PAGES

MISSING

FIG. 1.—A GATEWAY.

FIG. 2.—UPPER PORTION OF GATEWAY.

FIG. 3.—SPECIMEN OF ROUGH MAORI WHARE.

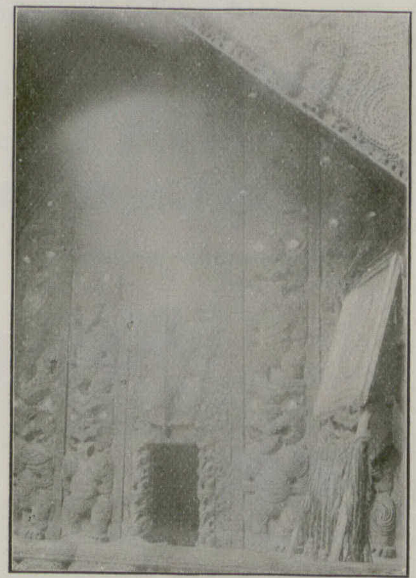

FIG. 8.—CARVED FRONT OF A PATAKA.

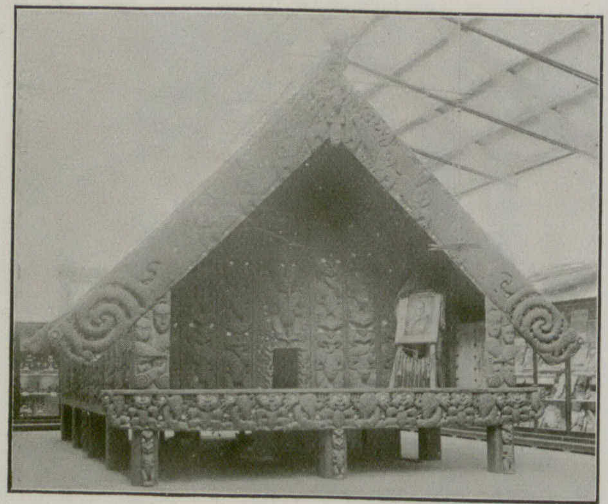

FIG. 6.—LARGE SPECIMEN OF A PATAKA.

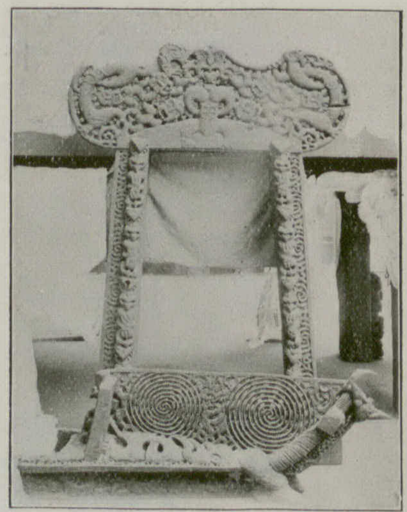

FIG. 12.—UPPER PORTION—ENTRANCE TO A WHARE PUNI.
FIG. 13.—LOWER PORTION—CARVED PROW OF A CANOE.

FIG. 10.—TWO DOORWAYS OF PATAKAS; CARVED WALL SLAB; TWO SMALL TEKO TEKO.

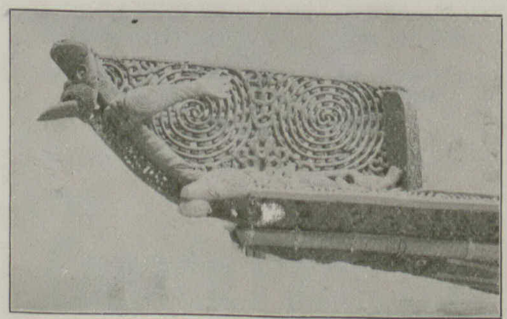

FIG. 16.—CARVING OF FIGURE HEAD OF CANOE.

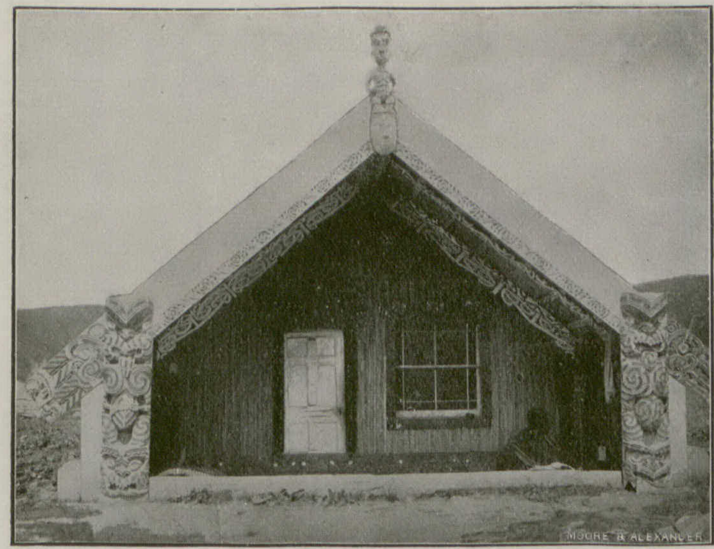

FIG. 4.—SPECIMEN OF HIGH-CLASS RAUPO WHARE.

FIG. 5.—A PATAKA.

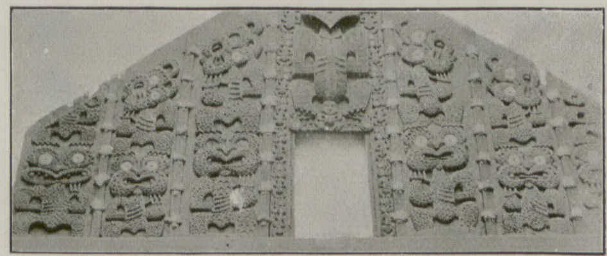

FIG. 9.—CARVED FRONT OF A PATAKA.

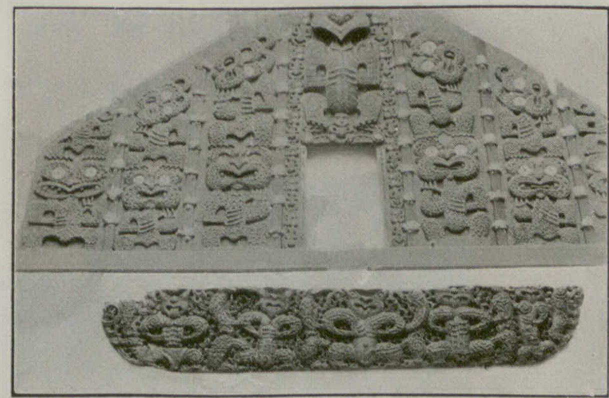

FIG. 11.—ANCIENT PIECE OF CARVING.

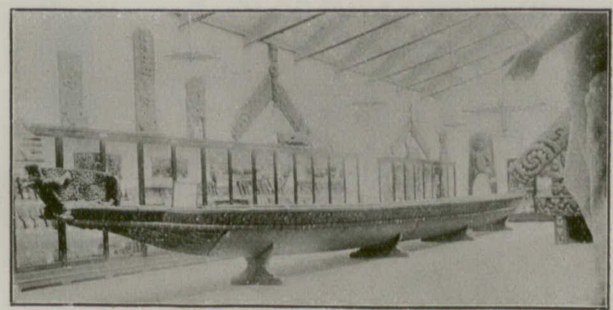

FIG. 14.—MAORI WAR CANOE.

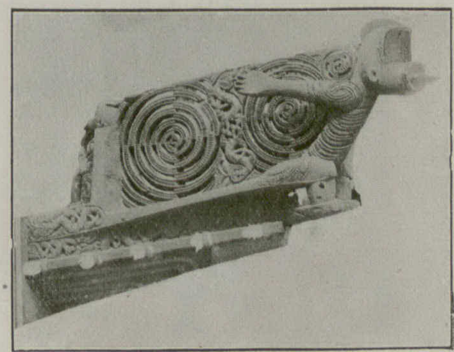

FIG. 15.—PROW OF CANOE.

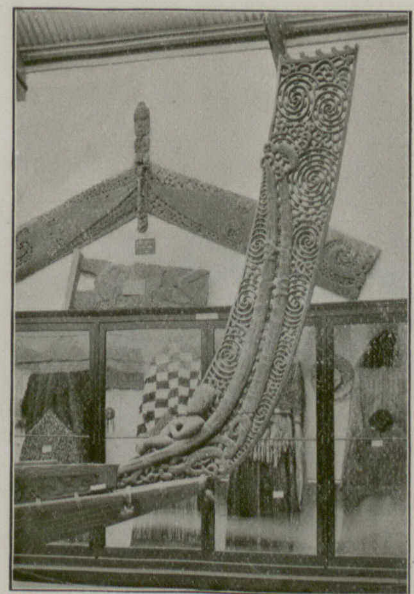

FIG. 17.—STERN POST OF CANOE.

FIG. 18.—TREATMENT OF FIGURE HEAD OF CANOE.

SPECIMENS OF MAORI ART, ILLUSTRATING ARTICLE IN THIS NUMBER BY MR. R. M. FRIPP, F.R.I.B.A.

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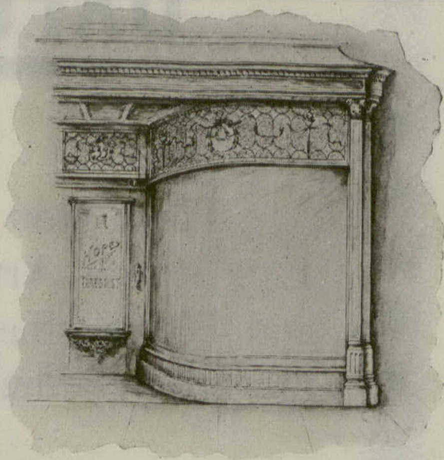

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CANADIAN ARCHITECT AND BUILDER.

VOL. XIII.—No. 5. MAY, 1900 PRICE 20 CENTS. $2.00 PER YEAR.

—THE—

CANADIAN ARCHITECT AND BUILDER,

A Monthly Journal of Modern Constructive Methods,

(With a Weekly Intermediate Edition—The CANADIAN CONTRACT RECORD).

PUBLISHED ON THE THIRD WEDNESDAY IN EACH MONTH IN THE INTEREST OF

ARCHITECTS, CIVIL AND SANITARY ENGINEERS, PLUMBERS, DECORATORS, BUILDERS, CONTRACTORS, MANUFACTURERS OF AND DEALERS IN BUILDING MATERIALS AND APPLIANCES.

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

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REMOVAL NOTICE.

On May 1st, 1900, the Montreal office of this publication was removed to larger quarters in the Imperial Building, 107 St. James street. Customers will always find the office open during business hours, and visitors in Montreal are extended a cordial invitation to call at the office, where they will be given every possible assistance and furnished with requisites for answering correspondence. The telephone number is Main 2299.

Ontario Society of Artists' Applied Art Exhibition.

THE promoters of this exhibition have done well to carry it out in spite of lack of encouragement from manufacturers and craftsmen who should have been the most interested in making a good exhibition of this kind. It may be that non-exhibitors know their own business. There is no Arts and Crafts Society—no recognized movement—at the back of this exhibition, as there has been at the back of the English exhibitions, of which this is an obvious imitation; and it may be that some manufacturers see no particular gain in helping to create such a movement if lack of help will leave things as they are. But this sort of holding back is always a mistake. Public taste is moving, and it seems to be moving in a wholesome direction. Whether by imitation of England or infection from the same source, there is a new taste arising, if indeed it has not arisen, which will no doubt be more easily defined in a quarter of a century hence than at the present time when it is in process of development, but which seems to have as its basis a new appreciation of the natural quality of material. A somewhat crude manner of design is the result in English work, with little moulding and an elementary form of ornament, something like a snaky water weed, which appears in every material—wood and stone carving, silversmiths' and other metal work, leaded glass, leather, wall paper, wall hangings, and painted decorations—in all alike appears this rudimentary vermiform weed. Something of the same kind is the characteristic form appearing in the carving of all primitive peoples, and it has made its appearance again, we can only suppose, according to a natural law of the human mind, in this nascent work of the young English school, indicating how far they have gone back to the beginning of art in shaking off the degeneracy of its late developments. We may assume that it indicates also that there is a great deal of development yet to come to the English work before it (still in obedience to law) degenerates. In the meantime, some of the exhibitors in the Ontario Society's exhibition have thought fit to adopt the peculiarities of the English Arts and Crafts Society's work with the same seriousness with which they would set up an Order. But there are many good things in the exhibition ; enough to show that we have designers and that the exhibition has been worth while to hold. If there is to be another in prospect at some fixed time in the future—say a year hence—this example will cause the future exhibition to be borne in mind during the year, and we may expect good results.

Fire Tests with Partitions.

THE British Fire Prevention Committee have recently published an account of two fire tests which are of general interest as giving some reliable evidence as to the fire resisting quality of partitions, both economical and occupying but little space. The partitions tested were an ordinary stud partition packed with what they call "silicate cotton" or "slag wool (evidently the same thing as our "mineral wool"), and a partition of wire lathing plastered three coats on each side, the whole resulting thickness being but 2½ inches. The testing chamber in each case was the same, a brick hut measuring 10 feet by 10 feet with a 7 foot 10 inch ceiling. There was a doorway at one end of the hut and the partitions were built about two feet in from this, so as to leave a passage in which the observers could stand to watch the effect of the fire upon this side of the partition. The fire was applied on the other side, which was closed except for draft holes and holes through which observation could be made and the water introduced to play for a couple of minutes upon the heated material as the final condition of the test. The fuel used was gas, and the supply was regulated by valves and dampers. There were instruments for recording the temperature at different points both within the fire chamber and on the protected side of the partitions. Both partitions were made thoroughly tight at walls, floor and ceiling with precautions unnecessary to mention, as forming part of that particular situation only. The plaster partition was laid on wire lathing of ¾-in. mesh, 19 gauge galvanized iron wire protected at the junction of the vertical and horizontal wires by ¼-in. terra cotta connections burnt on to the junctions. On this was plastered three coats, the first consisting of 1 lime to 4 sand, and four pounds of hair to each cubic yard, and also of lime and "burnt ballast," in the proportion of 1 lime to 2 burnt ballast. These materials were incorporated in equal proportions, and plaster of Paris was added in the proportion of 1 part to 3 of the incorporated stuff. The second coat was of the same materials. The third consisted of 2 lime to 1 plaster of Paris. In 4 minutes after the heat was turned on there were hair cracks on the passage side of the partition, which increased by degrees, and after a time steam came through the cracks. The partition itself became too hot to bear the hand, the heat beginning at the top and extending gradually downwards ; but until the time the test closed—25 minutes—it was never possible to ignite a vesta by contact with the surface. The thermometer in the passage rose from 38.5° Fahr. to 100°. The water turned on for two minutes on the inside of the partition at a pressure of 20 lbs. washed off some of the two upper coats of plaster, at the point where it struck. The maximum heat was 2,000° Fahr. The wooden partition was built of 2 x 4 in. "yellow scantling," 14½ in. on centres, covered with galvanized iron wire netting fastened to the studs with galvanized iron staples. The space between the studs was then packed tight with "slag wool" and the partition covered with ¾ inch tongued and grooved sheathing. The test lasted 45 minutes, the maximum heat was 1800 degrees Fah'r. Within 5 minutes after heat was turned on the inside sheathing was all on fire. It soon fell off and the studs flamed freely. After a time the slag wool appeared to be incandescent all over. The effect, as seen after the fire was turned off, was that the wire netting was sound and good, the studs burnt, but not far enough in to set the staples free, the slag wool was fused all over the inner face about ¼ inch deep and blackened next to the studs for about an inch inwards. The surface of the slag wool was slightly pitted by the action of the water. The slag wool behind the fused face was as good as when put in. The whole of the boarding on the passage side of the partition was clean, white and sound. There was no effect perceivable in the passage except that immediately before the heat was turned off the two top boards of the sheathing were just warm to the touch in the centre. The thermometer in the passage which stood at 54 degrees Fahr. when the test began was still 54 degrees half an hour afterwards. The thermometer hung against the boards of the partition midway up.

Decorating Toronto City Hall.

