scheme appears quite practicable, and the only objectionable thing that we have read about it is that the post-master of Brooklyn is said to be engaged in financiering the company which is to build the line. The impropriety of this, supposing the story to be true, is so obvious that the company is likely to find difficulty in gaining the confidence of the public, but the experiment, if carried out, as now seems probable, will be interesting.

AN interesting question of the rights of an engineer or architect as final referee under a contract was decided by the highest court in England a few weeks ago. A contractor named Jackson agreed to build a lock for the Barry Railway Company, and the contract between the company and the contractor provided that any dispute should be referred to the company's engineer, whose decision should be conclusive and binding upon both parties. A dispute arose as to whether the walls of the lock should be built of stone, or of a certain rocky marl, the engineer demanding stone, and the contractors claiming that they should be allowed to use the marl all through the work. The company referred the question to the engineer's decision, as the contract provided, but the contractor objected to this, on the ground that the engineer, Mr. J. Wolfe Barry, had already expressed himself, in correspondence, in a manner which showed that he had previously made up his mind on the point in dispute, and was therefore not fit to act in a judicial capacity in regard to it. As the company insisted, the contractor applied for an injunction to restrain the company from proceeding with the settlement of the dispute in this way. The letter which was offered in evidence, as showing most clearly that Mr. Barry had made up his mind on the subject, was one written by him after the serving of the writ, in which he said, "I have already stated in my previous letters that there was never any intention to construct the breakwater in any way differently from the others — namely, exclusively of stone filling, with protecting stones on the outside, and smaller protecting stones on the inside — until in December last I agreed to accept a small portion of rocky marl, as a concession to you." The case was first tried before Mr. Justice Kekewich, who held that Mr. Barry had formed and expressed such a decided opinion on the matter that he had not that "open mind" which an arbitrator ought to have; and he accordingly continued the injunction against further proceedings. The company appealed, and the Court of Appeals, by a vote of two out of the three judges sitting, ordered the injunction set aside, on the ground that the letter did not imply that the engineer would not do his best to decide honestly between his own view and that of the contractor, when the matter came formally before him, and that it appeared rather that the contractor was "clutching at a straw," endeavoring, on the ground that the engineer had revealed a view which every one was aware that he entertained, to escape from a clause which he had accepted as a part of his contract, and substitute some different and more agreeable kind of arbitrament before a stranger, or a jury of strangers. One of the judges, dissenting, held that the letter showed that Mr. Barry was not doing his duty in keeping his mind open in regard to the matters in dispute, and that under these circumstances the contractor was entitled to come to the court for relief. The *British Architect* agrees with this judge, and the judge of the inferior court, and thinks that the company ought to have been compelled, under the circumstances, to select another arbitrator.

IN this opinion we are quite unable to coincide. Both the *British Architect*, and the judges whose arguments it commends seem to us to confuse the position of the engineer, as defined by the contract, and accepted by the contractor, with that of an independent arbitrator. If the contractor had merely agreed to accept the engineer as a referee in cases of disputes over points to which the engineer was a stranger, the latter would then have been an arbitrator, and his previous expression of a decided opinion on a point to be submitted to him might properly disqualify him from acting judicially upon it; but the whole tenor of the contract clause shows that the contractor agreed, and intended to agree, not only to accept the engineer as an arbitrator but to accept his view of the meaning of the plans and specifications, or other technical portions of the contract; and, if the engineer thought that the intention of the contract was that the breakwater should be of stone, it is ridiculous to claim that his reiterated and emphatic expression of his opinion relieved the contractor from his agreement to follow that opinion. We suppose that the *British Architect* will hardly say that the engineer ought never to have told the contractor what he considered that the contract required, but should have allowed him to build the whole breakwater of marl before deciding that it should have been of stone; yet this is the logical result of confounding the two functions, of interpreter of the contract, and arbiter in cases of dispute, which, by the agreement of the parties, the engineer was to exercise. Of these two functions, the former is, in all such cases, by far the most important, and nothing could be more unfortunate, both for owners and contractors, than a legal precedent by which the mere statement of the directions of the architect or engineer would rob those directions of their authority, and would substitute for them a trial by jury on every point wherein the opinion of the owner and the contractor as to the meaning of the plans and specifications happened to differ.

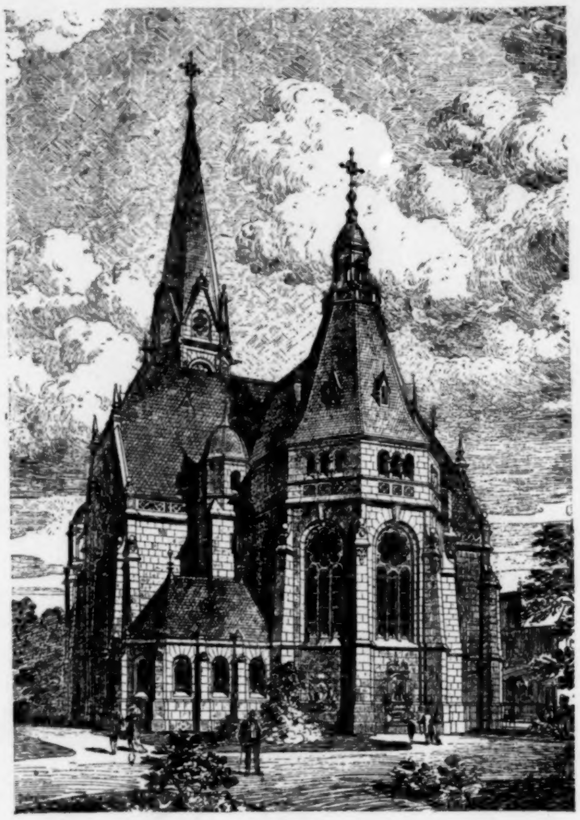
THE *Schweizerische Bauzeitung* gives some interesting particulars of the business career of the late Dr. Werner von Siemens. As every one knows, Dr. Siemens began life, as becomes a German youth of distinguished family, by entering the military service, and at twenty-two was an officer in the Imperial Artillery. His passion for scientific research, however, could not find a sufficiently wide field in the study of military problems, and he soon resigned, to devote himself particularly to electrical invention, in which he had already won some reputation. In 1847, he decided to place himself in a position to carry his inventions into practice on his own account, and formed a partnership with a mechanical engineer, named Halske. The new firm, under the title of Siemens & Halske, opened a small establishment for telegraph construction. Almost the first contract carried out by the firm was that for telegraph lines from Berlin to Frankfort and Aix-la-Chapelle. Both these lines were laid underground, it being then, as now, thought advisable in Germany, for military reasons, to lay important telegraphs below the surface; and Siemens devised a special insulating covering for the purpose. He had already experimented with insulating coverings for wires, in the construction of a system of submarine torpedoes, to be fired by an electric spark, for the protection of the harbor of Kiel; and he was soon enabled to use the experience so gained in a contract for a submarine telegraph line between Bona and Cagliari. The next year, the firm contracted to build, for the Prussian Government, a complete telegraph system for North Germany; and, in 1853, it was awarded the contract for the Russian system. Halske, although his name was retained, and has become famous by its connection with that of the firm, soon retired from the business, and the great house of Siemens & Halske has for many years only consisted, in reality, of Dr. Werner Siemens and his brothers Charles and William, whom he established as the English representatives of the firm. The three brothers, all of whom soon became noted for their scientific achievements, have carried on the business with a success which is worth noting as a reply to the popular notion that scientific tastes and business capacity are incompatible. The English branch alone has laid six telegraph cables between Europe and America; a branch established at Tiflis carried out the Persian line to Teheran, and the Vienna branch, as well as the parent house at Berlin, has devoted itself particularly, of late years, to building electric railways and electrical machinery. Individually, the members of the firm are reputed to be immensely rich, but it is curious that there is so much to say of their learning and ingenuity that one hears very little of their wealth.

MESSRS. FALDANE AND CARNELLEY have recently made some tests of air in houses and school-rooms in Dundee, Scotland, which appear to differ from any previously made, and have a considerable importance. Samples of air were taken from inhabited houses of various classes, and from school-rooms, some ventilated by artificial means and some by the natural method — with roof ventilators, open windows and so on — and each sample was tested chemically for carbonic acid and organic matter, and microscopically for floating organisms. Of rooms in inhabited houses, it is enough to say that the impurities in the air varied from eleven parts of carbonic acid in ten thousand, with sixty micro-organisms to the litre, in one-room dwellings, with two hundred and twelve cubic feet of air-space on an average to each person, to eight parts carbonic acid and nine micro-organisms in houses with four or more rooms, and an average of about eighteen hundred cubic feet of space per person. In school-rooms, as might have been expected, the results were more unfavorable. In crowded school-rooms, with natural ventilation, having not over one hundred cubic feet of air-space per person, the investigators found twenty-two parts of carbonic acid in ten thousand, and sixteen parts of organic matter, and an average of one hundred and nineteen micro-organisms to the litre. In rooms with from one hundred and fifty to two hundred cubic feet of air-space per person, with natural ventilation, they found an average of nineteen parts carbonic acid, twelve of organic matter, and one hundred and fifty micro-organisms, while, in similar rooms with artificial ventilation — that is, with fresh air forcibly blown in — they found eleven parts of carbonic acid, ten of organic matter and fourteen organisms. This apparent influence of artificial air-supply in diminishing the proportion of infectious germs in the atmosphere is probably to be attributed in part to the fact that school-houses with artificial ventilation are, as a rule, of comparatively recent construction, as compared with the others, for the same experimenters found that of two rooms, similar in all other respects, the one which had been longest built usually showed the largest proportion of bacteria, as if, so to speak, the scarlet-fever and measles germs had made nests and multiplied in the rooms during their longer occupation. It is to be noted that, in rooms with artificial ventilation, the amount of air-space per person seems to have less influence on the number of floating germs than the care with which the room is scrubbed. In a public school-room, where only one hundred and ninety-four cubic feet of space per person was provided, but which was scrupulously clean, only three bacteria to the litre were found; while a rather dirty one, somewhat more crowded, showed thirty, and the average for this class was fourteen.

AN illustration of the difference between the practical knowledge of engineers and architects, and the folly of the attempt, which is often made, to set either to do the other's work, is to be found in a communication recently made to the *Engineering Record*, signed "M. Am. Soc. C. E." The writer of the communication, whose membership in one of the best professional societies in the world gives evidence of his technical knowledge of his own work, wishes to have public attention called to the necessity for legislation, to compel builders to plaster the inside of chimney-flues. He goes on to say that "an unplastered flue is the result of coöperative neglect of inspection by the builder, and laziness by the workman; and proposes that if such a flue should be discovered in a building, the contractor should be subject to fine or imprisonment, unless he produces the workman who built the chimney, in which case the fine or imprisonment should be imposed on the workman. This remedy for "defective flues" seems to its inventor "so effective and simple that there must be some objection to it not seen by the writer, or those who have been consulted, else it would doubtless have been adopted before this"; and he thinks that its adoption would "add greatly to the safety of our habitations and factories."

WE hardly know whether lawyers or architects will be more astonished at this proposition. The idea, when a crime is committed, of laying hold on an innocent man, and imprisoning him until he produces the guilty one, might please a Chinese mandarin, but is quite unsuited to civilized legislation; and, independent of this point, on which we do not feel called upon to enlarge, the assumption that the building of chimney-flues without plastering them inside is the "result of laziness and neglect," or of any other evil traits, on the part of either contractor or workman, is totally unfounded. In point of fact, it takes more labor to build a flue without plastering inside than it does to plaster it, but a very large proportion of architects, builders and fire-engineers think that the unplastered flue is the safer of the two. Every architect knows, either from experience, or from instruction, or both, that, where flues are plastered inside, the interior plastering, in the course of years, is very apt to scale off, and fall, dragging with it a portion, often a large portion, of the mortar in the joints to which it may happen to adhere. If the exterior portion of the mortar in these joints has become loose, as often happens, from various causes, a crevice may be opened, through which sparks may, and often do, escape from the flue, and work mischief. Scores of houses have been set on fire from this very cause, and it is for this reason that the plastering of the inside of chimney-flues was forbidden by law in New York City for many years, and may, for all we know, be still prohibited. Yet the engineer correspondent of the *Record* would have the builders of all the houses erected in New York in compliance with this law, and those of all buildings executed under the direction of architects whose opinion coincides with that of the experts who framed the New York law clapped into jail. Personally, we are inclined to think that the disintegrating action of acid vapors on the joints of unplastered flues rather more than offsets the risk of pulling out the mortar from the joints by the fall of the plastering; and that, if the plastering, or, as it is more properly called, pargeting, is done with mortar containing cement, such as should always be used for the joints, and is put on new, clean brickwork, and brushed down smooth with a wet brush, the flue is somewhat better protected than by simple struck joints, and many fire-engineers take the same view; but it is acknowledged by every one who knows anything about the subject that the question is one of balancing disadvantages, which circumstances of local material or custom may determine either way, and, however "effective and simple" it may seem to an M. Am. Soc. C. E. to solve it by locking up all those who favor one side in the penitentiary, we doubt very much whether the *Record* will second his efforts.

ARCHITECT, OWNER & BUILDER BEFORE THE LAW.[1]—XXVI.



Competitive Design for an Evangelical Church at Heilbronn. From *Architektonische Rundschau.*

THE INTERPRETATION OF CONTRACTS.—ENTIRE AND DIVISIBLE CONTRACTS.

IN some of the discussions contained in the preceding chapters, the distinction between an entire and a divisible contract has been briefly mentioned. In the first, one party agrees to do a certain complete piece of work, for which the other agrees to pay a definite price, no part of which is due until the whole service is performed; while, in the other, the service to be rendered is divisible, either by agreement or by inference, into separate portions, on the completion of each of which a proportionate part of the price agreed to be paid is due. An illustration of an entire contract would be found in an agreement for making a suit of clothes, under which nothing would be due unless the clothes were completely finished; and the purchaser would not be required to receive or pay for a part of the suit, while a divisible contract might be illustrated by a bargain for building ten houses, at five thousand dollars apiece, under which it would generally be held that, if only six were built, the contractor would be entitled to be paid for these.

As a point of abstract legal theory, apart from extraneous considerations, the courts usually hold that a building contract is an entire contract, and must be carried out in full to entitle the builder to any part of the contract price. A man once contracted to build a house for a fixed sum. The builder owed the owner money on some other transactions. When the house was partly done, it happened to become necessary to adjust the accounts between the builder and the owner, and the builder endeavored to set off a part of the value of his work on the house against what he owed the owner. The Supreme Court of Colorado,[2] however, held that, unless the contract for building the house had been entirely performed at the time of the accounting, the builder was entitled to no credit for the work done under it. In this case no time had been specified for the completion of the house, but the court did not consider that this fact entitled the builder to payments on account, or to credit for partial service.

In a Vermont case,[3] a builder, A., agreed to repair a house, and to complete the work by a day named, and the owner agreed to pay a certain sum "when the job is complete." When the builder had partly finished his work, he was sued by another person, and a trustee writ was served on the owner, B. A. subsequently abandoned his work, without fault on the part of B. B. was sued as trustee for A., but the Supreme Court held, in three trials of the case, that B. was not liable for anything as trustee, because the contract was an entire one, and full performance of it by A. was necessary to entitle him to payment, and that A., not having finished what he had agreed to do, was not entitled to *pro rata* compensation for what he had done.

PAYMENT ON ENTIRE CONTRACT NOT DUE UNTIL WORK IS COMPLETED.

Where, therefore, a contract consists of a simple proposition and acceptance, or fails to provide expressly for payments during the progress of the work, on account of the contract price, the contractor is not entitled to claim any such interim payments, and nothing is legally due him from the owner until he has completely fulfilled the contract; and, if he never fulfils it, the owner never owes him anything, provided his failure to complete it is not due to the fault of the owner, or to the interference of the law.

PROVISION FOR INTERIM PAYMENTS DOES NOT AFFECT ENTIRETY OF CONTRACT.

Where, however, the contract expressly provides that payments on account of the contract price shall be made from time to time as the work goes on, it is sometimes questioned whether this provision does not make the contract divisible, so that the contractor, if he has completed the work up to the point at which an instalment of the price is due under the contract, may claim payment of this instalment, even though he abandons the work immediately afterwards.

There would probably be a difference between the courts of different States in their reply to this question in practical cases, but in theory it seems to be generally held that, as the Supreme Court of Ohio[4] puts it, the provision for payment by instalments "is for the convenience of the contractor only," and does not affect the entirety of the contract, so that, strictly, if a contractor fails to complete his contract, the owner is entitled to recover back from him all the instalments that he has paid on account of the contract price, whether they have been paid in accordance with the express stipulations of the agreement, or simply as a favor. Where a builder abandons a contract, it rarely happens, in practice, that he is solvent enough to pay back the instalments that he has received, even if the owner should get judgment for them, and there are very few cases in which the attempt to collect them has been made; but the principle has been repeatedly asserted in connection with other matters, as will be seen later.

It sometimes happens that the question of the divisibility of a contract is more difficult to decide. Sexton,[5] the contractor for the Chicago City-Hall, made his proposal as follows:

"For basement, $15,400; for first story, $17,300; for second and third stories, $35,000; for fourth story, with skylight and roof, $36,602.69, complete, according to advertisements, and according to the plans and specifications on file in the Department of Public Works of the city of Chicago, for the sum of $105,302.69." The contract provided that payment should be made on estimates, during the progress of the work, of 85 per cent of the value of the work done and in place at the time of issuing of such estimates, the remaining 15 per cent being reserved until the final completion and acceptance of said work. It appeared that payments were made on estimates by stories. The city, by the Mayor, who was, by the contract, entitled to do so, declared the contract forfeited, on Sexton's failure to put on roofs and skylights as called for by the original plans.

It will be remembered that the Supreme Court[6] decided this point in favor of Sexton, holding that, as he had been shown

[1] Continued from No. 871, page 144.
[2] Walling *vs.* Warren, 2 Colorado 434. *See, also,* Smith *vs.* Brady, 17 N. Y. 133; Brown *vs.* Weber, 38 N. Y. 187.

[3] Kettle *vs.* Harvey, 21 Vt. 301, 24 Vt. 515, 33 Vt. 39. *See, also,* Strauss *vs.* R. R. Co., 7 W. Va. 389.
[4] Lumber Co. *vs.* Purdum, 41 O. S. 373. *See, also,* Grossman *vs.* Bonn, 5 Stud. 43; Sch. Tr. *vs.* Bennett, 3 Dutch. 513; Haslack *vs.* Myers, 2 Dutch. 284.
[5] Chicago *vs.* Sexton, 115 Ill. 230. *See, also,* Brigham *vs.* Hawley, 17 Ill. 38; Holmes *vs.* Stummel, 24 Ill. 370; Evans *vs.* R. R. Co. 26 Ill. 189; Dobbins *vs.* Higgins, 78 Ill. 440; Folliott *vs.* Hunt, 21 Ill. 654.
[6] *See, also,* Butts *vs.* Huntley, 1 Scam. 410.

only tracings of the plans, in which the skylights and other details shown on the original plans did not appear, his contract only required him to execute the works indicated on the tracings shown him. Sexton then claimed that, as the city had declared his contract forfeited without just cause, he was en-entitled to treat the whole contract as having been rescinded, and recover the market value of all the labor and materials which he had furnished by *quantum meruit*, without regard to the contract price which he might have agreed to take for them. The city resisted this claim, maintaining that, even if Sexton was entitled to recover on *quantum meruit*, on account of the rescission of the contract by the city, the contract, as agreed upon by the parties, was separable, each story forming the subject of a separate agreement, so that a rescission of one section of the contract did not disturb the remainder. The court, however, decided against both parties, holding that the contract was not separable, but entire, and that Sexton, under the circumstances, was not entitled to recover the market price for his work and materials under *quantum meruit*, but that their value must be determined by the stipulations of the contract so far as those stipulations could be applied.

DIVISIBILITY OF CONTRACTS ACCORDING TO THEIR STIPULATIONS.

There is another point in which a contract may be divisible. Besides providing for the execution of successive portions of the work, all building contracts divide the description of the work to be done into a great number of separate stipulations regarding the class of materials and the sort of workmanship to be used in every part of the building, and such a contract, even if not separable into portions following each other successively in point of time, might be conceived as separable into a number of independent agreements as to materials and workmanship, the violation of one of which need not necessarily involve the forfeiture of all. If the latter view of the subject can be taken, the contract is divisible; but, if all the stipulations must stand or fall together, it is entire.

It is obvious that the question whether a building contract is an entire one, so that the builder is entitled to no pay unless he carries it out in every particular, or is to a certain extent divisible, so that he can get something for his work, even if it is not completed exactly as the specifications require, is a very important one; and it is one on which the courts have spent a great deal of time, without, however, coming to any very definite conclusion; and it will, perhaps, make the presentation of the law on the subject more clear to refer first to the decisions which take the view most unfavorable to the builder, and then to those which incline to the opposite side, mentioning last some which endeavor, not very successfully, to adopt both views at once.

The leading case [1] on the subject in this country is that known as Smith *vs.* Brady, which was decided in the New York Court of Appeals some years ago. As the decision in this case reversed that of two courts below, and was very fully explained by the judges, it will be of advantage to describe it at considerable length, particularly as it is frequently referred to in building suits.

In this case, a builder, by two agreements, contracted to furnish materials and build three cottages, with out-houses and fences, in accordance with certain plans and specifications, except where otherwise provided, in the best and most workmanlike manner, and to the entire satisfaction of certain architects named in the contract. It was further provided that their decision upon questions of extras and omissions should be final. For this work the defendant agreed to pay the plaintiff $4,900, of which a part was to be paid from time to time as the work progressed, and the balance "when all the work should be completed and certified by the architects to that effect."

