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The Canadian Engineer

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For THE CANADIAN ENGINEER.

RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C.E., ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

CHAP. V.

ROADBED CONSTRUCTION.

ARTICLE 23.—MASONRY BRIDGE PIERS.

The material most commonly used for masonry pier construction is stone, although in certain cases brick may be cheaper and also satisfactory; but wherever there are strong currents of water or jams of ice or logs, brick is hardly suitable, as the individual pieces are liable to displacement; but concrete piers are becoming quite common in certain parts of America, the compact and simple form of a pier lends itself readily to concrete construction, the ebb and flow of tides will not affect well made concrete whereas it has a disastrous effect often even on the heaviest class of masonry, percolating through the many joints loosening the stones and mortar; concrete piers are usually much cheaper than first-class masonry work, and even the compromise of a pier with the sides and top of stone and the interior of concrete, offers considerable saving. In designing piers located in river beds we have three special questions to study, namely, the dimensions and construction of the coping, the batter of the sides to insure stability, and the design of the cutwaters; of course the question of foundations enters into designing this class of work even more seriously than with structures built on land, but the subject of foundations will be taken up in a more general way applicable to all structures.

(1) The coping dimensions will be determined by the width apart of the trusses, the size of the bed-plates, and the loads to be carried locally on the masonry work, the variation would be for single track roads, from say 4 feet by 16 feet under coping for small deck trusses to as large as 12 feet by 40 feet for long through spans. The coping should project two or three feet beyond the bed-plates at the ends, and six inches to two feet at the sides, depending on the weight of the span. Copings should consist of an 18-inch thickness of very strong carefully made concrete, surfaced with a layer of 1 to 1 mortar before the concrete has set, or if of stones, they should be large, well-bedded, cut all over the top surfaces by fine pointing, pean hammering, or in some way giving a good surface for the bed-plates; the vertical joints should be cut and preferably the beds also; but the faces look better with the quarry face left on, if the rest of the pier is rock faced ashlar. They should be dowelled into place, or clamped to one another, and so arranged that the pedestal plates of the bridge trusses will come *exactly* on the centre of a large stone, or if one stone cannot be found large enough to distribute the load, a large, deep pedestal block should be cut for the purpose and placed on top of the coping; for very large trusses, a steel pedestal is constructed to distribute the load over several coping stones (*e.g.*, new Victoria Bridge). Coping plans showing the exact size and position of each stone should be furnished the contractors, and it is a mooted question, whether better results as to exact surface, etc., can be obtained by bedding in mortar, or by shimming up the whole coping to an exact level on wooden chips, then pointing up all the outer bed and vertical joints, and pouring liquid grout into the receptacle of interior joints and beds thus formed until every crevice is filled, the latter plan is probably preferable, if care is taken to have the joints and beds open enough to secure their being thoroughly filled, particularly the beds.

(2) The batter of the sides is usually 1 in 12 or 1 in 24 and is a matter of appearance, as vertical piers would look top heavy, but in each case a calculation should be made for stability, under the most unfavorable circumstances; considering the stability in direction of the railway line, the forces acting would be (*a*) the wind blowing at 45° to the direction of truss, on the truss, train and pier, at say 40 lbs. per square foot, the force of a fully braked train covering one or two spans depending on the location of the expansion rollers, at say, 10 per cent. of the weight of the train, and vertical loads which would consist of a *loaded* span and the weight of the pier itself; the resultant of these forces should not fall appreciably outside the middle third of the base, (*b*) with the wind as before, but

