CANADIAN ARCHITECT AND BUILDER
FINE AND INDUSTRIAL ARTS · DECORATION · FURNISHING
CONSTRUCTION · SANITATION · ENGINEERING

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—THE—
CANADIAN ARCHITECT AND BUILDER,
A Monthly Journal of Modern Constructive Methods,
(With an Intermediate Weekly Edition—The CANADIAN CONTRACT RECORD),
PUBLISHED ON THE THIRD SATURDAY IN EACH MONTH IN THE INTEREST OF
ARCHITECTS, CIVIL AND SANITARY ENGINEERS, PLUMBERS, DECORATORS, BUILDERS, CONTRACTORS, AND MANUFACTURERS OF AND DEALERS IN BUILDING MATERIALS AND APPLIANCES.

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ADVERTISEMENTS.
Prices for advertising sent promptly on application. Orders for advertising should reach the office of publication not later than the 12th day of the month, and changes of advertisements not later than the 5th day of the month.

EDITOR'S ANNOUNCEMENTS.
Contributions of technical value to the persons in whose interests this journal is published, are cordially invited. Subscribers are also requested to forward newspaper clippings or written items of interest from their respective localities.

The Ontario Association of Architects has appointed the "Canadian Architect and Builder" its official paper.

The publisher of the "The Canadian Architect and Builder" wants to ensure the regular and prompt delivery of this Journal to every subscriber, and requests that any cause of complaint in this particular be reported at once to the office of publication. Subscribers who may change their address should also give prompt notice of same, and in doing so, should give both the old and new address.

INTERMEDIATE EDITION.

ON Saturday, the 22nd inst., we shall commence the regular publication of our weekly intermediate edition, the CANADIAN CONTRACT RECORD. As the name implies, the purpose of this weekly edition will be to present as complete a record as possible of contracts open to tender. A list of important contracts awarded, and when obtainable, the prices at which they were obtained, will also be given. The members of the Ontario Association of Architects, comprising upwards of 95 per cent. of the architects of the Province, signified by resolution at their recent convention, approval of this new enterprise, and pledged themselves to place in the columns of the CONTRACT RECORD all advertisements asking for tenders. This is alone sufficient to make this intermediate edition of great value to every contractor. Each subscriber in good standing to the CANADIAN ARCHITECT AND BUILDER is entitled to receive the CONTRACT RECORD without extra charge. The names of regular advertisers will be published in a properly classified directory on the same liberal terms. The CONTRACT RECORD will be mailed or delivered to subscribers every Saturday. The date of publication of the regular edition of the CANADIAN ARCHITECT AND BUILDER will in future be the third Saturday in each month.

THE pressure upon our space compels us to hold over several articles of interest for future publication. In our issue of March, we hope to present some thoughts for the consideration of Canadian Master Builders arising out of the proceedings of the recent meeting of the National Association of Builders of the United States, at St. Paul, Minn.

THE leakage of water from a street hydrant led to the sinking of one of the walls of the new Northern Pacific railway offices at Winnipeg. It has been found necessary to take the wall down and re-build it. The cost of so doing will amount to about $6,000, and the owners of the building have entered an action against the city for the recovery of this sum.

MR. Sproatt's resignation of his position as City Engineer of Toronto, and the appointment of Mr. Jennings, of the C. P. R. staff, as his successor, are the most important matters with which the new City Council has been called upon to deal. It is understood that Mr. Sproatt's valuable services will be retained for the city as Assistant Engineer. In this capacity he will be relieved of the worry incident to the management of the Works Department, which has been the means of seriously impairing his health. Mr. Jennings, while more familiar perhaps with railway than civic engineering, is said to be an excellent manager, and this is what the situation appears to demand.

THE advisability of appointing a "city architect" is engaging the attention of the Toronto City Council. There is something to be said for and against such an appointment. It is undesirable that all city buildings should be designed by one architect. Variety and not uniformity of design should be the object sought. For this reason the method of employing the services of different architects is to be preferred. On the other hand, it is evident that the services of a capable superintendent of building construction for the city are much needed. The person appointed to this important position should be a thorough mathematician, and should be perfectly familiar with every detail of modern constructional methods.

ON a previous occasion we stated that the important work of plumbing inspection in a large and rapidly growing city like Toronto, could not be efficiently performed by two inspectors. Three or even four inspectors would be none too many. We are pleased to observe the following reference to the matter in the Mayor's inaugural message for the present year, indicating that an effort to secure greater efficiency in this department is likely to be made: "The inspectors of plumbing should also be maintained in sufficient number to do the work thoroughly and expeditiously. Last summer frequent complaints were made about delay in plumbing inspection, and I believe these delays arose from want of a sufficient number of men to do the work. It is very important for the health of the city that the Plumbing By-law should be efficiently carried out, and this can only be done by a competent and sufficiently numerous staff of inspectors."

THE gratifying information reaches us that steps are being taken to form Architectural Associations for the cities of Montreal and Quebec. The promoters of the movement have the best wishes of their professional brethren of the O. A. A. It is to be hoped that the architects of these two cities will not stop short of attempting to form an Architectural Association for the entire province of Quebec. We hope to be in a position to state in our next issue that the work of organization has been succesfully accomplished.

THE Montreal Subway Company is seeking incorporation for the purpose of conducting electric wires underground. Further, it seeks to be clothed with powers such as would enable it to work its own will and snap its fingers at any efforts on the part of the city to control its operations. It wants a 40 years' franchise for nothing, to be protected from the interference of any other company, and to have the right, after giving the city eight days' notice, to open the streets, roadways, alleys, and so forth, for the purpose of laying underground the conduits. In short, this enterprising company seems to "want the earth." We cannot for a moment believe that the Legislature of Quebec would saddle the city of Montreal with such a monopoly. It behooves the City Council, however, to be watchful of the city's interests in this matter.

THE Building By-laws of the city of Toronto provide that "no person shall commence the erection of any new building, or the repair or alteration of any old building, within the fire limits A, B, C, and D, unless and until they shall have first submitted the plans and specifications of the proposed building, alterations, or repairs to the Inspector of Buildings for his inspection, and shall have obtained his written certificate that the proposed building, alterations or repairs, are in compliance with the provisions of this By-law, and will not involve a violation of any By-law or regulation of the City relating to prevention of fires or the erection, repair or alteration of buildings." So far as our observation has gone, the above clause is disregarded in a very large number of instances, and the attempts made to enforce compliance therewith are of the feeblest character. We have already pointed out the fact that permits which should be obtained before work is commenced, are in most cases not obtained until the building is well under way or nearing completion. It is not unreasonable to suppose that under such a slip-shod method, the provisions of the by-law are frequently violated, yet we seldom or never hear of work being ordered to be done a second time on that account. While the City Council are considering amendments to the by-laws designed to govern the erection of buildings, they would do well to endeavor to secure the efficient administration of these laws.

THE report of the committee appointed by the Toronto City Council to consider a method of regulating the erection of scaffolds within the city limits fully bears out what was said in the January number of this journal on the subject. The committee say they think it impossible to frame a by-law which would be workable and which would state just how every scaffold should be erected, as the circumstances under which they are to be erected differ so materially. They have come to the couclusion that the better plan is to let the city commissioner, or inspector of buildings, be the judge, upon complaint, as to whether a scaffold is safe or not, and would recommend that by-law No. 627 be changed so as to read as follows: "When information comes to the inspector of buildings, or when by any means it comes to his knowledge that any building, or portion of a building in course of erection, alteration or repair, within the city limits, or the scaffolding or hoists connected therewith shall be deemed unsafe, he shall immediately examine the same; and should he decide the same to be unsafe, he shall immediately stop all work connected with the part of the building so condemned, and shall at once notify the owner, contractor or agent to make the said building, scaffolding, hoists or other work so condemned, perfectly safe, and any owner, contractor, agent or workman who does work, or allows work to be done upon said condemned work (except for the purpose of making the same safe) until he has received a certificate from the inspector that the said condemned structure has been made safe, shall be subject to all penalties of this by-law." The committee cannot overlook the fact that after all, the workmen who erected or are employed upon a scaffold are the very best judges as to whether or not the scaffold is perfectly safe, and would strongly recommend workmen who suspect a scaffold or building to be insecure, to refuse to work upon the same, and to instantly notify the commissioner's department that such scaffold or building is supposed to be unsafe. The committee had before them correspondence from the principal American cities, and find that in no case have they a specification defining just how a scaffold should be built. It is also recommended that placards should be placed upon all buildings in course of erection or alteration, informing the workmen engaged thereon of the provisions contained in by-law 627 for their protection, and that all complaints made by workmen or others will be held in strict confidence.

IT seems very strange to the profession that, notwithstanding all that has been written concerning competitions and the manner in which they should be conducted to meet with a response from the best men, instructions such as those issued by the city of Quebec should still be prepared in all seriousness, believing that they are all that architects can wish for, and that they will result in the selection of a superior and unobjectionable design. These instructions have been prepared with great care and in the most elaborate manner. Much instruction and advice has also been offered for the benefit of competing architects. Here and there pithy statements have been made as to this and that, which some might profit by if they would, but which will be disregarded by all. It is evident that the city of Quebec does not wish to discover a good design together with its author, so much as they desire to secure a set of plans which can be placed in the hands of the City Engineer or some favored local architect to have a building erected therefrom. While they were about it, they should have asked for detail drawings, and thus have placed themselves in possession of all the drawings necessary to the complete erection of the building. As there are three premiums and all the premiated drawings are to become the property of the city, they should have more than sufficient drawings and information for the erection of this most important building. We cannot imagine any sane man undertaking to prepare a design under these instructions, in the hope of receiving any one of the three prizes. The work called for is tremendous, and the first prize, if obtained, would not pay the actual cash outlay of preparing the drawings. If one attempts to compute the cost to the profession of entering such a competition, he would be astounded, more especially if he takes into consideration the reward. The profession should take some concerted action which will result in the complete failure of all such competitions. The instructions state that the cost of the proposed building "shall not exceed the sum of $200,000." This is a very definite statement, and should be strictly adhered to. How it is to be done we know not, for we are convinced that it would require between $400,000 and $500,000 to erect in Toronto a building of the size of this proposed structure, and if the suggestions made in the remarks at the end of the instructions are followed, the building could not be erected for $750,000. Why problems impossible of solution are seriously placed before architects by men who are considered to be capable and of sound mind, we cannot comprehend. We have never known of an architect supplying the deficiency, so the hope that he may do so cannot be put forward as a reason for appropriating only one half or one third of the necessary funds. Granted that the building can be erected for $200,000, the architect who may win the first premium will give value in the form of drawings and specifications to the amount of $5,000, as the plans and specifications asked for are nearly all that would be required for the making up of tenders. If the building should cost $500,000, which it will most certainly, the drawings to be supplied would be worth $12,500. Would any member of the City Council of Quebec agree to sell $12,500 or even $5,000 worth of goods, for $1,500. Certainly not! And yet that is what they think archi-

tects are prepared to do, with the additional risk that they may not even receive one cent for their trouble and outlay. If architects had not been too ready in the past to accept terms very nearly as one-sided as the above, the city of Quebec would not have issued such ridiculous and unfair conditions for this competition. The three experts who are to adjudicate on the designs submitted should be named in the instructions. Competitors should know who the experts are to be, as they have often found that where they supposed competent professional men would be selected, incompetent professional men, or men of no professional knowledge whatever, were appointed. The only reason that can be urged why the names of the experts should not be given is, that it might be possible to "fix them." If they should be men that can be "fixed," they will be "fixed" in any case. We believe, however, that they should be men who cannot be "fixed," and such men should be appointed. However, if they are named in the conditions, the competitors can judge of even that side of the question.

No designs should be exhibited to the public before the competition is decided, for two reasons. The experts should be allowed to do their work without bringing pressure to bear upon them. If the public see the designs there will be selections made, and the selected designs will be pressed on the notice of the experts. There is no use having the designs submitted under motto if they are to be exhibited. The public would know at the end of the first day the author of every design, with the possible exception of those from a distance. We believe we can speak for the profession in Ontario in stating that there will be no designs submitted from this province. The conditions of the competition are most unreasonable and unfair, and the amount of work required to prepare the ⅞ scale drawings, specifications, etc., is out of all proportion to the rewards offered.

IT is to be hoped that the Bill respecting the practice of architecture in the province of Ontario will pass the Legislative Assembly. Those who understand the position of the profession of Architecture at the present time, are in sympathy with the proposed Act. There is nothing in it to which any reasonable objection can be taken. The whole object of the Act is, that the qualified practitioner may be distinguished from the unqualified, and that before any man can be registered as a qualified architect he must pass such examinations as may from time to time be determined on as sufficient to ensure his having a fair knowledge of architecture in all its branches. The man who passes this examination will be entitled to use the word "architect" as defining his profession, and will be registered as a properly qualified practitioner of architecture. There is no desire on the part of the profession to make any person about to build obtain a set of plans for the building he proposes to erect if he does not wish to have plans, nor in case he desires plans, to go to a qualified and registered architect. He will be allowed to build with or without plans, and he can go to any man he pleases for his plans; but if he goes to a man not registered as an architect he will only have himself to blame if his building be defective in any particular. It is desired to compel public bodies, entrusted with the expenditure of public funds, to employ a properly qualified and registered architect.

It will be argued that the object of this Act is to make the profession of architecture a close profession, solely to the benefit of its members and not necessarily for the benefit of the public, and that the public does not desire that such a Bill should pass. There is nothing in the Bill constituting the profession of architecture a close profession, but even if there were, we maintain that the public has shown in many ways that none but qualified men should be allowed to practice as architects. The newspapers, as representing the public, are always complaining of defects in buildings, resulting, as they maintain, from the ignorance of architects. Well, if there is this ignorance on the part of some architects, something should be done to weed the ignorant out of the profession and leave only the intelligent, as it would appear that the public is not capable of selecting the competent from the incompetent, or such mistakes would not occur, since there are qualified men, though not in such numbers as the unqualified. Unless there is a standard, the competent man cannot say to the incompetent one that he is not a properly qualified architect, and that he should not claim to be an architect, as he injures the standing of the profession and calls down upon it the condemnation of the public. If he did, he would only be laughed at for his impertinence.