A COMMITTEE of the Toronto Guild of Civic Art waited upon the Property Committee of the Toronto City Council last week to present a memorial proposing that, if the City Council would provide $1,000 a year for a few years, the Guild would undertake to oversee the decoration of the walls of the entrance hall on the ground floor, at the rate of a couple of panels a year, according to a scheme of subject matter set forth in the memorial. It was proposed that the theme of the Pioneers, begun in the six panels presented by Mr. Reid last year, should be continued in the fourteen other panels that remain. Subjects suggested are : Early Cultivation, Clearing the Land, Felling the Forest, Building a Log Cabin, Treaty with Indians, Hunters' Camp, Long Portage (extending over three panels), Early Missionaries. The arguments are obvious, both that the work of decorating should be continued and that the oversight and change should be committed to a body of cultivated and public spirited men like the Guild of Civic Art. The finished appearance and agreeable tone of the hall at the point where Mr. Reid's decorations are in place is in marked contrast to the crudeness of the remaining portion which is not decorated. Decoration of some kind is needed that the hall itself may have justice done to it. But subject decoration by means of oil painting is more than wall colouring. If these paintings have the ordinary success that scale, position and subject matter should give, the decoration of the city hall would be a rival to the building itself ; for it is remarkable how, after visiting foreign cities, the recollection of great buildings fades from the mind, while the impression of wall paintings within them remains fresh, and to most visitors the wall paintings are the greatest attraction. If the city hall is intended to form one of the attractions of Toronto, there is no better way of making that end sure than by spending another $7,000 or so in mural paintings for the entrance hall. The deputation of the Guild was met with sympathy, respect and even admiration, but on the money question all was dark. Indeed, while waiting to be heard, the deputation had the privilege of listening to a discussion by the Property Committee as to whether some alterations required to make one of the civic departments comfortable could be executed, and heard the conclusion that it was of no use either ordering the work or referring it to the sub-committee, because the appropriation for the building has, as was clearly and definitely stated, "come absolutely to an end and there is no more of it." After this the ill-omened politeness with which the Mayor received the deputation, and his unqualified regret that there was no money for the purpose they proposed, were to be expected. But this does not alter the fact that a thousand a year spent on the city hall in this way for a few years would be an incalcuable addition to the two millions already spent, perfecting the building so as to give it value outside of its ordinary uses, as one of the attractions of Toronto. It would perhaps be possible, as was suggested afterwards by an alderman, to obtain, by private contribution, money for the decoration of the city hall, but the work is after all a municipal work, and it does not seem proper that persons who are essentially private persons, groaning under taxation like the rest, should be asked to subscribe to this work, only because they have a taste for art. To interest in the project a wealthy man, whose residence in Toronto has proved so profitable that he feels inclined to return thanks by a handsome gift to the city, would be another thing.

Code or Rules for Tendering.

In another department of this number will be found a code of rules for tendering, recently adopted by the Vancouver Builders' Exchange. The state of affairs that has led to the foundation of this code is no doubt distressing, but, if the cause at the bottom is looked for, it will be found to be the keenness of competition among the builders themselves. This condition, however hard, is unfortunately normal. What has to be guarded against is the degeneration of competition into unfair competition, and it is obvious that the surest way to prevent this, to safeguard the interests of the competitors themselves, is not to surround the tendering with conditions of mystery and suspicion, but to have the tendering conducted as openly and as much above board as possible. The conditions which stipulate for clear drawings and specifications, so that there can be no mistake about their meaning, are excellent. It is also a fair and business like contention that in bulk tendering a commission should be allowed on the sub-contracts, and there is no reason why bulk and separate tendering should not be made in this way. It is an architect's duty to find the lowest price at which he can get good work done,but no architect in respectable practice wants to be involved or to involve his client in cut rates or scamping prices ; and if he knows that the recognized building practice is to make bulk tenders for a commission, he—speaking still of the ordinarily respectable architect—is not drawn to the contractor who offers to go behind the practice of his exchange in this respect. But when it comes to involving the architect in the suspicion which is properly due to shifty competitors in the building trades, concealing from him the details of the price, endeavouring to make him open tenders in public, this is to force him out of the middle position he should occupy, seeing fair play for both parties to the contract, and make him take side with the owner only, leaving the builder, as he will have it so, to look after his own interests himself. The more the architect knows about the prices the better. If he is left to imagine, in consequence of elaborate precautions for secrecy, that the margin for profit is unreasonable, he thinks it his duty to deal with the man who appears to be willing to bring this down to a reasonable limit. If he knew that the price offered him meant failure or scamped work, he would be as much against it as the competing contractors. A bill of quantities and schedule of prices submitted with each tender, to be opened when the tender is accepted, would be the most satisfactory basis for considering the price and would do away with all difficulty and suspicion in adjusting changes. A fair price for good work is for the interest of every one. The more definitely this price can be fixed and known the better for every one ; it is only as the readiest means of arriving at it that competitions have been established, and the more mystery is made to surround it the keener will be competition, the more chance there is for unfair competition, and the less chance for the ultimate attainment of the really fair price. Publicity is the preventive of underhand dealing; it acts as a check on all parties. As far as the architect is concerned, if there is reason to doubt of good faith of an architect, if he cannot be trusted to open tenders, to deal fairly in a matter of bulk and separate tendering, to make a proper use of a bill of quantities and prices, the obvious course is to decline to tender in his office. The sooner he is brought to understand that he must stop his practices or his practice the better.

ILLUSTRATIONS.

DESIGN FOR A BUNGALOW.—R. M. FRIPP, F.R.I.B A., VANCOUVER, ARCHITECT.

SPECIMENS OF MAORI ART, ILLUSTRATING MR. R. M. FRIPP'S ARTICLE, IN THIS NUMBER.

BAPTIST CHAPEL, SOUTH LONDON, ONT.—BURKE & HORWOOD, ARCHITECTS.

The site and position of the lot and the finances of the congregation made it necessary to adopt a basement school room. It was also an instruction of the committee that the entrance should be roomy and attractive, and that it should light up well at night, as the sides of the building would not be seen to any extent. The large porch permits of broad easy stairs to the auditorium and easy and direct entrance to basement.

Mr. R. L. Macdonald has assumed the management of the brick and terra cotta works at Pugwash, N.S.

It is rumored that Mr. George Campbell has secured, for a syndicate, options on all the granite properties in the vicinity of St. George, N. B.

A GLIMPSE AT MAORI ART.

By R. M. Fripp, F.R.I.B.A.

Head of Chief Patara.

The advent of the missionary and the rum bottle, the British trader and his Brummagem wares, quickly followed by Tommy Atkins and the burning of powder in a heathen land, is so generally considered, by good Christians at least, to confer untold blessings upon the benighted savages thus honored by these advanced guards of civilization, that it is somewhat difficult to make it believed that the moral, intellectual and substantial gain is not all on the side of the poor barbarian; certainly, as in the case of the Maori for instance, cannibalism has passed away, but so too have about five-sixths of the natives, who, once a martial valiantrace, having received the Gospel, have ceased to fight any foe but consumption, which up to now has scored an all too easy win. Less than half a century back these "benighted savages" were daring seamen, building canoes 80 and even 100 feet in length, to beautiful lines and decorated with magnificently carved prows and stern posts, cunningly wrought paddles and sails prepared from native flax coaxed and softened almost to the texture of spun silk. Then, too, these people fortified their simple villages with a skill that not infrequently baffled British generals and British troops and caused them to spend many weeks before these outlandish defences on which guns, both great and small, failed to make much impression, indeed those so called untutored savages offered to our arms as noble a resistance as was ever made by a gallant people to the hosts of the invader. The entrance to the Maori Pah was through an elaborately carved wooden gateway surmounted by grotesquely hideous figures of idols; their meeting houses were enriched with a lavish display of the carvers' art, for the walls, gables, rafters, purlines and ridge poles, eaves and porches all called forth the best powers of the native artist, who revelled in curious scrolls and intricate conventional forms. The great chiefs delighted in the possession of Whare puni or dwelling houses, scarcely less magnificent in scale and richness of decoration than the meeting house, and the Pataka or raised storehouse was in many cases superior to either in point of finished building and ornamentation; but we have changed all this, and the Maoris have forsaken their Pahs on the healthy hills to dwell on the more easily accessible low lying lands where rheumatism and pulmonary complaints wreak havoc among old and young. For the picturesque meeting house is substituted a vulgar little weather-board church to which a horrid clanging little iron bell summons the remnant of a tribe to go through the outward forms of a religion with little enough, if any, real appreciation of the noble ethics which lie concealed beneath the accumulated mass of mystery and mumming which 19 centuries priest craft has heaped upon them. For the dignified, well constructed and highly artistic Whare puni we find crazy, ill built houses or rather shacks of inch thick weatherboards, with galvanized iron roofs, which, hot in summer and cold in winter, take the place of warm thatch; hideous mill stock doors replace the carved architraves and stoutly clamped door of past times, mill made fret work that is not more flimsy than villaneous in design has displaced the side and well carved slabs, and so on ad nauseam. The thick, soft, warm capes and cloaks, made of dressed and stained flax, which were absolutely impervious to wind and rain, beautifully stained and colored, ornamented with feathers of that strange, wingless bird the Kirri, have given way to poor, shoddy tweed trousers hitched up with one half of a brace, and to coats, dresses and head coverings of the ordinary type which give their wearers a wretched appearance, in sad contrast to that presented by the fathers of the later generations before they were made acquainted with all the blessings of civilization. The Maoris generally lived in a Pah or native village situated on a piece of rising ground commanding a fine view of the surrounding country, not that the natives cared so much for the fine prospect as for the means their elevated position afforded of detecting the approach of an enemy. The Pah was always surrounded by a high and strongly staked fence or palisade, and was often strongly entrenched. The gateway was a great feature, and Fig. 1 is a fine specimen and is made of Rata wood carved with stone tools, and colored with kokowai, a red earth which is burned, ground to a powder and mixed with fat. The eyes are of Pawa shell as were the eyes of all the Maori carved figures. The wooden pins which fasten them in their sockets project slightly and are colored black and so made to represent the pupils. This gateway, the opening of which is over seven feet in height and nearly three feet wide at the base, once adorned the entrance to the famous Putterau Pah at Rotorua. Similar gateways were frequently carved for large Pahs and were furnished with strong doors that were securely fastened on the inside.

Fig. 2 represents the upper portion of another typical gateway and has been severed from the lower portion, which had unfortunately become so greatly decayed as to necessitate its removal.

The simplest form of dwelling was and still is the Raupo Whare, or a hut, usually of one room, built with a frame, the studds or uprights of which were driven into the ground and to these were lashed top plates and vertical stringers; the lashings being made with New Zealand flax (phormium tenax), a broad leaved plant which is found in every swamp. The roof was always gabled and prepared for thatching, the rafters and purlines being lashed together. The framing throughout was usually of Manuka scrub, a tough, stringy hardwood of a fine red color, and is now sometimes used for turnings when straight enough. Rushes known as Raupo, or native bullrush, which grow in the swamps and all the margins of the lakes to a height of 8 to 10 feet, are cut and dried in the sun, and the walls and roof were well thatched with it and often beautifully laced with flax. Fig. 3 shows a specimen of the roughest form of Maori Whare. In a particularly fine Runanga or meeting house, the rafters and purlines are all carved or painted with kokowai, and the central column supporting the roof is richly carved at the base, and the great lizard descending is the finest bit of work of its sort that I have met with. The walls

For figures referred to in this paper see illustration sheets.

are covered with thick matting prepared from reeds and is quite equal in design to much of the Japanese matting. The roof is maintained beautifully smooth and straight on the under side. Fig. 4 is another splendid example of the highest class of raupo whare. The lower edges of the large boards are exquisitely cut and the lower ends are also good. The teko-teko or finial is quite characteristic, as are also the great carved upright posts. The lintels and architraves of the door and window are not so well executed as the rest of the work, but the plinth at the base of the raupo wall thatch is capital. The window and door are modern and speak for themselves. The verandah is about 4 ft. 6 in. wide and a straight round log rails it from the outer ground space and gives it an increased air of completeness.

The most advanced dwelling was the Whare puni. An excavation from two to four feet in depth was first made, usually on a dry, sandy place, and the walls and roof were built over this basement and the excavated earth was banked up against the walls on the outside. Down the center ran a sort of path about 4 feet wide, distinctly marked with wooden kerbs; on the right and left the people made their beds, sleeping with their heads to the outer wall and feet to the passageway, in the center of which stood the fire place, which consisted of a hollow scooped out of the earth. In this hollow were placed stones heated at a wood fire burning outside the house, and it is surprising how intensely warm the building thus heated sometimes becomes. I passed one very wet night in a large house then belonging to a now long deceased chief of the Ngatimaniapoto. There were about thirty-five natives assembled there, all of them smoking, women as well as men. The stone fires were maintained vigorously, the doorway closed and mats and rugs piled up in heaps. I bore the intense heat until the perspiration poured from me and I was half suffocated and reeling with giddiness, while the Maoris seemed to enjoy what was to me an aggravated Turkish bath. I slept on the verandah, preferring the rain to asphyxiation

The Pataka or raised store houses were the show places of a village, and on these were expended the greatest labor and skill. Every portion of the gable ends was richly carved, the figures illustrating mythological legends, the significance of which is almost lost. The influence of the Pakeha or white man is shown in some of the work of the early part of the century—in one instance the Teko Teko wears a low crowned bell topper; the effect is most ludicrous. The Pataka was always set on stilts to raise the building about four feet off the ground, erected in fact on the same description of foundation as bears the ordinary frame or timber house of the white New Zealander. The Pataka being merely a place in which food was stored out of reach of the once numerous native rat, was necessarily not a large building. Fig. 5 gives a fair idea of the usual proportions. This Pataka has a history, being originally the property of Haere Huka, a chief of the Arawa, and was erected on the shore of the lovely Rotoiti lake. The sideboards and inner fronts were executed about 1825; the large boards and Teko Teko are probably a few years later. Haere Huka, the original owner of the Pataka, is well known in Maori history as the treacherous murderer of Hunga, a chief of the Ngatihana tribe, at Parihaka, Rotorua, on Christmas day, 1835. This incident and the blood thirsty war that followed it and lasted until 1840 is fully related by W. J. A. Wilson in his life of Te Whahawa.

Fig. 6. This is a particularly large specimen of a Pataka and the carving is peculiarly bold in character and deeply cut, the eyes are all of pawa shell and the woodwork painted with kokowai. The eaves are formed by enclosing the feet of the rafters with an elaborately carved fascia board and a plain soffit board, and it is curious to note that the colonial builders have adopted this manner of finishing the eaves of their timber houses, merely adding gavlanized iron eaves spoutings spiked to the fascia, and ugly mill brackets beneath the soffit, and is, with a few trifling variations, almost the universally adopted method in these islands. In fact, it is not too much to say that the Maori as an architect was a much better artist than his white successors are.

Fig. 8 and 9. Carved front of a Pataka.

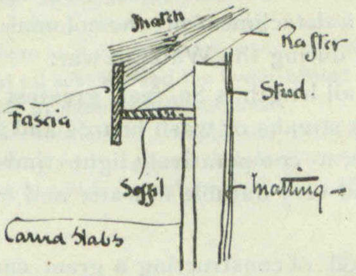


FIG. 9.

Fig. 10. Two doorways of Patakas; carved wall slab. Two very small Teko Teko. The broad bladed instrument is a ko or spade, the other objects are spears.

Fig. 11 is the most ancient piece of native carving known to exist in this part of the island. I have been unable to ascertain what it represents or what purpose it filled; the carved ground behind the figures is pierced. The wood is black with age and the eyes have all fallen from their sockets.

Fig. 12. Carved entrance to a Whare puni.

Fig. 13. Carved prow of a canoe.

A Maori war canoe when fully manned must have been a fine sight; even now a race between three or four canoes with fifty or sixty paddlers in pairs, all stripped to the waist and dipping their paddles in remarkably precise time about fifty strokes to the minute, each stroke accompanied by a gutteral Hugh! Huh! and excited by the song of the chief who stands in full costume in the stern, every man digging away with wild energy, throwing the foaming water from his blade, each canoe seems to tear along; first one gains a trifle and then another, until one crew perhaps in rather better condition than the others slowly forges ahead, the old chief stamping his feet and yelling encouragement to his men, who spurt with a splendid vigor, their paddles flashing like one in the sun, once in every second. The other canoes, still urged madly along, fight desparately for second place. The winners slap their chests and wave their paddles and one obtains a fleeting glimpse of the old fighting temper for which this dying race was once so famous.

It was perhaps in their canoes the Maoris best displayed their mode of carved decoration; the prows and stern posts are wonderfully delicate; the double spirals being pierced, the effect is very light and lace like. The origin of the double spiral was two snakes, as may be seen by examining ancient examples, in many of which the heads of the snakes form the eye of the spiral, the heads being finished with mouths, teeth, and pawa shell eyes. These snakes have a mythological origin which has been gradually lost as the snakes become more and more conventionally treated. Comparatively early divergence from the true snake forms is well exemplified by the carving of the feet of the bargeboards of the Patakas in Figs. 5 and 6, and the development may be observed in the feet of the bargeboards in Fig. 4. The latest and highest development of the form is indicated in the quartered and pierced spirals in the canoe prow, Fig. 15, which is considered the finest specimen in New Zealand.

The Maori war canoe (Fig. 14) Toki-a-Tapiri was built by the Ngnatikahungunu tribe located between Gisborne and Napier about 1835. It passed into the possession of the Ngatiteata who dwelt on the shores of the Mannkan harbour, the bar at the entrance of which is one of the most wild and desolate, as well as dangerous, in this country. It was here H.M.S. "Orpheus" was wrecked. The canoe was taken from the Ngnatiteata in 1863 by a detachment of the colonial forces under Capt. Lloyd during the Waikato war.

The over all length is 80 feet, greatest beam 7 feet; the hull, top streaks or wash boards and all the carving are of totara, a comparatively light timber straight in the grain and very durable in water and of a rather rich red color.