The answer to the plaintiff's petition averred that the plaintiff had not performed the covenants on his part; that the work was not done in the most workmanlike manner, or to the satisfaction of the architects; that the materials furnished were of inferior quality; that the plaintiff never procured the certificate of the architects, or either of them; and that, in regard to extras, the defendant had disputed the plaintiff's charges, and had offered to submit them to the architects, as agreed, but the plaintiff had refused to submit them.

The plaintiff, in reply, admitted that he had never procured the certificate of the architects, in consequence of the unreasonableness and frivolous objections of said architects, or one of them, in refusing to give any certificate. He admitted that the work was done, and materials furnished, except for extra work, under the contract.

The case was first tried before a referee, who found that there were omissions and deficiencies in the work and materials, and that the loss to the defendant thereby amounted to $212.57; that the plaintiff had done extra work and furnished materials therefor, to the value of $295; and that the defendant in June (the contract was to be completed May 1) took possession of the three cottages, without objection at the time, and appropriated them to his own use. He reported that, after making the proper allowances and deductions to the parties respectively, the plaintiff was entitled to judgment for $1,934.43, some payments having already been made on the contract.

The defendant appealed from the decision of the referee to the Supreme Court, which approved the referee's judgment; and he then appealed to the Court of Appeals, which reversed it.

It appeared from the evidence that the specifications called for nailing-joists in the frame twelve inches apart from centres, but that they were actually placed sixteen inches from centres; also, that whereas the contract required the third floor beams to be sixteen inches apart, they were actually placed twenty-four inches apart. About 200 joists, in all the buildings, besides the beams, were saved in this way. The plaintiff, to meet this evidence, produced testimony tending to show that the houses were sufficiently strong; that the joists and beams were placed at the distances customary in that neighborhood, and that the defendant was not really injured at all by this violation of the contract. No other variation from the specification is mentioned in the report, and these would probably account for the referee's deduction of $212.57. No explanation of the omissions was given, nor was any evidence offered to show that they were not intentional.

The Court of Appeals, in reviewing the case, set itself this question. "In a building contract, where performance is to "precede payment, and becomes a condition thereof, can the "builder, having failed to perform on his part, recover for his "work or materials, making the other party a compensatory "allowance for the wrong done him, it being also a further "condition of the question that the employer chooses to occupy, "and enjoy the erection, rather than to remove or require the "builder to remove it from his premises?" The Court cited decisions both in the negative and the affirmative. In Ellis *vs.* Hamlin,[2] tried before Chief Justice Mansfield, the plaintiff, a builder, had omitted to put into the building certain joists and other materials. Failing to prove performance of the contract, he resorted to a general count for work, labor and materials, claiming that the defendant, having the benefit of the houses, was bound at least to pay for them according to their value. "But Chief Justice Mansfield repudiated that "doctrine. He said, 'The defendant agreed to have a build-"'ing of such and such dimensions. Is he to have his ground "'covered with buildings of no use, which he would be glad to "'see removed; and is he to be forced to pay for them besides? "'To be sure, it is hard that a man should build houses, and "'not be paid for them; but the difficulty is to know where "'to draw the line; for, if the defendant is obliged to pay for "'one deviation from his contract, he may equally be obliged "'to pay for anything, how far soever distant from what the "'contract stipulated for'; and the plaintiff was non-suited."

The Court of Appeals went on to say that "the supposed "liability of a person who enters and occupies a building "erected on his ground to pay the builder, although the latter "failed in performing his contract, has always been referred to "the general doctrine that benefits received and retained under "a contract must be paid for without regard to the conditions "of the contract itself. I am confident that no case can be "found in which the building-contractor's right to recover has "been maintained on the ground that the owner, by the mere "possession and occupancy of the building, has waived the "condition of performance." "In this State [New York] "the sanctity of contracts, in this respect, at least, has been "strictly maintained, and no encouragement has ever been given "to that loose and dangerous doctrine which allows a person

[1] Smith *vs.* Brady, 17 N. Y. 173.

[2] Ellis *vs.* Hamlin, 3 Taunt. 52. McMillan *vs.* Vanderlip, 12 John. 665. Thorpe *vs.* White, 13 John. 53. Jennings *vs.* Camp, 13 John. 94. Champlin *vs.* Rowley, 13 Wend. 258. S. C. in Error, 18 Wend. 187. Paige *vs.* Ott, 5 Denio. 406. Pike *vs.* Butler, 4 Comst. 360. Pullman *vs.* Corning, 5 Seld. 93.

"to violate his most solemn engagements, and then to draw "the injured party into a controversy concerning the amount "and value of the benefits received. . . . If the owner, having "regard to strength and durability, has contracted for walls of "specific materials, to be laid in a particular manner, the "builder has no right to substitute his own judgment for that "of others. Having departed from the agreement, if perform-"ance has been waived by the other party, the law will not "allow him to allege that he has made as good a building as "the one he had engaged to erect. He can demand payment "only upon and according to the terms of his contract; and if "the conditions on which payment is due have not been per-"formed, then the right to demand it does not exist."

"Cases of this kind," the Court continued, "must not be "confounded with others having perhaps a slight resemblance, "but no real analogy. . . . If A. should agree to make and "deliver to B. a carriage of a particular kind, and should "make a different one, B. may elect whether he will take it or "not. Until he so elects, he has no property in the fabric. "If he voluntarily accepts it, he either waives the objections "which he might make to it, and is liable to pay for it under "the contract, or he must pay for it on its own merits, as if "there had been no previous contract. But where the owner "must, in the nature of things, receive the benefit of the par-"tial performance of the contract, he is, if the contract so pro-"vides, under no obligation to pay anything unless the contract "is completed. Thus, if one engages to labor for a year, al-"though the employer receives the benefit of each day's labor, "he is not bound to pay anything if the laborer without just "cause abandons his service before the year has expired. "Also, if one contracts to plough twenty acres of land, and "abandons the work after ploughing nineteen, he can recover "nothing, although the owner plants and cultivates the nineteen "acres, for the reason that the owner cannot reasonably do other-"wise. . . . He is not obliged to abandon his field in order to "be enabled to insist on the condition of the contract." So with building contracts. "The owner of the soil is always in "possession. He is not in a situation to elect whether he will "or not accept the benefit of an imperfect performance. He "cannot reasonably be required to tear down the building in "order to stand upon the contract, and there is no rule of law "against his using it without prejudice to his rights. More-"over, as being annexed to the soil, the building is his prop-"erty, and the builder would have no right to remove the brick, "or stone, or lumber, after annexation, even if the employer "should unjustifiably refuse to allow him to proceed with the "work."

"It is true that contracts embrace a variety of particulars, "and that slight omissions and inadvertencies may sometimes "very innocently occur. These should be indulgently regarded, "and they will be so regarded by courts and juries. But there "can be no injustice in imputing to the builder a knowledge "of what his contract requires, nor in holding him to strict "performance. . . . If he fails to perform, when the require-"ment is plain, and when he can perform if he will, he has no "right to call upon the courts to make a new contract for him; "nor ought he to complain if the law leaves him without "remedy."

The Court, therefore, held, that the evidence to show that the houses, as built, were sufficiently strong, and the timbers placed at distances customary in that neighborhood, was improperly admitted, and that the plaintiff was not entitled to recover for his work and materials, even upon making to the defendant an allowance for the breaches of the contract, to be adjusted according to some principle of equity.

Another somewhat noted New York case[1] extends and explains the doctrine held in Smith *vs.* Brady. One Gugerty, a mason, agreed in writing to provide materials, and execute certain work "in a good, substantial and workmanlike manner, in strict conformity with plans and specifications prepared by E. J. Webb, architect," so that the house might be completed, if the carpenter should be guilty of no default, on or before a certain day. In consideration of this, the owner, Smith, agreed to pay $5,900, by instalments, each payment to be made when the architect should certify in writing that the work had been performed which entitled Gugerty to such payment. The owner "reserved the right to alter, add or omit either workmanship or materials," and to "pay and allow a fair valued price for any addition or alteration so ordered that may add to such contractor's expense"; and he also "made it a right to claim a fair valuation for either workmanship or materials which, by a written order, delivered to the contractor by a third person, he, the owner, should think proper to have omitted." But it was agreed that "no such deviation from the original plans should impair the contract between the said parties, or destroy its binding influence or validity."

The owner ordered verbally a considerable amount of extra work, and also verbally directed omissions to be made. The house was not finished until long after the contract time. The architect gave his final certificate as follows: "I pronounce the houses finished, and if not literally so in every punctilio, they are done in that manner that, was I the owner, I would accept them for myself."

Smith kept back a part of the price for the contract and extra work, on the ground of delay, and said also that no written order had been given for the extras, and that the architect's certificate did not set forth that the work had been performed according to the plans and specifications.

Gugerty sued for his money, and recovered it. In its decision, the Court said, "The parties to building contracts apparently differ most widely in reference to their obligations. "The builder seems to suppose that while he adheres gener-"ally to the plan which is prescribed for him, he is at liberty "to disregard minute and unimportant particulars; while the "owner imagines that a departure from such plan in any re-"spect, although it may be the effect of accident, and of no "possible injury to him, exonerates him from the obligation to "make any payment which is in terms made dependent upon "the full performance of the contract. Both are wrong. . . . "A substantial compliance, without any intentional variation, "should in all cases be considered as a full performance of a "condition, whether precedent or consequent."

With regard to delay, the Court said: "Taking the old work "and the new together, Gugerty never agreed to perform the "whole within the time specified in the contract. An exten-"sion of the work called for, and justified, an extension of "time. But if there had been no additional labor, the pro-"traction of the time, if assented to by Smith, would not im-"pair Gugerty's claim. This assent need not be in writing," and here Smith, by making no complaint of the delay at the time, tacitly assented to it.

As to the absence of written orders for changes, although there was no positive evidence that Smith ever verbally ordered all of those made, he certainly saw them made, without objection, and ordered at least many of them himself. On one occasion, where he had given verbal orders for extra work, and Gugerty objected that the contract required a written order, and said that he had done enough without a written agreement, and should do no more, Smith called a witness, and in his presence, and in that of the architect, said, "Whatever extra work you do for me, I will pay you for it." And the architect said, "Mr. Gugerty, that is as good as a written order to you, and I will see it right to you." The Court mentioned this evidence, and observed: "Moreover, Smith claims deductions "for omissions, without proof of written orders, and the infer-"ence is clear that the parties mutually waived the provision "requiring a written memorandum for extra or omitted work."

As to the insufficiency of the architect's certificate, the Court held that, as Smith had by his own acts, or with his consent, made it impossible for the architect to certify that the work was done according to the specifications, he could not object that the certificate was insufficient.

WILFUL OR CARELESS DEPARTURES FROM CONTRACTS.

There are indications that the contract in this case was not drawn in the ordinary way in regard to certain points, such, for example, as the provision for extension of time in case of extra work; so that some parts of the decision would be modified, if applied to the forms of agreement which architects now generally use. However, the principles laid down by the Court are valuable, and are well summed up in the report, as follows: "Parties to building contracts should be exact in the fulfilment of their agreements, even to the smallest particulars; and if they wilfully or carelessly depart from any one of them, they should incur the penalty, however severe it may be. But if a party, while acting in good faith, and with a determination to do all that he has contracted to do, unintentionally, and without any negligence, happens in some trifling matter to vary or depart from the terms of the contract, the law is not so severe

[1] Smith *vs.* Gugerty, 4 Barb. 614.

and exacting as to deprive him of all compensation. It ever regards the substantial rights of the parties, but overlooks trivial and unimportant matters.

"Where, after the making of a building contract, additions to the original specification are made, at the request of the owner, and requiring additional time, the time limited for the completion of the contract will be deemed to have been extended, by mutual agreement of the parties, if an extension is necessary for the protection of the contractor."

As before observed, this doctrine would not apply to a case in which the contract itself specified in what way, and under what conditions, the time for completion should be extended, or to one which expressly provided that it should not be extended under any circumstances. In such cases, the parties having themselves agreed upon the rule by which they will be governed, the courts will not interfere with their agreement.

WHAT DEVIATIONS ARE UNINTENTIONAL AND INADVERTENT.

Just how much variation from the plans and specifications would, under this stricter theory of the entirety of a building contract, be regarded as "unintentional or inadvertent," so that the court would still consider that the contract had been "substantially" complied with, is a rather indeterminate point, although an important one; and perhaps nothing better can be done to illustrate it than to collect a number of actual decisions, the account of which, if tedious to the general reader, will be all the more valuable to persons in need of suggestions on the subject for being somewhat minute.

A block of stores was built under contract[1] in New York. The city gave the contractors the wrong grades for the sidewalk, so that the stores were set a step higher than they should have been. The contractors, during the progress of the work, pointed out the mistake, and explained to the architect, and to a representative of the owner, the cause of it. No complaint or objection was then made by either. When the buildings were completed, the architect gave his certificate for the final instalment of the contract price, and a part of the instalment was paid. Payment of the balance was, however, refused, on account of the mistake in setting the buildings. The suit of the contractors for their money was carried to the Supreme Court, which decided in their favor. The Court said, "Where "there has been no wilful departure from the terms of a build-"ing contract, nor any omission in essential parts, and the "laborer has honestly and faithfully performed the contract, in "all its material and essential features, he will not be held to "have forfeited his right to remuneration by reason of mere "technical, inadvertent and unimportant omissions or defects. "A substantial compliance with the contract is all that is re-"quired to entitle the builder to his reward."

Where a contract[2] had been made for altering a house, the price for the work, as fixed by the contract, being $550, with board for the contractor and his workmen, and fodder for his horse, it appeared, after the work was finished, that the roof and chimneys were not well supported; that the folding-doors were not well hung, and their casings were not well fitted; that the tarred paper and clapboards were in some cases not well put on, and that one door and casing was set so that the door would not shut. The referee appointed by the Court found that, notwithstanding these omissions, for which he thought that $100 should be deducted from the contract price, the contract had been substantially performed.

The owner, probably thinking that a contract could hardly be said to have been "substantially performed" by a contractor who had left out about one-sixth of what he had agreed to do, appealed, and this insignificant controversy was carried to the highest court in the State of New York, which sustained the decision of the referee.

(To be continued.)

INSURANCE COMPANIES AND THE MAINTENANCE OF FIRE-DEPARTMENTS.—How much do the great insurance companies of New York contribute toward the maintenance of the Fire-department of New York? In London the fire-insurance companies are taxed to the extent of about $200 for every $5,000,000 insured. This gives the Metropolitan Fire-department an income amounting to several hundreds of thousands of dollars. The London County Council is now discussing a proposal for increasing this contribution by the fire-insurance companies, on the ground that the British metropolis has increased during the past few years both in size and wealth.—*N. Y. Tribune.*

[1] Sinclair *vs.* Tallmadge, 35 Barb. 602.
[2] Woodward *vs.* Fuller, 80 N. Y. 312.

CONSTRUCTION.[3]—XVIII.

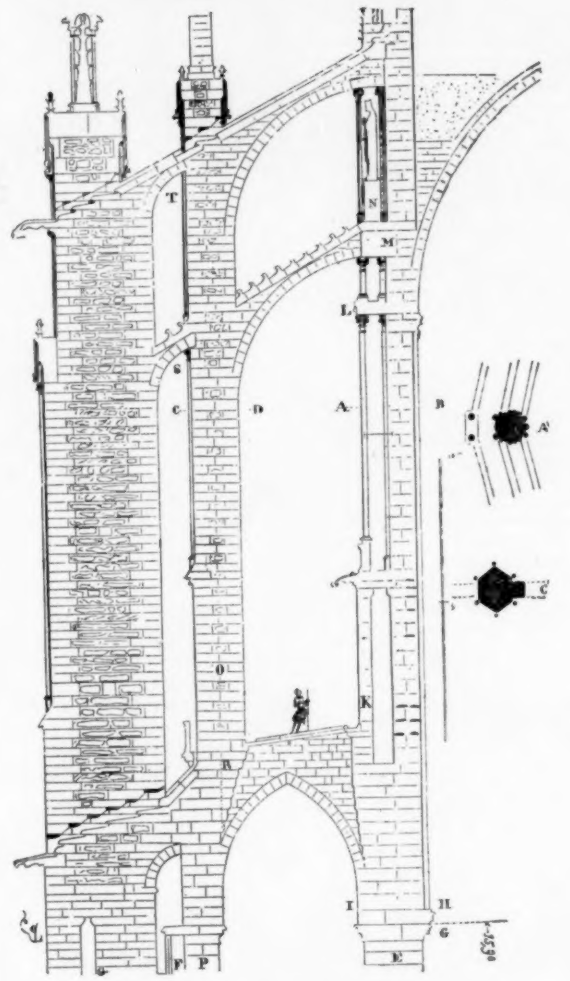


Fig. 101. Flying-Buttresses at Beauvais.

WE have given in the article "*Arc-Boutant*" (Fig. 61) the general view of the system adopted for the building of the flying-buttresses of the apse of the Cathedral of Beauvais. We must return to the details of this construction, and it will be seen how the builder of this choir tried to surpass the work of his fellow-architects at Amiens. Yet these two apses were built at the same time, that of Beauvais perhaps being later by some years. We suppose, just as we have done for a flying-buttress in the choir of Notre Dame of Amiens, a section made through the axis of the piers of the apse at Beauvais. (Fig. 101.) It is interesting to compare these two sections; we, therefore, give them on the same scale. At Amiens, the piers of the chancel are 14 metres high from the pavement of the aisle to the abacus of the capitals supporting the vaults of the aisles. At Beauvais, these same piers are 15.90 metres. But at Amiens, the absidal chapels are as high as the aisle, while at Beauvais they are much lower, and between the platforms that cover them and the vaults of this aisle there is a gallery, a triforium *F*. At Amiens it is the intermediate pier which has the passive rigid resistance, thanks to its mass and to the manner of building the lower piers, as we have just shown; the second pier is only an accessory, a surety, an additional though necessary precaution.

At Beauvais the master-builder tried to give this intermediate pier an active resistance, and to bring to the second pier, the exterior one, the passive resistance which he must always find somewhere. He expected thus to be able to secure more lightness in the general effect of his structure, more height and more solidity. As we have already said, the piers *E* of the chancel have more space, are thicker than those at Amiens, in the direction of the thrusts.

The groups of pillars carrying the pointed and wall arches of the high vaults are set in corbel-form upon the lower capital *G*.

The impost *H I*, is hence greater, and the pier *K* of the large triforium rests vertically upon the lower pier.

Upon this pier *K* of the triforium there is no longer one column, as at Amiens, to receive the end of the flying-buttress, but two smaller columns set against the cleavage, as seen by the horizontal section *A'* made through *A B*.

These two columns sustain the lintel *L*, which is a course acting

[3] From the "*Dictionnaire raisonné de l'Architecture Française*," by M. Viollet-le-Duc, Government Architect, Inspector-General of Diocesan Edifices, translated by George Martin Huss, Architect. Continued from No. 886, page 182.

as ceiling. The other two columns are set between this lintel-course and the top of the flying-buttress, which rests against an enormous block *M* of stone, weighted by a course, as cornice, and a pedestal *N* supporting a colossal statue.

Another pair of pillars is placed in front of this statue, between the first and the second flying-buttresses. These latter pillars support, not the top of the flying-buttress, but a pinnacle whose form and structure we shall at once point out. The whole system resembles that which we have seen at Amiens. Yet we notice that the whole method of double building exerts a vertical pressure upon the lower pier, whose interior is built in courses, and its exterior in large, rigid pieces, set against the cleavage, to give firmness to the structure at once so slender and so tall: we notice, too, that the strong lintel *L*, the block *M*, and its burden *N* tend evidently to add considerable weight to the top of the support below, in order to keep it vertical and make good its function of stanchion.[1]

Hence the inner pier is made as rigid as possible, for it is now necessary to resist the thrust of the vault, acting from an enormous height.

The architect felt unable to get along with a single flying-buttress, as at Amiens, even were it surmounted by a rigid open-work; he was right, for at Amiens, in the parallel parts of the choir which received three vault-groins instead of one, these flying-buttresses with open-work were displaced by the pressure of the vaults, and in the fifteenth century it was necessary to build new flying-buttresses under those of the thirteenth. But the master-builder of Beauvais here evinced an unparalleled hardihood, and at the same time a rare sagacity. It is seen that the intermediate pier *O* does not rest squarely upon the pier *P*, the summit of the chapel, as in the Cathedral of Amiens, but that its axis is in the same vertical with the inner facings of that pier *P*.

Let us say at once that this pier *O*, whose horizontal section through *C D*, we give at *C'*, has greater weight in its side *C*, than on the side *D*. Its centre of gravity is then inside of the dotted line *R*, or, in other words, above the pier *P*.

Still the pier is thus in equilibrium, and tends to incline towards the interior of the church rather than toward the large outer buttress; it succeeds, then, by its position; first, in drawing off the thrust of the two flying-buttresses, secondly, in adding to the resistance opposed by these flying-buttresses a tendency to incline toward the choir.

The vertical pier *O* thus does the duty of an oblique prop. If this active resistance does not suffice (and it cannot suffice), the pier *O* is in its turn sustained in its function by the two secondary flying-buttresses *S* and *T*, and by the large passive buttress. But, some one may object, why this intermediate pier? Why do not the large flying-buttresses rest simply upon the large passive buttress without?