Architects, in submitting this Bill to the Legislative Assembly of Ontario, are only doing the work that the public should perform for itself. In nearly every case where a building has been found to be defective in any particular, the press has laid the blame on the profession as a body. If every case of failure were investigated, it would be found that the mistakes were owing to the engagement of an ignorant man, who had no right by training or natural ability to assume the duties of an architect, as well as to the fact that the public is unable to distinguish between the competent and incompetent. It certainly is not fair to blame a profession as a body for the errors of individuals who have no standing with the profession. These men claim to be of the profession, the public accepts their statements, employs them, finds them incompetent, and forthwith condemns the profession as a body as if there were no competent men in it, but that all were like those men whose statements they are so ready to accept. The Bill of Registration, if passed, will remedy this state of affairs, unsatisfactory alike to the profession and the public. The man who employs a registered architect will have some guarantee that he has a reasonable knowledge of his business, that is, after the Bill has been in force a few years—for as all men now professing to be architects will be entitled to be registered, it will require time for those among them who are incompetent to pass out of sight. If the profession asked the Legislature to pass an Act which would make it unlawful for any but a registered architect to practice architecture, and which would not allow anyone to erect a building except he employed a registered architect, there would be more than ample grounds for the throwing out of the Bill. The profession cannot gain anything from the passing of the Bill except in an indirect way. The men who are now practising will in the course of a few years have to contend with young men who will have had the advantage of a thorough and systematic training. Our best men will feel the competition of these young men, and the inferior men must suffer materially. Yet in spite of such facts, nearly all the architects now practising in this province are united in asking for the passing of this Act.

The practice of law has been made a close profession, because an ignorant or unscrupulous lawyer might ruin his client; medicine has been made a close profession, because the ignorant medical man might kill his patient. These are both good and sufficient reasons for making these close professions. The ignorant architect may cause serious loss to his client through his want of knowledge, or he may even cause his death through not knowing anything of sanitary science or the art of construction. We have therefore the two principal reasons which have caused the practice of law and medicine to be made close professions to urge as grounds for the closing of the profession of architecture against the ignorant and unqualified. It should not be possible for a man knowing nothing of construction to be able to erect a building the fall of which might result in serious loss of life. But such is the case, and that more lives are not lost through bad construction, is difficult for one to understand who has any knowledge of the methods of construction adopted by ignorant architects and builders. There is another class of ignorant architects and builders against whom the public should be protected, viz., the men who, unable to calculate strains, determine to err on the right side, and build much too heavily in places, at the sacrifice of much material and labour, which results in worse than mere waste of the client's money, as all such overplus of material necessitates the strengthening of the work in other parts to carry such unnecessary load.

Some may imagine that this movement for the incorporation of the profession of architecture is local and recent in its char-

acter. Such is not the case. The question has been more or less before the profession for the last twenty-five years, since the Royal Institute of British Architects made a movement toward that end a quarter of a century ago. During the last three or four years the movement in Great Britain has assumed a definite form, and a Bill was submitted to the House of Commons in 1888, which, however, was withdrawn at that time, owing to the opposition of the Royal Institute of British Architects and the Civil Engineers, but submitted again in 1889 in a revised form. There is no doubt but that it will eventually pass. In some of the Australian colonies the matter has been taken in hand, and a Bill to incorporate the architects of these colonies is now under discussion. In the United States, Bills have already been submitted to some of the State Legislatures, and advanced several stages ; and in many of the other States Bills are under preparation for submission to the Legislature. It will thus be seen that this movement is not a new or sudden one. It is rather an old one which has slowly gathered force until Acts of Incorporation are now being asked for in all quarters of the world for the proper and equitable acknowledgement of the profession of architecture, in order that the public may be protected from loss of life and money through the ignorance of many supposed qualified practitioners. The membership of the Ontario Association of Architects includes 92 per cent. of all men now practicing architecture in this province, and when those who have applied for admittance to the Association are received, the percentage will be 97. The movement has received the full and hearty support of the medical profession in Great Britain. Medical men are brought into contact with the ill effects of bad building, drainage, etc., and knowing the results, are only too anxious to aid in securing such legislation as will remedy an evil which has caused many deaths, much sickness, and heavy pecuniary losses.

THE ABILITY OF ARCHITECTS TO ESTIMATE.

Editor CANADIAN ARCHITECT AND BUILDER.

IN the last issue of your journal I notice an editorial comment on my letter published in your November edition on the above subject. Apology is made for the publication of the letter, and the reasons assigned are "that all duly qualified architects are capable of approximately estimating the cost of the erection of their designs ; that the custom in England as stated is misleading," etc.

In reply I respectfully submit, that every properly qualified architect should be thoroughly competent to estimate the cost of the erection of his designs, and if he is not, he should have it done for him. But just here is where the trouble exists, for it is well known in the profession, both in Canada and elsewhere, that very few, if any, of the very best architects can prepare a systematic bill of quantities. They never learned how to do it, and always consider it unnecessary that they should learn. It is a duty requiring time, skill and practice of quite a different character from designing and preparing plans, and if they are qualified to give a fair estimate of the cost of proposed buildings and feel it their duty to do so, their results prove either inability or neglect of duty.

I am well posted in the routine of architects' offices in Great Britain and Canada, and take exception to the statement that the custom in England as laid down by me is misleading, for the custom I presume is the same in Great Britain now as it was fifteen years ago, at which time it was the general rule or practice for the architect having prepared his plans and specifications, to either retain the services of a professional quantity surveyor, and supply bill of quantities to parties tendering for the work (to be paid for by the successful competitor), or the contractors united in appointing the surveyor, paying him themselves as by agreement made. Some contractors having a preference for a certain surveyor, would possibly engage his services to check the quantities, as at liberty to do but unless the job was a small one, the surveyor was always retained. I never knew that the client was consulted or concerned at all about the quantities, or paying for them. He placed his building in the architect's hands on whom he had reliance as to ability and integrity, and the architeet knowing his duty to all parties concerned, supplied quantities to the contractors, the successful one having to pay for them whether he used them or not. On Government work, however, the Board of Ordnance always supplies printed bills of quantities (without charge) to the contractor to estimate on, at so much above, below, or at par on the schedule prices, and which also rules for extra work and advances made on the contract.

As regards the architect or his client's responsibility for the correctness of the quantities, it was always specially agreed upon that the contractor himself was solely responsible.

I have pleasure in replying to Mr. A. T. Timewell's able letter in your last issue on the subject, and coincide with all he has set forth, with the exception of the statement that some architects for their own protection make a practice of taking out the quantities. I don't think they do anything of the kind, for if they are qualified to do so, barring the reputation for giving close preliminary estimates, it entails a deal of time and trouble without any direct recompense. At least they are not obliged to do it, therefore they don't, and all the duly qualified architects know it. The rule of practice should be that a competent party should be engaged to take out the quantities for which he would be paid by the contractor to whom the contract was awarded.

The columns of your journal are certainly the proper medium to discuss this important subject, and the profession should not be too conservative on matters calling for immediate reform.

Yours, &c.,

T SQUARE.

[Our correspondent in his letter of November wrote in the present tense, and now he states that it was of fifteen years ago that he was writing. We hardly know why he should "presume that the custom is the same now as it was fifteen years ago." The custom in regard to quantity surveying is not the same now as it was eight years ago, to say nothing of fifteen. We do know cases in which about eight years ago the architect took out his quantities, had them printed or lithographed, and the successful tenderer paid the printer's bill on the receipt of his first certificate on account of the work he had executed. But the custom now in the best offices is to employ the services of a member of a new profession, namely, a "quantity surveyor," for although quantity surveyors had existed for years previously as a convenience for architects and builders, yet until about seven years ago the necessity for the regular employment of properly qualified surveyors of quantities was not recognized. Quantity surveying is now a separate profession. The employers are usually the architects, not the builders, and the architect includes in his charges, "preparation of quantities," and pays the surveyor's account, his client having already paid him for them.—ED. C. A. & B.]

OUR ILLUSTRATIONS.

COMPETITIVE DESIGN FOR CATHEDRAL OF ST. JOHN THE DIVINE, NEW YORK.—JAMES R. RHIND, ARCHITECT, MONTREAL, QUE.

THE dome is 555 feet from the floor of the church to the base of the cross, and 595 feet from the level of 110th street in front of the building. It would take St. Peter's at Rome inside, as St. Peter's will take St. Paul's, London, and it would be the largest and loftiest dome in the world. The dimensions of the dome are 200 feet inside and 240 feet outside. The height of the front towers from 110th street is 360 feet. The dome is to be on a line with 112th street. The length of the building inside is 400 feet, according to conditions of competition. The height of the nave to the top of the domed ceiling inside is 180 feet. The length of the building outside the portico is 512 feet.

INTERIOR OF ST. MARY'S CATHEDRAL, HAMILTON, ONT.—THOS. CONNOLLY, A. R. C. A., ARCHITECT, TORONTO.

RESIDENCE FOR THOS. MARKS, PORT ARTHUR, ONT.—EDWARDS & WEBSTER, ARCHITECTS, TORONTO.

The students, graduates and faculty of the Toronto School of Practical Science, spent a most pleasant evening together recently on the occasion of their first annual dinner.

QUERIES AND ANSWERS.

WILL you please if time and space will allow answer the following: Two years ago I had the supervision of a house which is built in an exposed position. The chimney to the north has always shown signs of dampness from top to bottom. The flue is used in connection with a small, wood-burning hot water furnace, and is 9 in. by 9 in. inside. Flue was carefully parged inside with lime mortar. From the outside, the chimney seems to be always saturated from top to bottom, that is, of course, when the furnace is burning. An answer would oblige.

ENQUIRER.

ANS.—The discoloration on outside of flue is caused by the condensation of the wood smoke. The wall of flue being probably only 4½ inches thick, absorbs the dampness from the exterior atmosphere or from a driving rain, is always cold and damp in weather cold enough to need artificial heat. The smoke striking this cold brickwork, is condensed, forming the well-known inky fluid, which is often seen dripping from stove pipes when of great length. The burning of green wood would probably aggravate the trouble. A flue on an outside wall should have at least 7 inch thickness on exposed side. An absolute remedy would be to build into the flue 9 inch glazed drain pipes, if special flue pipes are not obtainable. The brickwork could be cut out from the exterior, and pipes inserted if the chimney-breast inside is of sufficient size to allow of it.

TORONTO ARCHITECTURAL SKETCH CLUB.

THE housewarming, held in the new club room on January 28th, passed off in a pleasant and satisfactory manner. The large room was filled with a congenial and enthusiastic gathering, who spent the greater part of the time in the discussion of the drawings and sketches submitted in the first club competition, the subject of which was "An Entrance to a Dwelling House." Mr. Frank Darling, the critic of the evening, filled his position in a highly satisfactory manner, his criticisms and suggestions for improvement amply repaying the competitors for their labour.

By the vote of those present, the order of merit was decided as follows: Senior section—1st, Mr. Ernest Wilby; 2nd, Mr. J. A. Radford; 3rd, Mr. Geo. W. Couton and Mr. A. H. Gregg (equal). Junior section—1st, Mr. Alf. Broadhurst; 2nd, Mr. Cecil Tredger.

The meeting held on February 11th, though having a smaller attendance, was most interesting. Mr. R. W. Gambier-Bousfield's illustrated paper on the "Different Styles of Gothic Architecture" was thoughtfully and carefully prepared, and though by no means lengthy, explained the gradual evolution of the styles in a very lucid manner. The remainder of the evening was devoted to "time sketching." The subject, "A Hall Staircase," was given out, and the members were allowed half an hour to express their ideas.

An announcement of interest to all will be that Mr. Frank Darling has very kindly consented to act as permanent "club critic." This is a position he is admirably qualified to fill, as abundant proof was given at the last club competition.

A number of excellent architectural casts have been loaned the club for sketching purposes by Messrs. Holbrook & Mollington, and will prove an attractive feature.

Mr. J. W. L. Forster, the well known artist, who has taken a very lively interest in the club since its inception, is on the programme for the last meeting of this month, and his paper should be heard by all, as it will undoubtedly be a very interesting one. It is desirable that members should bear in mind that the meetings are held on the second and fourth Tuesday of each month.

"CANADIAN ARCHITECT AND BUILDER" SERIES OF PRIZE COMPETITIONS.

REPORT ON PLUMBING ESSAY COMPETITIONS.

THE essays received in the above competition, four in number, we beg to report as standing in the following order of merit:

1st, "Lucidus in Ordo," placed first, is a clear, concise setting out of the reason and urgency for having such plumbing fixtures as may be necessary in one's home done in the simplest and most effectual way, and going on, shows an accurate knowledge of the practical working of the various plumbing and sanitary appliances, with a critical appreciation of the merits of the many claimants for public favor. Among the points made which are calculated to improve local usage, we would reiterate the following: That concealing work is the cause of bad work; more extensive use of wrought iron; screw pointed pipe; inspection and testing of cast iron pipe at foundries; keeping house drain above basement floors; and that the porcelain urinals are susceptible of much improvement, as by make that would give sufficiancy of standing water with peirodc flush out.

"Aplomb and T Square" may perhaps be bracketed together as showing knowledge of the subject, but failing to treat it as completely as "Lucidus in Ordo."

"Octo" has evidently an exact technical knowledge of plumbing fixtures, but treats the subject almost entirely as an analysis of these in a harrassing manner that can hardly be called essay writing. Having first stated under twenty eight heads the characteristics of the ideal water closet, he gives under numerous heads the points of the four classes of closets now in use, and leaves the conclusion which is the best to our own intelligence and attention. This synopsis occupies two-thirds of the whole. There is very little consideration of the general subject. He concludes with forty one questions about hot water boilers—"just to give an insight to the importance of a boiler." There are no answers given to the questions, which is rather tantalizing. It is to be hoped that "Octo" is open to persuasion to publish the answers to his questions; they would form a valuable paper upon the boiler.

W. A. LANGTON.
JOHN GEMMELL.
R. J. EDWARDS.

SERVICE PANTRY.