The method of constructing a great canoe may be of some interest. Firstly, a suitable tree was not to be discovered without much search in the forests, and the position of the tree when found had to be carefully considered, for a stick about 100 feet long and 8 or 9 feet in diameter is not easily taken out of the woods by a handful of simple folks who knew not of greased ways or timber shoots. The giant of the forest was laboriously laid low by relays of men armed with stone axes, and was minutely examined when fallen, for if seriously "shaken" another tree must be found and all the work recommenced. Should, however, the great trunk pass inspection it was cleared of its branches and removed to the village. The hull was then roughly lined out and hollowed partly by burning and partly by dubbing with stone axes. The hull having been completed the wash boards or Ranawa had to be cut from trees almost as great as that which provided the hull. The labor of working these down to the required thickness, especially if carved from end to end as in this instance, must have been immense. Holes had to be bored through the Ranawa and through the sides of the hull, through which the flax lashings were passed to bind them together, and the magnitude of this minor operation is better understood when it is explained that the only implement of the nature of an auger was a stick armed with a piece of quartz.

Then followed the carving of the figure head (Fig. 16), and of the stern post (Fig. 17), and as these were cut out of solid slabs and only a little could be done at one time lest the timber should split, years often passed before they were completed. The thwarts or Taumanu were prepared and firmly lashed to the gunwale on each side.

The work of preparing the flax fibre was always performed by the women, who also plaited the sleeping mats and made the baskets in which the provisions were carried.

Lastly, the seams and holes through which the lashings passed had to be caulked with the feathery down obtained from the head of the native bullrush (the ranpo), and the whole canoe painted with kokowai, and the canoe was ready for sea. The paddles, usually made from a hard, tough scrub, were well shaped, smoothly finished, very handy to use, and sometimes the ends of the handles were carved. The ends of all the thwarts of the toki-a-tapin were carved with heads, and gratings cunningly formed of straight pieces of Manuka about an inch thick laced together and resting on cross pieces, enabled the paddlers to keep their lower limbs and their belongings well above any water that found its way in through leaks or dashed over the sides.

One of the most striking features of the canoe here described is the delicacy of her lines and the slight but well defined sheer. As sea boats these vessels hehaved excellently, and long voyages were frequently undertaken on these rugged and storm beaten coasts.

Fig. 18 gives us an example of another well known treatment of figure head.

To properly illustrate and describe all the various phases of Maori art is a task which would richly reward who so might undertake it, but my aim has been merely to show that Maori art possesses much of interest in itself and was of no mean order in its way. I am obliged to omit the examples which mark the ingenuity, patience and skill expended upon minor articles of domestic use, such as feather boxes, walking sticks, water vessels, combs, knives, fishing gear, eel traps, nets, wearing apparel and arms of wood and stone, personal ornaments of jade, stone or wood, and scores of other things which help to prove that the natives of these islands were cultured in their tastes to a degree quite surprising in a people addicted to cannibalism, engaged in perpetual warfare and sunk in gross superstition.

COST OF HIGH BUILDINGS.

MR. Richard Pelham Bolton read, recently, before the American Society of Mechanical Engineers, some interesting statistics in relation to the cost of high office buildings and their equipment. Including a moderate amount of exterior ornament, the cost of a building sixteen storeys high, with steel frame, and, of course, fireproof construction throughout, and inclusive of plumbing appliances, elevators, boiler-plant, pumps, heating apparatus, electric light wiring for isolated service with switch boards, engines and generators, is, in New York City, from thirty-six to forty cents per cubic foot, measuring to the outside of the walls. Higher buildings cost proportionately more, and, of course, any sum may be spent on exterior enrichment. About one-seventh of the entire expense is in the boilers and engines, heating and lighting apparatus and plumbing. These must be of the very best type if the building is to be profitable, for the saving of the repairs required for inferior apparatus, and the economy of fuel which can be secured by using triple expansion pumps and compound engines, represent a large proportion of the balance of income left over after deducting taxes and mortgage interest and necessary expenses. Even in the matter of fuel, a little forethought is a valuable investment. Nearly all the high New York buildings have coal-bin capacity only for two or three days at most, and many of them must have coal delivered every day. Under such circumstances, the cost of their coal is greater, while they are at the mercy of sudden strikes, or heavy snowstorms, which may expose them to the dilemma of paying extortionate prices for fuel, or damages to their tenants. In the Bowling Green building the capacity of the coal bins is four hundred and twenty tons, and this fact enables the managers to save about ten cents a ton, on an average, in the cost of their coal, and, probably much more, indirectly in the assurance of an ample supply.

A PROPOSED AQUARIUM UNDER DUFFERIN TERRACE, QUEBEC.

To the Editor of the CANADIAN ARCHITECT AND BUILDER:

DEAR SIR,—The accompanying sketch is that of a cross-section of an aquarium for Quebec. The site is admirably adapted for the purpose, the height under the terrace being some 20 feet; so that the housing corridor—15 feet wide by 10 feet high—would leave ample space beneath it for defense of city through the loop and port holes in the lower 10 feet. For the present the extent of aquaria tanks, end to end, would be some 700 feet or more, ranging between the terrace piers or buttresses from the second kiosk (the Lorne and Louise) to the fourth entrance and exit thereto and from, being at and under shelter of these by a spiral stairway 8 to 10 feet in diameter at centre thereof, and hermetically protected from wind and weather by a circular glazed enclosure of that diameter and proper or proportional height—the ground plan of stairs shown on section to save space of another diagram.

The front wall of terrace is made up, above the 10 feet lower wall where the loop holes are, of a series of buttresses at 20 feet centres, say 4 to 5 feet wide and leaving 15 to 16 feet clear for the aquaria tanks, which would have an aggregate length of some 500 feet. These would be as usual, of heavy plates of glass cemented into grooved iron framework, with wrot iron 1-4 inch bottom plates riveted to framing, water tight cisterns say 4 feet wide and 4 feet high, resting on a continuous table of proper strength to support the weight—upper surface of tank open for aeration either by lifting out some of the water and dumping it in again from a higher level to cause it to stir up the body of water in the tank, or by a jet of water under pressure from a pipe above, penetrating the contents of the tank and thus restoring the oxygen taken in by the marine and fresh water fauna: fish, crustacea, zooplytes, mollusca, etc,—the oxygen being also supplied by vegetable growth or plants, which, as is well known, take in carbon and give out oxygen under the influence of sunlight.

A somewhat detailed estimate of cost figures up to about $9.00 per feet lin. of housing corrider, or for

the 700 feet	$ 6,300.00
500 feet tank at $14.00	7,000.00
Two heaters and piping	2,500.00
Two entrance kiosks and stairways	500.00
Total	$16,300.00

The yearly cost would be:—

For interest on capital at 5 per cent	$ 815.00
105,000 cubic feet of space to heat at 20 tons per 20,000 feet	630.00
Salary of specialist	1,200.00
Wages of stoker and helper	600.00
Cost of common salt, Epsom salt, chlorate of magnesium and chlorate of potasium for artificial sea water, for say 300 ft. lin out of the 500 ft. of cisterns	200.00
Total	$ 3,345.00

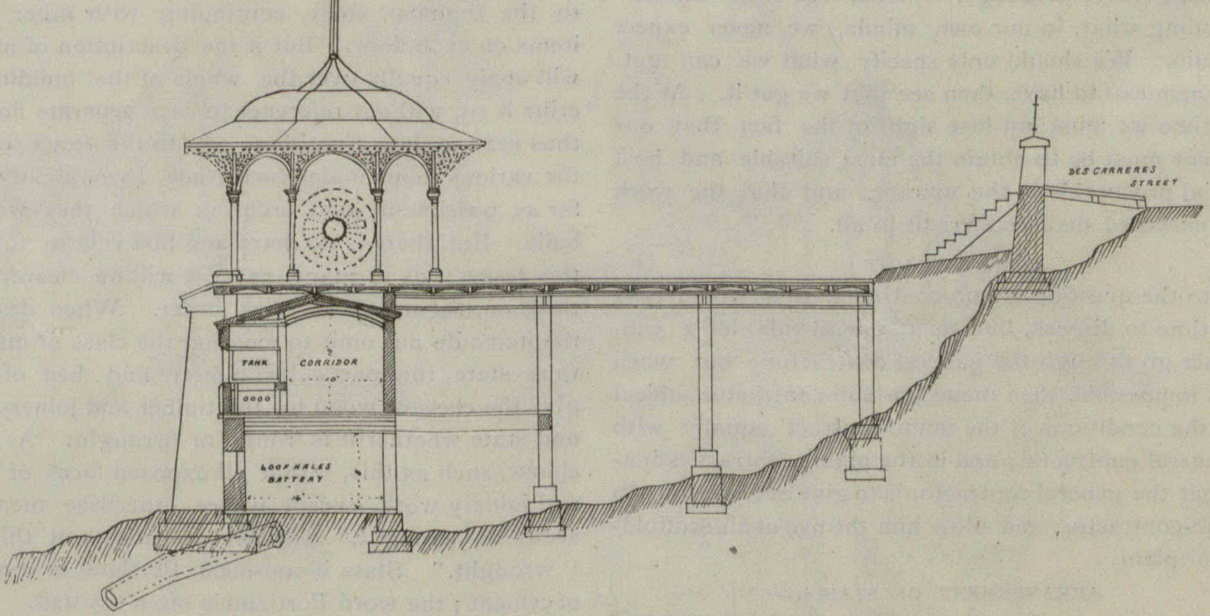
It is argued that as an educational feature, governments—Imperial, Federal and Local—might contribute to construction thereof, and that an average 20 cent entrance fee would cover yearly cost for interest and maintenance. The entrance fee at Brighton, England, is, I believe, 50 cents, those who visit it under invitation by the city authorities having, of course, nothing to pay. This aquarium is more than 700 feet in length by 100 feet in breadth—or was at the time I went through it in 1874—but the ground covered also contains a conservatory, a library, reading and lecture rooms, etc.

There is also an extensive aquarium at Sydenham—some 6 miles from London. It is in the old so-called Crystal Palace erected by Sir Joseph Paxton for the London Universal Exhibition of 1851, and thereafter removed to Sydenham, its length being 1800 feet and height of dome or ceiling over nave 100 feet.

Contributions to the required salt and fresh water fauna and flora to be exhibited would no doubt be had from the above mentioned aquaria, as well as from those of Naples and elsewhere; the Marine and Fishery Departments of our Federal and Local Governments also helping us in the process of procuring the necessary exhibits. The larger species, the porpoise or white whale, sea lions and other such mammalia, with such entities as the shark, the dolphin, etc., if procurable, can be accommodated in an excavated reservoir or tank of adequate depth and size at the Victoria Park, and housed in, of course, under a glass dome as a conservatory, where the proper heat may be maintained at all seasons and the water cooled in summer by the now liquid air process of refrigeration.

We have just finished, or nearly so, as suggested by the writer some twenty years ago, an 1800 feet sidewalk or promenade some 12 feet in width around the foot of the citadel walls, and when this promenade is completed, reaching as it does from the south end of the terrace to and along the crest of the cliff to the old French fortification mounds at Cape Diamond, 330 feet above the St. Lawrence, when this is done and the Aquarium built, it will then be true to assert, as Princess Louise said at the time the Marquis of Lorne inaugurated the terrace, that, "it is the finest promenade in the world," congratulating the undersigned the while on its constructive, pleasurable and emotional features.

C. BAILLAIRGE,
Architect and Engineer.



PROPOSED AQUARIUM UNDER DUFFERIN TERRACE, QUEBEC.

ARTS AND CRAFTS ASSOCIATION.

A MEETING of those interested in the formation of an Arts and Crafts Association in Vancouver was held in the rooms of the Vancouver Builders' Exchange on April 25th, at which steps were taken to form an association. The objects of the association are: The greater encouragement of the arts and crafts; the association of those engaged in these pursuits for their mutual benefit and education, together with the collecting of examples of arts and craftsmanship, and the establishment of a library of reference.

The provisional committee consists of R.M. Fripp, F.R.I.B.A.; S. M. Eveleigh, architect; A. Woodroofe, architect; James Bloomfield, designer.

Mr. C. G. Horetzky, who for many years was employed by the Ontario Government as a civil engineer, died in Toronto a fortnight ago.

SPECIFICATIONS.*

THERE is one word in a specification of which the meaning is often disputed. It is the word "best" when applied to workmanship and materials, especially to materials, and is, I grant, somewhat ambiguous. But I would not use such terms as "best," "finest," "extra best," super best," best best," and so on; but merely employ the word best once and for all and attempt to define its meaning. Here is a suggested definition of this word: "The word 'best,' as applied to materials, articles and workmanship, shall mean that there is no superior quality of material or finish of article in the market, and no better class of workmanship obtainable." In fact, by defining this word "best," it will only be necessary to mention it in the one clause when stating that all materials and workmanship are to be of the best quality and class.

MECHANICAL DEFINITIONS.

We are all apt to fall into the error of describing certain materials mechanically, such as timber from a market which has long since been entirely exhausted, or stone from a worked out quarry, or we use misleading and exaggerated language, "timber free from knots," demanding what, in our own minds, we never expect to obtain. We should only specify what we can get, what we mean to have, then see that we get it. At the same time we must not lose sight of the fact that our endeavor must be to obtain the most suitable and best material procurable in the market, and that the work when executed shall be a credit to all.

SUB-CONTRACTS.

As to the question of sub-contracts, this would take some time to discuss, but, as a general rule, let a sub-contract go through the general contractor; but when this is impossible, then make the sub-contractor subject to all the conditions of the main contract equally with the general contractor, and in the main contract stipulate that the general contractor is to give every facility to the sub-contractor, and allow him the use of his scoffolding and plant.

ARRANGEMENT OF STAIRS.

Having now, so far, settled the general scope and bearing of a specification, the next step is to put the various items into order and place. As I have before said, we cannot do better generally than to divide the specifications into separate headings or trades, as they are called. As to the order in which these trades should be placed, I do not think that very important, only let each trade, if possible, come in the order in which the building would be erected.

Thus the specification would be started with the preliminary items or general clauses, under which heading would come every item that would apply to the building generally as a whole. Then would follow the trade of excavator, this being the first start of the actual work. Then the trades embracing the structural parts of the building, such as bricklayer or mason, whichever trade would chiefly apply to the walls. In like manner you would go on constructing the building on paper until it was roofed in, when the trades taking the interior fittings, finishings and requirements would follow, and finally the decoration and painting. As to what items each particular trade should embrace, or how many trades the specification should be divided into, that to some extent would be a matter of convenience and clearness consequent on the nature of the building in question. Thus, if pavior is a considerable item, make it a separate trade, but if a very minor point then the paving may come under the trade bricklayer. Again, if the drainage is a large item I would make that a distinct trade instead of putting it, as is often done, under excavator. Further, floor and wall tiling might either come under pavior, bricklayer or plasterer, as each of these trades, in certain parts of the country, is performed by the same class of workmen. Many other items may be treated in the same manner. Each trade is started with a preamble, or the general clauses most applicable to all the items under that trade, such as the description of the various materials, and the general covering clauses referring to similar parts of the work in different positions, after which follow in detail the actual items of work. Strictly speaking, a preamble is an introduction or preface; but in a specification the term is applied in the sense of denoting the general clauses and descriptions at the beginning of each trade. Going more fully into the various items of almost similar description under each trade, I think the best plan, in most cases, is to describe all the items of a similar nature to each floor separately, from the lowest to the topmost story, continuing with other similar items on each floor. But if the description of any item will apply equally over the whole of the building, describe it so, without reference to each separate floor, and thus save useless repetition. As to the exact order of the various items under each trade, I would put them as far as possible in that order in which they would be built. But there is no hard and fast rule to follow in this respect, as in many cases it will be clearer to run them on, regardless of that order. When describing the items do not omit to mention the class of material; thus state the particular quarry and bed of stone, give the class of wood for the timber and joinery work, and state whether it is rough or wrought. A general clause, such as this, "that all exposed faces of timber and joinery work, except where otherwise mentioned, are to be wrought," will save repetition of this word "wrought." State if you mean Portland or other kind of cement; the word Portland is often omitted. And all other descriptions of materials should be clearly defined.

Reverting once more to what may be considered the best order in which to place the items of work under the various trades, I know that this is one of the chief difficulties of the beginner, and I will sugest an arrangement for some of the principal items. I have before mentioned that, as a rule, it is best to specify the items in that order in which the work will be built, but that it is not always possible to carry out that order. But I would say that, whatever order you once adopt, always follow in all your specifications and in all its parts, so that you will know yourself where to find an item. I have also said that each trade in every case should start with a preamble, or the general clauses and description of materials. Now to take the principal items under the various trades respectively. In preliminary items I do not think any particular order is essential, but it would be as well to keep the clauses in that order which would mostly run with the order of the work to the building. If old buildings have to be removed the description would come under this heading of preliminary items. But if a housebreaker is employed then this work would form a separate and distinct contract by itself. In excavator take the surface excavation first, then the deep excavation, such as that to basements and cellars; then the general excavation to the founda-

*Extracts from a paper read before the London Architectural Association by F. W. Macy.

BAPTIST CHURCH, LONDON SOUTH, ONT.

BURKE & HORWOOD, ARCHITECTS.
(MR. HORWOOD Member of Eighteen Club).

tions and the attendant items, such as planking and strutting, filling and ramming; and, finally, any other small or particular items. Then describe the concrete foundations, after which the surface concrete and any brick rubbish under, then the concrete floors, roof and stairs. If the walls of a building are in concrete, I would take these immediately after the concrete foundations, of which they then would almost form a part. Under drainage describe the manholes first, then the pipes wlth the concrete, then the gulleys and other similar items. The items under the trade of pavior are so simple that any order might serve, but take first the important items of internal paving and follow on with the smallest items, and finish with the external paving.