It is because the large outer pier could not buttress the thrust of flying-buttresses of so great radius, without being doubly augmented, and because, thanks to the intermediate pier *O*, it has only to buttress a pressure that is diffused and almost annulled.

To explain clearly the function of the pier *O*, let us suppose that we have to put props under the choir of Beauvais, and let us suppose that we have only the large buttress to place our props upon.

If (Fig. 101*b*,) we set our props as indicated in *A*, we shall surely overturn the pier *C*; but if against the pier *C* we place, according to the drawing *B*, an intermediate prop *D E*, slightly inclined toward the choir but kept in a vertical plane passing through

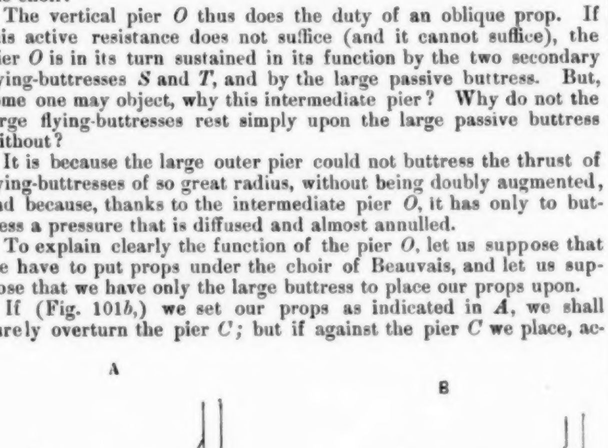


Fig. 101*b*.

[1] In the fourteenth century the columns placed upon the triforium had become broken, and there was placed instead of them a solid pier (See Fig. 61, article "*Arc-Boutant*"); but it is still possible to-day to recognize their position and approximately their diameter.

the axis of the piers of the radius of the chancel, and if from that prop we extend two supports *F* and *G* against the vault, and then two others at *H I*, we shall no longer need to fear the effect of the thrusts of the vaults *V* upon the great buttress *C*, for the intermediate prop *D E* will draw off a large part of the thrust by the two supports *F G*, and will transmit it to its base *D*. This is the whole problem given and solved by the architect of the choir at Beauvais. Unhappily, the execution is defective. Still, it is certain that this immense edifice would have kept perfect stability if the architect had made the two pillars above the triforium stronger and more resistant, if he could have made them of cast-iron, for instance. The disorders which have occurred in the structure have all come from this; these columns, too slender, have given way, for they could not resist the weight brought upon them when the inner piers began to settle in consequence of the drying of the mortar. In the disorder the lintels *L* (Fig. 101) were broken, the large blocks *M*, in swaying, rested too heavily upon the top of the first flying-buttress; this latter was thrust out of shape, and, the vault following the movement, the pressure upon these flying-buttresses was such that they nearly all were forced outward and their action annulled, while, in consequence, the upper flying-buttresses were loosened somewhat, since the vault no longer pressed against them. The equilibrium was broken; and considerable labor was needed to avoid the total ruin of the edifice.

Fig. 101*c*. Flying-Buttresses, Choir of Beauvais Cathedral.

Figure 101*c* gives in perspective the summit of the piers receiving the tops of the flying-buttresses, and shows us clearly that the intention of the master-builder was to obtain at the height of the piers of the choir of the Cathedral of Beauvais, and under the flying-buttresses, supports not solid, but perfectly rigid, in order, first to load the lower piers as little as possible; and secondly, to make the settling of the interior parts, built in courses, and stiffened by the pillars set against the stratum, naturally carry the weights inward. From this example and from those belonging to Gothic construction properly so-called, there is derived this principle: that every structure built of courses set upon one another in large quantities must be supported and made rigid by the addition of monoliths surrounding, flanking and sustaining the piers composed of courses. This principle is scarcely applied by the Romans, who had no need to resort to it; it belongs to the Gothic builders. From this principle they make one of the most ordinary *motifs* for the decoration of buildings and, in fact, it lends itself to the most brilliant and daring arrangements.

(To be continued.)

A NEW ENAMEL FOR IRON. — It is stated that M. Bertrand, who some time since invented a novel magnetic oxidizing process for the prevention of rust on cast-iron, a method now in successful application in Paris and elsewhere, has lately devised a new system of enamelling. Its satisfactory character is said to have become established to such an extent that the Société du Val d'Osne, well known as the principal ornamental casting manufacturing concern in France, has not only adopted the method, but has secured a monopoly of the market for art castings thus produced. The imitation of the most variegated marbles by this means is represented as being so perfect that the illusion is absolute. Further, M. Bertrand is able to enamel cast-iron, wrought-iron, and steel with equal facility, accumulating shade upon shade, delicately blending these so as to produce the highest artistic effect. — *New York Sun*.

COMPARATIVE MUNICIPAL BUILDING LAWS.—XIX.

[*Note:*—In these tables bracketed letters invariably refer to preceding passages in the same column.]

Fire-Stops and Timbers near Flues.

(See "*Fireproof Construction.*")

Boston:—*a*. *Every second-class building* (except as hereinafter provided) shall have sufficient fire-stop at each floor, covering whole floor of each story, through stud partitions, and extending to masonry walls.

b. Every air-duct (except those expressly sanctioned by this act) shall be effectually stopped at each story.

c. Such fire-stop shall consist of solid, air-tight, cohesive layer, at least 1″ thick, of tile, brick or like fire-made material, plaster, cement, cinder or ashes, or of a combination of same, or of equally non-inflammable, non-heat-conducting materials, laid between upper and under floors, or occupying all space between timbers under floor.

d. *Second-class buildings 45′ or more high, used for storage or for sale of merchandise*, shall have a tight-splined or tongued and grooved under floor of at least 2″ plank, with upper floor 1″ thick, matched and breaking joints. [*c* does not apply to such buildings.]

e. The foot of each partition and of each tier of studding or furring shall be filled solid between uprights to full width thereof, and for 6″ above floor, with incombustible materials as provided under *c*.

f. The spaces between such parts of floor joists as rest on partition heads shall be filled with materials as specified under *c*.

g. Spaces between stair strings and landing joists, unless unceiled, shall be so stopped with materials as specified under *c* at least at three places on each flight of stairs, so as to be air-tight.

No wood furring shall be used against or around any chimney but plastering directly on masonry or metal lathing. No floor timber shall be within 2″ of chimney. No studding or furring within 1″ of any chimney.

Baltimore:—*h*. No woodwork shall be placed against any flue used to convey heated air, unless plastered behind such woodwork with incombustible or non-conducting material. No timber shall be placed within 2″ of outside of any flue.

Brooklyn:—*i*. No timber resting on wall shall be placed within 8″ of inside of any flue, nor shall any header be placed within 6″ of inside of any flue, and the space between wall and header, if less than 2″, shall be filled with plaster-of-Paris. No woodwork shall be placed within 5″ of any flue.

Charleston:—

Chicago:—*j*. *Buildings with area exceeding* 10,000 *square feet, and over 40′ high, and buildings with areas exceeding* 6,000 *square feet, and over 56′ high*, shall have floors deafened with mortar, or its equivalent, at least 1″ thick. *Hotels and tenement-houses*, scantling partitions to be lathed and plastered shall be filled with brickwork 8″ high in best manner.

k. *Buildings for residence and business* shall have brick project not less than 1½″ inside face of wall between the joists of each floor and ceiling.

l. Floor beams, joists and headers shall be kept at least 2″ clear of wall enclosing fire-flue or chimney-breast, the space between framing and such flue filled solid with gauged mortar; to be a heavy coat of plastering put on walls of such flues before woodwork is placed against it.

Cincinnati:—*m*. Joists carried on girders shall have cut-off partition or row of solid bridging not less than 1½″, set in and solidly nailed over girder to prevent passage of fire or smoke. *Wooden buildings in blocks of two or more* shall have party-walls of incombustible material extending to under side of roof boards.

n. No timber or woodwork shall be placed within 6″ of any smoke-flue, or within 2″ of face of wall enclosing a flue, unless face of wall is plastered.

Cleveland:—(*m*); (*n*).

Denver:—*In brick buildings over two stories high other than dwellings:*

o. The inside of all furred brick walls shall have fire-belt composed of some fireproof material at least 6″ wide, thoroughly set up between furrings at top and bottom of each story, and

p. The whole area of each floor covered with asbestos paper or other incombustible material satisfactory to Inspector, placed upon under or rough flooring, and

q. On each story in which stud walls or partitions rest on wall or partition immediately under such stud construction, the space between floor joists and between studs from under side of joists shall be filled with incombustible material, solid and flush with face of plaster on both sides, or, if such studs rest on solid timber for full length thereof, then the same height of such filling shall be placed on top of joist. Or

s. Where there is no wall beneath such stud construction, a strip of tin or galvanized iron at least 1″ wider than said partition, continuous under partition, or wall may be substituted for filling, and

t. Spaces between stair strings and landing joists of all wood staircases, unless such strings and joists are not enclosed, shall be closed at intervals of 3′ by substantial stops of incombustible materials.

u. *In brick buildings*, floor timbers shall be placed at least 2″ from outside of chimney flue, and space between timber and wall closed by proper fire-stop of incombustible material.

Detroit:—

District of Columbia:—No timbers or other wood shall be built into any flue or fireplace, nor placed less than 2″ from outside of brickwork of any flue or fireplace. No woodwork shall be placed against any flue until well plastered externally with proper material.

Kansas City:—*Buildings exceeding 50′, and not exceeding 75′ in height (not including chimneys and fire-walls), except churches and grain elevators* (*o*), (*p*), or with plaster 1″ thick (*q*). Filling to extend 6″ above top of joists (*r*).

v. Or, *when there is no wall or partition* beneath, a strip of tin or galvanized iron at least 2″ wider than studs, continuous under footing of wall, or partition may be substituted for filling.

(*t*) Or such spaces plugged solid with incombustible material.

w. Forms of construction tending to form air-spaces from one story to another, such as about pipes, ventilating-shafts and chimney-breasts furred out, shall have fire and smoke stop of incombustible material at each floor, as approved by Superintendent. (*u*).

Louisville:—*x*. *In hotels and tenement-houses*, scantling partitions to be lathed and plastered shall be filled with brickwork 8″ high between scantlings.

Memphis:—*y*. In furred walls, the course of brick above the under side and below top of each tier of floor beams shall project the thickness of furring.

z. *In brick and frame buildings*, headers and trimmers and all timbers resting near flue must be lined with tin or sheet-iron on side next flue and 8″ beyond.

aa. Iron posts in front of party-walls shall be filled solid with masonry and made smoke-tight between post and wall.

bb. Wooden beams shall be trimmed away from all flues; trimmer 12″ from inside of flue in a straight way, and 8″ in a chimney-breast, and header 4″ from outside face of flue. (See "*Recesses.*")

Milwaukee:—Floor timbers must be kept 2″ clear of wall enclosing fire-flue or chimney-breast, and heavy coat of plaster put on wall of such flue before woodwork is placed against it. (*k*).

Minneapolis:—Floor timbers shall be kept at least 1½″ clear of wall enclosing fire-flue or chimney-breast, the space between framing and wall filled solid with gauged mortar; to be heavy coat of plastering on wall before woodwork is placed against it. (*x*).

Residences and business buildings shall have brick project not less than 2″ inside face of wall between joists of each floor and ceiling joists, the full height of joists.

Buildings containing church, school or assembly room, or any stone or brick building in which wooden furring and partitions are used, shall have at bottom of such furring or partition timbers in each story, cut-offs of slow-burning material, put in in such manner as approved by Inspector.

cc. *Factories, mills, buildings where more than 25 operatives are employed, hotels, boarding, lodging, apartment and tenement houses, business buildings less than 50′ high not hereafter specially mentioned*, shall have partitions enclosing or adjacent to stairs of incombustible material.

Nashville:—Floor timbers shall be kept at least 1½″ clear of any wall enclosing any fire, hot-air flue or chimney-breast. Space between framing and such flues filled solid with gauged mortar. (See "*Flues.*")

Brick or frame building: No timber shall be placed within 8″ of inside of flue used for smoke or hot air.

Newark:—No woodwork shall be placed within 8″ of inside of flue.

No beam or header within 2″ of outside of chimney or flue.

New Orleans:—No timber resting on walls shall be placed nearer than 8″ to any flue.

No chimney shall be built against timber.

New York:—(*y*). Recesses around pipes shall be filled with solid masonry for the space of 1′ on the top and bottom of each story. (*aa*); (*bb*).

Omaha:—Floor timbers shall be kept at least 2″ from brickwork of chimney or ventilating flue, and space between timbers and chimney or flue closed with gauged mortar.

All brick buildings, (*o*); the whole area of every floor from wall to wall deafened with lime mortar at least 1″ thick, or a two-ply covering of asbestos paper properly lapped; or two thicknesses of heavy building paper placed upon the under or rough flooring. In each story in which stud walls or partitions are constructed and rest on walls or partitions said stud construction shall have space between floor joists immediately under such construction, and between studs from under sides of joists to a line 6″ above said joists, filled solid and flush with face of plaster on both sides with incombustible material; and if such studs or partitions rest on solid timbers whole length thereof, such filling as above shall be used; (*t*) or shall be plugged solid with gauged mortar.

In hotels and tenement-houses, scantling partitions shall be lathed and plastered on both sides, and filled with brickwork 8″ high in best manner.

Brick buildings, (*w*).

Philadelphia:—*dd*. No timber shall be built into any chimney or flue.

ee. No timber shall be placed within 2″ of outside of flue.

Pittsburgh:—(*dd*).

Providence:—(*cc*) or of at least 2″ by 3″ studding, plastered on both sides and protected as follows: The space from top of lathing or head of partition below to line 3″ above top of baseboard, or, if no baseboard, 6″ above top of floor; also space adjoining strings of stairs from under side of strings to line 3″ above baseboard, or, if no baseboard, to 6″ above rake of nosings, shall be filled solid with brick or stone set in mortar, concrete grouting, tile or other incombustible filling. If stairs are wainscotted, similar filling 3″ above and below top thereof. In such *buildings three stories high, warehouses, storehouses, business buildings over 50′ high*, and all business buildings in first district, said partitions shall be constructed as above and filled solid whole height, or, on side adjoining stairway, plastered on iron laths or covered with other incombustible material. *All above buildings*, spaces between floor joists in each story at stair landing, and space above floors immediately below stairs; if ceiled or lathed with wood, shall be filled with mortar or concrete from top or laths or ceiling to ½″ above bottom of joists, and connection between such spaces and other parts of floor so cut off.

Buildings within first and second building districts more than one story high (except dwellings occupied by not more than two families) in which walls are furred off or (*q*) filled 6″ above top of joist (*s*). Above filling shall be put in at each floor of building, and between tops of wall, plates and partition heads and roof boards.

St. Louis:—(*l*) applies also to rafters, etc.

San Francisco:—*All buildings.* No timbers shall be placed within 6″ of flue. No woodwork shall be placed within 8″ of flue. No timber shall be placed under fireplace or hearthstone. No woodwork shall be placed against any smoke-flue unless there is at least 8″ of solid brickwork between it and flue.

In brick walls, recess around pipes shall be filled solid for space of 2′ on top and bottom of each story, to prevent passage of smoke or fire.

When chimney-breasts are furred out and flues are less width than chimney-breast, the space between furring and flue shall be so bridged at each half-story and at ceiling line as to prevent passage of fire and smoke.

Partitions formed of more than one row of studding, or are cross-furred, the bridging shall finish flush with the face of the studs or furring at each side, so as effectually to prevent passage of fire or smoke.

Brickwork used for deafening between partitions of framework shall be commenced on proper footings 12″ below surface of ground on which building rests; shall not be less than 4″ thick; shall be solidly laid in good lime mortar, joints smoothly struck on both sides; proper cross-ties, not to exceed 1½″ by width of studs, placed at each half-story in height, securely spiked to studs which shall not be more than 2′ on centres. (*aa*).

Wall furred or lathed with wood, space between lathing and wall shall be filled with plaster at top and bottom side of floor beams of each story and ceiling joist of roof.

Wilmington:—(*dd*); (*ee*).

Compiled by HENRY A. PHILLIPS.

A GIANT MAGNET.—We have heard of a bold and costly undertaking which an eminent personage, still living, projected in his youth. He caused a magnet to be built of such size and power as had not yet been imagined. It was his intention to charge this gigantic object without witnesses, so as to enjoy the unparalleled result in selfish solitude. Happily, a great authority called at the moment and received an invitation to assist. When he saw the preparations his face paled. Neither he nor any one else could foretell what would happen if that twenty-foot magnet were set to work; but it was probable, at least, that the house would fall. The thing still remains uncharged, or did a few years ago.—*The Saturday Review.*

A DISTINCTION IN THE ACOUSTIC PURPOSES OF PUBLIC BUILDINGS.[1]

Saloon in Schloss Bruchsal: Balthazar Neumann, Architect. From *Der Formenschatz.*

THERE is I think no department of our profession in which so much uncertainty prevails as in reference to the properties which in the designing of any building shall insure good acoustic results either for public speaking or for music. It would, of course, be impossible for me in a single paper to deal at all at length with the general subject of the acoustics of public buildings, and I therefore propose to confine myself, as the title of my paper implies, to the discussion of an important distinction in the acoustic purposes of public buildings, by showing that there are essential differences in certain acoustic elements between buildings intended principally for public speakings and buildings intended principally for music. I have said "principally" in both cases, because, while, of course, certain buildings, such as lecture-theatres, law-courts, legislative assembly-halls, etc., are certainly not intended for any other purpose than speech, and while also on the other hand certain buildings, such as our modern mammoth concert-halls, are, as far as acoustics are concerned, intended almost solely for music, there are other buildings, such as theatres, churches, etc., in which the question of compromise between the two purposes has to be considered. Being, as those of you who know me are aware, the organist of one of our larger city churches, and taking a very warm amateur interest in music, you will readily understand that this subject naturally appeals very strongly to me more especially upon its musical side. Many of you may possibly be able to recall instances of rooms or buildings which while favorable for speaking have been unfavorable for music, and of rooms which though difficult to speak in have been flattering to music. To illustrate what I mean, and as an indication of the question which I wish suggestively to bring before you this afternoon, let me here, before proceeding to discuss the subject in its proper order, quote two examples which helped very strongly to impress upon me the distinction I wish to emphasize. In December, 1878, Herr Kretschmann organized in Sydney a series of grand musical recitals in honor of Beethoven, and obtained the use of our University great hall for them. This was I believe the first occasion on which this hall had been used for music since the inaugural musical festivals held in it at its opening in 1858 or 1859, and some of us, who as late undergraduates had had ample opportunity for discovering how bad the hall was for public speaking, thought that it must necessarily be equally so for music. To our surprise, however, we discovered that quite the reverse was the case, and that soloists, whose voices were so familiar to us as to supply a standard for judgment, were heard to more than usual advantage, and that the lighter orchestral music was distinctly audible even at the extreme end of the hall. On the different nights of these performances, I sat in entirely different parts of the hall, intentionally changing my seat after the first night to various positions, to verify its unexpectedly good musical properties. Some of the principal soloists also, to whom I afterwards spoke on the subject, confirmed my opinion, and stated that they also were surprised at finding how pleasant a building it was for them to sing in. On further inquiry I learned that the same favorable impression of its musically acoustic properties had been formed at the inaugural festival twenty years earlier. Through the courtesy of Mr. Cyril Blacket I have obtained the dimensions of this hall, but it will be better to discuss these later in their proper place. Still more recently another illustration of the flattering effect upon solo-singing produced by a building was impressed upon me in connection with one of our ecclesiastical buildings (which is certainly not favorable to public speaking) where shortly after the arrival of a cultivated soloist who, at that time was often to be heard there, I had several opportunities of listening to him with great enjoyment. A very little later I heard him in one of our concert-rooms, as well as three or four times in private, and on each of these later occasions, while all the cultivation was still evident, the apparent difference in the quality of tone was such, that I thought with some disappointment that I had previously over-rated his voice, until still later on hearing him again under the first conditions, I noted that the voice had recovered its apparently lost charm, and discovered that the building rather than the singer was responsible for the difference. These two illustrations will, as I have said, serve to indicate the more especial question which I wish suggestively to lay before you this afternoon, for, of course, to attempt anything like an exhaustive inquiry into the general subject of building acoustics would, as I have said, be impossible in the short time at my disposal. In discussing any question in connection with building acoustics, one cannot but feel much regret and some degree of astonishment, that this branch of applied, or perhaps I should say unapplied, science should be still in the unsatisfactory conditions of uncertainty in which it is, and that there should be so little published teaching upon it, for while we have several modern treatises on sound, the only English text-book on applied acoustics that I know of is Mr. Roger Smith's very interesting little book, the remaining published matter on the subject consisting of papers and articles, some of which are almost more embarrassing than helpful from the diversity of their advice. I propose to divide my subject by — 1st, stating and defining such of the laws affecting the propagation and transmission of sound as bear upon it; and, 2d, distinguishing in their application to buildings between those which appear more especially to afford favorable conditions for public speaking, and those which appear to afford favorable conditions for music. In what I have to say I shall avail myself largely of Professor Tyndall's and Doctor Stone's treatises on "*Sound*," and of Mr. Roger Smith's little manual, though I shall adopt a somewhat different classification and order to the last named. First, then, to state and define such of the laws affecting the propagation and transmission of sound as bear upon my subject. 1. Sound is the effect upon the ear of an undulatory or wave-like motion of the particles of an elastic medium, caused by the vibration of an elastic body. Sound may be generated in various ways, *e. g.*, by shock, explosion, friction, etc., but it only becomes sound to us when there is some elastic medium of conduction to convey to our ears the motion set up by the generating body. This may be illustrated by the well-known experiment of causing a bell to be struck under the exhausted receiver of an air-pump, when no sound is audible. The most common medium of conduction is, of course, the atmosphere, the elastic particles of which undergo a wave-like motion, being alternately compressed and rarified, each individual particle communicating its impulse to its neighbors, but with very little forward movement of the particles themselves. As Doctor Stone says: "There is nothing resembling the flight of a rifle bullet between the source of sound and the auditor's ear." Of course, the waves of sound issuing from a sonorous body in an uninterrupted medium, like the rays of light from a candle, must not be regarded as moving merely in a linear direction. It is true that both in the case of sound and of light, the communication between the producer and the recipient takes a linear form, but the real constitution of the unconfined wave is spherical, though owing to the modifying influences of original direction and variation of atmosphere, quite apart from the alteration by obstacles, this spherical form probably exists absolutely only in theory.