Of three drawings submitted, it is difficult to decide as to the first place between "Spero Meliora" and "Art." "Spero Meliora" has made the best drawing, and has the best plan by the extent of making a pass door between the kitchen and the pantry. His details also have a finish which makes the room more pleasing without giving it any unfitting pretentiousness. He has also considered the question of heating. If he had placed his radiator in the corner opposite, and moved the pass door and flap-table by so much further to the left, he would have been able to utilize the lower part of the cupboard now omitted to allow room for the radiator. There would then be more certainty in his favour as against "Art," whose merit is abundance of accommodation. On the other hand "Art" has by his copiousness of closet, rather skimped the sink room, and so detracted from the real comfort of his plan.

On the whole, considering the superiority of his drawing, we feel inclined to give the first place to "Spero Meliora."

"Lilliput" has committed the cardinal fault of having a pass door between the pantry and dining-room. His details are also rather coarse, and his plan not very clear.

W. A. LANGTON.
R. G. EDWARDS.
JOHN GEMMELL.

ENTRANCE AND VESTIBULE DOOR.

The competitors rank in the following order: "Circle," "Dono," "Cimarvac," "Linked Squares," "Ont."

All are alike in indicating no shelter for the door way. It may be supposed to be under a porch or other cover.

The two first are almost equally good. Preference has been given to "Circle" on account of the superiority of his detail The quantity of bracketing and projection of moulding in "Dono's" interior finish is a mistake in taste. "Circle" has not considered his plan in drawing his elevation, but this reflects more upon his accuracy than upon the design. "Cimarvac" is also good—better on the outside than on the inside, which lacks refinement.

W. A. LANGTON.
R. J. EDWARDS.
JOHN GEMMELL.

The names of the successful competitors in the above competitions are as follows: "Lucidus Ordo," (C. H. Acton Bond), Toronto; "T. Square," (H. N. Wilkinson), 24 Chomodey St., Montreal; "Spero Meliora," (Ernest Wilby) Toronto; "Art," (James Walker), Toronto; "Circle," (Thos. R. Johnson), Toronto; "Dono," (Ernest Wilby), Toronto.

STUDENTS' COMPETITIONS.

Editor CANADIAN ARCHITECT AND BUILDER.

SIR,—You published in your November number, conditions for a competition for a bath-room not to exceed 75 square feet. I entered this competition, and was surprised to see that "Birdseye" had been awarded first place for the design of a bath room greatly exceeding that limit in size.

I now see that in the December number of your paper, the clause limiting the size of the room was omitted. As my bath-room was planned before the December number was delivered, and I did not see the change, my design was placed at a considerable disadvantage.

It was surely unfair to amend the conditions within two weeks of the date at which the drawings had to be in, and then to judge a design prepared under the limitations of the first conditions, on the same basis as one that had profited by the change.

My French bath, which is criticised as being "unworthy of a place in a good bath room" would certainly be preferred to a common bath by many, particularly where the space is limited, and had the writer of the report figured the matter up, he would not have said its water-saving faculty was fallacious. The fact is, that the bath I show would take 40 per cent. less water to fill it than one such as "Birdseye" shows, which, if permissible in a 150 foot room, would leave room for little else in a 75 foot room. I assume that the reproduction of "Birdseye's" design is one half the size of the original, because it is mentioned in the conditions that the drawings must be reduced one half, and allowing a slight margin, the reproduction measures one half the size specified in the conditions.

The fact that the pipes may be got at from a bed room closet is another point in my design that is severely criticised. As the pipes should surely be accessible, I conclude the writer of the report would have them boxed out into the bath room itself. I do not see that this would much lessen the evil effects of a leak of sewer gas, and as "Birdseye" makes no such provisions, I do not think his design should be given any preference in this matter, for it is certainly better to place the pipes in a box in the thickness of the partition where they would be accessible, than to place them in the partition without the box, and inaccessible, as "Birdseye" evidently intended them to be.

"Birdseye's" fixtures are arranged without regard to cost in making the plumbing connections. The w. c. is placed in a separate compartment, which is destitute of light and ventilation. The shower-bath is closed round in a way that would make it difficult to turn on the water without getting in the bath-tub. The basin is too small to be used with comfort, and one of "Birdseye's" drawings is "cooked." The door is shown nine inches, and the basin five inches narrower in elevation than on the plan, giving the room a false appearance of symmetry. In competitions of this sort, surely any attempt at "cooking" ought to disqualify a competitor.

I can appreciate the generous motives that induced the committee of the Guild to undertake the difficult task of judging these competitions. Still I think that, having undertaken to make the awards, they should be willing to devote sufficient time to the work to fairly weigh all the merits and demerits of each design. That this was not done in the present case, seems to me evident.

The object of these competitions is to raise the standard of draughtsmen and pupils, and if the criticism of the designs is carefully and justly made, it will be of far more benefit to the competitor than the study necessary to the preparation of the design.

Yours, etc.,

"DADO."

[We were unaware until our attention was called to the fact, that any change had been made in the printed conditions governing this competition. It was found necessary to alter the wording of some of the conditions in order that their meaning might not be ambiguous. It now appears that in making these alterations, the omission of which our correspondent complains accidentally occurred. We can only say that we exceedingly regret the circumstances, and the fact that it is now out of our power to make any reparation for the mistake, unless the judges of the competition should decide that, apart from the objection to the size of the bath, "Dado's" design would have been entitled to first position.—ED. C. A. & B.]

CANADIAN SOCIETY CIVIL ENGINEERS.

THE fourth annual meeting of the above society was held in the city of Montreal on Jan. 22nd. Added interest was given to the occasion by the inauguration of an annual dinner, and the attendance thereat of His Excellency the Governor-General and a number of ladies. The President, Col. Gzowski, presided.

THE PRESIDENT'S ADDRESS.

The president's address, was, as usual, the chief feature of the meeting. Its most important features are reproduced below:

"The progress of the society since its recent organization has been very gratifying. The roll of members, as you will have observed from the report of the council, is as follows:—Honorary members, 7; members, 266; associate members, 100; associates, 66; students, 154; total, 953. The society has every reason to be congratulated upon and take pride in the representatives of engineering talent on her roll of honorary members.

Here followed a reference to a number of engineering works that have attracted attention the past year. First of these was

THE ST. CLAIR TUNNEL,

under the Detroit river, to connect the Grand Trunk system in Canada with its connections in the United States at Sarnia. The total length of the tunnel with approaches will be two miles and 1,145 feet. The length from face to face of the portals is 6,000 feet. The depth of open cutting at the east, Canadian side of the tunnel, is 62 feet; at the west, United States end 52 feet. The length of that part which is under water will be 2,310 feet with a gradient to the west, rising one foot in one thousand. The greatest depth of the River St. Clair on the line of the tunnel is forty and one half feet. The minimum thickness of the roof is 16 feet. The bottom of the tunnel is about ten feet above the rock underlying the clay. This has been ascertained by very accurate soundings and borings taken near the line of the tunnel at each 20 feet. It may be well to say that the flow of gas was found immediately above the rock, indicating that its source was in or below that strata, the gas escaping through fissures in the rock. Locating the bottom of the tunnel above the rock and yet securing sufficient thickness of material to support the roof was in order to avoid meeting with gas. The material through which the tunnel is driven is clay, with pockets of wet sand and gravel. The tunnel in cross section is circular with an inside diameter of 19 feet 10 inches. It is a circular tube lined throughout with flanged plates of cast iron, two inches thick, five feet long, bolted together. The ends of these plates are planed to make a close joint, and before being used they are heated and soaked in tar. The lower half of the lining is encased outside in three inches of grout formed of the best Portland cement and coarse sharp sand. Holes are made in the upper part of each plate, through which the grout is poured in. Under the river the whole of the outside of the cast iron lining will be covered this way. In the prosecution of the work, an iron shield is used, under the protection of which the excavation is carried on, and the cast iron lining is put together. The shield is just large enough to enclose the cast iron lining, and as the excavation in front of it is advanced, it is moved forward just far enough to put together one section of the tunnel lining. As the width of these sections or rings is only eighteen inches, and as the rear portion of the shield which encloses the lining overlaps it thirty-nine inches, the forward end of the lining is always within the shield. To ensure safety as far as possible in the event of a sudden strong flow of quicksand or water, an iron diaphragm or bulkhead is built across the shield forty-eight inches from the rear of it, with two sliding doors which can at once be closed. The total length on both sides of the river of the completed tunnel to 22nd January, is 2,006 feet; in Canada, 844 feet; in the United States, 1,162 feet. The time named for the completion of the tunnel is July, 1891.

THE BRIDGE ACROSS THE FRITH OF FORTH.

The Frith is five miles wide, and blocks the direct line of the east coast railways. Its construction was long delayed owing to the great width and depth of the Forth. It is not easy to realize how vast is the difference between a bridge with a 1,700 feet span and the largest span of a railway hitherto constructed. The height of the steel work is also exceptionally great, being equal to that of the golden cross of St. Paul's, 360 feet, while the total height of the bridge is just equal to that of the Great Pyramid, 460 feet. As regards the principle of design, "Cantilever" is a 200 year old term for a "bracket," and the Forth bridge spans are made up of two brackets and a connecting girder. On these brackets there is a horizontal pull of 10,000 tons, and on their bases rests a weight of 100,000 tons. The principle of bracket and girder construction is as old as the hills, as it lends itself particularly to timber construction, which preceded masonry. A wooden bridge built 230 years ago in Thibet, with a span of 182 feet, was the true prototype of the Forth bridge, which only became possible when Bessemer steel was invented. One of the advantages of the cantilever system is facility and safety of erection, as such bridges can be built by commencing at the piers, and adding successive bays of the cantilever right and left until the whole is completed. There is thus no moment when the safety of the whole structure is dependent on the integrity of some temporary staging. The cantilevers or brackets of the Forth bridge are enormously strong. Mr. Baker says that half a dozen ironclads might be hung upon them. The works of the bridge were commenced in 1883. Mr. Arrol, of Glasgow, was the contractor. A start was made with the pier work simultaneously with the erection of shops and machinery for the manufacture of the superstructure. Each main pier consists of a group of four cylindrical masonry piers about 70 feet diameter. These are founded on rock or hard boulder clay at depths ranging up to 90 feet below high water. Six of the cylindrical piers were put in place by the use of compressed air. The piers were floated into position by building them hollow in the first instance and filling them with solid masonry subsequently. The whole was enclosed in a bottom placed about seven feet above the external cylindrical skin, so that a huge diving bell, 70 feet in diameter and 7 feet high, constitutes the bottom of each pier. When in position, the water was driven out of the chambers by forcing in compressed air. Workmen then entered through airlooks, and carried on the excavation 90 feet below the waters of the Forth. The superstructure of this gigantic bridge

required the manufacture on the spot of 50,000 tons of steel girders and other work. As a rule, the compression members consist of tubes, and the tension members of lattice girders; this arrangement from an architectural point of view proved most effective. The central connecting girder was erected in two halves temporarily connected with the projecting ends of the cantilevers. The bottom members of the two halves at the centre of the 1,700 feet span had large holes bored in them for the insertion of pins to connect the two projecting halves of the bridge, each, of course, 850 feet long. These holes had to be watched so as to seize the right moment when the varying temperature and consequent expansion of the steel brought them opposite each other, so that the pin could be dropped in. The next thing was to release the temporary ties holding the top members of the central girder to the cantilever. These were steel bars, three feet wide and two inches thick; to cut through such section of steel would have taken a long time. Mr. Arrol, contractor, arranged portable oil furnaces by which the ties could be made white hot in a short time, and so the strain on the ties was relieved as effectually as by cutting them. Mr. Baker admits that the cost of the bridge exceeded the estimates. He claims that this was not an exceptionable thing, and says that if such a bridge had to be built again, time and money might both be saved. It is expected that trains will begin to run over the bridge in March next.

Before concluding a reference to this great bridge, I may add that last year a charter was granted for a 2,800 feet span bridge at New York. This year, Messrs. Schneider & Company, of Creusot, in conference with Sir John Fowler and Mr. Baker as consulting engineers, have designed the steel work of a bridge over the English channel, and Messrs. Hersent & Co., of Suez and Panama canal fame, have designed the piers. The total length of the projected bridge is 24 miles, the number of piers 120, the width of the openings from 328 to 1,640 feet, the clear headway for ships 180 feet, the greatest depth of water 180 feet, and the height from the foundations to the top of the steel work 600 feet. It is calculated that a trifle less than a million tons of steel would be required for this stupendous structure. The estimated cost of the bridge is £34,000,000 sterling. The Forth bridge is not only a lasting monument to the designers and constructors, but verifies and most forcibly illustrates the fitness of the motto adopted for the profession of civil engineer:—"Whereby the great services of power in nature are converted, adopted and applied for the use and convenience of man."

ELECTRICAL ENGINEERING.

Electricity as a science and electrical engineering are making very rapid progress to control that wonderful power in nature for the use and convenience of man, which was so graphically described by Mr. Thomas Keefer in his address to the society as "That force like steam, and like it chiefly known by its effects; its range is universal, in the heavens above and the earth beneath, and apparently in all things living, in all animal and vegetable life." As chairman of the commissioners of the Victoria Niagara Park, I am in negotiation for the use of Niagara Falls to generate electricity in sufficient quantity and power to be transmitted to Buffalo, Lockport, Rochester, Hamilton and Toronto, there to be used as a motive power for working stationary engines at a greatly reduced cost per horse power. The project is to drive a tunnel under the falls at a point about 165 feet below the upper level of the river, and at its termination excavate a large chamber for placing water wheels and dynamos, the supply of water to be from pipes leading into the tunnel, with a fall of about 160 feet. That an almost unlimited electric power can be generated by the use of Niagara Falls is not doubted. The transmission of that power to contemplated distances in effective form is maintained by some electrical experts as quite practicable; there are others, again, who place a much shorter limit to the power of transmission. However that may result, there can be no doubt that the science of electricity and its uses are still in a very early stage of development.

RAILWAY DEVELOPMENT.