In bricklayer commence with the general walls of the building, then the damp course, hoop iron and other attendant items. Then those parts in cement, such as rough arches, trimmer arches, piers, sleeper walls, half-brick walls and dry areas. Then the external facings and pointing, gauged or other external arches, dressings, moldings and ornaments, external glazed brick-work or flint facings. Then the internal facings and pointing, glazed brickwork and wall tiling. Boundary and retaining walls, and such-like distinct items, should come last, and be described separately and completely by themselves. Terra cotta facings might either come with other external facings or be kept as an item by itself after the description of the other general work, and before such items as boundary or other walling.

In mason commence with the rough stone, such as templates and corbels, if not elsewhere described, and follow on with the thresholds, sills, copings, internal pavings, staircases, hearths and chimney pieces. Then the external paving, steps and curbs. If the walls are built or faced in stone, I would describe these first completely, with all the labors, moldings and ornaments on them, and then follow on with the rough stones and internal items, and finally with the external items, such as pavings, steps and curbs. I would not trouble to keep all stone of a similar nature under the one heading, unless it should happen to come in that order.

Many make carpenter and joiner two trades. In a large work perhaps it is better to separate them, but in a small work I should certainly keep them together. But it is immaterial whether they are separated or not as long as the descriptions are clear. Personally, I prefer them generally under one heading; you will perceive the reason from the order of the items I will now give you under these trades. Lintels, breast-summers, posts, cradling, floor and ceiling joists and plates, sound boarding roof or flat timbers, felt, battens, gutters, and all external joiners' work to the roof or flats, except windows, doors and skylights, such as rolls, fascias, large boards and such-like items. Then would come quartered partitions, followed on with flooring, windows, skylights, external doors, internal doors, framed partitions, skirtings, dadoes, wall and ceiling panelling, staircases, sinks, and water closets ann bath casings, and other internal fittings, such as shelves, cupboards and such-like domestic fittings. Fencing, weather-boarding or other outside work should be complete items by themselves and come last. Half-timber work with all its attendant items might, I think, come after the description of the rough timbers. I would not separate hardwoods from softwoods, but describe them as they come on each separate story.

In smith and founder take this order: Lintels, chimney-bars, straps, girders, floors, columns, roofs, carriages, iron windows, gutters, stack pipes, external railings and gratings, stoves and ranges and heating. Heating may come under heating engineer.

Under slater and tiler, roofs first, then vertical slating or tiling, shelves, cisterns and such-like smaller items.

In plumber, take gutters, flashings and other roof finishings, flats and their gutters and finishings, then drinking water supply pipes, cisterns, sinks, lavatories, baths and fittings. Then water-closet supply pipes, cisterns, water-closets, slop sinks, urinals and fittings, soil and ventilating pipes, hot water circulation.

ZINC WORKER AND COPPERSMITH.

Take flats, gutters and finishings, pipes, lightning conductors. In plaster describe first the general plaster work to ceilings, partitions and walls, then follow with cornices, coves, center flowers. Then those parts in cement, and finally the external plaster or cement work, or, if preferred, take the external work first.

GLAZIER.

External glass to sky-lights, windows, doors, then internal lights and screens, and pavement lights last.

PAINTER AND PAPERHANGER.

Internal work to ceilings, walls, wood and ironwork and polishing. Then external painting to wood, iron and cement work. As to the order in the trades I have mentioned, such as bellhanger, gasfitter and electric lightning engineer, which are not generally of any considerable variation, there is very little to suggest, but keep the order of the work, such as the main items first and fittings afterwards. I might mention that the order adopted in bills of quantities is not precisely the same in all parts as that of the specification. The order in quantities is placed to an extent to facilitate the pricing, and the order in the specification should be to distinguish quickly the position of the work.

PRICES.

One word before I come to the last part of this paper. If the prices in a bill of quantities are not to be taken into account in the settlement of extras and omissions, or if quantities have not been supplied, then a schedule of items should be provided for the builder to fill in, and be attached to the specification and form part of the contract upon which variations may be valued.

ADDITIONAL HINTS.

I have now, I think, stated the various points which are necsary to be observed for efficient specification writing, and I will just mention a few matters which are worthy of attention and which are not always found to be clearly stated in a specification, but are sometimes omitted altogether, taking preliminary items first. Always state that the plant and temporary erections are to be removed when directed, such as scaffolding, hoarding, shorting, clerk of work's office, and any other items temporary in their character. The provision of these items is usually stated in the specification, but their removal is not always mentioned. State if the hoarding is not to be let to an advertising contractor. Clearly define what you mean by prime cost and provisional amounts. State if the employer's business is to be carried on during the building operations. Mention that the contractor is to give due facilities to other tradesmen who may be employed on the premises, and also that the contractor is to allow such other tradesmen the use of his scaffolding and plant. State to whom any coins or curiosities found on the premises or during excavations are to belong. If the contractor has done any work previous to signing the contract, then embody this work in the contract, otherwise an extra may be claimed for some small items which at the time of signing the contract were understood to be included in the contract amount.

EXCAVATOR.

Where the foundations in a length of walling are not all one level, require the excavation to be in steps and not on the rake. Stipulate that there should be no excavations for ballast or sand unless necessary for the actual excavations, as this may affect the stability of the building. Specify that brick rubbish be put under surface concrete which receives wood block flooring or paving. There will be less liability of damp coming through. In clay soils require the foundations to be taken down below the action of the weather. This may necessitate the foundations being taken down some four feet, five feet or six feet below an otherwise good bottom. Specify a proportion of coke breeze, slag or gypsum in concrete fireproof construction. It will the better resist the action of fire. State that all foul earth and cesspools are to be removed and the excavation filled up with clean rubbish or concrete. Encase new drain pipes in concrete ; if a slight settlement occurs they will the better hang together. Half channels in manholes are better formed in cement than with half-pipes. A cleaner flow of sewage can thereby be obtained. Then as to the items under bricklayer. Do not forget to mention these points : To tie the walls in ; build external walls hollow, if possible, but in damp situations certainly ; and specify the lead covering over the heads of the doors, windows or arches coming within the hollow space. This will prevent the wet being communicated to the inner thickness of the hollow walls. Describe a weather joint externally to brick walls. Build the brickwork up in even heights and fill up all the joints. Let the sand be free from dirt and the water clean. Sea water or sea sand may be used where dryness is not essential. Build chimney stacks, where they appear above the roofs, either partly down from the top or else wholly, in cement, preferably the latter. Build all parapet walls and the brickwork immediately under the eaves a certain distance down in cement, and a second damp course here and to chimney stacks will not be amiss. Half-brick walls should, of course, be built in cement. Boundary fence walling should have a damp course, and preferably be built in cement. In retaining walls against earth do not omit the weeping drains or other device for taking off the accumnlating water at the back. Smoke flues should not be too large—nine by nine inches is sufficient for most fireplaces ; and gather the brickwork quickly over the fireplace openings. Build all stoves around solid, and fill up the boxing to chimney pieces. Fires have often occurred through neglect of this precaution. Do not put too long a description to terra cotta work because it may be the custom. Put a straight joint between connecting walls and a heavy tower, and do not attach a large chimney shaft to the main structure.

MASON.

Stone templates should be of considerable area and tooled and not left rough. In fact, any stone upon which work is built should be tooled as a least labor on it. Do not forget the cement packing between the rivet heads on top of flange girders and the cover stones. Stone hanging steps are almost better placed in position and pinned in after the building is up, sand courses being left in the brickwork for the purpose. In stone columns or pilasters the apophyges should be worked on the shafts. The effect is better. Portland cement will stain delicate marbles and some limestones.

CARPENTER AND JOINER.

When possible employ wood block flooring on the lowermost floors next the ground. The ordinary joists and flooring for this position are more liable to decay. In this latter case let the joists and plates be of oak. Put cast iron shoes on stone bases to all solid door frames. Bed window sills on to the stone sills in white lead, and do not omit the iron tongue. The cleats to roof trusses and horns on solid door frames are sometimes forgotten. Snow boards to roof gutters will often prevent wet penetrating when snow melts. Open casement windows outwards if you want to be perfectly sure of keeping out the wet. The ends of timbers, where bedded in walls, should have circulation of air around them. A little sap on the edges of timber exposed to the air will not be any very great sourch of weakness, and will not be likely to affect the rest of the timber. All gutters should be wide enough to walk along. Small angle fillets at the junction of horizontal and vertical planes of a roof flat will make better work than if the lead work be turned up sharply. This remark will also apply to lead gutters. In some cases it is almost preferable to put a p. c. amount for the ironmongery to each door, window or other fitment and select the class of ironmongery afterwards.

SLATER AND TILER.

Tiles and slates without boarding under should be torched.

SMITH AND FOUNDER.

Let rain water pipes stand out one inch clear of the walls.

PLASTER.

Timbers over three inches wide should have the arises taken off before the lathing is nailed on ; this will enable the plastering to get a better key. The walls at the back of skirtings, or any other woodwork, should be plastered over to prevent vermin harboring. The outside of all flues between timbers, floors, and where in the roof should be roughly rendered over. This will be a preventative against fire. Shingle laths should not be lapped at the joints, as is often done.

PLUMBER AND GASFITTER.

Do not omit the exhaust pipe to hot water circulation or to the heating arrangements. Keep all hot and cold water pipes well away from each other and from the action of frost. All pipes, whether gas or water, should be readily accessible and, if possible, on the face of the walls. The furring up of hot water pipes is chiefly found between the boiler and the circulating cylinder or tank This portion of the piping should be easily accessible for cleansing. All horizontal gas pipe should be laid with a fall to prevent any condensed liquid remaining in any part of the pipes, and thereby affecting the efficiency of the gas supply. It is a good plan to fix all internal pipes about three-fourths of an inch clear of walls, especially hot water pipes. Do not work the hot water supply and heating arrangements from the same boiler. Failure is almost certain.

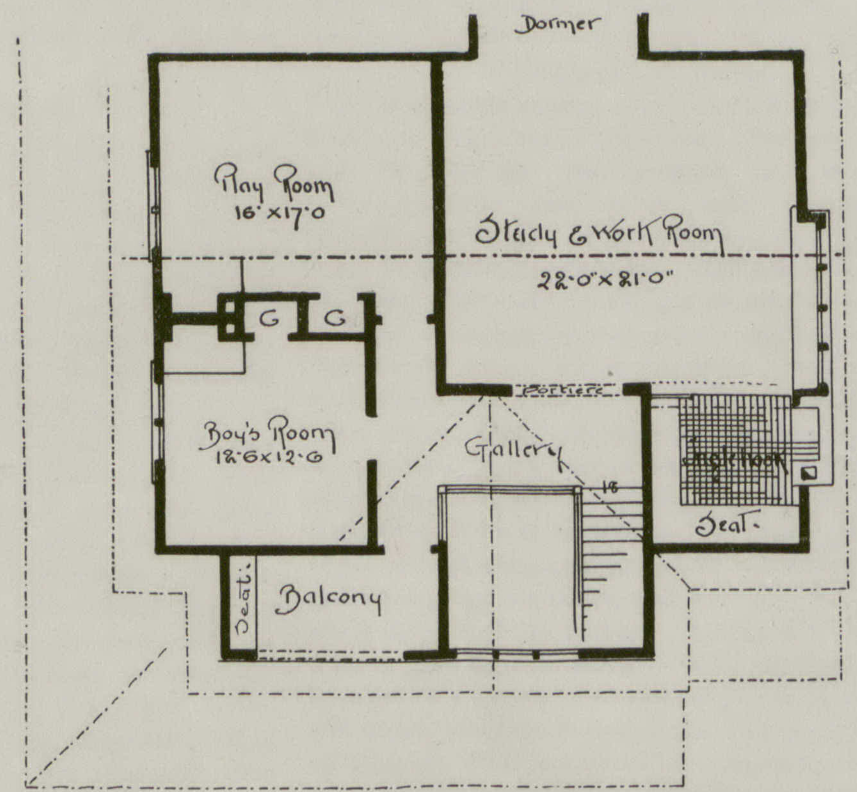
GLAZIER.

All glass subject to jars should be bedded in wash-leather or India rubber, as well as in putty. I might

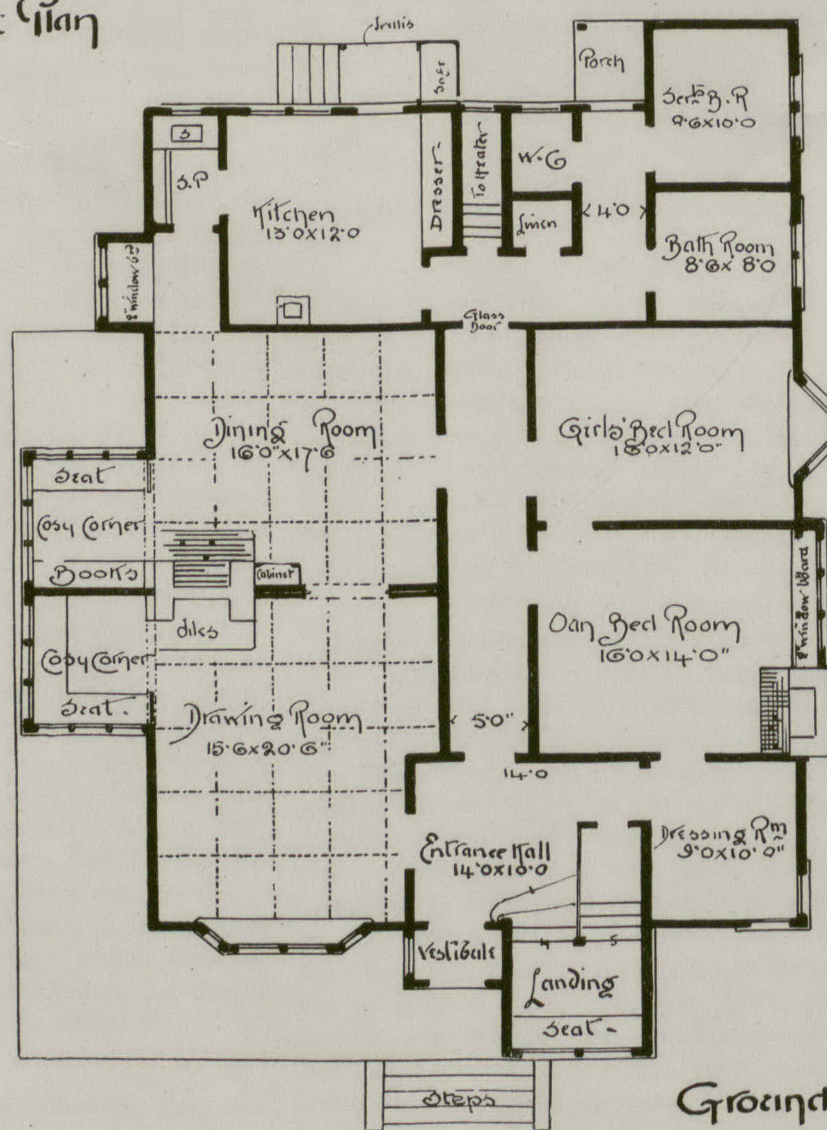
Sketch for a Bungalow to be built of timber on a foundation of rubble rock walling