2. Sound may be classified as of *unperiodic* vibration and of *periodic* vibration. I put this classification thus early because it is at this point that the distinction, which is the special subject of my paper, begins. Single separate vibrations acting upon the tympanum of the ear, I will, for the want of a better term, define as "*dissonant*," by which I do not necessarily mean discordant, sounds, while those which act with continuous regularity of vibrations I will call "*consonant*." Professor Tyndall, in distinguishing between noise and music, says: "The pulses which produce noise are of irregular strength and recurrence." And, again: "The only condition necessary to the production of a musical sound is that the pulses should succeed each other in the same interval of time," and, he adds: "No matter what its origin may be, if this condition be fulfilled the sound becomes musical. If a watch, for example, could be caused to tick with sufficient rapidity — say, one hundred times a second — the ticks would lose their individuality and blend to a musical tone." Every schoolboy knows how to produce a note or tone with his slate-pencil; holding the pencil vertically and somewhat loosely between the fingers, on moving it over the slate a succession of taps is heard, by pressure these taps can be caused to succeed each other so quickly as to produce a continuous sound, which, though we can hardly call

[1] A paper read before the Sydney Architectural Association by Mr. H. C. Kent, M. A., and published in *S. A. A. Notes.*

it melodious music, is still decidedly a note or tone. The production of a musical sound by taps has been often illustrated by causing the teeth of a rotating wheel to strike in quick succession against a card. From this, then, we see that dissonant sounds may become consonant or musical by repeating them with a periodic velocity. Speaking and singing may, I think, be said to differ in kind in this particular, although, of course, there are degrees of regularity of vibration in speech, depending upon the mode of uttering and sustaining words, and speech may of course itself shade into singing, as, for instance, in intoning, to which I shall allude again later on. In confirmation of what I have just said as to speech belonging to the class of sounds of unperiodic vibration, I will quote again from Professor Tyndall, who, speaking of the celebrated scientist, Dr. Robert Hooke, and quoting from "*Birch's History of the Royal Society*," published in 1757, tells us that "Mr. Hooke showed an experiment of making musical and other sounds by the help of teeth of brass wheels, which teeth were made of equal bigness for musical sounds but of unequal for vocal sounds"; and again, quoting from Richard Waller's "*Life of Hooke*," that "he [Doctor Hooke] showed a way of making musical and other sounds by the striking of the teeth of several brass wheels proportionately cut as to their numbers, and turned very fast round, in which it was observable that the equal or proportional strokes of the teeth, that is two to one, four to three, etc., made the musical notes, but the unequal strokes of the teeth more answered the sound of the voice in speaking." The question of the generation or production of sounds of periodic vibration brings us, of course, at once to the musical side of our subject, and here I feel it necessary to put a restraint upon myself, as this subject of musical vibration is so wonderful and fascinating that to deal with it at all, as it deserves, would mean writing a book rather than a paper. To any of you who care to follow it, I would, in addition to Doctor Stone's book, commend a very charming little book on "*The Theory of Sound in its Relation to Music*," by Professor Blaserna. I shall necessarily deal with this portion of my subject more fully when speaking of the Pitch and Reinforcement of sounds. Under the present head I will content myself with stating merely that musical sounds may be generated by shock or friction setting up vibration: (*a*) In plates, bars, or strings of metal and other fibrous strings. (*b*) In columns of air. Under the first head we may class bells and all stringed-instruments, and under the second head all wind-instruments. Having so far, then, distinguished between sounds of unperiodic and periodic vibration, let us next in order note that:

3. The sound is transmitted at a uniform rate of velocity in the same medium, but with constantly diminishing intensity. The velocity of sound in air is about 1,090 feet per second at 32° F., or about 1,120 feet per second at 60° F., *i. e.*, about twelve and one-half miles per minute. In water the velocity of sound is about four and one-third times as rapid, but there is considerably more loss in resonance. In wood and in metals the velocity of sound is very much greater still; the velocity of sound in the atmosphere, as we should expect, is affected by the density of that medium, and therefore varies slightly with the temperature, as indicated by the above figures, as well as with the humidity. The degree of intensity of sound is due to the force of the original movement, to the distance through which the vibrations have acted, to the directness of their line of action, and the density of the medium. The intensity, or loudness of a sound, does not alter the measurement from crest to crest, which we call the wave-length of each vibration, but causes greater or less amplitude in each undulation. It will be readily understood that the intensity of sound diminishes as it becomes more and more extended, inasmuch as the original impulse is spread over a constantly increasing area, so that the quantity of it which strikes upon any given point will be proportionately less. As with light, so with sound, the intensity in an unconfined medium diminishes as the square of the distance. The diagram on the wall, copied from Dr. Stone's book, will illustrate the diminution in intensity of a sound-wave through an unconfined medium. You will observe that while the wave-length is the same, the amplitude of each undulation diminishes as it recedes from the source. The diminution of intensity may of course be modified by preventing the sonorous wave from spreading equally in all directions, *e. g.*, if it be confined to a tube, it may travel for long distances with but very slight loss of intensity. The ordinary office speaking-tube is a familiar example of this.

4. Sounds differ in pitch and in quality. The pitch of a sound is that characteristic by which we distinguish it as being shrill or deep, or as we are accustomed to express it in music as being high or low. We have just seen that the intensity or loudness of a sound depends on the amplitude of its vibrations. The pitch of a sound depends entirely upon the greater or less rapidity of the vibrations, the greater the rapidity the more shrill the sound, so that pitch and intensity are entirely distinct. The characteristic of pitch will be clearer to you after an examination of the manner in which strings and columns of air vibrate. [The lecturer then dealt with the method of vibration of strings and columns of air and showed how from the subdivision thereof are obtained the fundamental tone and its harmonics, and the simple numerical ratio of vibration which these bear to each other.] If you have followed me in what I have just said as to the manner in which the strings and columns of air vibrate you will now be better able to consider the subject of *Pitch*. The pitch of a sound, as I have already said, depends entirely upon the rapidity of vibration. When notes from entirely separate sources are of the same pitch their rates of vibration are the same. If, for example, a string, a tuning-fork, an organ-pipe and the human voice yield notes of the same pitch, it is because the vibrations in each case are of the same rapidity. This is capable of absolute proof by means of a most interesting instrument invented by Cagniard de la Tour, and which is called "the Siren." [The lecturer then showed how from "the Siren" can be obtained the relative vibration values of a note and its harmonics, confirming their ratios; then he dealt with the audible limits of pitch, showing by table the approximate limits of audible notes and the range of instrumental and vocal music; next he showed how from pitch can be deduced the wave-length of a sound and the length of an organ-pipe of this note, and then described the phenomenon of the interference or beats of discordant notes, and afterwards briefly referred to the variations in musical standard pitch.] I fear you will think that I have dwelt at undue length under this heading of pitch, but you must remember that I have included therein the explanations of the mode of vibration of strings and columns of air, in addition to which I have been anxious to sufficiently emphasize the dependence of harmonies of musical tones upon simple numerical ratios. Thus far we have seen that the sensation of musical tone is due to a rapid, perfectly periodic vibration of the sonorous body, and that of noise to less periodic or unperiodic vibration; and, further, that the intensity of any sound is due to the width or amplitude of its vibrations, and the pitch of it to the frequency, *i. e.*, to the length of its vibrations. We next proceed to discuss another characteristic of sound which is generally defined as quality.

Quality. — We have said that sounds differ in *quality*. The quality of a sound is principally due to the nature of the substance which emits it, though it is also more or less slightly affected by the nature and condition of the transmitting medium. Examples of distinction in quality may be illustrated by the difference in effect upon our ears between a blow struck upon different substances, or by the difference in music between a note of the same pitch sounded upon a wooden flute and upon a brass horn. The French call this difference "*timbre*," and the Germans call it "*klangfarbe*" (clang-tint). We are all, of course, perfectly familiar with the difference, but possibly not so familiar with what constitutes it. As it does not bear so much upon the practical side of our subject, I shall not dwell upon it longer than is necessary to indicate the lines of the constitution of this difference. In explaining to you the vibration of strings and columns of air, I stated that co-existent with the fundamental vibration we always have proportionate smaller vibrations going on, so that in reality we always hear a note more or less enriched by its harmonics, and it is to these affiliated or subordinate waves producing co-existent harmonics, or overtones, or upper partial tones, as they are sometimes called, that is due the character or quality of any sound. If we could make the vibrations of sound suddenly visible, we should, doubtless, find that although the wave-lengths of different sounds of the same pitch are equal, the varieties in subordinate form are practically infinite, the main waves being accompanied by smaller waves, and broken into what would probably appear as differing ripples of differing amplitude and form — rounded, pointed, and of all sorts of form, possibly including spirals. Professor Tyndall, in justifying the use of the terms *over-tone* and *klangfarbe* (clang-tint), makes a suggestive comparison between the varying vibrations of light and those of sound, productive of compound colors in the one and combined tones in the other. This characteristic which we call the *quality* of musical sounds is treated at some length by Dr. Stone, who tells us that "musically, there are very few cases in which the sound of a resonant body consists of a simple tone, the chief instances being tuning-forks, mounted on a sounding-box, and large-stopped organ-pipes very gently blown." And, again, that "the sensation of a musical tone is compounded out of the sensations of several simple tones, the prime tone being louder than any of the upper partial tones, and hence alone determining the pitch." And, once again, that "even when these upper partials are not separately perceived because they fuse into the whole mass of musical sound, their existence in our sensation is established by the difference in the quality of the tone." When speaking previously of harmonics I showed that when the note C, for instance, is sounded, it introduces, besides its octave, the new notes, G and E, and these, of course, produce, in a fainter degree, further upper partials; and thus, out of what we usually call a single note, we really hear a compound tone, which, if its upper partials are more strongly marked, is more brilliant, as in bass instruments; and if less strongly marked, is less brilliant, as in wood tones. I might go farther than this, and explain that combinations of tones give rise to still further tones, which we call resultant tones, but I think enough has been said under this head to show you that through its dependence upon the sounding of harmonics the *quality* of what we call individual tones, as well as the harmony of combined chords, is intimately connected with the simple ratios of numbers.

5. Sound is subject not only to conduction, but also to *reflection*, *deflection*, *refraction* and *absorption*. As already stated, all sound only becomes audible to us by *conduction*.

Conduction. — Although the most common medium of conduction is the atmosphere, any elastic medium will convey sound, and the higher the elasticity of the medium, the greater the velocity of conduction: *e. g.*, as has already been stated the velocity of sound through water is about four and one-third times as rapid as through air, and in wood (along the fibre) and in the harder metals it is much greater still, being in iron as much as fifteen times as rapid as in air. The conductions of sound can, as I have also previously stated, be greatly assisted by preventing its spreading equally in all directions, as for example in an office speaking-tube, or in a speaking-trumpet. The possibility of the conduction of sound by the conversion of its vibrations into electric vibrations and *vice versa* is shown in that most wonderful recent discovery, the modern telephone. Mr. Roger Smith tells us that the phenomenon of the whispering-gallery of St. Paul's is due to conduction, his explanation being that the whisper spoken by any one with his face turned towards the wall and close to it is conducted at the same time in two opposite directions along the smooth surface of the interior of the circular drum below the dome, and that thus the two conducted sounds, arriving by opposite paths at the other side at the same moment, reach there with but very little loss of intensity, so that a listener at that spot will hear a sound twice as loud as at any other part of the circuit. If this explanation be correct, Doctor Stone and Professor Blaserna are in error in ascribing the phenomena to reflection from a focus of one curve to a focus of another curve.

Reflection. — The reflection of sound is one of the most familiar of the phenomena in connection with acoustics. Sound in this respect follows to a certain extent only the same law as light, the angle of reflection being equal to the angle of incidence only when the angle is greater than 45°, for according to Mr. Scott Russell when the vibrations strike at an angle between 45° and 30° they are not perfectly reflected at an equal angle, and when striking at an angle more acute than 30° they are not reflected at all, but are conducted along the surface of the object in the same way that a water wave when striking against a bank at a very acute angle glides along it instead of being reflected by it. To this power of reflection, of course, is due the well-known phenomenon of echo, one of the most annoying of the effects of a bad acoustic building. The velocity of sound being, at an ordinary indoor temperature, about 1,120 feet per second, and experiment having shown that about five syllables are produced in one second, and that therefore the time length of a syllable is about one-fifth of a second, in which time sound would travel over 224 feet, it follows that if a reflecting wall be 112 feet distant, one syllable, taking one-tenth of a second to reach the wall and one-tenth of a second to return to the observer, in all one-fifth of a second, would be reflected just a syllable of time after the sound uttered. Now, if the distance be twice as great, *i. e.*, 224 feet, we might get two clear syllables reaching the observer by echo, and at three times the distance, three syllables, and so on. An echo may also be multiple when the sound is reflected from two parallel walls, at a sufficient distance from each other. Professor Blaserna tells of a case near Milan, where a building with two parallel wings repeats the report of a pistol as often as thirty-two times. As with light and heat, so also with sound, when the lines of vibration strike upon a concave surface they will be reflected to a focus, and conversely if the sound emanates from the focus of a concave surface it will be reflected to the more distant point, in which case, of course, its intensity will not diminish as the square of the distance. Professor Tyndall tells of a case cited by Sir John Herschel, in connection with a Silician cathedral, where the confessional was so placed that the whispers of the penitents were reflected by the curved roof, and brought to a focus at a distant part of the edifice. The focus was discovered by accident by a man, who for some time afterwards entertained himself and his friends with listening to utterances only intended for the priest's ear. One day, however, his own wife being the penitent, both he and his friends were made acquainted with secrets, which, however entertaining to his friends, afforded anything but amusement to himself. The similarity of reflection between heat or light and sound from concave surfaces is very strikingly shown in the case of two parabolic mirrors, which, from the nature of their curves, reflect any lines striking on them from their foci away in parallel lines. Probably many of you have seen the familiar experiment of reflection and concentration of light and heat from a pair of parabolic mirrors placed a long distance apart, and the parallel experiment of hearing in the focus of one mirror the ticking of a watch placed in the focus of the other. Efforts have been made to utilize this property of reflection from parabolic curves, so as to prevent echo, for of course you will see that from a parabolic surface there could be no echo except at the focus, and even at this point the distance the reflected waves travel will be comparatively so short that the interval between the direct and the reflected sound will be scarcely, if at all, perceptible.

The Deflection of sound is due to the spreading again of the waves of vibration after they have passed some obstacle in their course. You must all be familiar with the phenomenon of sound shadows, as they are called, *e. g.*, in the case of an obstacle intervening between an auditor and a church bell. As you retreat from such an obstacle, even though it remains in the same direct line between you and the sound, it ceases to have so marked an effect, because the waves have spread again round it.

The Refraction of sound, that is, the bending of it when it enters a medium of different density, is a phenomenon analogous to the refraction of light, and doubtless plays a part in the acoustics of buildings from the different density of the layers of the atmosphere caused by heat and wind currents.

The Absorption of sound by a soft or yielding surface is a phenomenon analogous to the absorption of light by a dark surface. A familiar illustration of the absorption of sound may be found in the diminution produced in the resonance of a room by furnishing it, especially when curtains, and hangings, and carpets are introduced, or by the filling of a hall with an audience. I myself have a constantly recurring experience in the absorption of sound, for in playing the concluding voluntary in the Pitt Street Church when there has been one of the huge congregations that we sometimes have, I can clearly feel the gradual difference in resonance as the people depart, indeed, I think even if I were blindfolded I could almost tell from the organ whether there were a packed or a moderate or a sparse congregation.

(6) *Sound is capable of reinforcement by setting up a vibration in bodies which will vibrate to the same note.* One of the simplest illustrations that can be given of this characteristic of sound is that of striking a tuning-fork and then bringing the end of it in contact with the body of a violin or the sounding-board of a piano when a most perceptible reinforcement of sound will be obtained. A less familiar, but perhaps more striking illustration is afforded by striking the tuning-fork and then holding it over a long glass jar and gradually shortening the column of air in the jar by gently pouring in water, when suddenly at a certain point the reinforcement bursts out into distinct tone. An exactly parallel example to the last named is obtained by striking a tuning-fork and bringing it to the opening of an organ-pipe of the same note, when the reinforcement is heard, whereas if we bring it to the opening of another organ-pipe there is little or no reinforcement, and if any number of different tuning-forks were struck and placed in the same pipe at once the pipe would respond only to that of its own note and its harmonics. This law of what we may call *sympathetic vibration* is from a musical point of view of the greatest importance. You have already seen, when we were discussing the vibration of columns of air, that the tone of an ordinary organ-pipe is due to the sympathetic vibration of a column of air upon an original vibration produced by blowing against an intercepted film of air at the *embouchure*. Similarly in reed pipes the tone is due to the sympathetic vibration of the column of air upon the vibration of a small tongue of metal. Similarly in all wind-instruments the tone is due to sympathetic vibration of the column of air upon an original vibration produced by *embouchure*, by reed or by lip tension. All wind-instruments, therefore, depend for their tone upon this law of sympathetic vibration. This law of sympathetic vibration, however, not only gives their tone to all wind-instruments, but equally so to all stringed-instruments which depend for their tone upon the power of exciting sympathetic vibrations, either first upon thin wood, and thence upon enclosed masses of air of special dimensions, bearing simple ratios expressible by the numbers 1, 2, 3, 4, 5, 6, so that they may respond to every possible note, as in the violin and all kindred instruments, or else upon specially constructed wooden sounding-boards, made of such shape as also to respond to all notes, as in a piano. You will see this at once, for without the resonance-chamber of a violin, or the sounding-board of a piano, the strings of these instruments would be feeble in the extreme, and the variations which make one violin or one piano so much more valuable than another for musical purposes do not lie in the strings themselves, but in the special success or otherwise in the construction and dimensions of the reinforcing body which they throw into sympathetic vibration. Now every mass of enclosed air in an apartment may for musical purposes be regarded to a certain extent as a resonance-chamber. If then the ratio of numbers plays so important a part as we have seen it does in the resonance-chambers of the instruments which produce musical notes, surely the relation of simple ratios in the dimensions of the hall or room in which the music is to be heard must also play some part in both the quality and reinforcement of musical sounds. Having thus far stated and defined such of the laws affecting the propagation and transmission of sound as bear upon our subject, I now turn, as I am sure you must think it time I did, to the second part of my subject, which is:

(II) To distinguish, in their application, between those which appear more especially to afford favorable conditions for public speaking, and those which appear to afford favorable conditions for music. Mr. Roger Smith, in treating of the obstacles and auxiliaries which buildings may present to sounds, says that he has heard it expressed as a deliberate opinion by one of the greatest living authorities on acoustics that there is no possible building equal to the open air for perfection of hearing. If this should really apply to public speaking (and, considering how much sound must be lost overhead, it ought not even to apply to this), I venture to say, even in the face of so great an authority, that it certainly does not apply where music is concerned. Let us, then, in considering this distinction in the acoustic purposes of buildings, deal first with buildings for public speaking.

(1) *Buildings for Public Speaking.* — In inquiring which of the laws of sound just considered apply to buildings for public speaking, it must first be noted that such building may have an outline approaching a semi-circular or horse-shoe shape, or may be rectangular in form. In either case some limit of size must, of course, apply, and this must be obtained from some definite results of past experiment or from fresh experiment. Mr. Roger Smith tells us that the experiments on this subject undertaken by Saunders and recorded by him in his book on theatres gave as a result that, when a person was made to read from a book on a still day upon an open plain, he could be heard 92 feet in front, 75 feet each side and 31 feet behind, and the bounding line shown as denoting these limits was a flattened circle having a radius of 75 feet all round, excepting in the rear,

where the radius would be shortened to 41 feet. Sir Christopher Wren, in a letter on church-building, however, Mr. Smith goes on to tell us, gives a much more limited range, and says that a moderate voice may be heard 50 feet distant before the preacher, 30 feet on each side and 20 feet behind the pulpit. Rhode, in his book, assigns a limit intermediate between the two above named, and considers that a theatre will be within the range of the natural direct radiation of sound where no person is farther than 70 feet from the speaker, and that such a theatre would occupy about 6,000 square feet of ground, and would seat about 1,000 persons on the ground floor and about 2,000 altogether, including galleries. I think that the profession would be glad to have this question more fully experimented upon by a committee of scientific experts for the establishment of something like a definite rule. Next, in considering the application of the laws of sound, it must be evident that if the first requirement in the acoustics of a building for public speaking is that its limit of size shall be such as to bring all auditors within the range of the voice, the second requirement is that there shall be nothing to mar the distinctness or separateness of enunciation. Anything, therefore, that tends to sustain or prolong the vibrations of separate syllables so as to fuse them into one another, however much it may improve the quality or tend to reënforce the musical tone of a voice, will be detrimental to speaking, as tending to destroy distinctness. Hence I think we must conclude that we cannot hope to improve by any aid from a building the natural voice of a speaker, which is, perhaps, the half-truth enunciated by Mr. Roger Smith's quoted authority when he said that no building is equal to the open air for perfection of hearing. If, however, we cannot improve the natural voice, we can surely do something towards preventing its loss in undesirable directions. The problems, therefore, I think to be solved in connection with buildings for public speaking can, perhaps, best be stated in negative terms as follows:

(*a*.) To avoid such dimensions as will tend to undue resonance.