Canada has now in operation within her borders no less than 13,410 miles of railways representing a capital of $727,180,448. In this vital necessity of rapid locomotion the Dominion, with its five millions of people, is as full and favorably equipped as the States with sixty-five millions. But vast as has been the development of Canada's capacities for meeting the needs of agricultural, mineral and industrial enterprises, and for providing the conveniences of ever enlarging commerce, and of domestic life, the future will see even greater strides made in the material progress of our country. The works that have signalized the past only foreshadow those enlarged opportunities for usefulness and distinction which the future will open up to the civil engineer.

Permit me, in conclusion, to say a few words about our society. The report of the council shows a considerable increase in our numbers. This no doubt is highly satisfactory from my own point of view, not only because of this increase, but as a proof that the society is doing work that is appreciated by engineers, and that the work is good, for were it otherwise they would not have joined us. During the year of my office as your president I have to regret that owing to my residing at so great a distance from the headquarters of the society, and for other reasons beyond my control, I have done but little towards promoting the interests of the society. This failure to do more has been from inability and not from earnest good will towards or interest in the society. Allow me, however to say that any effort of your president alone will not suffice to ensure success. He is powerless unless aided by members. Pardon me if I say that it is the duty of each one of you to help. Each member should bring before the society, every subject of interest connected with our profession of which he has experience in the course of his practice. He ought to attend the meetings for reading and discussion of papers as frequently as possible. You will forgive me for these words of personal advice to every member. Although they come from one who was your nominal head but for the short term of twelve months, he is not wanting in age in other ways, and let me assure you that they are inspired solely by a desire that the transactions and papers selected by the council for discussion should be worthy of the society They are the proper medium by which the society's usefulness is to be maintained. By the printing and distribution of those papers our work becomes known, and by their merits new members are attracted. Accept the assurance that I will do all in my power to further the interests of the society, and I shall watch its progress with anxious desire to see it prosper.

I cannot sit down without making an allusion to the death of my predecessor in the presidency of the society, Mr. Samuel Keefer, who was my warm personal friend, and the earliest professional colleague I had in Canada. During the period of my service in the Department of Public Works, from 1841 to 1846, Mr. Keefer was my superior officer. I always found his advice sound and most valuable. He was devotedly fond of his profession, to which he did honor. He left important engineering works with which his name will always remain associated. His irreproachable life reached almost four score years, the limit allotted to man, leaving a good example to be followed by all members of our profession."

THE ANNUAL REPORT

shows that during the past year the membership of the Society has been increased by seventy. The honorary members elected were His Excellency the Governor-General, Sir John William Dawson, Sir Charles Augustus Hartley, Sir Frederick Joseph Bramwell, Bart., Sir William Thomson, Sir John Fowler and Sir John Hawkshaw.

Council again feels it an imperative duty to direct the attention of members to the qualifications required for admission into the several classes. As regards the student class, it is considered that a candidate should be capable of undergoing an examination equivalent to that required for the matriculation into the arts or science department of a university. The qualifications for admission into the classes of members and associate members should be rigidly exacted. Corporate members should make it a rule to verify the accuracy of the statement of the candidate's professional career, and should satisfy themselves that he would prove a fit and proper member of the society. This is especially necessary, as, in many cases, the applicant is personally unknown to the members of council.

During the year 1889, sixteen ordinary meetings were held, and four students' meetings, at all of which appropriate papers were read.

During the past year, the meetings of the society have been held in rooms at McGill College. The council, however, has long considered that the growing requirements of the society, and the need of a library, rendered it desirable that the society should possess rooms of its own. This has now been made possible through the liberality of the president, Colonel Gzowski, and the council has, therefore, secured the lease of the first floor of the new Bank of Montreal building, at the corner of St. Catherine and Mansfield streets, for a term of five years. It is expected that the rooms will be ready by the 1st of May.

The building committee reports the receipt of subscriptions to the amount of $3,323. It is very satisfactory to find that so high an average as $46.20 per subscribing member has been reached. Had all the members contributed in like proportion, the building fund would now amount to $25,000. The president, Colonel Gzowski, has generously given $300 a year, for five years, towards the rental of rooms for the society. (Hear, hear.) But the building committee feels that no time should be lost and no efforts spared in raising the sum required for the purchase of a site and the erection of a building, so as to give a more permanent basis to the society. Messrs. James Ross and R. G. Reed have also given $500 each towards the building fund.

The income for the year, ended on 31st December, 1889, amounted to $3,629.92, and the general expenditure reached $3,075.95, leaving a balance of $553.97, which, together with the balance of $1,948.92 brought forward from the year 1888, gives a total balance of $2,502.89 to be carried forward.

The report was adopted.

A resolution of condolence with the widow of the late Mr. Samuel Keefer was adopted on motion of the President.

OFFICERS ELECTED.

The following are the officers and council for the ensuing term: President, Colonel Gzowski; Vice-presidents, Messrs. Kennedy, Perley and Hannaford; Treasurer, Mr. Herbert Wallis; Secretary, Professor Bovey; Librarian, Mr. Chadwick; Council, Messrs. St. George, Rittan, Barnett, F. R. F. Brown, Masse, Wragge, Sir Jos. Trutch, Blackwell, Peterson, Munroe, Anderson, Dodwell, G. A. Keefer, Jennings and Ketchum.

A vote of thanks to the President for his valuable efforts on behalf of the society was moved by His Excellency, the Governor-General, and adopted. The business of the meeting closed with the passing of votes of thanks to His Excellency, Mr. Wallis, the Treasurer, Mr. Chadwick, Librarian, and Professor Bovey, the Secretary.

THE ANNUAL DINNER.

The first annual dinner of the society was held at the Windsor hotel. The *menu* was a choice one, and the table decorations of a charming character, while the presence of the ladies gave brilliancy to the scene. Col. Gzowski presided; the vice-chairs being occupied by Mr. E. P. Hannaford, and Mr. P. A. Patterson. The former and Prof. Bovey replied to the toast of of "The Engineering Profession."

"CANADIAN ARCHITECT AND BUILDER" SERIES OF PRIZE COMPETITIONS.

THE following is a list of competitions in Architectural subjects which we have decided to hold during the winter.

1st.—Details of the interior of a small house to include those for staircase, doors, architrave, base and windows Designs to be sent in on or before 1st March, 1890. First prize, $10; second, one year's subscription to C. A. & B.

2nd.—Design with details for four mantels, two of wood, one of brick and one of stone. Designs to be sent in on or before 1st April, 1890. First prize, $5; second, one year's subscription C. A. & B.

3rd.—Three designs with details, for front fence. Designs to be sent in on or before 1st May, 1890. First prize, $5; second, one year's subscription C. A. & B.

4th.—Essay on Heating and Ventilation. Essays to be sent in on or before 1st May, 1890. First prize $10; second one year's subscription to C. A. & B.

The Architectural Guild of Toronto have very kindly appointed a committee from their number to judge the above competitions. We shall publish each report as sent to us by the committee. Draughtsmanship, neatness and clearness of arrangement of drawings will be taken into consideration in awarding positions.

Drawings must be made on sheets of heavy white paper or bristol board

14 x 20 inches in size, and must be drawn to allow of their being reduced to one-half the above size. Drawings must be made in *firm, strong lines*, with pen and *black* ink. No color or brush work will be allowed.

Each drawing must be marked with the *nom de plume* of its author, and the author's name, *nom de plume* and full address, enclosed in sealed envelope, must accompany each drawing sent in.

We reserve the right to publish any design sent in.

Drawings will be returned to their authors within a reasonable time after the committee has given its decision.

FOUNDATIONS.*

IN all purely constructive work, the principal object is to obtain perfect stability with the minimum expenditure of materials and labour. In no part of a building should this object be more diligently sought than in the foundations. Generally covered up out of sight, and in no way entering into the apparent constructional outline of the building, utility is the one great test to be applied. Avoiding on the one hand an inefficient foundation which will imperil the stability of the building, and on the other a prodigal expenditure, where much is wasted that might be fruitfully employed on the superstructure.

To obtain this most desirable mean, it is evident that a careful and scientific investigation into, and adjustment of the relations of three things must be carried out, viz., 1st, the weight and character of the structure; 2nd, the solidity of the foundation bed; 3rd, the width, form and materials of the footings. These three factors are seldom the same in two cases, and it is evident that no mere rule of thumb method or so-called practical experience is a safe guide.

We owe it to our professional standing, as well as to our clients' claims, to give this important branch of construction much careful attention and study. While in this brief paper I may not present anything that is new to many present, I trust it may be the means of directing more of our attention to this important matter.

Before completing the foundation plans of any building, these two questions should always be considered: 1st. What is the weight of each part of the building upon each sq. foot of the foundation? and 2nd, What is the safe sustaining load of each sq. foot of the foundation bed? Not until these are at least approximately answered, can the size, form and material of footings be accurately determined. The weight of a building may vary in different places, and one part require much greater bearing area than other parts.

The foundation bed may not be homogeneous, and may require special treatment to make a solid bearing. Before plans are completed, pits should be dug, or holes bored on the site of proposed building, in order to reveal the nature of the foundation. These should be extended some depth below the proposed bottom level of footings. In ordinary soils, and for ordinary houses, 3 or 4 feet might suffice, while for heavier buildings, or in shifting or light soils, much deeper tests must be made.

Foundation beds may be classified under four heads: 1st, those incompressible under the load; 2nd, those more or less compressible under the load, but not requiring an artificial treatment; 3rd, those requiring artificial treatment to make them capable of sustaining the load; 4th. Those partly of the nature of two or more of the foregoing.

Strictly speaking, rock of good quality and sufficient thickness forms the only incompressible foundation bed. Soft sandstone and shale should be submitted to a test before any very heavy weight is imposed upon them. The best authorities consider that ⅙th of the crushing weight on average samples is the outside limit of the safe load for a rock bed. Sometimes there is a very thin strata of sound rock, with an inefficient foundation below it. If the building be heavy, and there is any cause to suspect such a contingency, test holes should be bored. If the rock be uneven, and the levelling of it likely to incur much expense, a level bed may be formed by filling up the depressions with cement concrete; or if the inequalities be large, by building coursed rubble with full, strong cement joints. Where the bed of rock is on a considerable incline, steps should always be cut to form a horizontal bearing. If the rock be subject to the action of running water, it may be advisable to insert anchor pins of iron to prevent the slipping of footing stones. Where, owing to the dip of the strata, part of the foundation goes lower than the rest, this portion should always be built up to the level of bottom of rest of work with cement, so as to prevent settlement.

Secondly—next to rock, strong gravel may be considered as an excellent foundation, it being almost incompressible under ordinary loads, and not greatly affected by the action of water. The safe load that may be placed on a gravel bed has been variously estimated at from one to two tons per sq. foot. The latter weight should not be approximated unless the bed of gravel is very thick, or there is a good substratum under it. And here it is well to remember that the cohesive power of gravel being so slight, a good deal depends upon the nature of the subsoil. A strata of sand or clay underneath, subject to the action of water, might very materially destroy the sustaining strength of even a deep bed of gravel. More especially should this matter receive considcration if the proposed foundation is so elevated as to be drained by any depression in the neighbourhood.

Sand, when not exposed to the action of water, forms one of the best soil foundations. It is almost incompressible, and its property of diffusing the weight laterally as well as vertically, is a great point in its favor. For this reason it may under favorable circumstances be safely loaded with two tons to the sq. foot. But owing to its fluid nature, foundations built upon it are exposed to many dangers. The action of water will at once destroy its stability, and all sand foundation beds should be protected from its ravages. Sometimes in this very attempt at protection, a new element of danger is introduced. Drains that were intended to protect the foundations from saturation, become easy channels for the escape of the sand by the action of water. The depth of a sand bed and the character of the underlying strata largely determines the safety of such a foundation. Frequently an underlying bed of rock or stiff blue clay forms a table over which flows the surface sinkings of a large area, rendering the bottom portion of the sand bed a moving quick sand. If this is not confined by artificial means, it may at some time move out in the direction of some new outlet, perhaps far removed from the site of the building. Then, of course, a sinkage must follow. On the other hand, if sand is retained in its position, either by natural or artificial surroundings, its semi-fluid property of transmission of pressure, is a great element in its favor.

Stift clay and marl, or as it is sometimes called, "hard-pan," forms an excellent foundation if kept dry and away from atmospheric influence. It is, of course, slightly compressible, but if the weights be uniformly proportioned, a safe load of from two to four tons per sq. foot can be imposed. The essential element in all clay foundations is thorough drainage, for under the action of water it is soon reduced to plastic mud, with little or no stability. This drainage should be done before or at the time the found a tion walls are built, and the trenches always kept dry. Of course in this as in all soil foundations, it is essential that the footings be below the disintegrating effects of frost, and that they be fully protected from its influence while the building is in progress. Owing to its retention of moisture, clay is very subject to the action of frost, and for this reason footings placed upon it require to be deeper below finished ground line than those on sand or gravel. All clays, especially hard blue clay, are very sensitive to the condition of the atmosphere, absorbing moisture in damp weather, and cracking and splitting in dry. For this reason, clay foundations should be exposed as short a time as possible to the action of the air. The expansive force of clay under the action of damp is very great, so that the necessity of protecting it from alternations of wet and dry is very apparent. Foundations on wet clay should not exceed 1½ tons to the sq. ft. unless the uniform weight and isolated position of the walls will admit of considerable sinkage.

Thirdly—on soft, homogeneous soils, or made ground of uniform compressibility, foundation beds may be rendered sufficiently solid for buildings of certain classes by the cheap and simple method of planking. Thick plank or squared logs, proportioned in width and thickness to the weight to be carried, are laid down in at least two thicknesses. The lower layer is placed longitudinally with the wall and the upper one transversely across wall. Three conditions, however, must be present in order to make such a foundation bed a success: 1st, the planking must not be subjected to alternations of wet or dry or to ordinary atmospheric influence, otherwise the wood will soon rot, and a settlement occur; 2nd, the weight of all walls, and the widths of footings under them must be so well proportioned that there will be the same pressure per sq. foot under the whole of planking; 3rd, the building must be so isolated, and of such a character that it may settle uniformly without dislodgement of any part. All timber used in such foundations should be creosoted, or otherwise preserved by some application before being used.