R. M. Fripp. F.R.I.B.A. Architect.

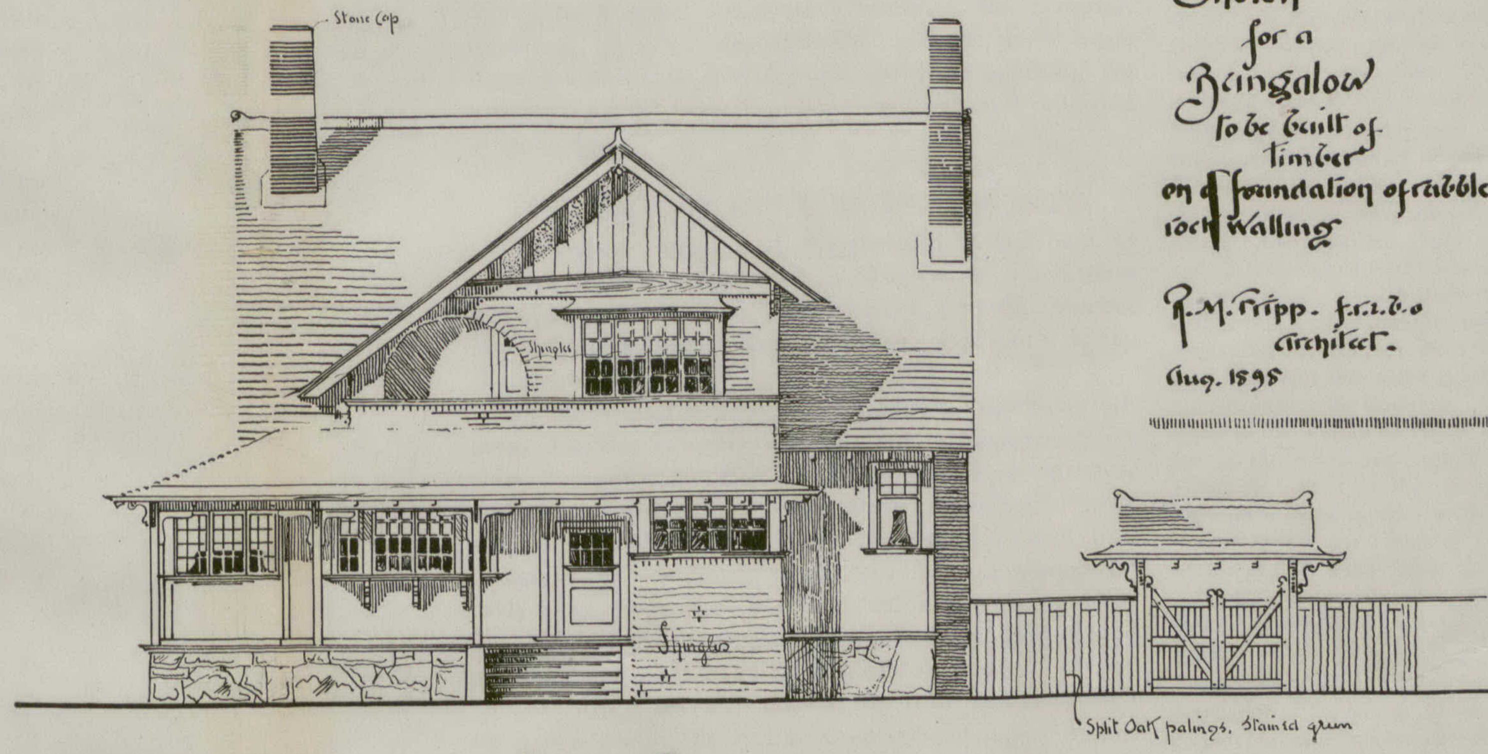
Aug. 1898



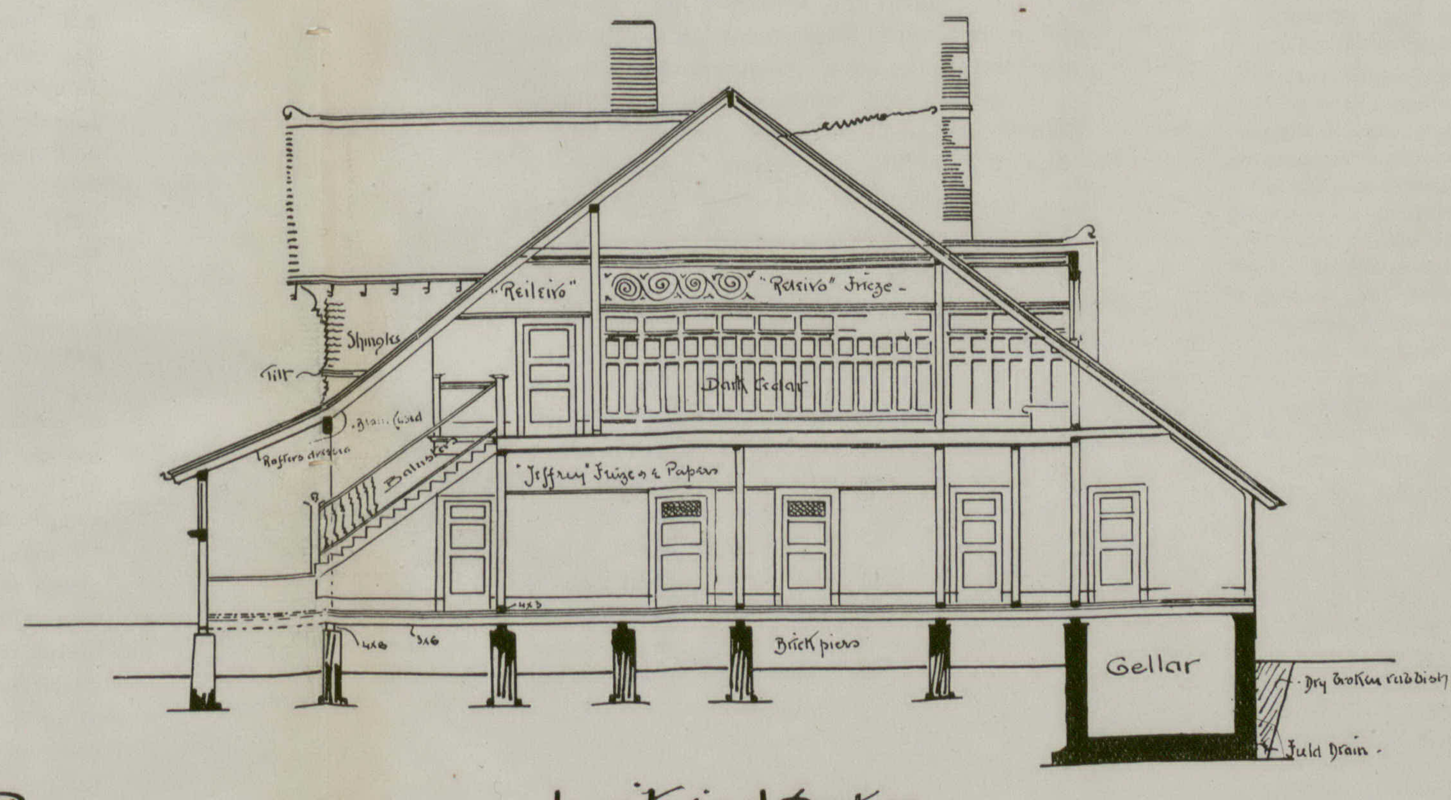
Attic Plan



Ground Plan



— Elevation to Road —



Longitudinal Section

mention that one of the best methods for glazing skylights is merely to seal the glass on a bedding of putty, and then to sprig it in and paint the joint over with the woodwork of the bars. It is perfectly watertight, and there is no putty on the weather side to get out of order. This plan is much adopted in horticultural building, both vertically as well as in the top-light glazing. The laps of the glass to the top-light should be cut to a curve, the water being directed down the centre of the glass and away from the rebate in the bars.

PAINTER.

External painting if done in the spring or autumn will give a more satisfactory result. No painting, papering, or other decoration should be done while there is a suspicion of dampness about the building. All ironwork should be well painted over before it is buried or covered.

THE ENGINEERS' CLUB OF TORONTO.

THE regular meeting of the above club was held at the Rossin House on Tuesday, May 1st, at which there were present : Messrs. Tully, Patton, Canniff, Lambe, McDougall, Johnson, Roy, Withrow, Galbraith, King, Butler and Chipman.

The secretary reported that the special committee appointed at the last meeting to make arrangements re club rooms had interviewed Mr. Horne, the proprietor, and Messrs. Gregg and Gemmell, of the Association of Architects, and that the committee was informed that the plans for the rooms would be fully completed at an early date, when they would be submitted to the Club for approval. A draft plan was submitted showing the proposed sub-division of the floor into rooms.

A resolution was carried that the draft plan submitted for consideration by the architects be changed as follows : (1) That there should be a landing in the stairway and no "winders" ; (2) Skylight to be built over stairway ; (3) Platform and blackboard to extend the full width of the room ; (4) Fireplace in engineers' room ; (5) Alcove in engineers' room ; (6) Ventilation, heating and lighting arrangements to be shown.

The following topic for discussion at next meeting was selected : "Freight Tariff on City and Suburban Tramways," by Mr. Jas. McDougall.

BY THE WAY.

AN Ontario architect who recently visited Winnipeg has given a glowing description of the climate in that city in winter. During a stay of several weeks the sun never failed to shine brightly every day. Owing to the clearness of the atmosphere the blue sky flecked with white clouds, seemed miles further from the earth than in eastern Canada. Nowhere else, save in Italy, is the atmosphere said to be so well adapted to the proper display of architecture. Shadows are strong and clean cut and mouldings and other features of buildings stand out with perfect distinctness. Light colored materials are considered best adapted to this climate, and are being employed in some of the more important works now in course of construction, notably the Bank of Commerce and the Dominion Bank, one being built entirely of terra cotta of a warm shade of brown, and the other of Ohio gray sandstone. While the atmosphere in winter is extremely frosty, it is said to be entirely free from moisture. It is consequently well adapted to the use of stone, which in the eastern provinces must be used more sparingly on account of the destructive effect of moisture in the air.

THE COMMERCIAL VALUE OF ART.*

By A. O. ELZNER, F.A.I. of A.

ART is one of the greatest factors of civilization, and probably the oldest and most powerful. It is the very first refining instinct that becomes manifest in the savage ; it is the great force that carries him upward through the successive stages of enlightenment until he becomes a great nation, and the last to remain, long after a nation or a people has passed from splendor and prosperity back again into the obscurity of antiquity. It is an open book wherein we read men's thoughts and deeds, their rise, prosperity and decline. It is a faithful record of the triumph and failures of humanity, of its joys and sorrows. Rightly understood, it is the very soul of our existence. It glows as a halo about all creation ; appeals to and summons our full nature, and inspires us to lofty efforts, if we will but recognize its ringing message—that Beauty is truth, and Truth is Love.

Some of you probably read the account of the manner in which Gibson first succeeded in having his sketches of the American Woman received. He was young and modest and, when he had made a couple of sketches, left them anonimously in the editor's office of a newspaper. They were not appreciated, and were, of course, consigned to the waste basket. Again he left new ones, and again they were destroyed. This continued for some time, until it was finally thought they really might have some little merit after all. So they were published, and soon attracted attention. But still the artist remained unknown, although he continued to leave his sketches. Finally he presented himself at the office as the author of those pictures of women, and now he is famous the world over, and his sketches command an immense premium. What is the result? Think of the thousands, yea millions of people who enjoy them, and are better men and women for it ; then think of the material influence exerted by reason of their publication.

Firstly, Gibson himself is making a great deal of money, by means of which he could, if he would, do much good in the world.

Secondly, the publisher's business thrives on account of their popularity ; this means the necessity of increasing his facilities, employing more hands, who welcome the boom with a full heart. It means further, that more paper and ink stock is needed on acoount of increased circulation, and forthwith the mills are taking larger orders, much to the benefit of those depending upon this branch of the trade, and the railroads doing better business, due to hauling the extra weight of stock.

And yet Gibson is only one of hundreds and hundreds of artists working in this manner, and whose influence extend far into the channels of trade, yielding support to hundreds of thousands that are engaged in some occupation whose very existence is dependent directly or indirectly upon the work from the fountain head. Such may be common laborers, mechanics at trades, machinists, engineers, draughtsmen, clerks, manufacturers, shopkeepers, dealers, landlords and bankers, brokers, real estate men, railroad magnates, and poor architects—when the publishing journal makes enough money out of the clever paper to erect a new building for itself, as was done in the present instance. I refer to "Life," which recently completed a splendid house of its own, and is probably now selling its paper very largely among all these people, who are enabled to support it by virtue of the reflex action of its own success.

Let us now anaylize a case of rather different character. I was invited recently into the rooms of a firm that makes a business of interior decoration—notably for fine dwellings. This firm naturatly could not exist at all were it not that the public taste had developed a demand for beauty and refinement in our homes, and in fact to such an extent that experts are required to take complete charge of the whole interior. This is supposed to be the proper thing—but without intending in the least to disparage the skill of the artist, I would say that, on general principles, it is a very dangerous step to take, unless one feels himself utterly devoid of artistc ideas. For a home should be all that this beautiful term implies, and a home, in order that it may be beautiful, should reflect the individuality of the occupants and should above all be expressive of comfort and ease. Now these are peculiar terms and capable of various constructions. Primarily, comfort in a home, means the perfect adaption of its parts,

*Address delivered before a meeting of The Cincinnati Chapter Architects.

its rooms, its furnishings and size, to the habits and customs of the family for which it is built. Yet, how seldom we find this to be the case; and it can be truly said that beauty is incomplete where the purpose is not faithfully served. Just as surely as one person differs from another person in character and individuality, so does one family differ from another family, and so should one house differ from another in character and individuality. But if you stop to enquire, you will find that many people build houses, not with the expectation of living in them all the remaining days of their lives, or with the idea of establishing a homestead for succeeding generations, but rather with the fear that they may not be able to occupy it very long, and may have to sell it off some day, and consequently they build a house which, as the expression goes, would suit some one else that may want to buy it. Thus passeth individuality and true art.

The other requisite of beauty in a home is that it should express ease, that is to say, it should be manifestly suited to its purpose and should evidence freedom from care for the housekeeper. It should avoid awkward and useless corners, fussy and finniky detail, cumbersome drapery and other senseless features that serve no better purpose than that of gathering dust and affording lodgings for disease germs. The true artist remembers all this and provides a home that brings rest with good cheer to the weary soul.

So when I stepped into the studio of this firm of decorators, I was pleased to see the tasteful simplicity that gave character to the work, and to find that it was this point that secured them the contract—quite a large one too at that—in direct competition with other firms. Here was another triumph of art. It was the most artistic production that was wanted; price cut no figure.

Now let us for a moment follow the result of the award. The first thing shown me was a magnificent rug, an oriental make of rare colors; and I learned that the manufacturers (an East India concern) had capable representatives, who spend three months of every year in traveling about the cities of all countries studying the tastes and demands of the market, then they take this knowledge home to India and produce rugs that bring a large price, and why? Because they are artistic; and as a result, foreign commerce is stimulated—transportation companies prosper, but only after the home people have all enjoyed their share of the good fortune in the many branch industries that are dependent upon the success of the manufacturer.

The same point applies naturally to the furniture, wall paper, goods and everything that was employed in the scheme.

But there will be many to answer that this is not what is commonly meant by the term art. But why not? There is art in everything; and art is the expression of beauty—beauty being perfection. But if such persons are not satisfied with these examples, let us see how the painter and sculptor help in the universal work. We will assume, for the sake of the argument, that most easel paintings are luxuries. But this is a mere relative term and not very definite.

The greatest of modern painters are commissioned at enormous prices to decorate the interiors of our public buildings. This requires the aid of many assistants and gives employment to mechanics and tradesmen of various classes. Sculptors of renown are employed in connection with our buildings and monuments; and their work also calls for the expenditure of large sums of money that are disseminated far and wide.

I have no intention of burdening you with further detailed analyses of cases too numerable for the occasion. But I do want to emphasize the great fact that Art is a living force; that it enters into, and penetrates the utmost depths of our daily life, and is in touch with our every thought and deed. It is the secret source from which springs all that is high and noble in the human breast, and bears testimony to man's divinity, for it is founded on the laws of proportion in form, and harmony in color—all revealed to us in the great and marvelous works of nature.

The rude savage decks his person with ornaments, and fastens his weapons and implements on lines of beauty. The commonest and most ignorant laborer rejoices in the attractive show bills and is happy if he can but secure some little colored picture to tack upon the cold bare walls of his haunt, and so testifies to the universality of the artistic faculty. Every mother will strain a point to make her child look pretty and dress her in dainty clothes. Whatsoever we buy, which in its nature is intended to have some definite color or form, appeals to our inborn love of the beautiful, and we will choose this article in place of that one, because we think it more artistic. The dry goods merchant, the milliner, the jeweler, the bric-a-brac dealer, the gas fixture man, the one that deals in carpets, hangings, wall papers, furniture, pottery, earthenware, china and glassware, also the florist, the book dealer, and many others, too numerous to mention, that supply our personal wants, all appeal to our artistic faculty.

The same holds true in other lines of trade. Manufacturers of machinery, especially engines, as well as of cars, vehicles, tools and implements, and similar products, pride themselves on the beautiful lines upon which the models are built.

Then too we find a most direct application of art in its purest form to the modern methods of advertising. Fortunes are spent in producing catalogues, which, in many cases, rank high as artistic productions, not only of the designer's genius, but also that of the printer and binder. Our magazines too are filled with evidences of this branch of art, and we have not far to look and we are shown valuable collections of marvelous poster designs, which really call into service the skill of the cleverest artist. Take a peep at our great lithographing establishments, where tons and tons of fine work are turned out to attract the public gaze, with elaborate announcements, all worked after smart water color sketches. There is no end of industries purely mercantile and manufacturing in character that pay tribute to art.

There is still another department which must not be overlooked. When a stranger comes to town, what is it that influences him chiefly? Is he impressed with the people—with our municipal government, or perhaps our police, or our street car system, or our granite and asphalt pavements? Perhaps so! But in all probability, the first question that he will hear would be: How do you like our city? He may be kind, and say it is beautiful, thinking it is really horrid; or he may be frank and say that St. Louis or some other city is away ahead of us, but that there is no place like New York; or if he has ever been abroad, he will say like Paris. There, he will say, is the wonderful Champs Elysees and all the other beautiful avenues radiating from the wonderful Arc de Triomphe—then there is the Place de la Concorde and endless buildings each more beautiful than the other. He will tell you how Baron Hansmann tore down blocks and blocks of old ugly houses to widen the streets, so that the Grand Opera and other palaces could be seen to advantage, and the city beautified, so that all the nations would come to her feet to do her homage. Paris with her architecture that astonishes the world, her parks that are marvels of beauty, her galleries that are perpetual sources of inspiration, and her shops that are the admiration and envy of all; Paris the home and temple of beauty and culture, and Paris with her unbounded wealth, teaches the great lesson of art; teaches that art is sublime, that it lifts up a nation, and that it pays all round, pays handsomely as a business investment. The French, and latterly the Germans too, put an artistic touch to everything, absolutely everything that they produce. Nothing is too mean to be slighted. And if we ourselves would take this lesson home with us and conscientiously strive to cultivate a similar spirit, and couple with it the determination requisite to apply it to our own case, perhaps we too before long might be a Paris, not only so-called, but in fact the real Paris of America.