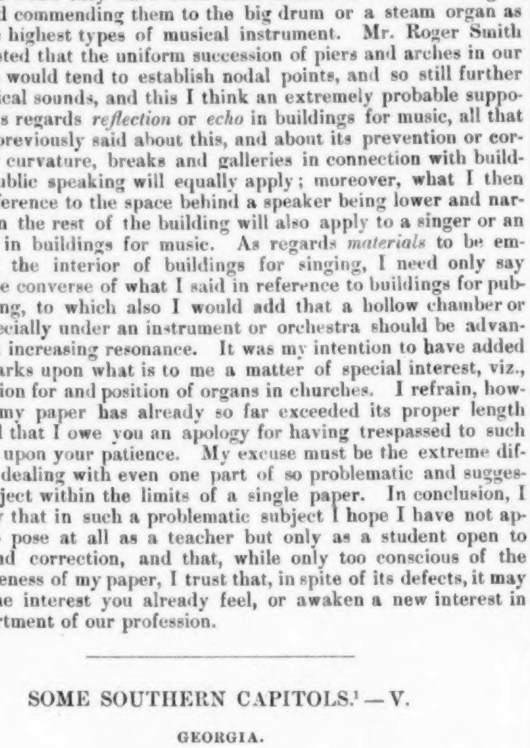
(*b*.) To avoid all arrangements and material that may obstruct or absorb or reflect in wrong directions the vibrations that should strike directly from the speaker upon his audience. Undue height, as compared with other dimensions, must, therefore, be avoided, as it will tend not only to resonance, if it be in harmonic proportions with the other dimensions, but also to absorption of sound overhead, and to risk of reflection from a high ceiling. A large amount of air behind a speaker must also be avoided, on account of its tending to absorption in a wrong direction. It appears to be agreed, as the result of experience, that it is advantageous for a speaker to have a little space behind him, but this space should be lower and narrower than the rest of the building; and, speaking generally, it would appear to be right to diminish the volume of air contained in a building for public speaking to the smallest amount compatible with good proportion and the preservation of free space for the sound to penetrate direct to every part. Concave parabolic reflectors have been sometimes placed behind a speaker to give greater effect to his voice, but they necessitate his always standing exactly at the focus; and, moreover, they have the great disadvantage of bringing all the whisperings and other slight sounds produced in the room and reflecting them in a concentrated form in the speaker's ear, for which reason they have been generally discarded. As a corrective in cases where there has been too large a volume of air over a speaker's head, a convex reflector has, however, been frequently used with advantage to prevent the sound being unduly absorbed in an undesired direction. This was done, Mr. Roger Smith tells us, very successfully by Mr. Penrose in St. Paul's Cathedral, when, a temporary pulpit having been erected under the dome, it was found necessary to prevent the voice from ascending and being lost in the dome. It is never well to elevate a speaker much above any part of his audience, as the voice can be thrown upward with much less effort than downwards. The floor of the auditorium should, therefore, when possible, be made to slope upwards, and the seats ranged one above another, and, if this rising line be set out upon a concave curve, determined by grading the seats to a definite gauge by radiating lines drawn from the speaker, as recommended by Mr. Scott Russell, and called by him an "Isacoustic Curve," it would seem to afford the best possible arrangement. In constructing a dramatic theatre, however, for a very large audience, the stepped seats must, to some extent, be superseded by tiers of galleries, but in each separate part of these the stepped arrangement can be adopted. As regards reflection or echo in buildings of a theatrical form, there will not be much risk from the wall, inasmuch as the stepped arrangement of the auditorium and the galleries, and the absorption by the occupants, will so break the direct lines of vibration as to prevent reflection from the walls; while if the ceiling be formed on a cove which has its focus close to itself, there can be no reflection back to the audience from it. In the buildings of rectangular, oblong form, however, the risk of reflection or echo is much greater, as, in addition to the direct echo from the end wall, and, if lofty, from the ceiling, also, we shall have to guard against the secondary reflection or echo when the conducted sound reaches the angles formed by the walls, and the angles of the ceilings with the walls. In such buildings, direct echo from the opposite wall can be largely obviated by such expedients as making the end wall elliptic, and by breaking it with recesses or with a deep stepped gallery, and even by such expedients as by using absorbent materials, such as draperies, while secondary echoes can be largely obviated by cutting off the rectangles with a curve, as well as by slight breaks in the side walls, which will prevent the conduction of the waves along their surface; direct echo from the ceiling may be prevented as in the previous case. I have said by slight breaks in the side walls, because deep, square recesses in the walls, excepting at the end opposite the speakers, and deep, square openings in the ceilings, also, such as lanterns, should, as far as possible, be avoided, as these will have a tendency each to set up its own little column of sonorous air, and to create, in this way, a set of conflicting vibrations. Thus far I have been treating of buildings for use by public speakers from a simple position, but there are other public-speaking apartments, such as legislative-chambers and law-courts, in which the sound has to proceed from various positions. Of these, law-courts, of course, present the simpler problem, inasmuch as the points of sound-propagation are fewer and more definitely fixed; for example, the bench, the barristers' table and the witness-box. So far as I am aware, these have very seldom, if ever, had a curved outline on plan, and in most cases are much too lofty for speaking purposes, and are frequently further acoustically ruined by ceiling-lanterns. From the comparatively limited dimensions necessary for a law-court, it ought not to be by any means an impossible problem to design a thoroughly satisfactory model, and I commend it to any of you who desire to win renown. As regards the materials to be employed in the interior of buildings for speaking, such as ceiling and wall linings, etc., it seems to be generally recommended, without discrimination between such buildings and buildings for music, that as much wood lining as possible should be used. Although this seems to be the prevailing opinion, I yet humbly venture to think that, however suitable the predominance of such materials may be in buildings for music, they are likely, by increasing resonance, to detract from the clear definition and distinctness which are the first requisites in a building for public speaking.

2. *Buildings for Music.*—Judging from the emphasis which in the first portion of my paper I have laid upon the relation of simple numerical ratios to the quality and reinforcement of musical tones, you will not be surprised to hear me express a very strong opinion in favor of harmonic proportions in the dimensions of buildings intended for music, and a desire for further scientific investigations as to what proportions will yield the best results. From what I have previously said it must be evident to you that in the production of musical sounds simple harmonic ratios in dimensions are of the most essential importance, *e. g.*, in the body of a violin, etc. Inferentially, therefore, they surely must, to say the least of it, be not unimportant in the transmission of musical sounds. Of course I am aware that such inferential argument is not proof, but I believe I am correct in saying that the few examples that can be quoted appear so strongly to support this theory as to very materially strengthen such argument, and to make us desire further efforts in the same direction. Mr. Roger Smith quotes two examples of very large halls which have proved exceptionally successful for music. The first of these is the Free Trade Hall at Manchester, the dimensions of which he tells us are: height, 52 feet; width, 78 feet; and length 130 feet; *i. e.*, in the ratio of 2 to 3 to 5. The second is the Surrey Music-Hall, the dimensions of which are in the ratio of 2 to 2 to 5, that is of the extreme dimensions; this latter building, however, of which Mr. Smith gives sectional drawings, has a central area with a clearstory, the galleries being under lower wing roofs all around, and if the proportionate dimensions of this central area be taken, as I think they should, they show the ratios of 2 to 3 to 6, viz: width, 45 feet; height, 67.6 feet; and length, 145 feet, which I think very instructive as an example. Strange to say these dimensions are almost exactly the same that Mr. Cyril Blacket has given as the dimensions of our own University Hall, to which I referred in my opening remarks, his figures being, width, 45 feet, height, 68 feet, and length, 135 feet. Mr. Roger Smith quotes one room of smaller dimensions, viz: a music-room in Edinburgh, designed by Professor Donaldson, where the principle of harmonic ratios has been intentionally carried out, not only in the leading dimensions, but even in all the details; in this room the ratios selected were 3, 4 and 5. In the main dimensions these have been slightly varied, however, for though the width is 36 feet and the height 48 feet, the length, instead of being 60 feet, has been extended to 90 feet, so that the length has had its first harmonic, *i. e.*, one-half added to it. The result musically is quoted as most successful. A musical friend of mine who had paid considerable attention to this subject, and with whom I have more than once discussed it, very strongly advocates the proportions 1 to 1 to 2 for width, height and length, as representing the ratio of the first harmonic or octave. Personally, I confess to a feeling that if the numbers 3 and 5 are in the ratio, there will be more of the harmonics strengthened, and so greater enrichment of the quality of the tone, for in addition to the fifth of which the ratio is $\frac{3}{2}$, and the third of which the ratio is $\frac{5}{4}$, the fourth of which the ratio is $\frac{4}{3}$, and the sixth of which the ratio is $\frac{5}{3}$ would also seem likely to be assisted, while the simpler harmonic of the octave is likely to be sufficiently in evidence, and, if I may so put it, may be left to take care of itself. From the examples of the Surrey Music-Hall, our University Hall and Professor's Donaldson's room, you will see that height which would be far too great for a building for public speaking seems distinctly favorable to musical effect, and it would further appear from examples that it is better that height should represent the second dimension, and be greater than width. Many cathedrals may be quoted as examples of this, for these buildings, while notoriously

unfavorable for speaking, are almost unrivalled in the musical richness of the support they afford to singing, intoning and instruments. I have been told on good authority that the voicing of many of the English Cathedral organs is extremely coarse, and that their exquisite effects are very largely due to the improvement in quality caused by the buildings. Speaking of *Intoning*, I may here say that the existence of intoning is in itself a verification of the distinction which is the subject of my paper, its origin undoubtedly being due not to anything specially reverent or devout or religious in a monotone (though to hear some people read even family prayers in a small room, you might think there was) but to the fact that while speech could carry but a short distance in such buildings as cathedrals, as soon as the vibrations of the voice were sustained along definite musical notes a reinforcement was obtained and the voice could be heard. As you are aware, our English Cathedrals also were almost invariably set out in dimensions of simple ratios carried through every part, though not for acoustic reasons. It may possibly be argued that surely the intensity of musical sounds cannot be so full in buildings when height is so great, and that in this respect, therefore, there is a loss. This no doubt is true, but to those who prefer quantity to quality in their music, and think they have had most music when they have been most deafened, I have nothing to say beyond commending them to the big drum or a steam organ as among the highest types of musical instrument. Mr. Roger Smith has suggested that the uniform succession of piers and arches in our cathedrals would tend to establish nodal points, and so still further favor musical sounds, and this I think an extremely probable supposition. As regards *reflection* or *echo* in buildings for music, all that has been previously said about this, and about its prevention or correction by curvature, breaks and galleries in connection with buildings for public speaking will equally apply; moreover, what I then said in reference to the space behind a speaker being lower and narrower than the rest of the building will also apply to a singer or an orchestra in buildings for music. As regards *materials* to be employed in the interior of buildings for singing, I need only say exactly the converse of what I said in reference to buildings for public speaking, to which also I would add that a hollow chamber or space especially under an instrument or orchestra should be advantageous in increasing resonance. It was my intention to have added some remarks upon what is to me a matter of special interest, viz., the provision for and position of organs in churches. I refrain, however, as my paper has already so far exceeded its proper length that I feel that I owe you an apology for having trespassed to such an extent upon your patience. My excuse must be the extreme difficulty of dealing with even one part of so problematic and suggestive a subject within the limits of a single paper. In conclusion, I would say that in such a problematic subject I hope I have not appeared to pose at all as a teacher but only as a student open to tuition and correction, and that, while only too conscious of the incompleteness of my paper, I trust that, in spite of its defects, it may deepen the interest you already feel, or awaken a new interest in this department of our profession.

SOME SOUTHERN CAPITOLS.[1] — V.

GEORGIA.



The State-House at Atlanta.

WHEN, in 1886, by his speech on "The New South" before the New England Society, the late Henry W. Grady became suddenly famous, and the *post bellum* prosperity of the Southern States became more generally known throughout the North than ever before, it was the State of Georgia, and more particularly the city of Atlanta, that furnished the inspiration for that speech. And could the speaker have postponed his speech until just before his death, three years later, he might have found further inspiration in the new capitol building in Atlanta, completed early in 1889, which speaks eloquently of a State rising, by her own efforts, from the impoverished conditions in which a most devastating war had left her, to a level with her more fortunate sisters. The history of such a building, however briefly it may have to be told, cannot fail to be interesting.

In *ante bellum* times the capital of Georgia was at Milledgeville, a town laid out for that purpose upon the organization of the State. The name Milledgeville could scarcely be made to grace a poem, and little mention is made of it in history. It appears to have been necessary for the army of General Sherman to go considerably out of its way on the famous "March to the Sea," in order to provide the history of Milledgeville with an event worthy of remark, viz., its total destruction by fire on the 2d of September, 1864, as one of the incidents of war. A detachment of the same army destroyed a far more important city, Atlanta. Upon its blackened ruins rose one of the fairest of Southern cities, and this was in due time made the capital of the State of Georgia. Everything seemed to conspire to make the State and its new capital prosperous, and, in 1883, it was wisely decided that such a prosperous State should have a building of becoming dignity wherein to transact its official business, and a prudent Legislature appropriated the sum of $1,000,000 to cover the entire cost of such a building, to be completed by the 1st of January, 1889. It was expressly stipulated that this sum was to be appropriated out of funds already in the State treasury and available for that purpose, and without increasing the general rate of taxation. The sum was small compared with what other States have expended upon their public buildings, but the published reports of the Capitol Commissioners, now before the present writer, show how wisely this money was expended down to the sum of $118.43, returned to the State treasury at the completion of the work. Out of the amount appropriated were paid the salaries of the commissioners, the supervising and consulting architects, expenses arising from squaring the capitol grounds, and many other items besides the contract price of the building, viz., $862,756.75. It is with pride that the commissioners in their fourth and final report, dated March 20, 1889, claim as the result of their labors a work eminently satisfactory to all who are interested in it, accomplished with economy and without parsimony. The secretary of the commission could not refrain from concluding the brief preface to this final report with these words: "This is the history of one of the best pieces of public work in the United States; a record of honest, conscientious discharge of duty, and the building will stand as a monument to the men who caused it to be erected." The report of the supervising architects, incorporated in this document, calls attention to the facts that "over three-fourths of the material entering into the construction of the building were products of the State of Georgia, and that the labor and artisan work were done principally by home men." They note also that while strikes were going on in other parts of the country while this work was in progress, little or no effect from that cause was experienced about the work of the capitol building. The disposition to congratulale themselves is certainly pardonable in the Georgians, in view of the facts, whether or not they have (to use the words of their commissioners) "more building and a better building for the outlay than any other State can boast of." They went to work in a business-like manner to obtain what they wanted. The act providing for the erection of the building is a model of legislative literature, and the various reports show a faithful carrying out in detail of the provisions of said act.

The act provided that the building should be of granite rock and marble as far as practicable, and that all the materials used in its construction should be procured within the State, provided that the same could be procured as cheaply as other materials of like quality in other localities. It was under this proviso that oolitic limestone from Salem, Indiana, was substituted for granite and marble. This substitution was the cause of an explanatory report of the commissioners to the Legislature showing the various tests made to establish the superiority in cost, beauty, strength, and durability of the oolitic limestone to any of the products of the Georgia quarries.

The design of the building, that of Messrs. Edbrooke & Burnham, of Chicago, was one of ten submitted to the commissioners. It is not of very striking originality. In the mind of the consulting architect it is classic Renaissance, and more academic than the others submitted. In the arrangement of its rooms it differs little from structures of that character generally, its basement being devoted to machinery and storage, the first story to offices, the second to the two legislative halls, the Supreme Court room, and the State library. The third story is for the accommodation of the House and Senate galleries and committee-rooms. The central rotunda, with its corridors, galleries, and stairway, is the most striking feature of the interior, while, of the exterior, the classical portico and the admirably proportioned dome, constructed of stone to the line of curvature of the roof, are the first to arrest the attention. The greatest length of the building from north to south is nearly 350 feet. Its greatest depth is 272 feet. The lantern surmounting the dome reaches a height of 237 feet. As the building occupies an entire block in the heart of the city, it has no grounds about it for the display of landscape gardening. A stranger in Atlanta, upon suddenly confronting this building, would not have to be told its purposes. It emphatically proclaims itself the capitol of a prosperous commonwealth.

ARTHUR HOWARD NOLL.

[1] Continued from No. 879, page 69.

SOCIETIES

BOSTON SOCIETY OF ARCHITECTS.

AT the latest meetings of the Boston Society of Architects and the Boston Architectural Club, the following resolutions of respect were adopted and recorded:

The Boston Society of Architects desires to record the esteem and sympathetic appreciation which its members long since learned to entertain for the late Eugène Létang. Not only those of its members whose privilege it has been as pupils to enjoy his teachings, guidance and friendship, but also those elder members, who, while not themselves profiting by his instruction, yet appreciated and applauded the great and unqualified success that attended his efforts, feel how much the profession suffers in his loss.

Self-exiled from a more congenial home and career, he unselfishly devoted himself for twenty years to promoting in the minds of those who fell under his care a sound conception of the real principles that underlie the art which he so sincerely loved and understood so thoroughly, and to whose interests he finally sacrificed his life.

BOSTON ARCHITECTURAL CLUB.

In the death of Professor Eugène Létang, of the Massachusetts Institute of Technology, the Club has suffered a loss which, to many of its members, is a personal one.

Not only do many of us look back with respect and affection to our intercourse with him as one of our instructors in architecture at the Institute in years whose profit was largely due to his knowledge and devotion, but many never connected with the Institute of Technology have learned, in the classes which he conducted in this Club, to value him for his own sake as well as for the technical knowledge he could so well impart. Therefore be it

Resolved, That the Architectural Club of Boston hereby expresses its sense of the great loss which (in common with the profession at large) it has suffered in the death of Professor Létang, and that we hereby tender our heartfelt sympathy to Madame Létang in her bereavement.

Resolved, That a copy of this Preamble and these Resolutions be sent to Madame Létang.

NATIONAL ACADEMY OF DESIGN, 1893. — SIXTY-EIGHTH ANNUAL EXHIBITION.

The Sixty-eighth Annual Exhibition of the National Academy of Design will be opened to the public on Monday, March 27, and will close on Saturday, May 13.

Works will be received from Thursday, March 2, to Saturday, March 4, inclusive, after which time no work will be admitted.

Lists must be sent to the Superintendent before Saturday, February 25.

Varnishing Day, Thursday, March 23, from 9 A. M. to 5 P. M.; and from 7.30 to 10 P. M., Academicians, Associates and Exhibitors will be admitted, and *no other person*, excepting the Press (by card) after 12 o'clock M.

The only exhibits eligible are original works in oil, pastel or sculpture, by living artists, and which have never before been publicly exhibited in the City of New York or Brooklyn.

All works received at owner's risk.

Rejected works not removed from the Academy within *one week* after the opening of the Exhibition, and accepted works not removed within *one week* after the close, will be stored at the risk and cost of the owners.

No accepted work can be withdrawn before the close of the Exhibition, and all works must remain as placed by the hanging-committee.

Glass on oil paintings will not be admitted, and not more than *three* works by any one artist will be exhibited.

A competent person will attend to sales upon which a commission of ten per cent will be charged. Prices should be stated on the list when sent in, and will be inserted in the catalogue, unless otherwise directed.

The Academy does not collect or return exhibits. They must be sent in and afterwards removed by the exhibitor himself, or his agent, within the specified dates. No packing-boxes will be received.

Works offered for exhibition by dealers must be accompanied by the artist's written consent thereto.

All contributions will be subject to the judgment of the following

JURY OF SELECTION.

J. G. Brown,	George H. McCord,
F. S. Church,	Louis Moeller,
Charles C. Curran,	C. S. Reinhart,
Thomas W. Dewing,	Augustus St. Gaudens,
Gilbert Gaul,	R. M. Shurtleff,
S. J. Guy,	D. W. Tryon,
James M. Hart,	C. Y. Turner,
Eastman Johnson,	Edgar M. Ward,
H. Bolton Jones,	Irving R. Wiles,
Will. H. Low,	J. H. Witt.

HANGING COMMITTEE.

J. G. Brown, Kruseman van Elten,
Irving R. Wiles.

PRIZES TO BE AWARDED AT THE ANNUAL EXHIBITIONS OF THE ACADEMY.

The Thomas B. Clarke Prize, $300. — For the best American Figure Composition painted in the United States by an American citizen, without limitation of age.

The Julius Hallgarten Prizes, $300, $200 and $100. — For the three best pictures in oil colors painted in the United States by American citizens under thirty-five years of age.

The Norman W. Dodge Prize, $300. — For the best picture painted in the United States by a *woman*, without limitation of age.

TIME, PLACE AND METHODS OF AWARDING THE PRIZES.

The method of awarding the Hallgarten Prizes will be announced later.

The Academicians will not compete for any of the prizes.