In places where there is a moderately soft foundation, not subject to the action of water, a good foundation bed may be formed by the use of sand pits or sand piling. This method of forming a foundation is to be recommended. There is no chance of decay such as in wood piling or planking, while the distributing property of sand is valuable. In forming the holes to receive sand piles, it is preferable to make them by driving and then removing the wood piles, rather than by boring. The ground around them is much more compacted by such a process, and the lateral transmission of the weight furthered. When the holes have been properly filled and rammed with damp sand, it is necessary to put a bed of concrete or planking over them, so that the sand may not be forced up by the pressure of the surrounding earth. If sand be used in trenches, it is usual to spread it in layers, fully ramming it as the work proceeds, until there is sufficient depth to distribute the weight to be imposed over the whole bottom surface of trench.

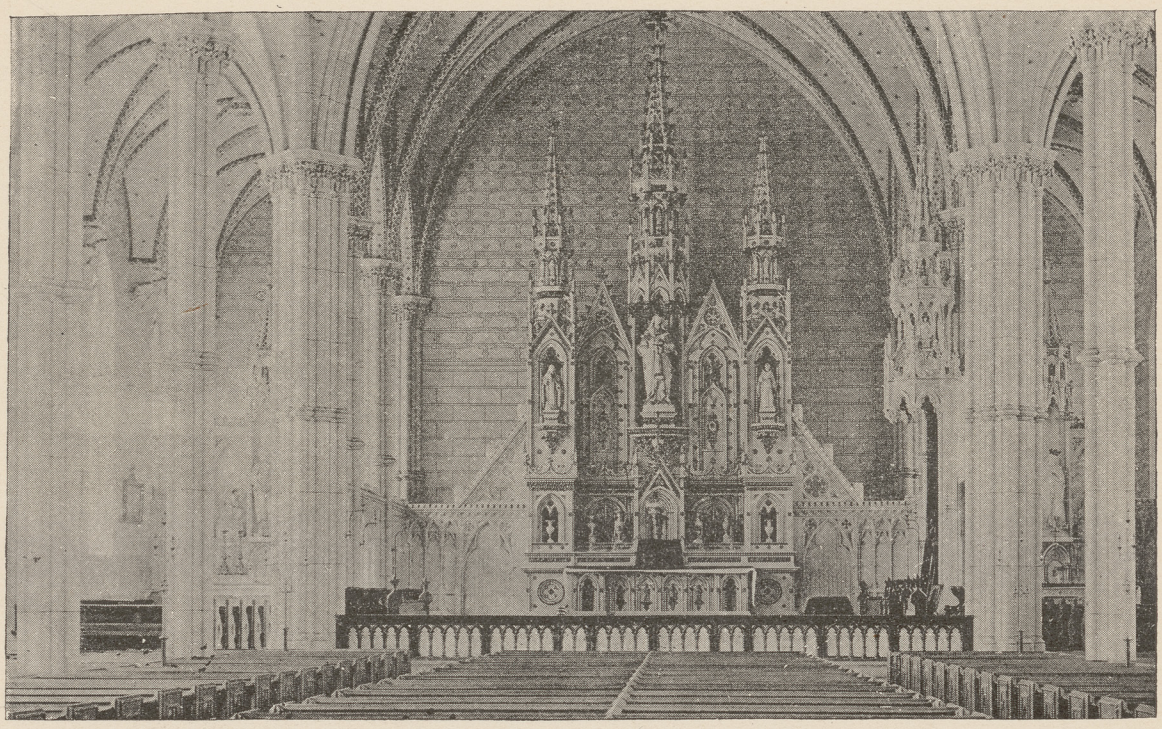
In order to secure a good foundation bed that will uniformly distribute the load over a wide area, the most common method is by using concrete beds or footings. The great points in good concrete making are, clean and pure materials, correct proportions, thorough mixing, and quick using. Any concrete which contains less than one-sixth of cement must be considered a poor substratum for any heavy weight. And here it is well to remember, that concrete is really an artifical rock, and that the projection of a course of it beyond the face of the footing stones above it, should not ordinarily be more than half the thickness of the concrete bed. If this important fact be overlooked, it may happen that the projecting edge of the heavily loaded concrete bed will break off, and the area of footing be so reduced as to cause a sinkage.

In silty, peaty or very soft ground, the usual recourse is to timber piling to secure a proper foundation. If there be solid ground underneath that can be reached by a 20 or 24 feet pile, it is generally best to drive them home, so that in reality they become posts resting on the firm ground. Usually it is not well to have a pile exceed 20 times its diameter; for if the soil be somewhat hard it is difficult to properly drive a longer one, while if the ground be very soft, it affords but little lateral support to the pile, and it becomes a stilted pillar. The outside limit of a safe load on a pile resting on solid ground at bottom, is about 1000 lbs. per square inch of area of mean cross section. Where there is no solid substratum to support the piles, they simply depend upon the friction or cohesiveness of the soil to hold them. Usually a pile of this description is considered fully driven when it does not sink more than one-half inch under a 1200 lb. weight falling 20 feet. The maximum safe bearing load of such a pile should not ordinarily be taken as more than 200 lbs. per square inch of area of head. In all cases, piles should be cut off below damp line to prevent decay. It is also very desirable to cresote or otherwise apply a preservative to all piles before they are driven. Where the piles are too far apart to receive directly and centrally the stone footings, heavy timbers should be laid longitudinally on top of them, and the spaces filled in with concrete. Should the semi-fluid nature of the ground be such that ordinary piling will not suffice for a foundation bed, recourse must be had to some special treatment, somewhat in the line of one or more of the following ways: Along both sides of where the wall is to be built, sheet piling is driven in to a sufficient depth (usually not more than from six to ten feet) to retain the semi-fluid soil. If the ground be not too fluid, the soil between the piles may be to some extent compacted by driving in compressing piles. Considerable judgment will have to be exercised as to whether such compacting is possible or not, or the result may be an aggravation of the mucky state of the soil between the sheet piling. In any case, some compact footing must be formed over the soil between the sheet piling, usually by a bed of concrete, sometimes by partial excavation and refilling with layers of sand. Still another method, when the soil is very fluid, is by planking and then filling in with concrete. Sometimes when solid ground may be reached at considerable depth, hollow iron cylinders are sunk, the soil inside removed, and the whole inside built up with rubble or concrete, thus forming solid piers to support the superstructure.

In the case of foundations under water, the usual method is to sink caissons or construct cofter dams, and then remove the water from inside of same until the piers or walls are built. But the further consideration of subaqueous foundations is rather a branch of civil engineering than a simple problem in architectural construction.

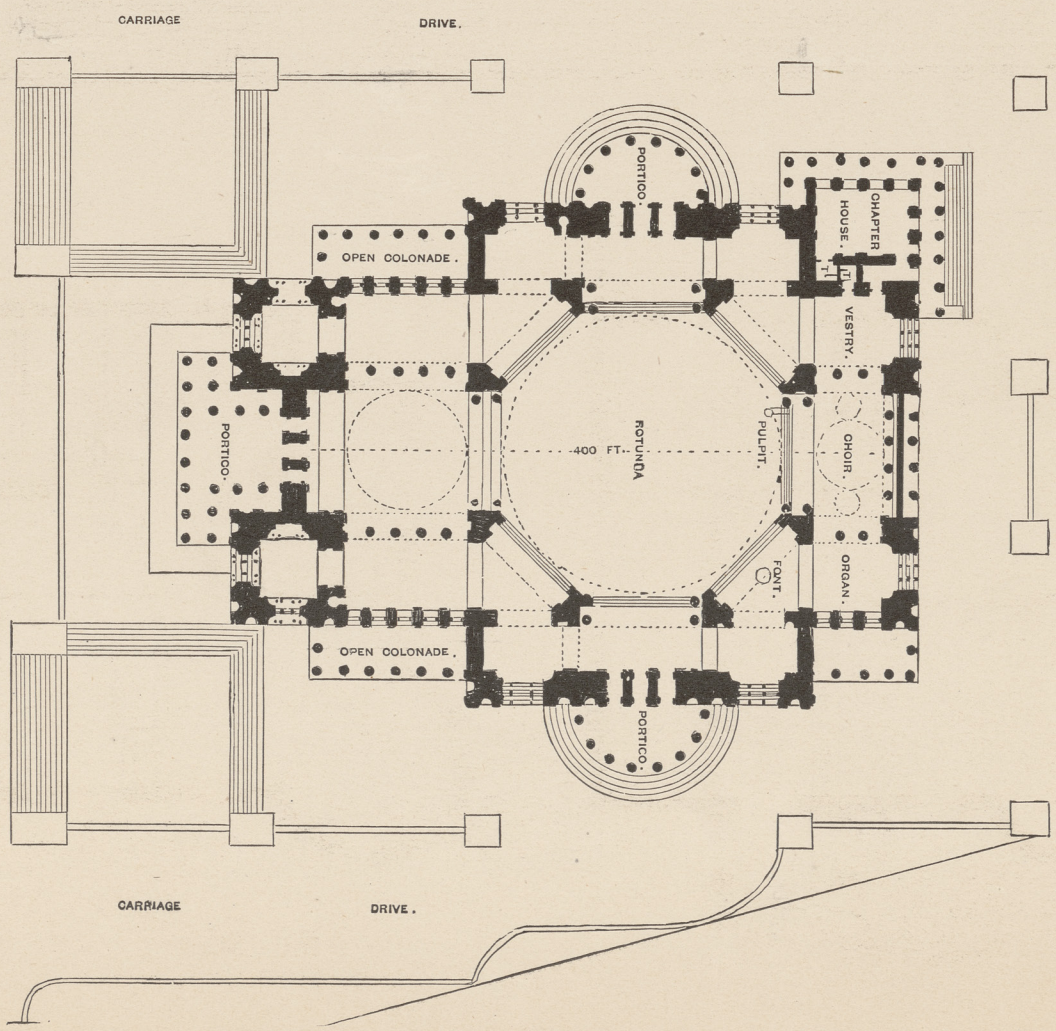
Fourthly—the most difficult problem of all is, when the different portions of the same foundation bed are of considerable difference of density. When the soft places are narrow, they may be overcome by arching or lintels. When the soft strata is of limited depth, a series of piers may be sunk to the

*Paper read by Mr. H. P. Gordon before the first Annual Convention of the Ontario Association of Architects.

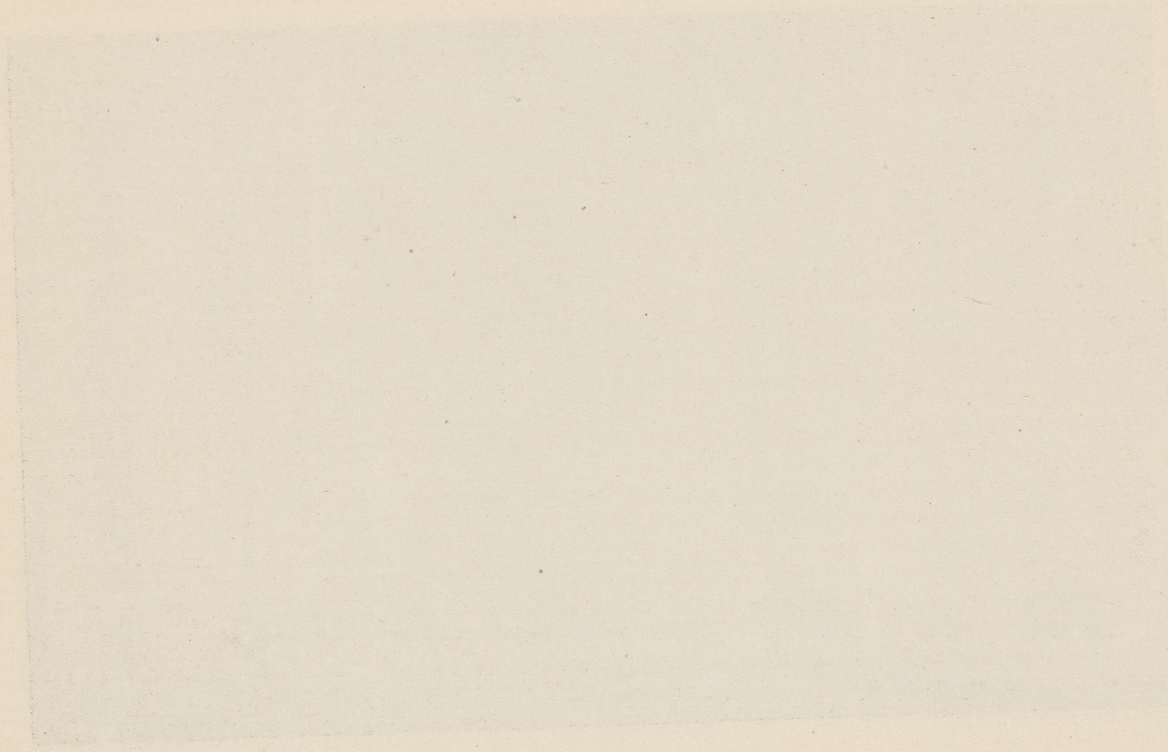


INTERIOR OF ST. MARY'S CATHEDRAL, HAMILTON, ONT.

Jos. Connolly, Architect, Toronto.



PLAN FOR CATHEDRAL OF ST. JOHN THE DIVINE, NEW YORK.