AMERICAN ARCHITECTURAL LEAGUE.

The second annual convention of the Architectural League of America is announced to take place at the Art Institute in Chicago, commencing June 7th. This league is composed of the principal architectural clubs of the United States and Canada, and its object is the promotion of American architecture and allied fine arts. The coming convention promises to be as interesting as any in the past.

The directors of the Hamilton Art School have decided to hold the annual meeting of the school on May 28th.

Mr. A. F. Byers, of Gananoque, Ont., is said to have secured a prize, offered by a firm of bridge builders in Kansas City, for the best design in bridge work.

The Atlantic Granite Company has been organized at Kittery, Maine, for the purpose of acquiring the Atlantic stone quarries at Lower Cove, Cumberland County, N.S. The capital of the company is $100,000, and Mr. George W. Davis, of Cranston, R.I., is president.

The new quarters of the Canadian Society of Civil Engineers have been almost completed. They are located at 859 Dorchester street, Montreal, a private residence having been remodeled by Messrs. Cox & Amos, architects, to meet the requirements of the society. A formal opening will take place some time during the summer.

THE BUILDER

[THIS DEPARTMENT IS DESIGNED TO FURNISH INFORMATION SUITED TO THE REQUIREMENTS OF THE BUILDING TRADES. READERS ARE INVITED TO ASSIST IN MAKING IT AS HELPFUL AS POSSIBLE BY CONTRIBUTING OF THEIR EXPERIENCE, AND BY ASKING FOR PARTICULAR INFORMATION WHICH THEY MAY AT ANY TIME REQUIRE.]

Some Uses of Portland Cement.

THE uses to which Portland cement can be applied are various and manifold, and a few hints on its uses and application and defects may not be inopportune. When used for foundations in concrete it should be remembered that the best made and best laid concrete will subside and crack unless the bottom be firm and the foundation sound. Upon soft ground where it is necessary to dig down a considerable depth in order to secure a hard bottom for foundations, a great saving of concrete may be effected by forming concrete piers beneath the points of the greatest weight, placed at distances from one another not exceeding eight feet. Concrete lintels should then be placed across the spaces between the tops of the piers. These lintels should have widths equal to the width of the ordinary foundation under footings, the depths varying with the weight to be carried. The insertion of small steel or iron joists within the lintels adds very considerably to their strength. The concrete should be composed of one measure of Portland cement to six measures of ballast. Any settlement of the bottom or any subsidence, contraction or expansion of a concrete foundation must be allowed for. Fine concrete is more liable to contraction or expansion than rough concrete, but is not so liable to subsidence. It will, however, take longer in setting than rough concrete. When laying concrete in a trench it is always best to stretch a line from one end to the other and drive stakes into the ground, allowing them to project sufficiently to permit the concrete to be levelled to them; this will save material and labor. A concrete footing is just as good as brickwork or the best masonry to bring the work up to the surface under ordinary circumstances, but in the case of piers subject to vibration, brickwork is decidedly preferable. Foundations of concrete intended to be covered with paving should never be less than six inches thick. For concrete walls the mixture should consist of two parts of sand, three parts of ballast which has passed through a round mesh 1½ inches in diameter, and one part of Portland cement. When concrete is placed on a timber frame the latter should be made strong and rigid to prevent sagging. If the wall is to have an external face, the boarding used as molds must be planed smooth, but if the wall is to be afterwards rendered this provision may not be necessary. Courses of concrete should not be laid less than six inches or more than 12 inches at a time, the upper surface of each course being left rough to form a key for the succeeding course. A 12 inch concrete wall is of equal strength to a 1½ brick wall, though some municipal regulations require the concrete wall to be of the same thickness as the wall above. A concrete wall will conduct sound readily. Where concrete covers timber the latter should be well welted before being covered with the mass.

Concrete Roofs.

When a good base is provided, there are few roofs that can be made more effective and durable than a good concrete one, finished off with a layer of fine Portland cement and sand, though care must be taken when the concrete is first laid that the sun's rays be kept off the work for several days ; indeed, the whole work should be kept damp and as cool as possible for a time, and this can well be done by covering it two or three inches deep with sand and wetting the sand from time to time with water from a spray hose or from an ordinary watering can. Cracks in concrete roofs are frequently caused by the settling of the buildings, either from natural shrinkage or from defects in the foundation. When cracks do appear, they should be filled with a fine mixture of Portland cement and sand. To counteract the expansion in roofs of this kind, compressible linings of wood strips should be used around the works where the flashings are usually placed, and a cement skirting or flashing 6 inches high and 1 inch thick should be well keyed into the walls with all concrete roofs, and this can well be done by raking out the mortar joints of the brickwork that is to be covered and wetting the whole before the cement is applied. No other flashing will be required. Where a concrete roof is laid on between the rafters, the timber work should be made strong, and there should be ample wood fillets well nailed to the lower edge of the rafters to hold the cross boarding on which the concrete is laid. When desired, slates or tiles may be either nailed to the concrete or bedded into it while yet in a damp state. The pitch most suitable for a concrete roof is about ⅜ of an inch to the foot. This is ample to carry off the water and not too much to effect the cement while being laid. Once a concrete roof is properly finished and all settling ceased the roof becomes almost everlasting, or at least it will last as long as the base on which it is constructed.

Concrete Floors, Ceilings, Stairs, Etc.

CONCRETE floors may be laid in one mass, or may be laid in sections ; or a first layer of coarse concrete may be laid down and a finishing layer in sections put on the top. Square slabs of concrete are much stronger than oblong ones. Slab floors being homogeneous throughout, the whole weight is a dead weight, and consequently there is no thrust on the walls. Joist concrete floors do not require much skilled labor in laying. The concrete is laid between, over and under the iron joists, which are fixed from 3 feet to 5 feet apart, according to the span and strength of the joists. Tiles or fine finish in cement may complete the surface, according to the quality of the work desired. A combined floor and panelled ceiling may also be formed in concrete, with the surface finished in fibrous concrete or cement. Damp or dry rot is an objection to concrete floors finished with flooring boards, and special care should be taken to prevent this. A good way to avoid this is to lay felt or mineral wool on the concrete from one half to one inch thick, before the boards are laid ; this will also act as a non-conductor of sound. Greater lightness may be obtained in concrete floors by the use of concrete tubes. Half-circle pipes laid on their side edges may be used to save concrete and prevent over-loading the floors. If underneath the joists is to be finished in plaster, some provision must be made for holding the necessary metal lath. If homogeneity in a floor is required without flaws or cracks, the floor must be completed at one operation and without cessation, or flaws will surely follow. In forming concrete steps or stairs, the foundation or base should be made good and strong, and iron pipes or T pieces may be placed in the concrete at suitable points to give strength to the steps or the strings. They also help to carry the dead weight until the mass is thoroughly set, and also prevent risk of sudden defection. When enriched finish is desired, fibrous plaster is well adapted for concrete surfaces. The soffits and strings by this method can be panelled or enriched with medallions or foliage as required. The operations necessary in the construction of concrete stairs are : (1) Setting out the stairs and landings ; (2) preparing the wood skeletons and fixing it in place; (3) gauging the materials and filling in ; (4) removing the framing when the work has set ; (5) cleaning up and finishing treads, risers and strings ; (6) striking the soffit and centering and finishing the soffits ; (7) protecting and wetting the work until it is set and hard. Sometimes stairs are built with the steps cast separately and then built in, in the same manner as in stone. Stairs should be built spacious, light, and easy of ascent. A 12-inch tread and a 5½-inch rise make a most convenient and comfortable stair to mount. No tread should be less than 8 inches or more than 16 inches wide, and no rise less than 4½ or more than 7 inches in height. In order to obviate slippery steps, the surface should be indented with a concrete roller, or three or four sunk V-shaped grooves from 1 to 2 inches apart should be made in the treads while the concrete is moist. To make the nosings and mitres sharp and true on the ends of the treads, and set the soffits of the stairs and landings properly, and form a true arris at the stringing, the plasterer's skill and training is indispensable ; without it the work will be uneven, rough and unworkmanlike. In the handling of Portland cements, in any form. it pays best to employ skilled labor. Results are always more satisfactory, and these are achieved with a minimum of material.

A local company has been formed, under the name of the Union Mining Company, for the purpose of engaging in the manufacture of cement at Miami, Man. It is said that satisfactory tests of the material in the district have been made by several experts.

The bricklayers in Vancouver, B.C., struck for an eight hour day on April 1st. The employers agreed to give an eight hour day conditionally, but the men refused to accept the conditions. A few days later the stone-cutters struck in sympathy with the bricklayers. The wages of painters in the same city has been advanced to $3 per day.

CODE OF RULES FOR TENDERING.

Following is a code of rules regulating the practice of estimating and contracting recently adopted by the Vancouver Builders' Exchange, to which reference is made elsewhere in this paper :

On and after April 10th, 1900, unless special permission is given by the Exchange, its members shall not tender or contract for work unless the following conditions are complied with :

1. Tenders may be submitted separately for the work in the different trades, or in bulk, but not for both. When whole and separate tenders are asked for the same work no bids shall be given.

DRAWINGS.

2. Drawings prepared for final or competitive estimates must be sufficient in number and character to represent the proposed work clearly, and shall be to a scale of not less than one-eighth of an inch to the foot (except block plans), and be rendered in ink, or some permanent process, and be either coloured, figured or otherwise marked in such a manner as to clearly show all kinds of material to be used, thickness of walls, grades and position and depth of city drains and sewers.

SPECIFICATION.

3. Specifications must be printed, written or typewritten in ink. They shall defintely describe work not clearly shown by drawings. Every distinctive class of work to be included in the contract must be mentioned and placed under its appropriate heading, as indicated by Outline for Specification attached.

NOTICE FOR OPENING BIDS.

4. Before opening bids, the bidders shall be notified of the time when, and the place where the bids will be opened, and they shall be opened in the presence of the attending bidders. If so required by an architect, when calling for them, tenders must be accompanied by a marked cheque equal to 5 per cent. of the amount of tender, cheques to be returned when bids are opened, excepting the lowest three ; these to be returned when contract is let.

PERCENTAGE ON SUB-CONTRACTS.

5. Contractors shall be allowed a compensation of five per cent. on all sub-contracts which at the time of estimating are "reserved" or not called for, but which may be assumed by them by request of the owner of architect, after building contract is let.

AWARD.

6. When work is to be let for which estimates have been solicited, the lowest invited bidder shall be entitled to the contract, and all changes amounting to less than 20 per cent. of the amount of his tender shall be agreed upon with him, provided his prices are equitable and his references prove suitable. Should the prices for changes made by the lowest bidder not be deemed equitable, they shall be settled by arbitrators, one of whom shall be appointed by the owner and the other by the bidder, the arbitrators to appoint a third if necessary, and the majority decision shall be final.

If changes are made amounting to 20% of the amount of the tender the whole competition may be re-opened.

Bidders must not be allowed to amend their estimates after the bids have been opened and before the award.

7. Bids shall be binding upon the bidders or owners for not more than ten days.

8. No payments on contracts shall be less than 80% of the value of the work done, and 50% the value of materials delivered and accepted by the architect ; the remaining 20% to be paid within thirty-three (33) days after the completion of the contract.

Sureties will be furnished by the contractors if so required by the owner ; and in such case the payments shall be 90% of the value the work done.

Tests were recently made by the city authorities at Vancouver, B. C., of samples of foreign and local cement. The results are reported to have proven that the local production was equal in quality to the imported cement.

Mr. Joseph Bourque, contractor, of Hull, is reported to have entered an action against the Catholic Corporation of Ottawa to recover the sum of $4,200 which he claims is due him for extra work performed on St. Patrick's church. The courch authorities, it is stated, ask indemnity for the work not being completed in the specified time.

SOME HINTS IN READING PLANS.

What I may say in this article will perhaps seem trite and commonplace to those readers who are accustomed to go every day into architects' offices and there carefully measure the drawings set before them in order to submit their estimates, for I have no special hints to give them nor short cut methods to suggest, but I know by experience that there are many young painters to whom a set of plans is a mystery which they cannot comprehend, and it is for their benefit that I am writing.

Now let us start out with the explanation that working drawings are not pictures of the object they are intended to delineate, but they are a conventional means of representing an object so that its different dimensions may be obtained by scale measurement, and so that the mechanic who understands the principles of working drawings may be enabled to construct the object represented. A working drawing is, geometrically speaking, a projection of the object represented upon a plain surface. At least two drawings are absolutely necessary in order to represent any object—a plan and an elevation, and to make a full set of working drawings usually four elevations are required and one or more plans, while in addition sectional drawings showing the object represented as being cut through are made to further illustrate points that require explanation. As a rule the painter will be interested only in such working drawings as come to him from the architect's offices, and these usually consist of the floor plans and elevations of the houses on which he is asked to bid. He is seldom shown the larger details, though these might materially modify his estimate.

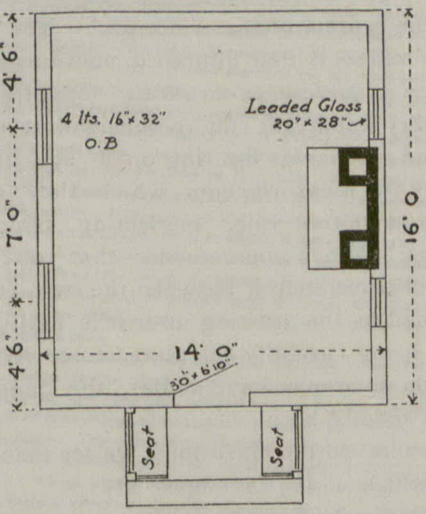


Fig. 1.—Plan.

With these preliminary explanations, let us start at once to consider a set of working drawings; and for the purpose I have selected the drawings of a small one story frame office building such as the village painter might be called upon to submit an estimate upon; just such a building as might be erected for the lawyer or doctor; plain and neat, and with no architectural pretensions.

First, let us examine the plan. (Figure 1.) A floor plan is the easiest of all working drawings to understand, for it is a conventional diagram, representing the building as it would appear were it cut through by a plane parallel with the ground at a point somewhat above the level of the window sills, so that all the window and door openings are indicated upon the plan. The observer is supposed to be looking down from above, and the drawing is made to scale the same as a map. In short, a floor plan is merely a map of the particular floor of the house which it is intended to represent, and as my readers have all studied geography we may at once proceed with the special points requiring consideration in estimating from plans, and the conventional signs that are used to indicate certain things upon a floor plan. In former days the architects made their plans upon tracing linen, and the sections of the walls that appeared upon the plans were colored yellow to indicate wood, red to show brick or blue to denote stone, but nowadays mechanics seldom see a tracing, but blue prints, made by a photographic process, are used instead. The use of colors has been practically abandoned and plans are drawn in simple lines just as shown by the figure, though in some offices the sections of the walls are cross hatched, or section lined. Brickwork is painted in solid. I have shown the chimney in solid black. On the blue print it would appear solid white.

Every change in level is represented by a line. For this reason two parallel lines are employed to show the walls and partitions, broken only at the doors. In this particular plan a line at the lower side of the door indicates the step leading down to the stoop of front porch. The door itself is indicated by a diagonal line to show on which side it is hung—though this is often omitted—and the size of the door is shown by figures. The windows are indicated by parallel lines running between short cross lines. This only gives the width of each window; the style and general dimensions we must gather from the elevations. But as windows are a very important thing for painters to consider, you must carefully count the windows on the plan and then just as carefully locate them on the elevations, checking up one by the other. Some architects figure the glass sizes on the plans, and also mark whether outside or inside blinds are to be used. Others put this information on the elevations. Still others do not figure the glass sizes on the general drawings, but leave them

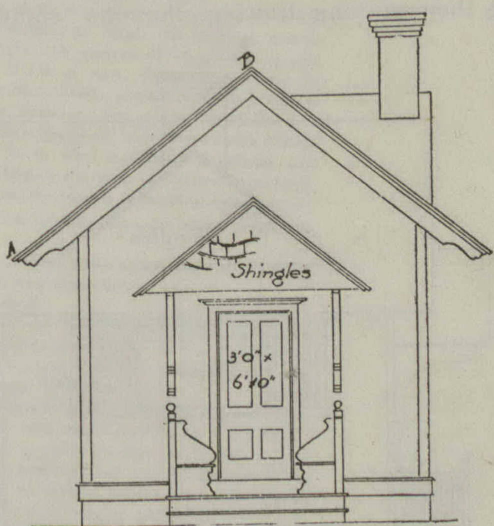


Fig. 2.—Front Elevation.

to be determined by the detail drawings that are furnished after the contract has been let. In this case it is well to scale the width of the window on the plan as closely as possible and deduct four inches for the stiles of the sash, dividing the remaining number of inches by the number of lights of glass to get the average with. But in doing this it is well to carefully compare the results thus obtained with the elevations, since a careless draughtsman may have made the windows on the plan narrower than they should be.