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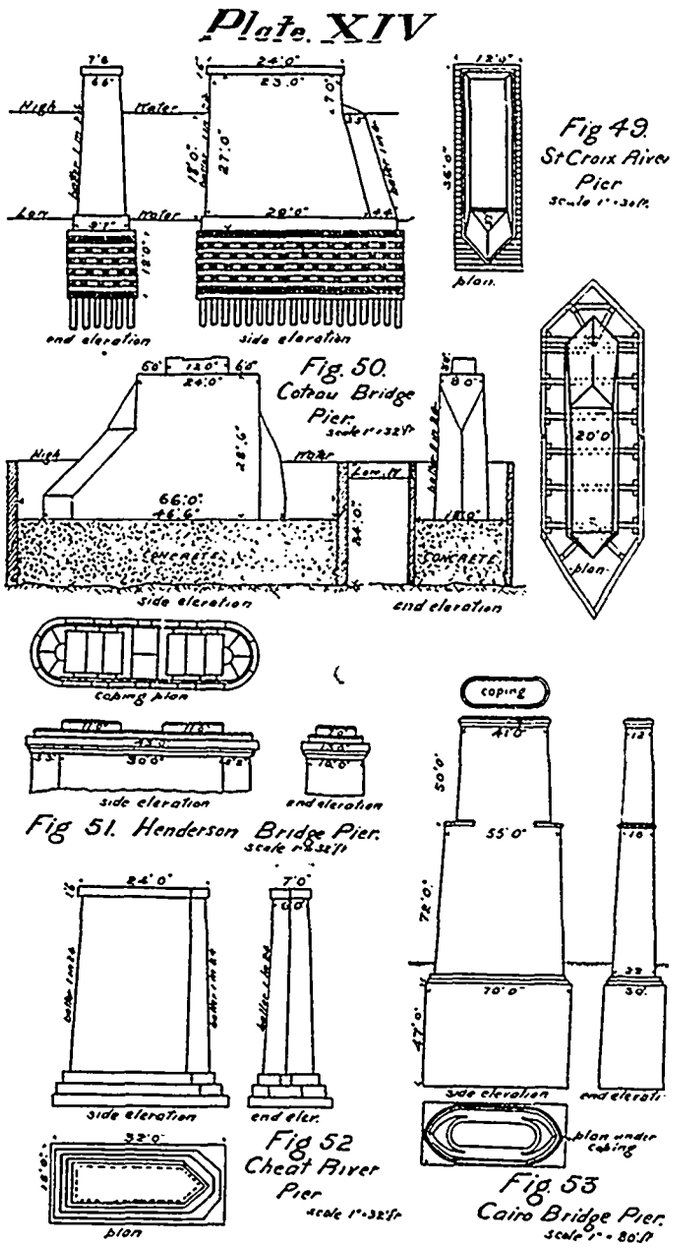
blowing on the truss and pier only, and the vertical loads of an *unloaded* span and the weight of the pier itself, the same criterion for stability should be applied as in (*a*), and in either case the remedy for instability would be to increase the batter, or introduce steps or offsets of, say, 6 inches every 10 or 12 feet, which would have the same effect. The stability of a pier at right angles to the bridge is practically never in question unless of very great height, in which case similar tests would determine what the necessary length of base should be.



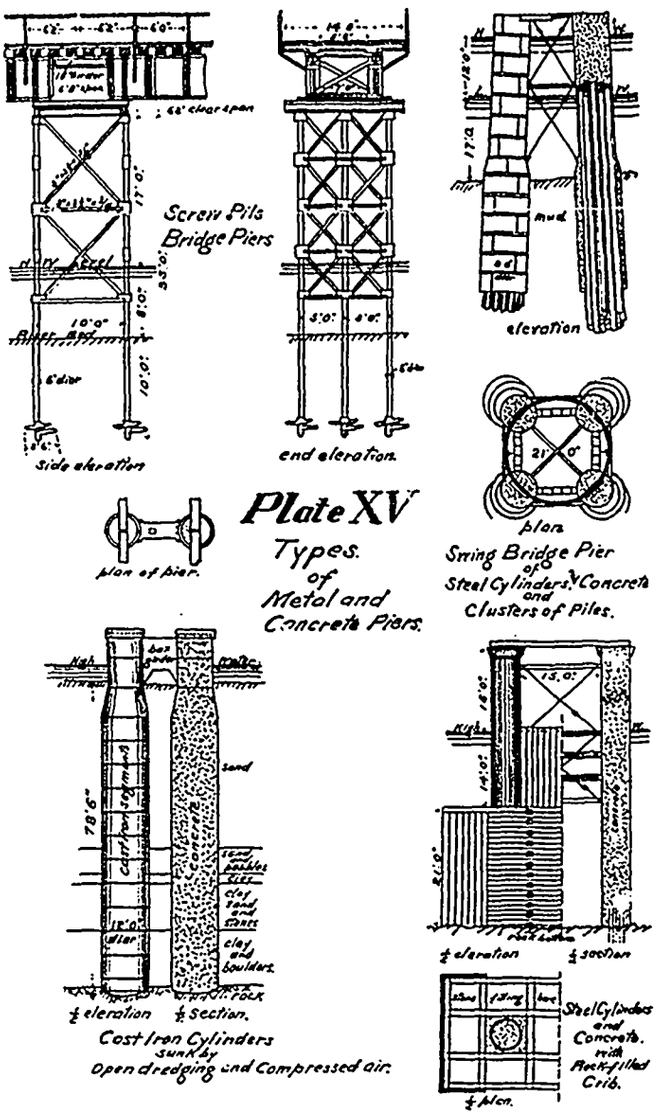
(3) Cutwater designs:—Wherever there is any appreciable current in a river, it is necessary to construct the up-stream end of the pier of such a form that it will divide masses of driftwood, ice, logs, etc., as well as the current itself. Probably the simplest form is that shown in Fig. 52, which will not cost appreciably more to construct than a square pier, as the nose is a right angle and the faces of ordinary quarry-faced ashlar, but such a form is suitable only for streams carrying light ice or moderate jams of logs; in place of this the more ornamental forms shown in Figs. 51 and 53 would be equally satisfactory, especially the latter, but cost considerably more, and should therefore be used only on very important structures.