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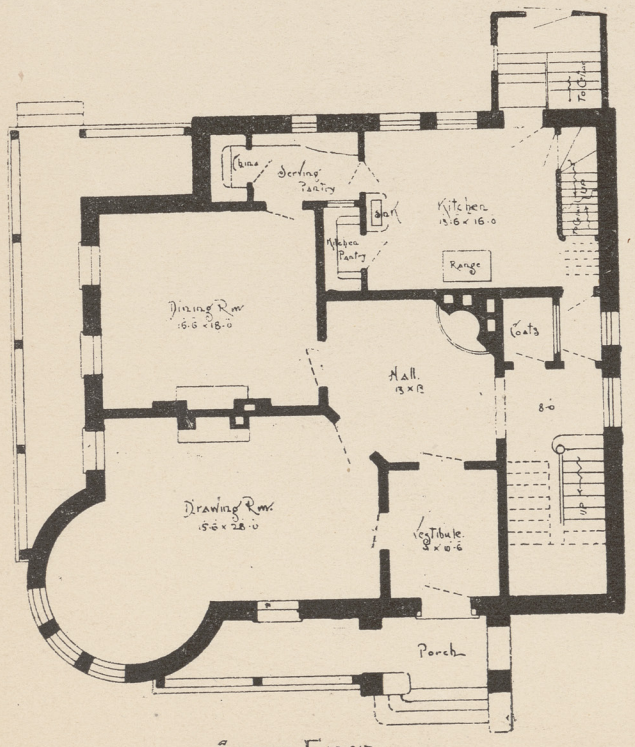
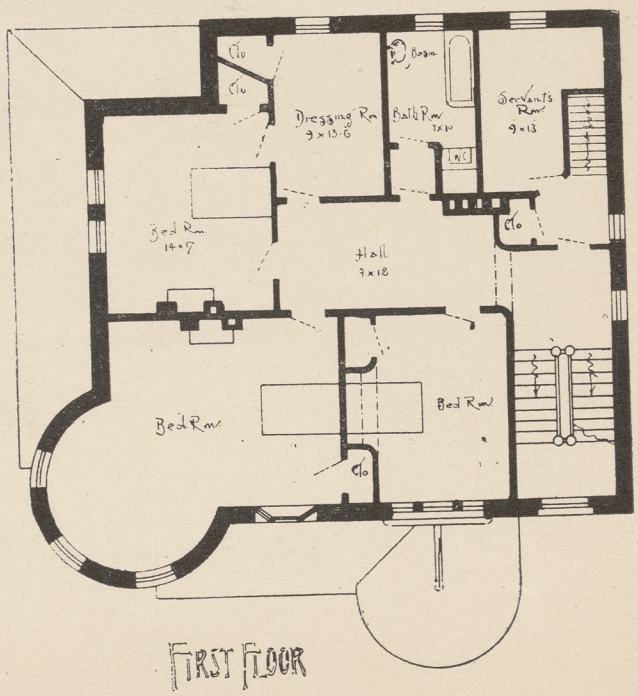


GROUND FLOOR

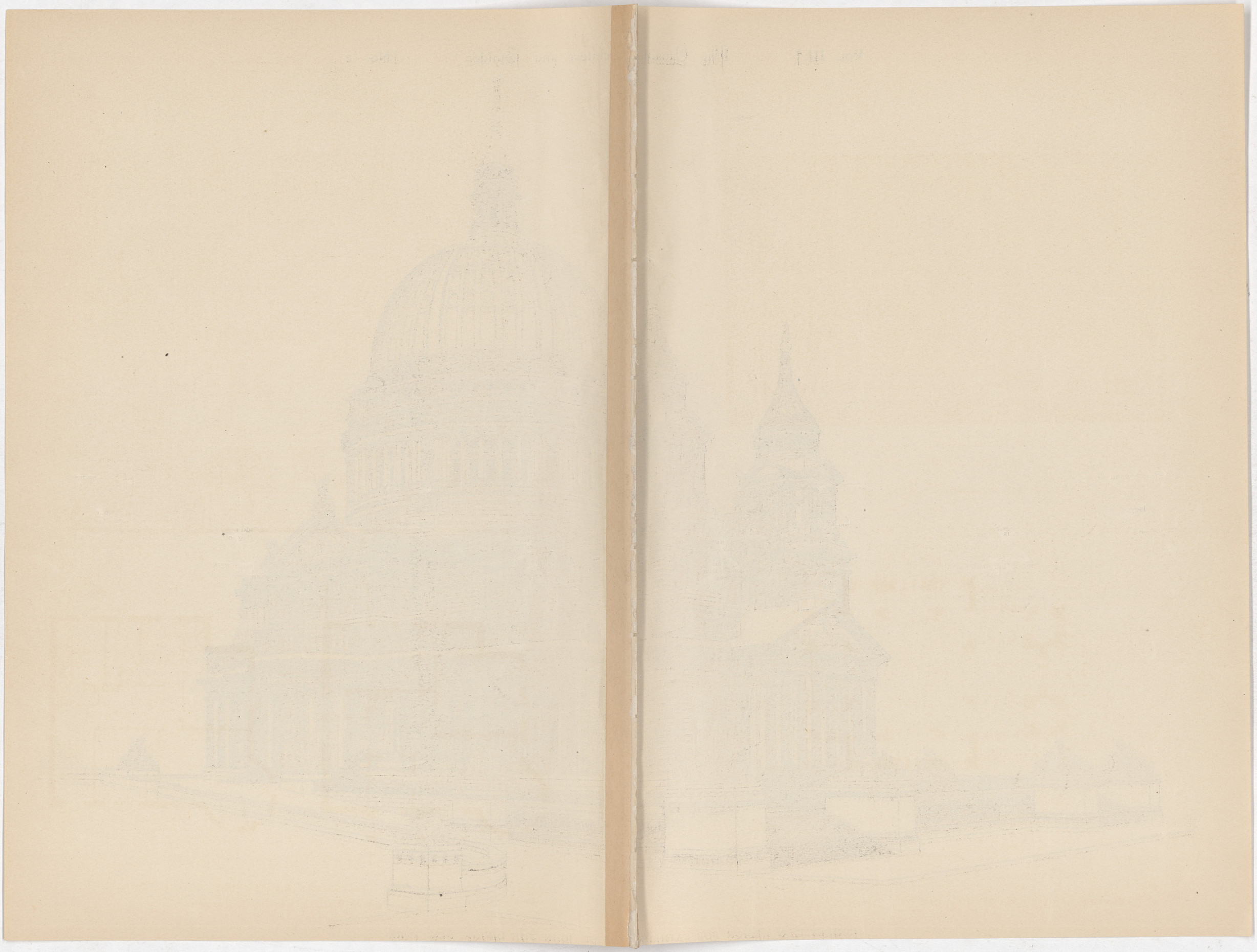


FIRST FLOOR

RESIDENCE FOR MR. THOMAS MARKS, PORT ARTHUR, ONT.

EDWARDS & WEBSTER, ARCHITECTS, TORONTO.

COMPETITION DESIGN FOR CATHEDRAL OF ST. JOHN THE DIVINE, NEW YORK.



solid bearing underneath. When the reaching of a solid substratum is not feasible, the only method is, to so proportion the width of footings in the various places in relation to the compressibility of the various soils, that settlement may be uniform. When, however, part of the foundation is on solid rock and the other part on compressible soil, the difficulty is very hard to be overcome. Under such circumstances, if the character of the building will admit of it, the superstructure should be built with a straight independent joint over the point of junction between the rock and soft soil, so that any settlement of the latter may occur without disturbing the rest of the building. In the case of continuous cornices, base courses, etc., allowance can be made in building for the probable settlement. Frequently, however, the style of the building will not admit of this division showing above ground; then recourse will have to be made to two or three expedients: By building the foundation walls up to ground line with ordinary mortar, where over rock, and with cement, where over soft soil, the sinkage of the mortar joints may in some measure counterbalance the sinking of the other part of foundation when the superstructure is imposed. Advantage to a limited extent only can be taken of the flexibility of the walls, by adopting something like the following methods: Form a continuous and solid concrete bed over the soft portion and allow the end of it to rest on the rock. This bed may be stiffened by the use of iron beams bedded in the concrete. The end furthest from the rock must extend considerably beyond the end of wall above, and the foundation be built with a good batter or wide offset, so as to give an extended bearing at that end. In building on such a bed, great care and judgment must be used in raising the work slightly higher at the free end than at the solid rock end, also giving the vertical corner a slight batter inwards, so that when all has settled to its place, the horizontal courses may be found level, and the end perfectly plumb. It is, however, over the point of junction of the rock and concrete foundation, that a crack may be apprehended, and to avoid this, strong wrought iron ties should be built in at short intervals all the way up walls.

Having briefly enumerated the principal kinds and characters of foundation beds, the next point that claims attention is to properly determine their size and relation to the weights to be carried. Here one point needs special emphasis, viz., the centre of the bearing of the foundation bed or footing should be as nearly as possible perpendicular to the centre of the weight carried. If to any extent this be disregarded, and there be any compressibility of the foundation bed, the footings will sink most at the side heaviest loaded, and the superstructure be thrown out of plumb. With buildings in which the walls are of uniform height, and more especially without large openings near the bottom, a uniform continuous wall is evidently the best form of foundation. It distributes the load uniformly over a large area. Where there are piers or large openings near the lower portion of building, it is manifest that a continuous foundation wall would be very unscientific; for where the piers rest, there would be a heavy load, and where the openings are there would be a light one. In such cases, it is best to adopt the principle commonly known as the insolated pier method of foundations, each part of the building being considered separately and the weight of each section or pier estimated in relation to the footings to support it, so that there may be a uniform pressure over the whole of the foundation beds.

In the majority of buildings there are also the important questions of the different heights of walls, the fact that some carry floors and others do not, and that many walls have a much greater weight resting on some portions than on others. And here it is well to advert to the use and abuse of inverted arches as a means of distributing uniformly the weight of foundations. In scientific hands, and after full and accurate calculation of the thrusts, they are a very serviceable device, but with unskillful treatment and without consideration of all the facts, they become a source of unexpected trouble and great loss.

An important part, sometimes overlooked, is the consideration of the thrust upon the end piers or abutments and the making of them sufficiently strong to resist all lateral movement. 2nd. It is also important to determine that the thrust is uniformly distributed from the piers in direct ratio to the weight which each pier is to carry. Otherwise one pier with great weight will outthrust one with less weight, the inverted arch be disturbed, and a settlement inevitably occur. 3rd. See that the form of the inverted arch is such that the least lateral thrust is entailed. Usually when the piers are about the same weight, a half elliptic curve with diameters of two to three is best. 4th. See that the arch is solidly built, with every joint fully flushed up and each voussoir receiving its proper share of pressure. A good method is to form a cement centering on the foundation bed, and build the arch upon it.

While my purpose is not to treat of foundation stones or walls, I might conclude by referring briefly to the subject of footings. 1st. As to form, certainly they should always have flat beds and tops, and the stones laid on their natural beds. It is desirable that they extend clear across the wall but where this is not possible, the jointing should approximate, being in the centre. Under no circumstances should the lateral joint of a footing course be near the edge of the wall. The proportion of projection to the height of a footing will vary according to the transverse strength of the material used. With concrete and all artificial stones, the projection should not exceed half the height. With good quality dimension stones, the projection may equal the height. 2nd. As to material, footings should be composed of some material that can stand great pressure and is not adversely affected by alternations of wet and dry. Granite, gneiss and slate stand in the front rank; limestones and marbles are also very good; but some limestones do not stand a great pressure, and their transverse strength is sometimes not very great. Sandstones are of such varying strength, that each sample must be considered on its own merits. Friable sandstones are of little value for such constructional work. Extra hard burned brick may be used where there is not much exposure to alternations of wet and dry. Brick footings should always be laid in cement, and the projection of each course should not be more than one inch, except under light walls.

Finally, to sum up the whole matter, in order that suitable foundations may be provided to our buildings, it is necessary that we carefully consider the weight and form of the superstructure; the character and bearing power of the foundation bed; the form, size and position of the footings, and the character of the materials used.

If in any way this paper shall have directed your attention to a further and deeper study of these important matters, the purpose of its presentation will have been accomplished.

DISCUSSION.

Mr. Bousfield, in moving a vote of thanks, referred to some interesting discoveries which had been made in excavations in Nottingham.

Mr. Gregg seconded the motion, and asked if it was not better when using small stone, not to make the joint run through the centre of the wall, but to lay them alternately so that the joint would surry, so to speak. He thought the best plan was to have the stone go two-thirds through the wall and repeat in the opposite direction. This would make a better wall than one with a regular joint down the centre.

Mr. Gordon said it was an important thing to make allowance for the weights on the piers. When the building was occupied, frequently there would be a great difference.

The Chairman said that in his judgment it was undesirable that there should be a centre joint in the walls.

QUEBEC.

(Correspondence of the CANADIAN ARCHITECT AND BUILDER.)

THE municipality of St. Sauveur, the scene of the great fire in May last, has now become part and parcel of the city. It has been divided into two wards, each returning one alderman and two councillors to the city council. Electric light poles have been planted through the new wards, and in a short time our new fellow-citizens will be able to congratulate themselves, with the rest of the Quebecers, on living in the best lighted city in America. A police station and a very fine fire station have been established, and in the early spring, water mains and drainage will be laid through the principal streets of the new wards, a boon alike to them and to the city proper, which has ever been threatened by the fearfully unsanitary state of St. Sauveur under its late government.

Two additional buildings to those named in my November correspondence have been put up on the newly-widened St. John Street, one belonging to the heirs De Blois, and the other to Mr. P. Cote. The former is built of fine cut stone, with trimmings of cast iron; first storey contains two stores with plate glass fronts, with dwellings above. Messrs. Lortie are the contractors; Mr. Peachey, architect. It will cost about $10,000. Mr. Cote's is a very plain structure of red and white brick, and will probably cost about $4,000.

Some new contracts have been let, while most of our architects are at work on plans for buildings to be constructed in spring. Work will be abundant next summer, and high wages will in all likelihood have to be paid.

Our city council, with the wisdom peculiar to all city councils, has resolved upon a very large scheme—no less than the construction of a $200,000 city hall! Architects are invited to send plans in competition, the prizes offered being respectively $1,500, $1,000 and $500 for the three best designs. Very voluminous instructions have been issued for the guidance of competing architects, the whole showing that Mr. Baillairge, our worthy City Engineer, has given a great deal of attention to the study of the details of the proposed new building. The requirements are very distinctly set forth, and foreshadow an immense and costly edifice—one which it is feared will exceed the limit of cost named in the instructions, viz., $200,000. The appropriation is not immoderate were it not that citizens, even with the thermometer at 10° or 15° below zero, and beautiful snow roads, remember the usually filthy state of our streets, and the fact that the corporation is always pleading "no funds," either for street cleaning, or (so far at least as last summer is concerned) for new sidewalks, our wooden ones blossoming forth in green grass, and our stone ones so out of shape and level as to set people wondering how far back in the past century they may date. It is to be noted that the advertisement distinctly says that the architect securing first prize will not necessarily be allowed to secure the larger plum—commission for superintendence. Why, each one may guess for himself.