Now let us look at the question of measurements.

Working drawings are always drawn to scale. The usual scale for general drawings is either one-quarter or one-eighth of an inch to the foot. That is, a quarter or an eighth of an inch on the drawing will represent a foot on the actual building. These scales are spoken of as "quarter scale" and "eighth scale." In the first, every quarter inch on your two foot rule, as you lay it upon the plan, will represent a foot on the building, every eighth inch six inches, and every sixteenth will

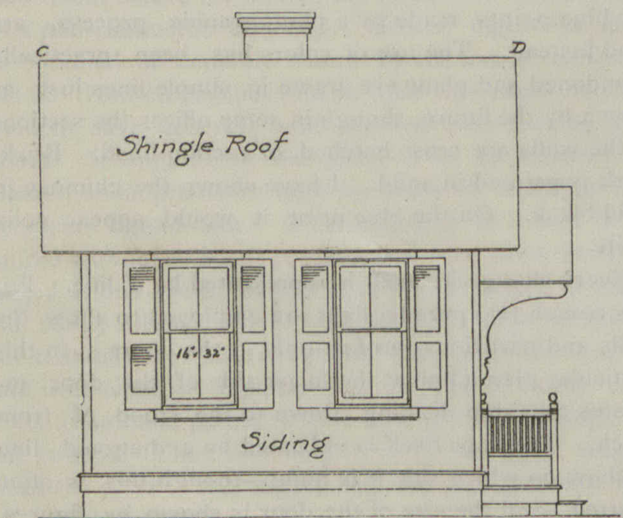


FIG. 3.—SIDE ELEVATION.

represent three inches. On an eighth scale drawing you cannot scale closer with a two foot rule than six inches, which is represented by a sixteenth of an inch. Occasionally sketches are made to a scale of a sixteenth of an inch to the foot, but except for approximate figures the mechanic should refuse to estimate from a drawing on this scale, as it is impossible to make such a drawing sufficiently accurate to permit of anything but guess-work. In general, a quarter of an inch to the foot is small enough for accuracy, except in the case of large buildings, though some architects are so particular in making their working drawings that an eighth scale

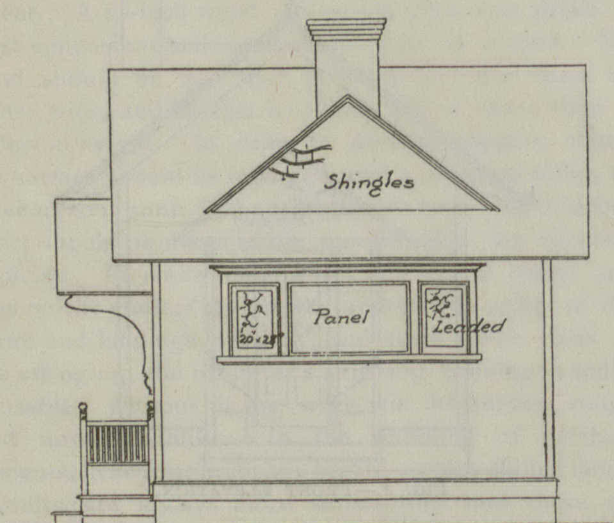


FIG. 4.—SIDE ELEVATION.

drawing from that office is more apt to scale correctly than a quarter scale from another office where the draughtsman is notoriously careless as to accuracy. These, however, are points that you will soon learn after a little experience in figuring out of different offices. On the plan all measurements are considered as being made on floor or parallel with it. The accompanying drawings have been originally made to a quarter scale and photographically reduced to an eighth scale.

In order to insure accuracy in laying out the building the architect does not depend entirely on scale measurements, but carefully figures the dimensions on his drawings, though this is not always done until after the contract has been let. These figures are placed either in rows across the plans, with arrow points to indicate the places between which these measurements are to be counted, or they are placed outside, with dotted or red lines running to the point indicated by the figures. At the bottom of Figure 1 you will find a general cross dimension, to the right and outside is the total length and on the left side is a dimension line indicating the centers of the windows. The rule in all architects' offices is that figured dimensions are always to be taken in preference to scale measurement, and this is a very important rule to consider in estimating. I have seen mechanics figuring on a set of drawings entirely by the measurements which they would read from their two foot rule, neglecting plainly figured dimensions. When you consider that often there is considerable discrepancy between the two (the figures being placed on the drawing after it is entirely finished, and then being carefully calculated to correct any error the draughtsman may have made), the danger of this practice is readily seen.

Now turning to the elevations, we see that the sloping roof, of which only the edges are seen in the front elevation (Figure 1), becomes a rectangle in the side elevations (Figure 3 and 4). If this is to be painted it becomes an important question to determine the number of square feet in this roof. To do so we measure from eaves to peak on the front elevation (A to B) and multiply by the length of the ridge line on Figure 3 (C to D). To obtain the number of square feet on the different perpendicular surfaces on each side elevation is merely a simple question of mensuration as given in the arithmetics. But to determine the area of any sloping surface we must first examine the drawings carefully to find its greatest length and greatest breadth, just as we have done in the case of the roof. Study carefully, in this manner, the method of determining the surface of the projecting hood, carried on brackets, shown only by two parallel lines on the front elevation, which extends over the front stoop.

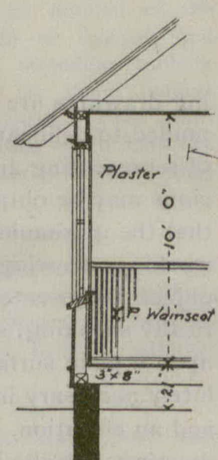


FIG. 5.—SECTION.

In the sectional drawing (Figure 5), which represents a piece cut through the building, we can scale the unde surface of the eaves, which the specifications tell us are yellow pine match boards that are to be oiled and varnished. We can also see the height of the wainscot that is to have three coats of varnish, and the quantity of rough plaster which is to be kalsomined.

In a brief article like this it is impossible to discuss every point that may be brought up in reading a set of plans, but the painter who carefully studies those plans which may come to hand by the same methods we have here employed, and who is guided in his measurements by the system of measurements adopted by the National Association of Master House Painters and Decorators, and published by them in book form, need fear no difficulties that may present themselves.—James K. Carpenter, in Painters' Magazine.

The journeymen plumbers of Halifax, N.S., went on strike on May 1st for an increase of wages to $2.25 per day.

FOUNDATIONS OF BUILDINGS.*

By S. Anglin, Master of Engineering, Royal University of Ireland.

In recent years the field of operations of the architect has been considerably enlarged by the introduction of steel and iron in the construction of buildings, and what was formerly considered to be exclusively the business of the civil engineer is becoming more the work of the architect. A knowledge, therefore, of the nature and properties of steel and iron and the methods of calculating the strengths of the various members of such structures is becoming more essential every day to the architect. It is not proposed in this paper to deal with the arranging and designing of such structures—this of itself would supply material for more than one paper —but rather to make a few remarks on the supertructure or foundations of such buildings, and, indeed, of buildings in general.

In ordinary buildings constructed of stone or brick walls, the pressure on the foundations is pretty evenly distributed over a comparatively large area of ground surface; so that pressure per square foot on the foundations is usually small, and does not call for any special consideration except when the ground is soft or treacherous. In the case of lofty buildings of enormous weight supported on pillars the case, however, is quite different. In such buildings as much as 1,000 tons may come on the foundations of a single pillar; this immense pressure being exerted on a comparatively small area of ground surface, it will be apparent that special means will have to be adopted for insuring the stability of such foundations.

My attention was forcibly drawn to the importance of this subject, and to the scant thought it sometimes receives by the architect, about four year ago, when I was asked to report on the causes of the collapse of a large mill then in course of construction in Germany. This was a typical Lancashire cotton mill, of several stories, the floors being for the most part supported on cast-iron pillars. These pillars rested on brick piers, underneath which were beds of concrete, the concrete itself resting on a sand foundation. Partly owing to the presence of water in the sand, partly owing to inferior bricks and mortar and the slovenly manner in which the work was executed, and perhaps, also, partly owing to to the defective cast-iron base plates on which the pillars rested, one day, when the construction of the mill was nearing completion, the foundations of one or more of the pillars subsided, causing the base plates to fracture, and the shafts of the pillars to pierce through the brickwork and concrete beneath. This occasioned the complete wreck of the structure, and entailed the loss of the lives of several of the workmen. Here we have an example of a building carefully designed and erected so far as its superstructure was concerned, but, owing to carelessness in the designing and execution of the foundations, meeting with an untimely fate.

In America the construction of lofty steel and iron buildings is carried to much greater lengths than in this country. The erection of what are termed "sky scrapers" seems to have originated in Chicago, and from there has spread to several other cities in the States, and it is not at all improbable that in the near future we shall see their introduction into England.

There may be many objections to these colossal structures from an æsthetic point of view, and I dare say many people consider them monstrous eyesores. There may be also objections to them as excluding light and air; yet, when we admit all this, we cannot but admire the ingenuity displayed in their construction, and from a commercial point of view we must admit their claims, especially in cities where land is very valuable. Such being the case, we should face the situation boldly, and, instead of decrying them as monstrosities, should rather study them and make ourselves conversant with all the intricacies of their design.

In America, the work of designing these structures is usually divided between the engineer and architect. The details of their construction are so varied that neither the engineer nor the architect by himself can satisfactorily cope with them. The work of the engineer consists in designing the steel framework, including the pillars and girders; that of the architect in arranging the plan of the rooms and offices and the skeleton walls and partitions, and also the general decorations; while the foundations, which are of the utmost importance, might be planned conjointly by both. In providing for these, the loads coming on the foundations must first be carefully calculated. These consist of, first, the dead weight of the building itself, including that of the floors and roof; and, secondly, the loads on the floors, which may consist of goods, machinery, and people, and also the wind pressure exerted on the building. These latter loads may change from time to time, and are sometimes termed live or accidental loads, and they vary considerably in different buildings.

The maximum live loads on the floors of dwellings may be taken as 1¼ cwt. per square foot; on public buildings at 1½ cwt. per square foot; and on warehouses at from 1½ to 3 cwt. per square foot. In the case of dwelling-houses and public buildings it scarcely seems probable that these loads can be reached, but it is always advisable to have a margin. It is quite possible that such floors may contain a densely-packed crowd of people, which may weigh as much as 1 cwt. per square foot of floor surface. In the case of lofty structures consisting mainly of offices with light fixed furniture it is not necessary to allow for such heavy loads as those specified. The weight of the roof, including wind pressure and snow, depends on the span, and varies between 25 and 65 lbs. per square foot of roof surface.

A lofty steel structure has just been completed in New York, and it may be of interest to refer to a few particulars respecting it.

This is the Park Row building, mainly consisting of offices. It is the highest building in the world, its height from the level of the kerb in Park Row to the top of the cupola being 386 feet. It has thirty-two stories, and contains 1,000 offices, having accommodation for 4,000 persons. The total weight of the building is estimated at 65,000 tons, and the pressure on some of the pillar foundations is as much as 1,100 tons.

The structure is carried on round timber piles of spruce from 10 to 14 inches in diameter, driven into a sand foundation to a depth of about 20 feet. The piles are placed from 16 to 18 inches apart, centre to centre, and are driven in rows, the distance between each row being 24 inches—centres. The load on each pile does not exceed 16 tons. The heads of the piles were cut off level, and concrete was filled in between them to a depth of 12 to 16 inches, the surface of the concrete being level with the tops of the piles. Upon the concrete are laid granite blocks which receive brick piers, which in their turn receive the grillage beams and distributing girders. Some of the interior pillars rest directly on the grillage beams, which are steel-rolled joists. In other cases distributing girders rest on the grillage beams of two or more of the foundations, and support two or three pillars. These distributing girders are massive steel-riveted girders of the box form, and vary in length from 20 to 47 feet, and in depth from 6 to 8 feet, and some of them weigh as much as 47 tons.

This example of a building is, of course, an extreme case, and the architect may never be called upon to consider such enormous loads and such intricate foundations; yet the general principles coming into operation here are, in a modified way, applicable to similar buildings of less pretentions.

Having said so much in a general way, we will now consider more in detail as to what constitutes a good foundation, and what working loads different foundations are capable of sustaining. I would, however, remark that within the scope of a brief paper, hastily written, it is not claimed that anything in the nature of a complete survey of the question can be attempted.

In preparing a foundation the first thing to be done is to examine the nature of the ground on which the building is to be erected. It is not often that the surface of the ground is suitable for building upon. If it is of rock, of course we have all that is necessary so far as the stability is concerned. It is the exception, and not the rule, however, that a rocky foundation is to be met with. It then becomes necessary to excavate until a reliable foundation is reached. As to what constitutes a reliable substratum is a matter very largely the result of practical experience.

Ordinary foundations may be ranged under three classes, viz:

1. Foundations in rock, or in some material whose stability is not affected by water.
2. Foundations in firm earth under which are included such materials as sand, gravel, and hard clay.
3. Foundations in soft earth.

It must be borne in mind that the base of every foundation should be as nearly as possible perpendicular to the direction of the pressure which it has to sustain; and moreover, it must be of sufficient area to bear that pressure with safety.

To prepare a rock foundation for being built upon it will be necessary:—(1) To cut away all loose and decayed parts of the rock; (2) to cut and dress the rock to a plane surface, or to a set of plane surfaces like those of steps, perpendicular to the direction of the pressure; (3) to fill, where necessary, hollows in the rock with concrete or rubble masonry; or it may be advisable, in order to distribute the pressure, to cover the surface of the rock with a layer of concrete varying in thickness from a few inches to several feet.

The crushing strength of rock varies considerably. That of chalk, if we may consider chalk a rock, is as low as 30 tons per square foot. The crushing strengths of different kinds of sand-

* A paper read before the Manchester Society of Architects, and reprinted from the Journal of the R.I.B.A.

stone vary between 140 and 450 tons per square foot, that of limestone about 500 tons per square foot, while that of granite or basalt is as high as 1,000 tons per square foot.

The intensity of the working pressure on a rock foundation should in no case exceed one-tenth of the pressure which would crush it. It is not often in practice, however, that the actual pressure on a rock, or indeed any foundation, approaches this limit. Speaking generally, the average pressure coming on a fairly good quality of rock is about 10 tons per square foot in work which has been executed; and the architect might fix in his mind anything up to 20 tons as a safe rule to go upon. On weak sandstone, which is so soft that it crumbles in the hand, 2 tons is sufficient to allow.

Having said so much on rock foundations I will pass on to the consideration of foundations laid on firm earth, under which head may be included hard clay, clean dry gravel, and clean sharp sand. For buildings resting on such foundations, it is desirable, in this country, that the foundations should be carried at least 3 feet below the surface of the ground for sand or gravel, and 4 feet for clay, in order that they may not be weakened by the disintegrating effects of frosts or other climatic conditions. In other countries where greater extremes of climate are experienced a greater depth is necessary. The practice in Germany, for example, I understand, is that for foundations of this kind the depth should be from 4 to 5 feet, and in North America from 4 to 6 feet.

It is very desirable that surface water should be kept from such foundations by constructing suitable drains.

Different authorities vary very much in their estimates as to what working pressure it is desirable to place on this class of foundations. The German authorities recognize 2.5 tons per square foot as a suitable pressure. With good clay, however, sufficiently beneath the surface of the ground to be protected from atmospheric influences, much higher pressures can be safely applied. The main piers of the Tower Bridge in London rest on clay, on which they exert a pressure of 4 tons per square foot. At Openshaw, near Manchester, the massive steel pillars of Messrs. Sir W. G. Armstrong, Whitworth & Co.'s works, which are subject to vibratory loads from passing cranes, exert in some cases a pressure of as much as 5 tons per square foot on the clay, and no settlement has been observed. In other buildings, no doubt, greater pressures exist; but this is the limit so far as my experience goes. In the great majority of structures built on clay the pressure is much less. That of the Nelson Column, in Trafalgar Square, London, does not exceed 1.3 ton per square foot. This column rests on clay of great depth and compactness. In preparing this foundation an excavation of 60 feet square and 12 feet deep was made and filled up with concrete to a depth of 6 feet; on this base's frustum of a pyramid 13 feet high was built in brickwork, on which the superstructure was erected. On a base 60 feet square, which may be taken as the real base of active support, the gross load amounts to 4,665 tons, equivalent to 1.3 tons per square foot, as already stated. I think I may say that three times this load could with safety be placed on this foundation.

Foundations in gravel and sand, under favorable circumstances, are capable of bearing heavy loads. The Campanile of Cremona, 395 feet high, standing on Pliocene gravel, bears with a pressure of 12 tons per square foot on its base.

It is not often that water is injurious to a gravel foundation, as it can percolate through freely; but with sand the case is quite different, as water so alters this material as to make it quite useless for a foundation. The obvious tendency of sand saturated with water is to escape laterally under pressure. If this tendency can be counteracted by any means it may be possible, though not desirable, to utilise a foundation of this description. Sheet piling driven around the foundation often answers the purpose. A case in point is supplied by the tower of Hamburg waterworks. This tower rises about 290 feet above the surface of the ground; it is built of brickwork, and rests on a circular block of concrete 56 feet in diameter and 11 feet thick. This in its turn rests on quicksand enclosed by sheet piling driven below the line of saturation of the river Elb. The gross weight supported amounts to 5,310 tons, which gives a pressure of about 2 tons per square foot on the quicksand.