The Thomas B. Clarke and the Norman W. Dodge prizes will be awarded by a Committee of three Academicians and two Associates of the Academy, who may receive the highest number of votes cast by the exhibitors. A blank form for this purpose will be sent to each exhibitor to be filled up and duly returned to the Secretary.

By order of the Council,
J. C. Nicoll, *Corresponding Secretary.*
Thomas W. Wood, *President.*

THE ILLUSTRATIONS

[*Contributors are requested to send with their drawings full and adequate descriptions of the buildings, including a statement of cost.*]

THE WEST END PRESBYTERIAN CHURCH, CORNER AMSTERDAM AVENUE AND 105TH STREET, NEW YORK, N. Y. MR. HENRY F. KILBURN, ARCHITECT, NEW YORK, N. Y.

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

THIS church, built of buff brick, relieved with terra-cotta of slightly lighter tone, is a very good example of rapid building as it is now carried on in this country, the corner-stone having been laid June 22, 1891. While the church proper was building, the society worshipped in the chapel annexed to the present structure designed in a similar style but by other architects.

THE INTERNATIONAL TRUST COMPANY'S BUILDING, DEVONSHIRE ST., BOSTON, MASS. MR. W. G. PRESTON, ARCHITECT, BOSTON, MASS.

STUDIO BUILDING, ST. LOUIS, MO. MESSRS. EAMES & YOUNG, ARCHITECTS, ST. LOUIS, MO.

HOUSE OF S. TAYLOR, ESQ., WINTERS, CAL. MESSRS. PERRY & HAMILTON, ARCHITECTS, SAN FRANCISCO, CAL.

The house is situated in a valley, which becomes excessively warm during the summer months, and was designed to make and have a continual circulation of air through the whole house, this being accomplished through the central court. The court has glass sides above the roof but is boarded over, and provided with hammocks on the top deck, to be used during the warm weather for sleeping. The entire house is plastered on the exterior from top to bottom, and is designed in the old Spanish or Mexican style prevalent in California in very early days. The inside finish of the house is made from walnut and other hard woods, and red-wood grown on the place.

OLD COLONIAL DOORWAY, ALBANY, N. Y. MEASURED AND DRAWN BY MR. G. F. CRUMP, ALBANY, N. Y.

TOWN HOUSE FOR MR. —— MR. B. F. WILLIS, ARCHITECT, YORK, PA.

HOUSE OF CROSBY S. NOYES, ESQ., SILVER SPRING, MD. MR. W. J. MARSH, ARCHITECT, WASHINGTON, D. C.

[Additional Illustrations in the International Edition.]

CHURCH ON CAPITOL AVE., OMAHA, NEB. MESSRS. WALKER & KIMBALL, ARCHITECTS, BOSTON, MASS.

[Aquareltype.]

PORCH OF THE WEST END PRESBYTERIAN CHURCH, NEW YORK, N. Y. MR. HENRY F. KILBURN, ARCHITECT, NEW YORK, N. Y.

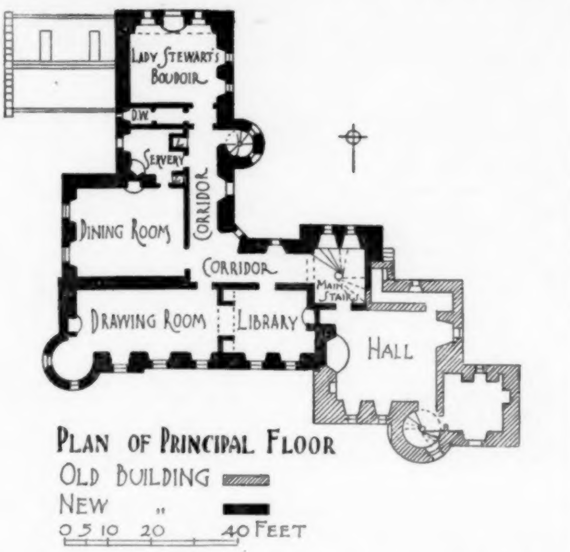
[Gelatine Print.]

ENTRANCE TO THE CHAPEL OF THE WEST END PRESBYTERIAN CHURCH, 105TH ST., NEW YORK, N. Y. MESSRS. CARRÈRE & HASTINGS, ARCHITECTS, NEW YORK, N. Y.

[Gelatine Print.]

GRANTULLY CASTLE.

On October 22 we published a reproduction of the drawing by Mr. Leadbetter, which appeared in the last exhibition of the Royal Academy. We now give, according to promise, the companion view, showing the castle from the southwest. It will be seen from



the plan that the additions are extensive, and they have been arranged "so as to provide the necessary accommodation for a modern country house, while at the same time retaining the spirit of design of the old building, and keeping the modern additions as subservient as possible to the original building." A description of the additions will be found on page 62, Vol. XXXVIII.

CAPITAL IN NAVE OF THE CATHEDRAL, MONREALE, SICILY. DRAWN BY MR. J. A. SLATER.

AMBO IN THE CATHEDRAL RAVELLO. DRAWN BY MR. J. A. SLATER.

KNAITH CHURCH RESTORATION.

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.*]

GRAPHIC ANALYSIS OF A ROOF TRUSS.

Salt Lake City, December 26, 1892.

To the Editors of the American Architect:—

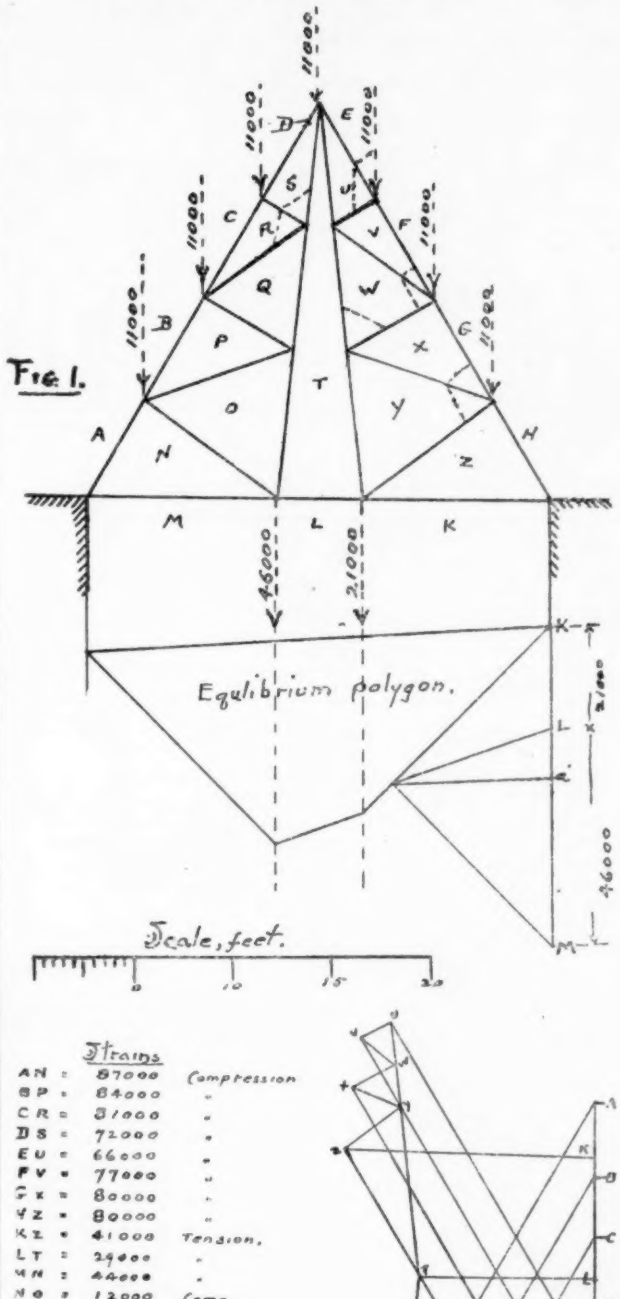
Dear Sirs,—I enclose strain-sheet of truss, in answer to "A Reader," in your issue of December 17.

Figure 1 shows the truss with its loads, in round numbers, omitting the two loads of 5,552 pounds; as they do not affect the strains, and may be neglected, further than to proportion the bays of each rafter to carry a uniform load of 11,104, in addition to the strains indicated by the diagram of strains, Figure 2.

This is with the supposition that the rafters of the roof rest on the truss.

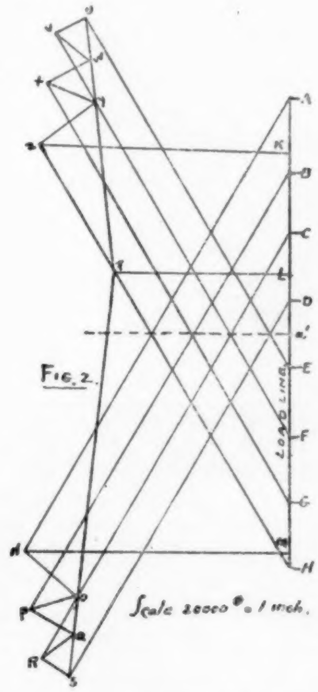
The unsymmetrical loading below necessitates an equilibrium polygon to obtain the reactions at the supports. This being put on the load line (Fig. 2) with the points a' coinciding enables us to measure the total reaction at once on the load-line, and also the total strain on each truss member in the diagram. It is evident, I think, that UV, WX and YZ are in compression, and VW and XY in tension.

The only strain in UV arises from the load EF and equals, as is found by drawing a parallelogram, 6,000 pounds. This creates a strain in TU and VW; the latter, which only concerns us now, is found to be 7,000 pounds and strains WX to the extent of 2,000 and GX in an amount that will be included in the total, which will be shown by the diagram. To the strain in WX, 2,000 pounds must be added, that arising from the load FG, 6,000 pounds; making 8,000, which creates an 8,000-pound pull in XY, and is reduced to 6,000 by the time it reaches YZ. Here it is augmented by 6,000 from the load GL, making 12,000 pounds total strain in YZ and the same in NO. Draw now, in Figure 2, HZ and AN parallel respectively to those members of the truss, until they meet horizontals from M and K. From Z and N draw ZY and NO respectively parallel to those members, and equal to 12,000. The remainder of the diagram is easily drawn, and will close if drawn accurately. The larger the drawing the more accurate will be the



Strains

AN	=	87000	Compression
BP	=	84000	"
CR	=	81000	"
DS	=	72000	"
EU	=	66000	"
FV	=	77000	"
GX	=	80000	"
HZ	=	80000	"
KZ	=	41000	Tension.
LT	=	29000	"
MN	=	44000	"
NO	=	12000	Comp
OT	=	53000	Ten.
OP	=	8000	"
PQ	=	8000	Comp.
QT	=	60000	Ten.
QR	=	7000	"
RS	=	6000	Comp.
ST	=	67000	Ten.
TU	=	42000	"
UV	=	6000	Comp
VW	=	7000	Ten.
WT	=	35000	"
WX	=	8000	Comp
XY	=	8000	Ten.
YT	=	28000	"
YZ	=	12000	Comp



amount of the strains. I have been puzzled several times in similar cases and the above is the only way I have found to get around them. Hoping I have answered "A Reader," or that somebody else will do so and tell me where I am wrong, I remain,

Yours very truly, Ezra M. Cornell.

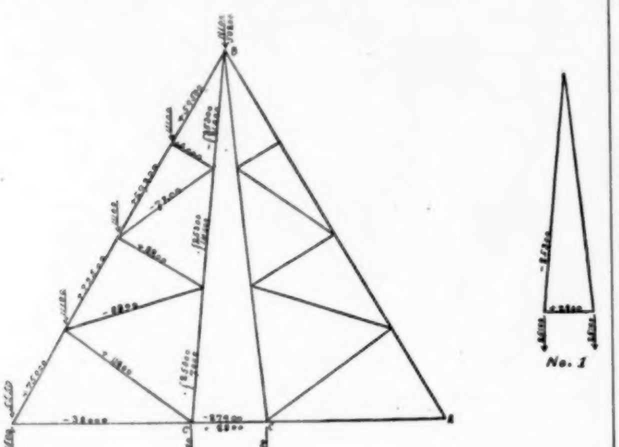
Indianapolis, Ind., December 24, 1892.

To the Editors of the American Architect: —

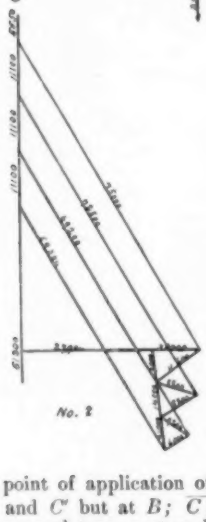
Dear Sirs, — Enclosed you will find graphical solution of truss problem, submitted by "Reader," page 188.

Like most students, "Reader" has discovered that the authors and college professors only tackle the easy problems.

One of the main points in any truss is to determine the points of application of the various loads. Diagram No. 1 shows that the



No. 1



No. 2

point of application of the two centre suspended loads is not at C and C' but at B; $\overline{CB}$ and $\overline{C'B}$ acting not only as parts of the general truss system, but also as ties transmitting the loads C and C' to B.

Another difficulty occurs at points C and C', as four members meet at these points.

The Fink truss on account of its symmetry allows a solution of the polygon of four forces; in all other cases one of the stresses has to be computed.

Taking moments about B of the forces to the left, we have

$$\frac{69500^{\#} \times 23' - [11100^{\#} \times (5\tfrac{3}{4} + 11\tfrac{1}{2} + 17\tfrac{1}{4}) + 5550 \times 23]}{39} = 27{,}900 = \text{stress}$$

in $\overline{CC'}$, from which the diagram is extended as in No. 2; half of diagram only being shown.

Owing to the small scale, the stresses given are approximate.

Very respectfully, F. A. Sherrill.

NOTES AND CLIPPINGS

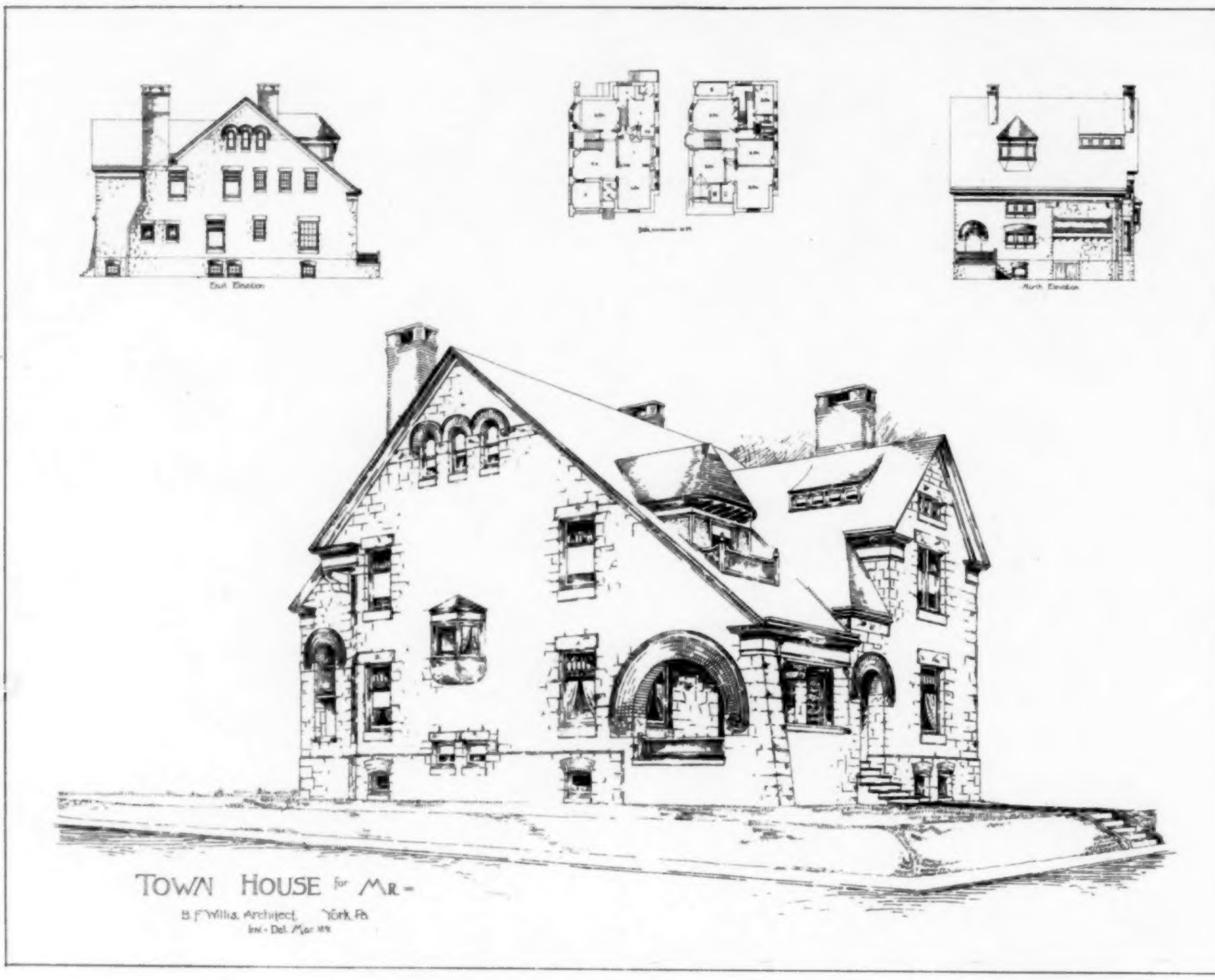
Natural Scenery and Advertisements. — The desecration of public buildings and of natural scenery by the barbaric advertiser of daily commodities and quack nostrums is a growing evil the whole world over, and is perhaps more generally prevalent in England than anywhere else. It has penetrated to the remotest corners of that nation of shop-keepers, and is to be met with alike in the Thames Valley, the passes of North Wales, and the loveliest spots of Devonshire. Some "signs" of more than common atrocity recently moved Mr. A. Waterhouse, the Royal Academician, to write a letter of complaint and protest to the *Times*, in which he suggested that such disfigurements ought to be heavily taxed. Mr. Waterhouse's broadside has been followed by another from two other artists, W. B. Richmond and Heywood Sumner, who brought the matter to the public attention two years ago. They make the following suggestions: "We would urge that the method now partly adopted by one firm for posting announcements relating to entertainments, publications, sales, etc., should be made universal and compulsory in its application to all casual street advertisement. The method consists in the division of a large board into numerous spaces by means of narrow strips of moulding intersecting each other at right angles. Each space thus enclosed is large enough to contain a double-crown poster sheet — *i. e.*, 20 inches by 30 inches — while an inscription is placed at the top of the board stating the subject of the announcements which may be placed thereon — entertainments, publications, sales, or what not. Such universal restriction as to size and subject matter would give a prevailng sense of order to the setting forth of the varied schemes of men, and would put an end to the present reckless appeals of the incontinent advertisers." — *N. Y. Evening Post.*

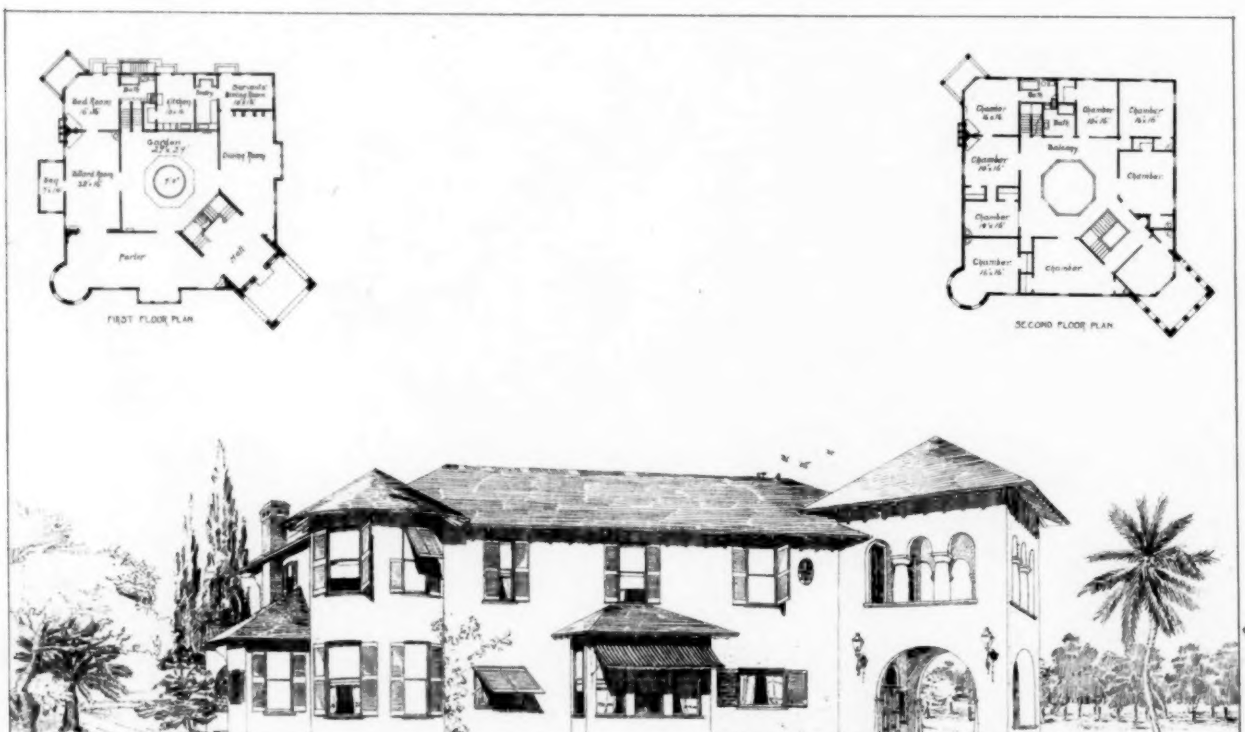
The Sewerage of Level Towns. — In reply to a question asked by the Indian Association in reference to the drainage of towns in the plains of India, Mr. B. R. Harrington remarks, that as the physical conditions of all such towns are nearly identical, the same general principles will apply to all. For such towns Mr. Harrington recommends the laying of an hydraulic main from four inches to six inches in diameter, laid about two feet below the street level, connected to a steam-pump capable of forcing water through it at a velocity of two feet a second, and discharging it at a sewage-farm some two or three miles away from the town. At convenient situations along the line night-soil receptacles should be placed. The contents of these receptacles should either flow into the pipe automatically or be forced into it by means of a force-pump. The latter plan must be adopted when the pressure in the main never falls below that of a head corresponding to the level of the night-soil receiver. For larger towns, and especially for those having a public water-supply, nine-inch gravitation drains laid at a slope of one in three hundred should be used. The sewage would flow through these to a pump-well, whence it would be forced to the sewage-farm outside the town. — *Engineering.*