MONTREAL.

(Correspondence of the CANADIAN ARCHITECT AND BUILDER.)

THE season is yet early to forecast the prospects of building during the coming year, although the late mild weather has had the effect of reminding one that spring is near at hand, and building operations will soon be in full swing. No doubt the coming season will by force of circumstances be a rather busy one if not interfered with by strikes.

Notre Dame street, from McGill to Chaboillez Square, is to be widened to 60 feet, which will cause all the buildings on the south side, with the exception of the Balmoral hotel, to be taken down and rebuilt, besides several on the north side. Some few contracts have already been let for private residences, and others are now being tendered for.

PLASTERERS ON STRIKE.

The dispute between the master plasterers of the city and the journeymen plasterers, which has been pending for about two years, reached a climax yesterday morning when all the journeymen plasterers went on strike. The chief point of dispute is that of wages. Two years ago it was patched up by an agreement between the Master Plasterers' Association and the Plasterers' Union, that $2.50 should be the rate of day's wages, which was continued up to May of this year. The plasterers are now demanding increased wages to take effect after the 1st of May, and they also complain that some bosses violated the agreement by receiving more than two apprentices. On Thursday last the master plasterers were notified that unless they agreed to pay their men $3.00 after the 1st of May next, the journeymen plasterers would go out on strike on Monday morning. A meeting was held on Saturday, and the men were asked to appoint a deputation to meet them. The men worked as usual on Monday, but on Tuesday morning struck.

I learn that the master plasterers have taken legal advice, and although they announce themselves willing to meet the men, are considering the question of proceeding against them if they hold out. Of course the strike has come at a very busy season, and will inconvenience every body engaged in the building business who have contracts on hand to be finished in a specified time. Not only will it affect plasterers, but every other branch of the building trade.

It is now high time that the Government took this matter of the Trades Unions in

hand and declared them illegal, but unfortunately it is difficult to find a Government who have the courage of their own convictions sufficiently to legislate for the good of the country—they prefer to cater to the popular vote. If the plasterers keep on demanding higher wages, the effect will react upon themselves and capitalists will prefer not to build, or the architects will have to consider some substitute for plaster. Another important question which arises is, who is responsible? The contractor says he is free from responsibility of fulfilling his contract in a specified time, owing to an unforeseen strike. If there is no recourse against the strikers, and the builders are not responsible owing to the strike, then the only person who suffers is the proprietor. This seems to me wrong, that a private individual who contracts with a builder for the erection of a house which he is either to occupy himself or has leased to another, is to be at a loss, or inconvenienced, because certain trades want to force the master builders into paying wages for work which is not yet contracted for. Certainly it seems to me that the person building least of all should be the one to suffer loss, and have no doubt in my own mind if a test comes before the courts, the responsibility would fall on proper shoulders.

PERSONALS.

Mr. G. W. King has retired from the firm of King & Gouinlock, architects, Toronto, and has formed a partnership with Mr. A. R. Denison, of the same city.

Much regret has been occasioned by the death since our last issue of Mr. W. J. Boon, one of the most widely known and respected master builders in the city of Toronto.

By the death of Mr. John G. Howard, of Toronto, the architectural profession of Canada has lost another of its pioneers. Mr. Howard was born near London, Eng., in 1803, and in 1832 came to Canada, where for many years he practised his profession with much success. He planned the present St. Lawrence Hall and market buildings, Toronto. In 1834 he gained the premium of £30 for laying out the market block; in 1836 the premium of £45 for the Toronto Gaol and Court House; in 1837 the premium of £45 for the Gaol and Court House, London, Ont.; in 1841 the premium of £25 for the new market at Kingston; in 1842 the premium of £50 for Queen's College, Kingston; in 1844 the premium of £30 for the Lunatic Asylum, Toronto. A few years ago Mr. Howard presented the City of Toronto with the beautiful property known as High Park, reserving for his own use until his death Colbourne Lodge, where he resided, and about 45 acres of land, which property now reverts to the city, together with his magnificent collection of oil and water color paintings.

PUBLICATIONS.

We have received a copy of the second volume of Mr. M. T. Richardson's "Practical Blacksmithing." This volume opens with a brief treatise on the early history of iron and steel. Artistic iron work is next considered, and the tests employed to show the strength of iron are given. The book contains numerous illustrations. Mr. T. Richardson, publisher, New York.

Our English contemporary, the *Builders' Reporter and Engineering Times*, comes to us reduced to a more convenient form, improved typographically, and bearing other marks of increasing prosperity, which we trust it may long enjoy.

The prospectus of the *American Architect* for the present year includes a series of papers on "Ancient Architecture for the Use of Students," by R. W. Gambier-Bousfield, architect, Toronto, Ont. Mr. Bousfield is well fitted to write on this subject, and will no doubt succeed in presenting in condensed form, details of ancient architecture which students would otherwise have to search many volumes through to gain possession of. Such knowledge as is proposed to be given is indispensable to enable students to make intelligent use of the numerous details characteristic of the various styles and periods of architecture.

Wood fiber bath tubs are said to be coming into use, and it is claimed they have the advantage of being movable and readily cleaned, the pipes are easy of access, and they do not, like stone or metal, chill the water and the bather. These tubs are grained on the outside to imitate any desired wood, and inside to look like enamel.

A most enjoyable evening was spent by the Toronto Master Plumbers' Association on the occasion of their annual meeting and supper. The proceedings were presided over by Messrs. W. J. Guy and John Ritchie. The latter in an interesting speech reviewed the city's progress since he first came to reside in it, in 1857. Mr. John Keyser, Secretary of the New York Master Plumbers' Association, was among the invited guests. He remarked in the course of his address that the plumbing done in Canada was superior to that of the United States. The officers elected are: President, W. J. Guy; First Vice-President, D. W. Kinghorn; Second Vice-President, Thos. Cook; Secretary, H. Hogarth; Treasurer, John Ritchie; Sergeant-at-Arms, Caleb Weeks.

A correspondent writes to the *American Engineer* as follows: "We are heating four greenhouses, each 75 x 21 feet, and one potting shed 50 x 20 feet, also one propagating house 50 feet long; using the "over-head and return under-bed" system of piping. We use two 2½-inch steam flow pipes in each house overhead and seven 1-inch return pipes. The boiler is a No. 7 Furman brick-set, and it heats all our houses on from ¼ to 1 pound of steam. The entire heating arrangement works to a charm. The boiler, especially, extracts about all the heat from the coal whether run on a small or a brisk fire. It makes steam on a run, and the effect is instantly felt in the houses. We consider it a complete success and far superior to hot water, by which we warm some of our other houses.

SANITATION AND HEATING

"CANADIAN ARCHITECT AND BUILDER" COMPETITION ESSAY ON "PLUMBING."

BY "LUCIUS ORDO."

ONE of the most important subjects to be dealt with in connection with modern house planning, is that which comes under the head of plumbing, that having probably more to do with the health and comfort of the inmates after the house is completed than anything else. The introduction of plumbing-work into a house is, broadly speaking, for two reasons: to bring in a good and sufficient supply of pure and wholesome water, and to afford adequate means for its disposal after use, together with human excreta and other waste matters, this refuse being generally comprehended in the term "sewage."

There can be no doubt that the simplest and most direct means possible are the best for accomplishing these objects, and in designing the plumbing system, simplicity and first principles should be continually kept in mind. In order to obtain a full inspection of the work at all times, and to prevent accumulation of filth in dark corners and consequent pollution of the atmosphere, all pipes, etc., should be fully exposed to view, and this, in fact, is the only sure way of securing first-class workmanship, for there are plumbers who, knowing their work will be covered up immediately on completion, care very little about the results if only they can get their job completed. Not so very long ago, a practical illustration of this came to notice, and that too in a house where all fixtures were exposed. In the main part of the building, the work was so well done as to attract particular attention; the joints of both lead and iron pipes were everything that could be desired, and the bends of full bore throughout were so well done and symmetrically arranged, as to be an ornament rather than an eyesore to the rooms in which they were placed; but in peering about the cellar, a lead waste pipe was discovered, partly hidden by the ground floor joists, in which the bore at the two bends in it was decreased fully one third, thus forming a serious means of obstruction. This only shows that where there is the slightest chance of the work being hidden, it is apt to be negligently carried out. The main pipes should be arranged so as to pass down in inferior rooms or closets, or else in chases specially prepared for them, the last mentioned way being least commendable, as in some cases it gives a pretext for careless jointing. If objection is made to the pipes being exposed, they could be covered with wood panelling, but this should only be screwed together to allow of easy access to the pipes. All fittings should be as little encased from view as possible; in fact, only the barest requirements in the way of casing should be conceded to. There is no earthly reason why every fitting should be shut out from sight as the custom has been for so long. If the work is well done, it is far from being an eyesore, and in the better rooms and more public places, the fittings could either be made entirely of brass, or else nickel-plated; and if safes are deemed necessary, they can be of marble, although the necessity for safes when all the fixtures are exposed is not quite apparent, for a leakage could not remain unnoticed long enough to do any damage, and in this case a superfluous appendage of the plumbing system might be done away with. This principle will be found to work best all through, for the simpler and less complicated the whole thing is, not only will it be less liable to get out of order and require frequent attention, but the cheaper it will be in the first place. Of course it is not to be understood that cheapness is to be of primary importance. By no means. Let enough money be spent to secure a thorough job. There must be no stint in that, but superfluities ought to be avoided. The amount of cold metal which goes into a house now, bears an alarming proportion to the cost of the whole building, and certainly economy in this respect ought to be regarded as much as possible.

There can be no question that metal pipes only should be used inside a building. The unreliability of cement joints in earthenware piping, and the danger arising from the pipes themselves being so easily broken, ought to preclude their employment in that connection altogether. The defects of other systems of house drains that have been made use of are so glaringly apparent, it is not necessary to mention them. On the whole, iron is more suitable for soil pipes than lead, at any rate in this country. In England where the wastes from baths and basins are not emptied into the soil pipe, and where the pipe itself is always outside the house, no doubt lead pipe may be suitable; from the universal use of it in that country one would gather that it is, but in this climate it is necessary to have the soil pipe not only inside the house to prevent it being choked up by freezing, but if possible against an inside wall, and the superiority of iron in a case like this can at once be appreciated. It is not only lighter and stiffer, but less liable to injury, such as by nails being driven through it, etc. These are important points inside a house, and then, with all wastes running into it, a lead pipe would soon be deteriorated by the action of hot water from baths, etc. Taking all this into consideration, with the fact that iron requires the least means of support, there is no hesitancy in claiming that it is the most suitable material. It can be cast into almost any shape, and in fact, the patterns usually kept in stock will meet any ordinary requirements. For the smaller branch wastes, etc., lead pipe, which is more easily manipulated, is generally used; and for these purposes is doubtless the best.

As a rule, *cast* iron is used both for soil pipes and house drains, and no doubt is very efficient; but for the upright pipes, wrought iron with screw joints, which is now being extensively used, is probably better, for where there is apt to be any pulling strain, occasioned by settlement or otherwise, the lead joints of cast iron pipes soon give way, and allow sewer gas to permeate the house. Then again, the heavy bells have rather an ugly appearance when exposed to view, and take up a great deal of room. Wrought iron pipe is also made in much longer lengths than cast iron, thus necessitating fewer joints.

When cast iron is used, it should be of extra heavy quality, and the hubs should be strong enough to allow a good caulked joint to be made, as these are the only joints ordinarily used which can be relied upon at all. It should be straight and perfectly smooth inside, and to insure against all flaws and defects, should be thoroughly tested by hydraulic pressure before being coated by coal-tar, which is done to prevent corrosion. As the efficiency of the pipe system depends largely on the joints, great care should be taken to see that these are all well executed.

The pipes should be placed within one another in as straight a line as possible, and a gasket of oakum well rammed into the hub between the two pipes to prevent the lead from entering the joint and forming an obstruction. Although some consider it better to pour in the molten lead in two separate

portions to allow of better caulking, it seems preferable that it should be poured in one continuous flow, as the joint will then be more homogeneous. When the metal is cold and has contracted, it should be well caulked. This is a very important operation, and should be insisted on to secure a thorough tight joint.

As before stated, the superiority of wrought iron pipe is chiefly due to the better method of jointing, which this material allows of. The screw thread is usually slightly tapering, and to make up for any flaws which may be in the thread, a mixture of white lead, linseed oil and red lead is used in making the joints, which hardens in a short time, and makes a perfectly tight connection. Wrought iron pipe needs to be protected against rust and corrosion, and for this purpose is usually dipped into hot asphalt after having first been heated.

The best way of connecting the lead pipes, is by means of wiped joints, and care should be taken in making these that there is no burr left in the pipe after being showed, which might form an obstruction—also to see that the inner pipe is not contracted at all by the outer pipe being insufficiently opened. These joints, when well finished, should present a rotund symmetrical appearance.

The usual way of joining lead pipes to cast iron, is by using a brass ferrule connected to the lead pipe by a wiped joint, and caulked into the iron pipe with oakum and lead. When wrought iron pipe is used, connection is made by means of a screw joint.

It has been a very common mistake in the past to use soil pipes of too large a diameter. This is almost as bad as having them too small. It is impossible for 5″ and 6″ pipes to be properly flushed by the usual amount of water sent down them. As a matter of fact, a 4″ diameter is quite sufficient to prevent any obstruction, and this size allows a good flushing of the pipe. A 3″ pipe could even be used where there is only one water closet.

It is preferable that the house drain, instead of being buried from sight, should run fully exposed along a cellar wall, or else suspended from the ceiling. This method, besides allowing the drain to be fully inspected at all times, admits of a proper fall being given it, which is sometimes hard to do when buried. If there are fixtures in the cellar, however, this is impracticable, and the drain must run below the floor. When this is the case, and it is not placed in a trench to be accessible throughout, it should at least have cleaning hand holes at all junctions, near bends, etc. No junction should be made at right angles, Y branches only being used, and thus facilitating the flow as much as possible.