A foundation of unequal density or compressibility is one to be avoided. When of equal compressibility any subsidence which takes place is uniform all over the foundation, and the structure erected on it is not materially damaged; but if one part of the foundation is more compressible than another, the structure has a tendency to be tilted out of the perpendicular, and cross-stresses are produced which may destroy its stability. In north Italy, as is well known, a number of leaning towers erected as far back as the twelfth and thirteenth centuries exist, and the reason assigned in the majority of cases for these being out of the perpendicular is the unequal compressibility of the foundations on which they are erected. A noted example occurs in the Campanile or leaning tower of Pisa. This is a circular tower 178 feet high, weighing 11,800 tons, with a base 60 feet in diameter, which is equivalent to a pressure of more than 4 tons per square foot. The soil under the foundation is of unequal density, it being more compressible in the direction in which the tower leans. That the settlement took place during the progress of the work may be inferred from the presence of iron bars introduced to hold the building together.

When foundations are too soft for building upon, and when the depth is too great for excavating to a reliable material, special means must be adopted. One method is that to which I have referred in the tower of the Hamburg waterworks. Another method is to consolidate the ground by timber piles, which was the method adopted in the Park Row building at New York. These bearing piles act as pillars, each supporting its own weight of the building. They may either be driven through the soft stratum until they reach a firm stratum underneath and penetrate a short distance into it, or, if that be impracticable owing to the great depth of the soft stratum, they may be supported wholly by friction in the soft stratum. From practical examples, the safe working loads on these piles may be taken as follows:—

For piles driving until they reach the firm ground, 1,000 lb. per square inch of the area of the pile may be allowed.

For piles standing in soft ground, and supported wholly by friction, 200 lb. per square inch of pile section is sufficient.

The best material is elm. The point of the pile should be fitted with an iron shoe, especially if stones or other impediments are to be met with, and the head should have an iron band to prevent its being split by the blows of the ram. They may be driven by band or steam power. For the piers of bridges and similar structures iron screw piles or cylinders may be used.

In ordinary steel or iron structures, the main pillars usually rest on concrete, brickwork, or stone, and some times on all three in combination. When laid in combination, a concrete block is first laid, upon which several courses of brickwork may be built, and lastly a stone slab placed on the top. It is not often, however, that all three materials are used together, one or two generally being found sufficient. The intensity of pressure on the ground underneath may be modified to the required extent by increasing the area of the concrete block, or by stepping out to the necessary extent the lower courses of brickwork.

It is of great importance that the architect should be conversant with the working loads allowable on these materials.

The working pressure allowed on concrete foundations of sufficient thickness varies considerably according to the quality and age of the concrete. Generally speaking, it may be taken as varying between 2 and 10 tons per square foot. It is not often, however, in work that has been executed that so high a pressure as the maximum mentioned exists, from 1 to 5 tons being most general. When pressures of 5 tons and upwards are to be provided for, great care should be bestowed on the manufacture of the concrete. All the materials composing it should be of good quality. All earthy substance, ashes, soft broken bricks or greasy matter should be excluded; round smooth gravel or stone should be broken. The best Portland cement should be used; it ought to have a cohesive strength of 400 lb. per square inch after seven days from mixing. The proportions of the different ingredients should be four parts of broken hard brick or stone, one of clean sand, and one of cement. The concrete should be turned over twice dry, and three times wet, and well rammed in 12-inch layers. It is not advisable to send the concrete down a shoot or drop it from a height, unless it is afterwards remixed, as the larger pieces fall to the ground first, the smaller pieces next, and last of all the cement. Whenever used under water, the water should be still; a current will carry away the cement and leave only the ballast.

The crushing strength of bricks varies considerably. It may be as low as 60 lb. per square inch, and as high as 1,700 lb. per square inch. Best blue bricks show a strength of 1,200 lb., while Stourbridge fine bricks will stand 1,700 lb., or even more. When great pressures have to be borne, the latter, or others similar in strength, should be used. It is desirable in a brick foundation that not only should the quality of the bricks be good, but also that they should be properly laid in good cement. Each course as laid should be well rammed down and bedded, leaving the layer of cement between each course as thin as possible. When this is done it is extraordinary what a brick foundation will support.

In connection with the failure of the foundations of the German mill already referred to, I had some experiments made as to what loads a brick pier was capable of sustaining. The test was made on a block of good red brickwork, 3 feet 1 inch by 2 feet 11 inches, and 1 foot 4 inches thick. It was built of five courses bedded in cement, the bricks being pressed close together, with a thin layer of cement between them, and allowed to set for ten days before the test was made. The bricks were made by Messrs. Smeburst, of Oldham (and some of similar quality were tested by Mr. D. Kirkalday, who found that it took a pressure equal to 480 tons per square foot to crush them). The pier composed of these bricks was inserted between iron plates and placed in a hydraulic press, the area of pressure on the brickwork being 5.3 square feet. Pressure was gradually applied until it reached 622 tons, which is equivalent to about 117 tons per square foot. The pressure was not increased beyond this point, as the press was incapable of anything greater. After the brickwork was removed and examined it exhibited no signs of failure, and was apparently as perfect as it was before the test.

According to the Berlin building regulations, with ordinary brickwork set in lime mortar a load of 7 tons per square foot is allowable for a working pressure, while with good hard bricks laid in cement 11 tons per square foot is recognized. Generally speaking, in this country anything between 2 and 10 tons per square foot is the practice.

With iron or steel pillars resting on stone, brick or concrete foundations, there is another very important matter, frequently lost sight of, which should receive careful attention, and that is the proper bedding of the base of the pillar. When it rests on a block of stone, the stone should be carefully dressed off to a level surface, and the bottom surface of the base of the pillar should also be true. Some engineers insist upon having the latter machined. Even with these precautions, in very important work a layer of sheet lead might be introduced between the two surfaces. I remember several years ago when the present Manchester Guardian newspaper offices were being built, a failure arising from improper bedding occurred. The main cast iron pillars supporting this building sustain very great loads. One day it was discovered that one of the cast iron base plates was fractured, and also that the stone on which it rested was cracked. This occasioned a good deal of alarm for the safety of the building and a celebrated London engineer was called in to report on the matter. He discovered that it arose from imperfect bedding. The top of the stone, instead of being tooled to a level surface, was hollow towards the centre, and the whole pressure was transmitted to two or three points towards the edges, which sufficiently accounted for the failure.

With concrete and brickwork foundations a good plan, when it can be adopted, is to bed the base in cement. This often can be done with a loose base, but in the case of steel pillars, where the base is an integral part of the pillar itself, it cannot be satisfactorily adopted. The modus operandi in such cases is to leave the surface of the foundation rough, and place the pillar upon it with iron wedges inserted at the four corners. By means of these wedges the pillar can be raised to the right level and made plumb. When this is done liquid cement should be carefully run underneath. This effectually fills up all inequalities and evenly distributes the pressure over the foundation. The cement should be of such a nature as to set hard, and may vary in thickness from ¼ inch to 1 inch.

THE PRISM QUESTION.

The story of Luxfer Prisms and their development from the first suggestion as contained in the crude Pennycuick patent, is an interesting chapter in the history of building materials. The large sums of money spent on this device, and its ultimate commercial success, has tempted a great many to imitate the scheme by copying one or more of the numerous refracting angles used by the Luxfer system, making some slight alterations, such as a nick in the top of the prism or a spot in the centre. These imitations have been put on the market from time to time, each having a fancy name indicative of their great light-producing qualities.

It is generally known that the Luxfer device is protected by a series of patents, so that users of imitation devices, when considering the cut prices quoted, will do well to ponder how far they can afford to take chances of a patent suit. So far, we are informed, architects have had no trouble in showing their clients that in Luxfers they get better value for the money expended than from any device yet produced, and, even if some one was daring enough to make an exact copy of the series of angles used by the Luxfer Company so as to give substantially same results, it is doubtful whether the architects would advise their clients to be a party to a patent dispute for the sake of a possible small margin in cost. It cannot be conceived that the Luxfer Company would, after spending so much money on their patent situation, allow any infringer to get a material hold on the market. So far the imitations that have been brought out have, after one or two insignificant installations, dropped out of sight. This will probably be the case with each succeeding attempt, but if it ever becomes possible for an imitation device to get any hold on the market, a lively time may be anticipated by the purchasers thereof, as the Luxfer Company will doubtless, if they consult their interests, take action against the user, who can always be got at, rather than the seller, who is generally an agent for some American company capable of being dissolved as quickly as it was created.

Not only is the building trade indebted to the Luxfer Prism Company, Limited, for the production of Luxfer Prisms, but this company has arranged to put on the Canadian market all the better lines of building materials, such as architectural terra cotta, hydraulic-press brick, marble mosiacs, myccnian marble, ornamental iron and art glass. The showrooms of the company at 100 King street west are a veritable exhibition, where architects and others interested in the building trades will find a large number of interesting things.

MARBLE.*

In architecture the word marble conveys the idea of a stone of more importance than an ordinary building material. It is a stone always possessed of some special beauty, either in texture, color, or both, and of sufficient hardness to take a polish. The varieties are almost infinite, and numerous as they are, it is rare that any two quarries are precisely the same; there is always an individuality of some sort or other.

We have marbles of one uniform color, as white, black, gray, red, yellow, green, and so on; but in all cases, even in whites and blacks, there are differences. The whites of Carrara, Italy, differ from those of Greece, Spain, and America. The blacks of Belgium are not the same as those of England and Ireland. The serpentines of the Lizard, Cornwall, differ from those of Banff, in Scotland, and Anglesea, and further vary from those of the Continent and America. These variations are not to be wondered at, when for a moment we study their origin and the different changes they have gone through as part of the earth's crust. Their ages are equally wide, some being, comparatively speaking, recent, while others are old, and some very old. The white crystalline marbles are now conclusively proved to be nothing more than ordinary sedimentary limestone rocks, like our chalk cliffs, or carboniferous rocks, which have gone through a process of cooking or baking under great pressure, while being hermetically sealed by overlaying rocks which have kept in the gases, causing the limestone rock to crystallize and alter its nature to that extent that rarely any of the fossils are now discernible; in short, a new rock is produced. There are other whites that have been produced by hot springs carrying in solution a large quantity of lime and silica, which deposits directly the carbonic acid gas is liberated in the atmosphere, often producing a rock of the purest whiteness, or colored by any metal that the hot water may pass through.

Black marble is a sedimentary limestone colored by carbon, which color is immediately destroyed by heat, producing the whitest of lime oxide. We get black marbles with white veins; these white veins are usually younger than the rock itself, being infillings of the cracks produced by different causes in the history of the rock. These remarks about black rocks apply equally to red and yellow ones.

Another class of marble, the Breccias, have gone through all sorts of nature's changes and disturbances; they are rocks that have been broken into irregular fragments, and been cemented together again by nature, and after that, in some cases have gone through a baking process and the like.

Nearly all our green marbles are earlier rocks that have been altered, and in some instances been broken up and recemented, like Verde Antico. The greens are nearly all magnesia, while the whites in the same mass are lime; occasionally we get both white and green in the same mass. This slight geological introduction will prove to you that, as marbles are produced under such varying conditions, the quality must be equally various, both in hardness and durability.

Again, some marbles, like the Purbeck, are not much more than tremendously compressed mud and fossils, others are only baked compressed clays. When used in damp situations these often go back to their original elements, and it further happens that a marble that behaves fairly well in Italy frequently will not stand at all with us. And there are marbles that, like building stones, have to be placed on their natural bed.

Most marbles will stand in isolated shafts, or engaged pilasters, but experience shows us that only a limited number used as slabs for wall linings can resist the moisture of a newly built wall. The destructive power of this moisture, be it hydraulic or chemical, is such that it very shortly destroys the face of many marbles; all those of a slaty or sedimentary nature, when face-bedded, go directly, for instance, the Swiss Cipollino, but if cut across the bed this stands fairly well. Then again, certain marbles, like Purbeck, Emperor's Red, and Verona, which consist chiefly of flattish fossil shells, when face-bedded on damp walls become pitted with small holes, while across the bed they stand all right; nearly all this class of fossil marble is only obtainable in thin beds, so a large slab has to be face-bedded. These same remarks apply to certain red marbles found near Carrara, which are red clays compressed and baked by the same heat that has produced the crystalline whites.

When the Greeks used marble in architecture it was always treated as an ordinary building stone, no attempt was made to save material, everything was massive, and the blocks were ground or rubbed together until the whole structure was next to homogeneous, without the aid of mortar or cement. Their columns, as you are aware, were built with thick drums; these blocks were worked roughly in the quarries, with projecting bosses on the sides, to which, most probably, were attached some wooden arms to enable the blocks to be revolved forward and backward on wooden centers, until the two faces came together with an almost invisible joint. When built the whole column mass was skillfully masoned into a pillar with all the Greek subtlety of diminishing entasis and delicate flutings. This work, had it not been for earthquakes, and the ravages of man, would have been perfect now.

* Abstracted from an address delivered before the British Architectural Association on November 1st, 1899.

Those who have not seen the Acropolis of Athens can scarcely realize the beauty of this immense marble pile ; the sublimity of color is in harmony with the subtlety of form. It is not the cold blue white marble of Italy, so common with us, but a translucent warm ivory tint, becoming often ocher yellow ; this deep color, which is only surface, is usually attributed to great age, but this is not correct, as is proved by the coloring of recent fractures on the Parthenon, and by modern buildings in Athens, a good example of which is a high slab plinth round the Royal Palace. This marble already is nearly as yellow as the Parthenon. The marble contains minute crystals of iron pyrites, the decomposition of which colors the marble a yellow ocher. In the Greek temples of Delphi, Sicily, and Pompeii the common worked stone was plastered over with a marble-like stucco, which is thought to be marble dust with lime and albumen. I think now, from what I saw recently in Greece, that it may be white crystalline marble not quite burnt through into lime ; this I saw being finely crushed with rollers by horse power for plaster work.

WHITE MARBLE.

Roughly speaking, perhaps, three-fourths of the white marble used in the world at the present day comes from the Carrara district of Italy. The marble mountains extend some twelve miles ; they consist of mountain peaks going up to an altitude of 6,000 feet. The sides of these mountains are scored with valleys and ravines which have only three outlets — Carrara, Massa, and Seravezza. On the sides of these valleys are the different quarries, of which there are some 600, "producing annually about 200,000 tons." The water coming from these ravines turns innumerable sawing mills, which slab annually some 60,000 tons of marble. The towns are full of workshops and studios. The marble businesses support in the district some 10,000 people. Any young man who likes mountain scenery, with picturesque sketching and architecture, cannot find a hunting-ground anywhere to surpass this. He will find beautiful Byzantine, Mediæval and Renaissance work in marble that cannot be surpassed, or rarely equaled, even in Italy. It was the land of the Medici, the playground of Michelangelo and Donatello. I believe a young man could spend a month, pay his fare from London and back, hotel accommodation, including food and Chiante wine, ad libitum, for less than it would cost at an English seaside town. He would also pick up a little Italian. Nearly all the best statuary of the world is quarried at Mont Altissimo, Seravezza, near Carrara. This is the famous H-marked statuary of commerce, H. being for Heuraux, the proprietor. In Italy there are also old white quarries near the coast not far from Grosetta, between Pisa and Rome. The Cathedral of Milan was built from quarries above Baveno.

Spain has several extensive deposits of white marble. The best is the one the Moors used at the Alhambra, the quarries of which I visited some years ago ; they are at Macael, between Lorca and Baza. There is good white marble in Trazos Montes, Portugal, where an enterprising company ten years ago quarried £20,000 worth without any prospect of getting the blocks away, and there they are now. France has some white marbles, but there is little demand for them, although there is a considerable duty on foreign produce in France. Norway has extensive deposits, though very little of it is good. Some was used for ashlar at the Junior Constitutional Club ; it seems to be standing very well. The finest quality is at Velfjord ; it is only about 100 feet off very deep water for shipping. There is further north a crystalline white marble, which is a dolomite.

The late war of the Greeks and Turks would seem to have enriched the Athenians, for they are pulling down their old buildings and erecting lofty Pentelic marble ones in their places. These are full of architectural detail, which is very well done. The marble is chiefly obtained from the south or Athens side of the mountain, near the ancient workings. A company is now working the north or Marathon side. I have examined the different quarries very carefully, and am of the opinion that they are the same beds as the south side, but the famous old cave statuary marble is not yet found. They are extracting large blocks, some of which are being used in the safety repairs of the Parthenon.

We are now working blocks of this marble, which those interested can see. It is considerably harder and more costly to work than Carrara.

In marble quarrying considerable skill and judgment are required ; the mass of rock is rarely solid enough to be stepped down as in ordinary stone quarries, and blasting cannot be employed, except for clearing away masses of inferior material.

Unquestionably the best yellow marble known is the Giallo Antico of the Romans. The columns of the Arch of Constantine, and half those of the Parthenon, are of this marble. It varies from deep ocher yellow to pale and delicate rose color ; its markings are red and blue purples, the grain is of the palaces of the Caesar, the baths of Carracalla—in short, it was the only yellow used in old Rome. The quarries, which are very extensive, are in Tunis, near the frontier of Algeria ; they were extensively worked about fifteen

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