Where piers are to be placed in swift currents, or in any stream carrying heavy jams of logs, or thick floes of ice, their cutwaters should be of designs similar to Figs. 49 or 50. The cutwater of the former hardly extends high enough and is not flat enough for Canadian rivers, and besides it lacks the valuable addition of a small pointed lower end, which is introduced to eliminate an eddy at that point in swift currents, which tends to undermine the end of the pier, unless on solid rock. Probably the St. Croix pier and cutwater are suitable for the conditions they were designed for, but the intention of the design on Fig. 50 is that the jams will rise on the nose and split in two, passing on harmlessly.

Stone masonry bridge piers will cost from $9 to $15 per cubic yard, depending on their height, size and the cost of quarrying, transporting and cutting suitable stone. If expensive cutwaters are needed this will add to the cost; those used under severe conditions being of a first-class cut stone construction of large dimensions, clamped together and dowelled also, with a strip of boiler plate added to the nose to prevent dislodgement of stones. The following specification of first-class bridge masonry will apply to both abutment and pier construction, but in many cases a less severe specification has resulted in satisfactory and durable work.

Specification for First-Class Bridge Masonry.—"This class of masonry will be ranged rockwork of the best description, from stone of approved weathering qualities, and will be laid in suitable cement mortar (1 to 2 natural, or 1 to 3 Portland). The face stones will be accurately squared, jointed and bedded, and laid in courses not less than 12 inches thick, decreasing in thickness from bottom to top of walls; the joints and beds to be less than half-inch and joints well broken, no break to be less than nine inches. The stretchers to average at least 3½ feet in length with 3 feet as a minimum, to have at least 16 inches bed, and always at least as much bed as rise. The headers to have a width of not less than 18 inches, and to hold the size back into the heart of the wall that they show on the face; they shall occupy at least one-fifth of the area of the face of the wall, and be practically evenly distributed over it, so that the headers in each course shall divide equally or nearly so, the spaces between the headers in the next course below. When the walls are not more than 3½ feet thick, the headers shall run entirely through, and when between 3½ and 6 feet thick, there shall be as many headers of the same size in the rear as the front of the wall, and the front and rear headers must alternate and interlock at least 12 inches with each other. In walls over 6 feet thick, the headers shall be at least 3½ feet long, alternating front and back as just described, their binding effect being carried through the wall by intermediate headers of a similar character. The stretchers in the rear of the wall, and the stones in the heart of the wall shall be of the same general dimensions and proportions as the face stones with equally good bed and bond, but with less attention to vertical joints, and must be well fitted to their places, and carry the course evenly quite through the wall; a header shall in no case have a joint directly above or below it, but rest entirely on a stretcher at the face; any small interstices that may remain in the heart of the wall shall be carefully filled with mortar and spauls. The face stones shall be left rough on the face, with no projection of more than three inches from pitch lines, and two-inch drafts will, in general, be carried up and around all projecting angles. In the construction of piers, it is understood that the description above given for face work shall apply to both ends and both sides of the pier. Copings are to be cut and dowelled or clamped according to coping plans furnished, the top shall be crandalled and pean-hammered,

or otherwise brought to a smooth surface, and so arranged as to bring the pedestal plates of the trusses exactly on the centre of especially large coping stones of dimensions given on the plans."