The system of pipes should be thoroughly ventilated. Even if gas from the sewer is prevented from coming into them, the air is always foul from use of the fixtures and filthy matter which to a certain extent coats their insides. For this reason the soil pipe, which should always be carried up in as straight a line as possible, should be extended at least full size up through the roof, and there left perfectly open. Ventilating hoods are no use on a soil pipe, and only impede the flow of air. This extension should be kept well out of the way of dormer windows, skylights, chimneys, etc. To secure a constant circulation of fresh air through the pipes, an inlet should be provided at the lowest point of the system, wherever there is no danger of freezing the water in the traps. In some localities the fresh air inlet has had to be dispensed with on this account, but all the same, where it is practicable it is better. The upward flow of air in soil and waste pipes is greatly helped if they can be arranged near a heated flue.

With any amount of ventilation, however, the system would still be imperfect if there were nothing to prevent sewer gas entering the house at the fixtures. To effect this, some barrier is necessary which will not impede the flow of waste matter, and at the same time will prevent the return of any foul air. The most efficient way of obtaining this is with a seal of water, which is gained in the simplest manner by a bend or dip in the pipe.

There should be a trap under every fixture, and that as near as practicable to the outlet, to prevent gases rising from the sewer to the soil and waste pipes. A trap should also be placed on the house drain between the fresh air pipe and the sewer. This trap should be provided with a cleaning hand hole—as indeed should all the traps—and when outside the house, should be accessible by means of a man-hole. Some sanitarians condemn the use of a trap in this position altogether, claiming that the soil pipe might be made use of to help ventilate the public sewer, but it hardly seems right to accomplish this by using the pipes in private buildings. To be secure against the danger of diseases being carried from house to house through the drain, perfect isolation from the sewer ought to be insisted on, and this can only be accomplished by trapping the house drain.

Traps in themselves are evils, as tending to impede the flow of water and sewage, but being absolutely necessary, the only thing which can be done is to use the best form which has been devised. The fundamental principle of all traps is, that they shall allow of the whole water in them being entirely changed every time they are flushed. Round pipe traps have been found by experience to be the best for this reason, and the forms most commonly used are the S. P. running traps. There is, however, a great danger of these traps under certain conditions losing their seal by siphonage, and also with being forced out by air pressure. To overcome these difficulties, almost every conceivable form of trap which could be devised has been made use of, but it has been found that those which are most efficient in this way are not self-cleansing. It was chiefly on account of its non-siphoning qualities that the filthy D trap was used for so long, but the objections against such a form of trap are so numerous as to preclude its use altogether in any place where the work is carried out on sanitary principles.

It is hardly necessary to describe the great number of traps now in use, for although many of them are very efficient for some purposes, there is none which can be so safely used for general requirements as the S trap, if properly protected against siphonage and back pressure. Siphonage takes place when atmospheric pressure is greater on one side of the trap than the other, and this is caused by a partial vacuum being created by the disturbance of air which takes place when a discharge is being sent through the soil pipe. To prevent this vacuum, and to render the trap safe against back pressure, a vent pipe is carried from the crown of the trap, connecting with the outside air. This also helps to perfect the system in another way, by completing the thorough ventilation of it, and thus preventing an accumulation of foul air in any of the pipes. Objections have been made against this method that it greatly complicates the plumbing apparatus, and at the same time increases the evaporation of water in the traps, but from recent experiments made by Mr. Glenn Brown at the Museum of Hygiene, U. S. Navy Department, it has been shown that evaporation is hardly increased at all by using the air pipe. Against the other objection no stand can be taken; it does complicate matters, but until the ideal trap has been evolved, that is, one which with a sufficient seal will be self-cleansing and non-siphoning, this is the only system which can be safely employed.

The vent pipes should in all cases be large enough to prevent frictional resistance to air passing through them, and in very high buildings the diameter will have to be increased in proportion to the length of pipe. It is not necessary to carry a separate vent pipe through the roof from each fixture; a main pipe can be taken from the lowest fixture and branched into the soil pipe above the highest, all other vents being connected with this one.

The fixtures themselves should be of the simplest possible character, and as far as practicable should be arranged in groups vertically above one another. All rooms containing these fixtures should be well lighted and ventilated, and not, as is often the case, be relegated to the most remote and unventilated corner of the building.

There are two classes of water closets made use of: those with movable parts, such as the pan closet, the valve closet, and the plunger closet; and those without movable parts, such as hopper and wash-out closets. Those not having movable parts are the only ones which should be used, the other class being liable to quickly get out of order and soon fouled.

Hopper and wash-out closets are flushed through means of a flushing rim, which is supplied by water from a flushing tank fixed at a suitable height above the bowl. The efficiency of these closets depends on the water flush to a very great extent. The best material for all fixtures of this kind is that which presents a smooth and non-absorbent surface, and for this reason, glazed earthenware is chiefly used.

Where urinals are employed, which should never be in private houses, they should be automatically flushed, and the basin should be shaped so as to hold a certain amount of water. This insures less pollution of the atmosphere, as the urine is diluted at once.

Kitchen sinks are preferable if made of earthenware, which has many advantages over the materials ordinarily employed for this purpose. Their outlet should always be protected by a strainer to prevent obstruction of the pipes, and a vented S trap should be used in preference to most other traps. The bell trap should not be employed under any consideration. The "Sanitas" flush pot seems to be an excellent arrangement, and if employed would save the expense of back venting.

To get rid of the hidden overflow pipe in baths, basins, etc., which is apt to become foul and cause an annoyance, many different arrangements have been tried, but the most satisfactory of all is that in which a standing overflow is inserted into the socket of the waste pipe, thus doing away with the use of the dirty plug and chain at the same time. To prevent this outlet being in the way when the fixture is being used, a recess for it to stand in should be formed.

The baths most generally in use are of tinned and planished copper, but as these require to be cased in, they are not as satisfactory as they ought to be. Enamelled iron or porcelain seem to be preferable materials, as these would allow them to be fully exposed.

It is hardly necessary to speak in detail of all the other fittings which are now used, but let it be sufficient to say that in choosing them, cleanliness and simplicity should be the first consideration. When safes are used, the drip pipe should on no account be connected to any waste or soil pipe, but should be made to discharge over the cellar or kitchen sink.

The water is usually brought into and circulated through a building by lead pipes. This has been condemned by some authorities, as lead poisoning may take place when the water contains certain acids, but brass and iron pipes have been recommended instead. Care should be taken to locate these supply pipes in such a way that they will not be liable to freeze.

All pipes should be graded to a point in the cellar, and provided with a stop and waste cock to allow of them being entirely drained when necessary.

It has been impossible here to enter fully into all details of the plumbing system, but a general survey has been given, and the most essential points touched upon. This is probably quite sufficient, for if the principles are understood, there ought to be no trouble in applying them to details.

MANUFACTURES AND MATERIALS

BURSTING PRESSURE OF LEAD PIPE.

THE following tables are taken from Rivington's "Notes on Building Construction":

	Lead Pipe.			Lead Encased Tin Pipe.		
Internal Diameter.	Thickness.	Weight per foot.	Bursting pressure in pounds per square inch.	Thickness.	Weight per ton.	Bursting pressure in pounds per square inch.
½	.2	2.3	1579	.14	1.3	1859
⅝	.2	2.6	1349	.13	1.4	1454
¾	22	2.8	1191	.15	1.9	1416
1	.2	4.1	911	.14	2.4	1265
1¼	.21	5.3	683	.13	2.7	835
1½	.24	7.1	734	.15	3.8	849
2	.21	9.2	498	.17	5.4	642

Deputations have waited on the government for and against a change in the tariff on wall paper.

The window glass manufacturers' association of the United States has advanced prices five per cent.

The Napanee Cement Works lately received an order for 1,500 barrels of their cement for the new Board of Trade buildings in Toronto.

The report comes from Winnipeg that the brick dealers have cornered the market, and that when the building season opens there will be a great shortage.

Messrs. McArthur Bros, of Belleville, Ont., contractors for the Grand Trunk double track, have opened a limestone quarry at Crookston, where they will employ 75 men and ship ten cars of stone per day.

CONTRACTS

CONTRACTS OPEN.

YARMOUTH, N. S.—$50,000 will be spent in street improvements.

CHATHAM, ONT.—A new Presbyterian Church is to be built here.

ELGIN, ONT.—A movement is on foot to erect a Methodist Church.

AVONBANK, ONT.—It has been decided to erect a new church this year.

BURLINGTON BEACH, ONT.—John McNeil will erect a summer hotel at once.

GUELPH, ONT.—A movement is on foot for the erection of a new drill shed.

WINGHAM, ONT.—It is the intention to erect a new Episcopal Church here.

ROCK ISLAND, QUE.—Messrs. Butterfield & Co., will build a machine shop.

SEAFORTH, ONT.—Mr. James Livingstone, of Baden, Ont., will erect a flax mill.

MORDEN, MAN.—A site has been secured for a new Methodist church to cost $4,000.

LACHUTE, QUE.—The Government is asked to erect a new post office building here.

AILSA CRAIG, ONT.—The Presbyterians are contemplating the erection of a manse to cost about $2,500.

FOREST, ONT.—The Presbyterians are looking for a suitable site on which to erect a new church next summer.

BEAUPORT, QUE.—A new Roman Catholic church to replace the one recently destroyed by fire, will be erected here.

WINDSOR MILLS, QUE.—A large Roman Catholic Church and school are to be erected here during the present year.

NEW WESTMINSTER, B. C.—It is proposed to erect a large three storey block on the corner of Columbia and Mary streets.

DENFIELD, ONT.—The plans prepared by Mr. John M. Moore of London, for the new Baptist Church here, have been accepted.

KINGSVILLE, ONT.—Messrs. Hiram Walker & Sons have purchased a piece of property near here, and will erect another large hotel.

PARIS, ONT.—A deputation will wait on the Ottawa Government to show the need of a new post office and customs house. A free site will be offered by the town.

LEAMINGTON, ONT.—The Oddfellows are talking about purchasing property and building thereon a three storey building, to comprise stores, lodgeroom and opera house.

BOWMANVILLE, ONT.—Mr. W. Bunney, architect, is preparing plans for the rebuilding and enlargement of the United Methodist Church in this town. The estimated cost of the proposed change is $12,000.

PETERBORO', ONT.—The Council has agreed to grant $2,000 towards the erection of an armory for the 57th battalion, on the condition that the county grants $1,000 and the Dominion Government $3,000 towards the project.

WINNIPEG, MAN.—The Mayor urges the necessity for the adoption of some scheme for the extension of the water-works system.—It has been decided to erect a suitable monument to the memory of the late Hon. John Norquay.—The Government will be asked to enlarge the Court House.

WEST TORONTO JUNCTION.—The Mayor suggests the propriety at an early date of extending the present conduit 2,000 feet further into the lake, thus securing purer and better water. He also suggests the advisability of employing experts to report on the best system of sewerage to accommodate 50,000 inhabitants.

BRANTFORD, ONT.—Two new Methodist Mission Churches will be built this year, one in Eagle place, and one on Terrace Hill.—Mr. Chipman C. E., has presented his report on the subject of sewage disposal. He recommends the immediate construction of a main sewer which will empty into the Grand river near the Mohawk church, at an estimated cost of $33,000.

KINGSTON, ONT.—The erection of a building for the Women's Medical College has been decided upon.—The Y. M. C. A. has purchased a site for a new building which will be erected as soon as funds shall have been subscribed.—Plans are being prepared for a summer hotel and club house to be erected next summer on Horse Shoe Island, by a joint stock company.

BROCKVILLE, ONT.—Application has been made to Parliament to incorporate the Thousand Islands Bridge Co., to build a bridge across the St. Lawrence River near this place.—Tenders are asked for by Geo. A. Allan, architect, for a brick and frame residence for Mr. A. S. Ault, probable cost, $6,000.—The School Board are considering plans for a four room school building for the west ward.—The Separate School Board propose erecting a school building on Pine St.

QUEBEC.—Several prominent gentlemen are said to be pushing forward the project of erecting a palace hotel on the site of the old Parliament House grand battery, overlooking the St. Lawrence.—The estimates of the local government for public works and buildings amount to $949,876. Of this sum it is proposed to expend $50,000 on colonization roads, and $10,000 in macadamizing country roads.—A new R. C. Church to cost half a million dollars, is to be built in St. Roch's ward; also a convent for young ladies.

LONDON, ONT.—A resolution has been adopted in favor of building a trunk sewer.—A number of new cottages are to be erected on the hospital grounds for the accommodation of persons afflicted with contagious diseases.—The Plympton Methodists are arranging for the erection of a new church.—At the meeting of representatives of Middlesex, Kent and Elgin Counties held here on the 5th inst., it was decided to call for tenders for an iron and stone bridge at Bothwell, with 220 feet span and 16 feet roadway. The bridge will cost, it is estimated, about $25,000.

HAMILTON, ONT.—Mr. P. B. Griffith has purchased a site at the corner of James and Herkimer Streets upon which he will erect a residence.—A committee of the Separate School Board recommends the erection at once of a new school, fronting on Sheaffe and Mulberry streets, and that Mr. R. Clohecy be appointed architect for the same.—The plans for the Bell Telephone Company's new offices on Hughson street have been approved by the head office, and the work will be commenced as soon as possible.—B. E. Charlton, J. Bruce, J. J. Stuart, M. Young and A. Bruce, all of Hamilton, are petitioning the Dominion Parliament for incorporation as the Hamilton Junction Railway Company, for the purpose of constructing a railway and erecting a central passenger station in Hamilton.

MONTREAL, QUE.—Plans have been prepared and a considerable amount of money subscribed towards the erection of a Masonic Temple, to cost from $100,000 to $150,000.—Ste. Cunegonde has decided to erect a new town hall in the spring.—Sealed tenders will be received until Feb. 18 for furnishing 1,000 tons of cast-iron water pipe, to be delivered in quantities and at dates stated in specifications. Address B. D. McConnell, Superintendent.—The Government of the Province of Quebec propose to