TRADE SURVEYS

The most encouraging feature in recently-published financial statements is that a larger volume of stocks are now paying remunerative dividends than at any time in our history. The percentage of non-paying securities and investments has been declining for over a year. The number of railroads that have gone into receiverships has also declined. The listing of securities on the Stock Exchange shows what an expansion of business there is in progress. All of the features shown in the financial reports are of an encouraging nature. There is, of course, a large amount of non-paying stock afloat, and there are hundreds of millions of stocks seeking listing privileges which will remain non-paying for a long time to come; but it is safe to say that the greatest care will be taken and scrutiny maintained in the accepting of any new securities. The tendency is to deal as nearly as possible on a cash basis. Ten to twenty years ago, a great many new enterprises were projected on paper and maintained on credit. Fewer ventures of this kind are now being made. Another favorable point is that nearly all of the new enterprises are promoted by existing corporations, or companies well backed by capital or credit. The importance of this condition of things is greater than is apparent on the surface; it shows and proves that the basis of business is stronger, and that the possibilities of reaction or depression, or financial panic, have been greatly reduced. It is difficult to see in the future any causes likely to interrupt this favorable condition of things. We are gaining in strength every year; the fact has been frequently pointed out that there is a healthy and steady decentralization going on, especially in the industries: this fact cannot be commented on too favorably or too strongly. There is no "manufacturing East" or "wheat-growing West" — not, at least, in the sense of five or ten years ago. Coal is being found scattered all over the country; oil is being produced in unexpected quarters; natural gas is being found in localities where the possibility of its existence was denied by experts a few years since, and these three potent factors are serving to stimulate industrial activity in many new sections. Small manufacturing plants are springing up, since it is now possible to save freight on long hauls. There is not now that dependence upon great Eastern manufacturing centres that there was a few years ago. All sorts of iron and steel using factories and shops are springing up in far-off Western and Southern sections; hardware establishments, hosiery and textile mills are numerous. Paper-mills are now strongly established throughout the far West, making fine grades of paper, and making money. This tendency is likely to expand, and to employ a vast amount of capital, and the effects of it will be to harmonize and equalize and strengthen our industrial system, and to develop it in a way and to an extent which would be impossible in any other country on the globe. The year opens with active markets in nearly all staple products. There seems to be a feeling among consumers that higher prices may possibly prevail, and the feeling is just strong enough to induce manufacturers to make liberal purchases on forward account. At the same time, they recognize the fact that there is an enormous producing-capacity everywhere. The monetary situation has not changed. The exportation of gold seems to have no visible effect. The doctors of finance disagree upon fundamental questions. The agitation against the greater use of silver is continued, and is assuming organized form. The contest will be fierce and bitter. The people of the far West are determined to have their way; the well-organized interests of the East are quite as bitter and determined on the other side. But little need be looked for from foreign conferences on monetary questions; selfish interests will probably dictate the course pursued. As regards the probabilities for the opening year, much that is said on the subject is, of course, merely guess-work; much is of that hopeful kind of talk so easily spoken and written. But all of the great changes, upward and downward, of the past twenty years have been sudden and unexpected. There is nothing more difficult to see into than the future conditions of trade and commerce. Panics come unannounced, like a thief in the night. The only safe and reasonable statement that can be made is that the country is strong, the industries busily engaged, profits sufficient to protect business against bankruptcy, and credit safe. The financial machinery of the country was never in better trim for the quick exchange of commodities and their values. In fact, the machinery of business was never more perfect, and the comprehension of what is required was never clearer. The business men, manufacturers, bankers, railroad managers all understand the problem before them — know how much to make, how far to go in competition, and when and where to stop.

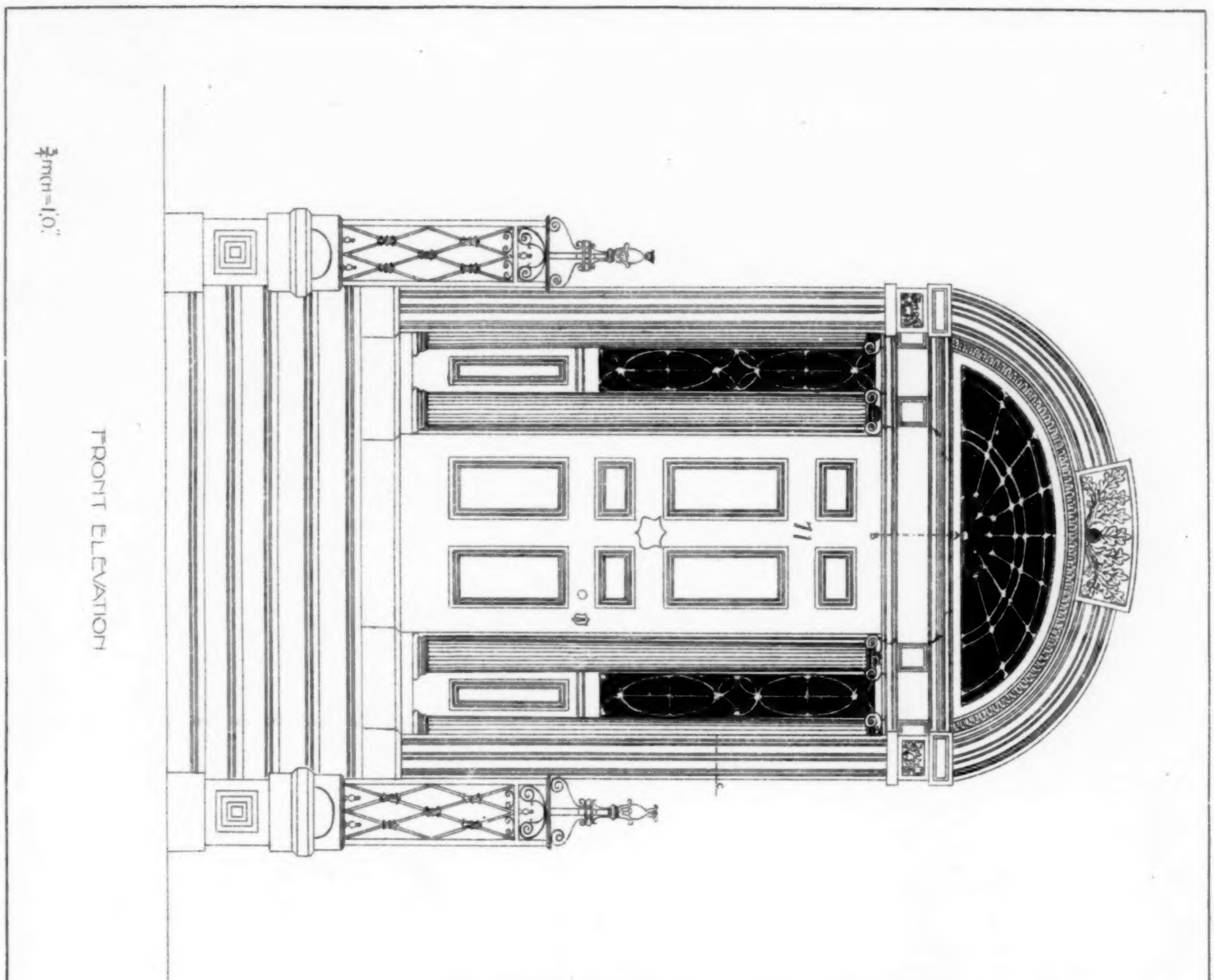
S. J. Parkhill & Co., Printers, Boston, U. S. A.


East Elevation
North Elevation
TOWN HOUSE for MR. -
B. F. Willis, Architect, York, Pa.
Inv - Del.

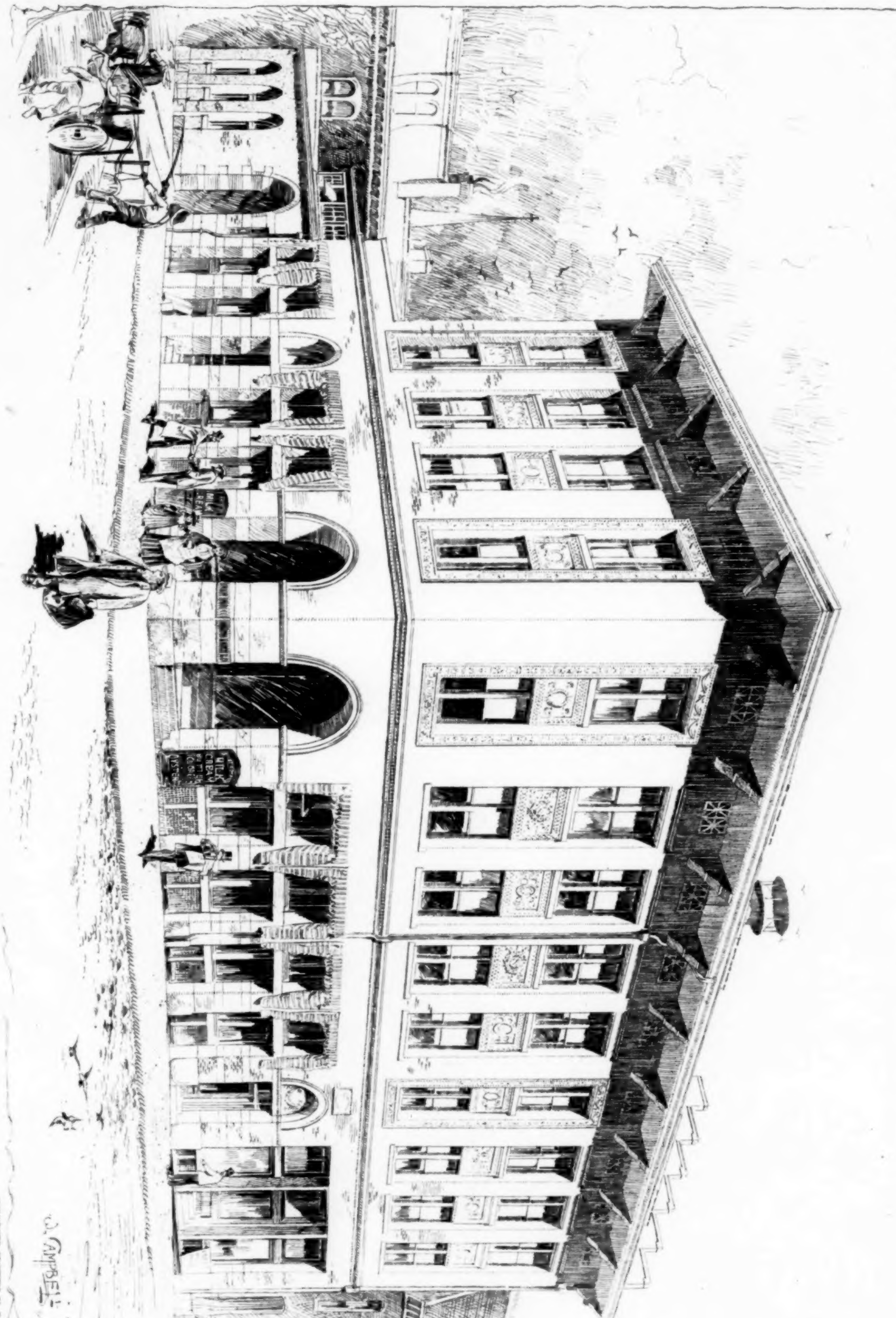

FIRST FLOOR PLAN
SECOND FLOOR PLAN
RESIDENCE of S. TAYLOR
NEAR WINTERS CALIFORNIA


"ALTON" NEAR SILVER SPRING MD.
RESIDENCE OF CROSBY. S. NOYES ESQ.
W. J. MARSH ARCHT.

AMERICAN ARCHITECT AND BUILDING NEWS. JAN. 7. 1893. No. 889.

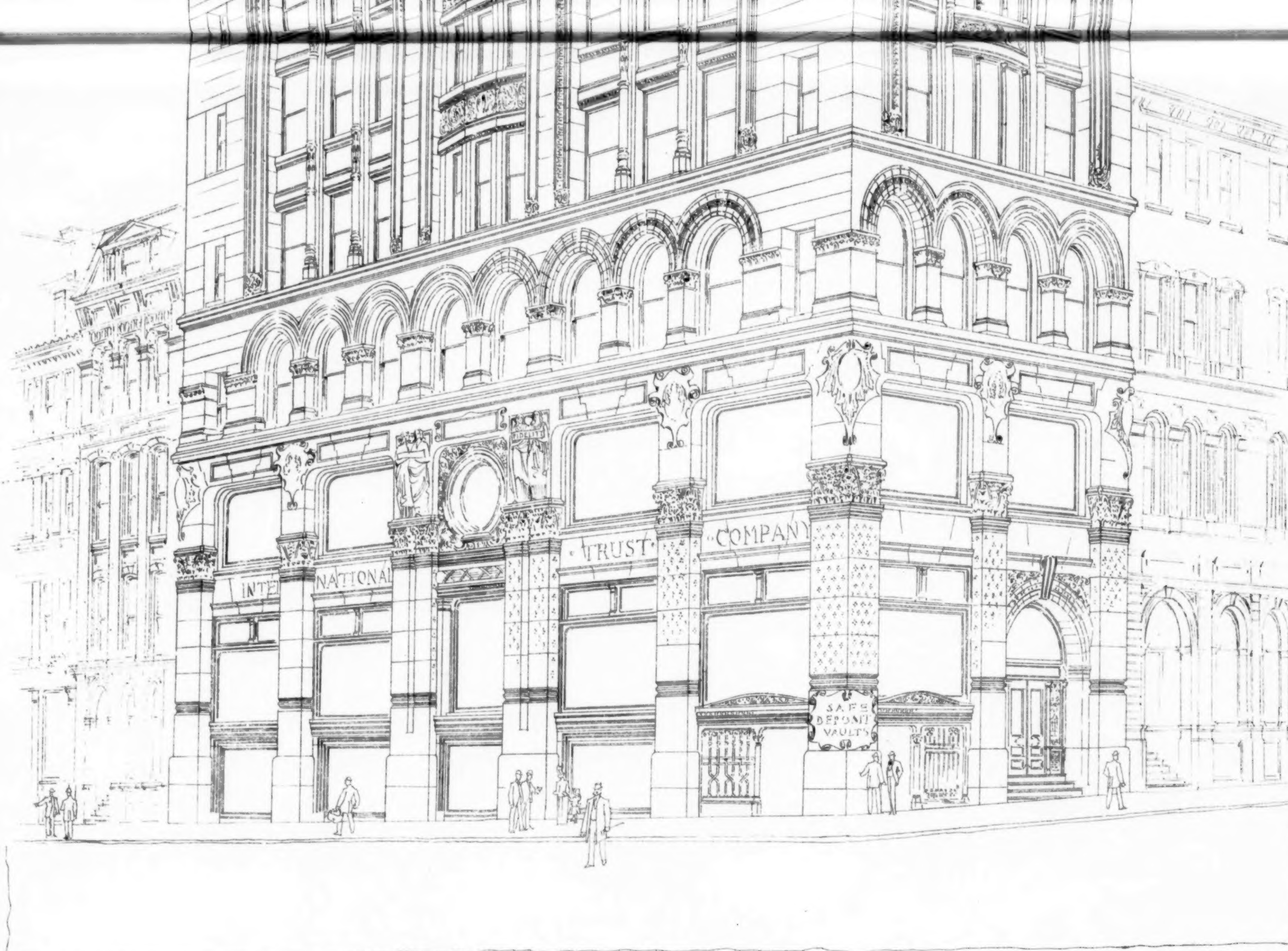


HELIOTYPE PRINTING CO. BOSTON



"STVDIO BVILDING", ST. LOVIS, MO.
EAMES & YOVNG. ARCHITECTS.

American Architect and Building News. Jan. 7. 1893.



HELIOTYPE PRINTING CO. BOSTON

·THE · INTERNATIONAL·TRUST·CO'S·BUILDING· DEVONSHIRE, ST, BOSTON.

·W·G·PRESTON ·ARCHITECT·

THE AMERICAN ARCHITECT AND BUILDING NEWS

ADVERTISERS' TRADE SUPPLEMENT.

No. 127. SATURDAY, JANUARY 7, 1893. VOLUME XXIX No. 889.

VALUABLE OPINIONS FROM EMINENT AUTHORITIES ON THE MERITS OF POTSDAM RED SANDSTONE.

THE stone produced by the Potsdam Red Sandstone Co., Potsdam, N. Y., is unequalled in beauty, strength and durability, commended by the highest expert authority, and is used in many of the finest buildings in the United States and Canada.

Prompt shipments guaranteed. Estimates for stone cut from drawings and delivered free on board cars ready to lay in the building.

The company makes a specialty of random rock-faced ashlar facings, ready cut, including rock-faced jambs and corners, shipped from stock, in any quantity. Apply for samples (free and prepaid to architects only), pamphlet and prices, as below.

"Among the sandstones deserving of special mention is what is known as the Potsdam Red Sandstone. This stone has been most thoroughly tested, and has won a wide reputation for durability and its capacity to withstand the effects of strong heat and sudden cooling. It has been indorsed in a very unqualified manner by many of the leading authorities on structural material in the country."

DR. WM. C. DAY,
Of the Division of Mining Statistics, U. S. Geological Survey. From "*Mineral Resources of the United States*," Government Printing Office, December, 1892.

"I consider this, from the standpoint of durability, almost an ideal stone. . . . Its surface affords no foothold for growing organism. Strong as the strongest granite. . . . Deserves even a wider recognition than it has yet received."

From "*Stones for Building and Decoration*," by Dr. Geo. P. Merrill, of the Smithsonian Institute, Washington.

"The element of beauty is no less important in a building stone than strength and durability. In these three qualities this stone is certainly unrivalled."

PROF. J. S. NEWBERRY,
Professor of Geology, School of Mines, Columbia College.

"There was no loss of weight in repeated treatment with water containing carbonic acid gas and with sulphurous-acid gas. A solution of 1 per cent of sulphuric acid occasions a slight loss in weight, equivalent to 2-100 of 1 per cent only. The test of freezing and thawing left the stone apparently unchanged. When heated to 1,200°-1,400° F. and suddenly cooled, the color was unaltered, there were no checks, and the strength of the specimen was but little impaired. . . . The Potsdam stone finds a wide market, and the demand for it is growing as its beauty, strength and durability are better known and appreciated."

From "*Building Stone in New York*," by Dr. John C. Smock, New York State Economic Geologist.

"This is the best of all building materials."

PROF. THOMAS EGLESTON,
Professor of Mineralogy, Columbia College.

"This remarkable stone has shown a resistance of more than 42,804 pounds crushing weight, while the strongest granites will stand only 19,750, and other stones still less. The color of the Potsdam product is soft, light reddish. For building purposes it has no equal." — *Scientific American, October* 29, 1892.

"Approximates more closely to the ideal building stone than any other that has thus far been proposed for use in this country."

DR. WILLIAM H. WAHL,
Secretary Franklin Institute, Philadelphia.

POTSDAM RED SANDSTONE CO.,
POTSDAM, N. Y.

CREOSOTE STAINS.

IN the artistic treatment of the exterior of a house, and especially in the harmony of color, consists often its chiefest charm.

Nature gives us many hints of how this can be attained. We note, for instance, that she never blinds us with glaring contrasts — masses of color in violent antagonism. On the other hand, we see beautiful effects in foliage with fruit or blossoms, where the contrasts are marked, but the colors are so blended as to avoid all crudeness.

This result has been attained with Creosote Stains, by putting one color directly over another. With red covered by green, for example, a beautiful effect like that of autumn foliage has been produced, the eye at close range being unable to note where green begins and where red, and at a distance the whole blending to beautiful neutral tints. An endless variety of charming effects may be produced by a proper selection of the two colors.

SAMUEL CABOT,
BOSTON, MASS.

MINERAL WOOL.

PLEASE mention as a news item that our factory at Stanhope, N. J., was partially destroyed by fire on December 1, by which we lost all stock on hand.

We started to rebuild at once, so as not to delay orders, and we hope to be in running order by latter part of current month.

UNITED STATES MINERAL WOOL CO,
2 CORTLANDT STREET, NEW YORK, N. Y.

NOTES.

A DETROIT evening paper lately reviewed at length the enormous stove and kindred industries of that city. The following extract will interest those in the heating trade who have observed the extraordinary growth of the young company referred to.

"The Capitol Heater Company is the latest to enter the field and it has met with speedy and surprising success. It only commenced business last February, yet it has already placed its heaters as far west as the Missouri river, and as far south as North Carolina and through pretty much all the intermediate region. The first sales were in this city, where they have had a fair share of the business this season. Thus far they have made hot-water heaters exclusively, but next year they will commence the manfacture of steam heaters as well. They take no contracts for putting in the heaters, only manufacturing and selling then. They buy their castings at foundries in Detroit and set them up at a rented factory on Macomb St., near Randolph, but intend to erect a machine-shop of their own next spring. They have come to the front with remarkable rapidity and though so short a time in existence are recognized by by the trade and papers everywhere. Their work has recently been put into the *Daily News* Building at McKeesport, Pa., the Second National Bank, which is the handsomest bank building in Lexington, Ky., and they are now making up a car-load for Lincoln, Neb. They have recently had to put an electric-motor into their works so that they can run nights as well as days."

THE NATIONAL CARVING COMPANY of Lynn, can talk profitably with all people interested in wood-carving, as per announcement upon another page. Prominent business men are in charge of the National Company's affairs, and it should be understood by all that the company has first-class carving machinery and can do its work exactly as represented. An illustrated book, giving all details, will be sent upon application to the National

Carving Co., Lynn, Mass. C. I. Barker and F. W. Parker, prominent mill gentlemen in Maine, are, respectively, President and Treasurer of the National Company. Be sure and see the company's illustrated book.

THE welded Chrome Steel and iron five-ply combination plates for safe, vault and jail construction, manufactured by the Chrome Steel Works, Brooklyn, N. Y., are proving immensely popular, and the trade in them increases yearly. Their employment insures absolute security against the finest of cutting tools, a fact which has now become generally understood and thoroughly appreciated. Business has been very good with the Chrome Steel Works during the year just closing, and the prospects for 1893 are of an equally rosy hue.

THE Illinois State Building of the Columbian Exposition will be heated by the Detroit Heating and Lighting Company's celebrated "Bolton" hot-water heater. The successes of the "Bolton" this year have been remarkable. Of the latest, the heating of the Fayerweather Gymnasium of the University of Virginia, Charlottesville, Va.; St. Bonaventure Church, Cincinnati, O.; Young Men's Christian Association Building, Middletown, O., and the First Baptist Church, Watertown, N. Y., are deserving of mention.

MR. JEAN A. WETMORE, who has just returned from a trip through the West in behalf of the Okonite Company (Limited), says that the Okonite insulated wires and cables are carrying everything before them in that section of the country. At the New York headquarters of the company, 13 Park Row, business is reported as "booming," and 1892 will close a very busy year with this widely-known concern.

IMMEDIATE shipments of Merchant's Guaranteed Brands of American Roofing Plates can be made by Messrs. Bolles & Wilde, Wholesale Hardware Dealers, 93 and 95 Pearl Street, Boston, Mass., of their guaranteed brands "Merchant's Old Method," "Merchant's Roofing" and "Alaska." Every sheet stamped with name of brand and thickness, every box guaranteed. No wasters.

THE Gorton & Lidgerwood Company, 96 Liberty Street, New York, are at work upon a new price-list for 1893 of the "Gorton" house-heating boilers, of which they are the sole manufacturers. It will be issued about January 1st.

BUILDING INTELLIGENCE.

Reported for the American Architect & Building News.

HOUSES.

Pittsburgh, Pa. — Two frame dwells. for Mrs. M. Kauffman; builder, L. H. Fellabaum.

Arabella St., two-st'y dwell.; owner, I. M. Y. McKennan; builder, George J. Hallon.

Winebiddle Ave., stone and shingle dwell.; owner, Mrs. E. H. Kuhn; builder, T. Stuckhill.

Woodland Ave., dwell.; owner, Miss N. Jones; builder, D. J. Evans.

Providence, R. I.—*Glenham St.*, n e cor. Taylor St., two-st'y frame dwell.; cost, $4,500; owner, Thos. W. Hoye; builder, Jas. E. Canning.

Stimson Ave., s s, two-st'y frame dwell.; cost, $8,000; owner, Henry A. Waldron; architects, Hoppin, Read & Hoppin; builder, A. A. Cyr.

Stimson Ave., n s, near Hope St., two-st'y frame dwell.; owner, Geo. H. Dast; architects, Stone, Carpenter & Willson; builder, O. C. Barney.

St. Louis, Mo. — Two-st'y brick dwell.; cost, $2,500; owner and contractor, F. Schelp.

Two-st'y brick dwell.; cost, $2,997; owner, W. Hubert; contractor, Geo. Ibers.

Two-st'y brick dwell.; cost, $3,500; owner and contractor, R. Deutman.

Three two-st'y brick dwells.; cost, $9,000; owner and contractor, W. Hambley.

Two-and-one-half-st'y brick dwell.; cost, $3,000; owner and contractor, H. Delay.

Two two-st'y brick dwells.; cost, $6,500; owner, A. K. Florida; contractor, R. H. Newberry.

Two-st'y brick dwell.; cost, $2,900; owner, Wm. Fisher; contractor, M. Wipfler.

Twelve two-st'y brick dwells.; cost, $60,000; owner and contractor, C. W. McFarland.

Two-st'y brick dwell; cost, $3,000; owner and contractor, W. H. Shea.

Two two-st'y brick dwells.; cost, $6,000; owner, Frein Building Co.; contractor, G. Newkum.

Two-st'y frame dwell.; cost, $3,000; owner, L. T. Ottofy; contractor, L. B. Wright.

Two-st'y brick dwell.; cost, $2,800; owner and contractor, Jno. D. Schneider.

Two-st'y brick dwell.; cost, $3,500; owner, Mrs. McLaughlin; contractor, Jno. Chaplin.

Two-st'y brick dwell.; cost, $3,000; owner, C. A. Grob; contractor, L. T. Ruskin.

Two-st'y brick dwell.; cost, $2,900; owner, Wm. Fisher; contractor, M. Wipfler.

Two-and-one-half-st'y brick dwell.; cost, $13,000; owner, Dr. W. G. Moore; contractors, Kronmueller & Co.

Two two-and-one-half-st'y brick dwells.; cost, $11,000; owner and contractor, E. C. Gerhart Building Co.

Four two-st'y brick dwells.; cost, $11,200; owners and contractors, Banker & Edwards.

Four two-st'y brick dwells.; cost, $12,000; owner, A. H. Banker; contractors, Banker & Edwards.

Two-st'y brick dwell.; cost, $3, 00; owner, Mrs. A. Henry; contractors, Banker & Edwards.

Two two-and-one-half-st'y brick dwells.; cost, $10,000; owner, J. B. Legg; contractors, Kelly & Lawton.

Three two-st'y brick dwells.; cost, $10,000; owner, Jno. N. Denny; contractor, E. T. Allen.

Two-and-one-half-st'y brick dwell.; cost, $3,600; owner, H. B. Anderson; contractor, H. Theleman.

Two-and-one-half-st'y brick dwell.; cost, $4,800; owner, F. Harnagel; contractor, Hoelser.

Three two-st'y brick dwells.; cost, $8,100; owner, A. Brueggeman; contractor, Weking.

Two-st'y brick dwell.; cost, $3,500; owner, H. W. Mieke; contractor, Schisler.

Two two-st'y brick dwells.; cost, $8,000; owner end contractor, R. Schimmick.

Two-st'y brick dwell.; cost, $3,000; owner, C. Rittman; contractors, Paul & Son.

Two-st'y brick dwell.; cost, $3,000; owner, E. H. Michel; contractor, W. H. Atkeson.

Two two-st'y brick dwells.; cost, $6,000; owner and contractor, E. Preisler.

Two two-st'y brick dwell.; cost, $7,550; owner, W. H. Frantz; contractor, Hughes.

Somerville, Mass. — *Rosgnore St.*, three-st'y frame dwell., flat roof, 26′ x 40′; owner, Thomas Mallhan; builder, John McGirr.

Albion St., frame dwell., 23′ x 36′; owners and builders, Belding Bros.

Caldwell Pl., three-st'y frame dwell., flat roof, 26′ x 40′; owner, Wm. O'Brien; builders, Waugh Bros.

Craigie St., frame dwell., 24.6′ x 34′; owner, Lizzie J. Rowe; builders, Gillis Bros.

Jay St., near Holland St., frame dwell., 22′ x 37.6′; owner, Alvin S. Mason; builder, I. B. Phinney.

Jay St., near Holland St., frame dwell., 24′ x 50′; owner, Charles J. Simpson; builder, I. B. Phinney.

Gorham St., near Holland St., frame dwell., 27′ x 50′; owner, Alice R. Carleton; builder, I. B. Phinney.

Cypress St., frame dwell., 22′ x 40′; owner, H. P. Colson; builder, John G. Poingdester.

Montrose St., No. 22, frame dwell., 24.6′ x 36′; owner and builder, A. J. Woods.

Porter St., cor. Frances St., frame dwell., 25′ x 39′; owner and builder, W. L. Glidden.

Belmont St., near Summer St., frame dwell., 24.6′ x 44.6′; owner, H. W. P. Colson; builder, Arthur W. Berry.

Worcester, Mass. — *Columbus St.*, two-st'y frame dwell.; owner aed contractor, Geo. W. Smith.

West St., 3 three-st'y frame dwells.; owner and contractor, J. B. Tucker.

Mt. Vernon St., three-st'y frame dwell.; owner, H. F. A. Lange; contractor, L. M. Petterson.

Millbury St., two-st'y frame dwell.; owner, F. D. Perry; contractor, L. M. Petterson.

Lyford St., one-and-one-half-st'y frame dwell.; owner, H. Wilson; contractor, F. J. Goff.

Cloven St., two-st'y frame dwell.; owner, Mrs. Bugbee; contractor, C. A. Stone.

Knox St., one-and-one-half-st'y frame dwell.; owner, J. R. Boyce; day work.

Dryden St., two-st'y frame dwell.; owners, Hatch & Barnes; contractors, Bernstrom & Olson.

Wyncote, Pa.—Contract for building dwells. for W. E. Weber has been secured by W. H. Thomas, Jenkintown; architect, Angus S. Wade.

OFFICE-BUILDINGS.

Baltimore, Md. — The Merchants' National Bank will build nine-st'y stone office-building, s e cor. South and Water Sts.

PULBIC-BUILDINGS.

Carrollton, Ga. — Contract has been awarded to L. L. Nunn, of Atlanta, for the building of the new court-house, at $25,788.

Chattanooga, Tenn. — The building of a city-hall, to cost about $100,000, is being agitated.

RAILROAD-BUILDINGS.

St. Louis, Mo.—Part of four-st'y Union Depot; cost, $500,000; owner, Terminal Railroad; contractors, Adams & Chandler.

SCHOOL-HOUSES.

New Iberia, La. — Building of high-school, to cost about $10,000, is contemplated.

New Orleans, La.—Sully & Toledaro have prepared plans for a three-st'y brick building for the H. Sophie Newcomb College, to cost about $30,000; contractor, F. Rausch, Jr.

New York, N. Y. — *Thirteenth St.*, n s, 80′ w First Ave., five-st'y brick school, mansard, tin and slate roof; cost, $50,000; owner, City of New York; architect, C. J. J. Snyder, 146 Grand St.

East Thirteenth St., n s, 80′ w First Ave., five-st'y brick school, mansard, tin and slate roof; cost, $50,000; owner, New York City, City Hall; architect, C. B. J. Snyder, 146 Grand St.

Richmond, Va.—$28,000 have been appropriated for a building for the Central School, from plans by the city engineer.

San Antonio, Texas. — Flary & Wagner have received contract, at $11,681, for the Garden St. School, and $11,840 for the Lopez St. School.

STABLES.

Baltimore, Md.—Dr. George C. Cornelius will build two-st'y brick and stone stable, n s Monument St., bet. Aisquith and Stirling Sts.

Brooklyn, N. Y. — *Lexington Ave.*, s s, 250′ e Marcy Ave., four-st'y brick stable and storage place, tin roof; cost, $9,000; owner, L. F. Allen, 741 Marcy Ave.; architect, E. Van Voorhis, 903 Kent Ave.

Madison St., s s, 195′ e Ralph Ave., two-st'y brick stable, tin roof; cost, $3,000; owner, J. A. R. Chilson, 589 Hancock St.; architect, Frank Holmberg, 1169 Broadway.

Camden, N. J.—*Liberty St., No.* 1014, one-st'y frame stable; owner, N. Jefferson.

New York, N. Y.— *One Hundred and Twentieth St.*, n s, 225′ w Seventh Ave., two-st'y brick stable, tin roof; cost, $8,500; owner, Wm. H. Lee, 516 Fifth Ave.; lessee, Christopher Gray, 1840 Park Ave.; architect, Andrew Spence, 163 East One Hundred and Twenty-fifth St.

Philadelphia, Pa. — *Reno St., No.* 3855, two-st'y brick stable; builder, John Eiseman, 416 South Twenty-first St.

Thomas St., w s, n Green St., two-st'y brick stable; builder, W. S. Roberts, 4915 Penn St.

Reading Pike, cor. Thorps Lane, two-st'y brick stable; builder, Thos. A. Lynch, 1619 North Fifteenth St.

Tudor St., No. 1419, one-st'y brick stable; owner, Jno. Ashmead, 1410 South Eighth St.

Second St., e s, s Mifflin St., two-st'y brick stable; builder, Robert McCurdy, 804 South Second St.

Passyunk Ave., No. 1528, one-st'y brick stable; builder, R. P. Bradley, 211 Dickerson St.

Jones Lane, near Seventy-eighth St., two-st'y brick stable; owner, W. H. Simon, Island Road.

Fifty-fourth St., w s, n Brown St., two-st'y brick stable; owners, Christian Schwartz & Bro., Powelton Ave., w Fortieth St.

Penrose Ferry Road, bet. Seventy-eighth and Seventy-ninth Sts., brick stable; owner, Barney C. Owens, Penrose Ferry Road, s Tinicum Ave.

Elizabeth St., w s, s Unity St., two-st'y brick stable; owner, Geo. F. Thompson, 1345 Unity St.

Worcester, Mass. — *Lodi St.*, one-and-one-half-st'y frame stable; owner, Banny Chase; contractor, C. H. Tisdal.

STORES.

Brooklyn, N. Y. — *Patchen Ave.*, w s, bet. Jefferson and Putnam Aves., 8 four-st'y brick stores and dwells., gravel roofs; cost, $90,000; owner and builder, E. J. Crawley, 418 Chauncey St.; architect, J. G. Glover, 186 Remsen St.

Eastern Parkway, s w cor. Sackman St., 5 three-st'y frame stores and dwells., tin roofs; cost, $3,500 each; owner and builder, B. Seeman, 393 Rockaway Ave.; architect, Hugo Smith, 10 Moore St.

Miller Ave., n w cor. Belmont Ave., three-st'y brick store and dwell., tin roof; cost, $8,000; owner, David Davis, 124 Van Siclen Ave.; architect, Alex. Fowler, 592 East One Hundred and Thirty-seventh St., New York City.

Eastern Parkway, n s, 50′ e Georgia Ave., 2 three-st'y frame stores and dwells., tin roofs; cost, $5,000; owner, Ann O'Gronen, Fulton and Hemlock Sts; architect, B. O'Gronen, Fulton and Hemlock Sts.

Bushwick Ave., n w cor. Jefferson Ave., three-st'y frame store and dwell., tin roof; cost, $4,000; owner and builder, M. Mulvihill, 1069 Greene Ave.; architects, Warren & Billard, 2581 Atlantic Ave.

Vandervoort Pl., n w cor. Thames St., 9 three-st'y frame stores and dwells., tin roofs; total cost, $45,000; owners, Mrs. Mary Erck & Co., 90 Hamburg Ave.; architect, Th. Engelhardt, 905 Broadway.

Chicago, Ill.—Joseph L. Domer, three-st'y store and flats, 1007 West Twelfth St.; cost, $8,000.

Ernst Mertins, two-st'y store and flats, 426 South California Ave.; cost, $3,000.

Mrs. Philomenne Fayette, 2 two-st'y stores and flats, 2527 Thirty-eighth St.; cost, $5,000.

Robert Garr, 8 one-st'y stores and dining-hall, 6100-6110 Stoney Island Ave.; cost, $5,000.

R. B. Cooper, four-st'y store and flats, 239-241 Fifty-fifth St.; cost, $20,000.

Joseph Oswald, three-st'y store and flats, Halsted and Fifty-second Sts.; cost, $4,000.

Ole Manland, 2 four-st'y stores and flats, 143-147 West Indiana St.; cost, $21,000.

M. Riordan, two-st'y store and flat, 70-72 De Kalb St.; cost, $10,000.

James Slavik, three-st'y store and flats, 3252 Fisk St.; cost, $5,000.

George Steurnagel, two-st'y store and flats, 939 Thirty-first St.; cost, $4,000.

Clinton Rhodes, four-st'y store and flats, 6249 Cottage Grove Ave.; cost, $10,000.

Clinton Rhodes, 2 four-st'y stores and flats, 703-705 Sixty-third St.; cost, $20,000.

Consumers Ice Co., two-st'y store and office, 92 Thirty-sixth St.; cost, $3,200.

S. Talbot, three-st'y store and flats, 6655 State St.; cost, $8,500.

Charles Nottbolun, 3 four-st'y stores and flats, Fiftieth St. and Cottage Grove Ave.; cost, $40,000.

James Baker, 7 four-st'y stores and flats, 713-721 Sixty-third St.; cost, $40,000.

Carl Lippman, two-st'y store and dwell., 990 Kimball Ave.; cost, $3,500.

Mrs. Cooper, three-st'y store and flats, 76 Ashland Ave.; cost, $5,500.

John D. Halleck, three-st'y store and flats, 1306 Van Buren St.; cost, $9,000.

A. Rundler, three-st'y stores and flats, 1909 West Lake St.; cost, $3,500.

John Bouchard, 2 three-st'y stores and flats, 657-659 Forty-seventh St.; cost, $7,000.

Mary Farley, 4 four-st'y stores and flats, 4314-4318 Cottage Grove Ave.; cost, $40,000.

William Martin, 4 three-st'y stores and flats, 792-798 Van Buren St.; cost, $15,000.

James C. Murphy, four-st'y store and flats, 266 West Madison St.; cost, $17,000.

Hutchinson & Wilkins, 2 two-st'y stores and flats, 3456-3458 Wabash Ave.; cost, $20,000.

James Urelline, two-st'y stores and flats, 3801 Dashiel St; cost, $5,000.

B. F. Rogers, 2 four-st'y stores and flats, 550-552 North Clark St.; cost, $20,000.

New York, N. Y. — *West Thirteenth St., Nos.* 13, 15, 17, six-st'y brick store, tin roof; cost, $50,000; owners, Timothy Kieley, 275 West Thirty-eighth St., and Helen A. Moser, 19 East Fifty-seventh St.; architect, L. C. Holden, 1 Union Square.

Greenwich St., n e cor. Tenth St., seven-st'y brick store, tin roof; cost, $40,000; owner, Wm. H. Ramsey, 14 West Sixtieth St.; architect, M. V. B. Ferdon, 265 West Thirty-fourth St.

Niagara Falls, N. Y. — John Courtenay, three-st'y brick store; cost, $4,800; architect, H. W. Beardsley.

IN PREPARATION.

To be published in Four parts, Folio, each containing Eighteen Plates, a portion of which will be reproduced from Photographs specially taken from the originals, and the others from measured Drawings by the Authors. With Letterpress illustrated by numerous Sketches.

Norman Monuments

—— OF ——

PALERMO AND ENVIRONS

A Study by ARNE DEHLI, ARCHITECT,

Author of "DETAILS OF BYZANTINE ORNAMENT," comprising: ST. MARK'S, VENICE and RAVENNA,

—— ASSISTED BY ——

G. HOWARD CHAMBERLIN, Architect.

ALTHOUGH numerous works have been issued on single monuments or those of single cities or provinces, the mediæval styles of Italy are yet far from having received the attention they deserve.

A perfect sifting of the elements that went to make up the architecture of mediæval Italy is yet to be undertaken, and will require as a preliminary work that of investigating the origin of the Byzantine style and clearly defining it. In the meanwhile every little stone that can be carried to the building may be of some use, especially if it represent honest and careful investigation.

The Siculo-Norman monuments of Palermo and environs belong to the most exquisite gems of mediæval architecture, and, interesting as they are from a historic point of view, they are none the less so to the practical designer. There is probably no set of mediæval monuments in Italy which offers such a large and varied mass of suggestions as the Palermitan monuments. Fergusson justly refers to the Palatine chapel as the gem of mediæval interior decoration, and the same is no less true of La Martorana, while the fame of Monreale and its cloisters is too well-known to require mention.

The author recently made a journey to Sicily and during his stay there devoted his time to the study of the Norman monuments. This work therefore represents a study by a practical architect and the text simply attempts to familiarize the reader with the circumstances under which these wonderful monuments were created, and with some of the peculiar technical processes employed in their construction and decoration.

The work will be issued in four parts, on fine paper, 14 x 18, and publication will be begun very soon. It will contain, in all, fifty measured drawings of details, with keys to the coloring and materials used, and twelve full-page and twenty half-page views, photographed on the spot, and printed in part from gelatine and part from photo-grain process, besides some twenty sketches interspersed in the text.

The price will be $5.00 per part, in all cases payable upon the delivery of the numbers. A deduction of ten per cent will be made if paid in full in advance. After completion, the price will be raised to $25.00 per set.

TICKNOR & CO., Publishers, 211 Tremont St., BOSTON.