ARTICLE 24.—METAL OR METAL AND CONCRETE PIERS.

On Plate XV. are shown several applications of metal and concrete for bridge piers. The method by screw piles founded in mud is quite unique and has not been attempted in America for railway bridge piers, but the steel cylinders filled with concrete and founded either in mud on piles or anchored to the rock by iron dowels are more familiar. For light highway bridges this method is quite suitable, but it is probable that, except in the form of one large cylinder, as a cofferdam to a pneumatic caisson, both filled with concrete and sunk in waters not needing cutwaters, their use for railway bridge piers will be exceptional, as the more massive forms shown on Plate XIV. will be better able to withstand the vibrations of trains and impacts of ice, etc.

ARTICLE 25.—IRON VIADUCTS OR TRESTLES.

The features usually under the control of the railway engineer are the general lay-out, the design and construction of masonry, and the erection of iron work; the detail designing of the iron being essentially a branch of bridge-work.

(*a*) *General lay-out.*—This has resolved itself in America to be, in general, a system of braced independent towers and suspended spans (see Fig. 54); the towers are usually about 30 feet spans, with posts vertical in side elevation; and, in end elevation, the girders are spaced 8 to 10 feet centres, and the posts battered at 2 to 3 inches per foot, depending on the allowance for wind, the aim being to avoid tension in the windward pedestals at the most unfavorable instant. The suspended spans are usually also plate girders of 30 feet to 60 feet span, depending on the height, the greatest economy being claimed when the cost of girders and longitudinal bracing is equal to the cost of towers and pedestal masonry. The usual design is with diagonal rods acting in tension and the girders resting on top of the posts, with slotted holes for expansion, but some late designs are for rigid, riveted bracing and posts extending to the tops of the girders, which are riveted to the webs of the posts, temperature changes being taken up in expansion pockets every 100 to 200 feet. This system is theoretically more rigid, but costs more and demands a perfect system of pedestals, any settlement being dangerous to a proper distribution of stress.

In estimating the weight of iron for approximate work, the following rule may be useful:

The weight of metal in the towers and bracings, in pounds, is equal to about 8½ times the longitudinal section area in square feet of the ravine below the line of girders and between the faces of abutments; this is based on a 100-ton consolidation engine and a high viaduct, say 100 feet, this will be changed to say 9½ times for a viaduct 50 feet high, and 10½ for a viaduct 35 feet high with the same weight of engine. The weight of girders, in pounds, may be estimated at $(9l+100)$ pounds per foot run of a span, where l = length of span. The price of iron varies considerably, with cost of erecting falsework, if any, and cost of erection and freight in general, but is about four cents per pound, in place, as a minimum. The floors of viaducts usually consist of say 8-inch by 10-inch oak ties about 12 feet long on their edge, boxed one-inch over the girders, and fastened to them by hooked bolts which pass through the guard rails and hook under the upper girder flanges; the spacing should be not more than six inches clear, and guard rails either double or with an inner guard rail of ordinary flanged rail. Some recent designs, however, call for solid floors of steel troughs filled with ballast and with ordinary track ties, which, certainly, would lessen vibration and increase safety in case of slight derailments.

(*b*) *Pedestal Masonry.*—The greatest care must be exercised in laying out and building the abutments and pedestals, as any error in position or appreciable one in height is very serious, because the iron work, being manufactured at a distance contemporaneously with the masonry, is shipped to the spot partially assembled, and cannot be afterwards altered except by a slight shimming up of pedestals built too low. The shoes of the columns are always bolted down to the copings, and in high structures these bolts should be built into the pedestals 5 or 6 feet, by passing through the stones as they are laid in place (see Fig. 54), the bolt holes are afterwards filled tight with sulphur, lead, or neat cement grout, while if the structure is not very high or subject to heavy winds, the anchor bolts are only sunk into the coping stones, dovetailed by wedges and cemented as before. Pedestal masonry is sometimes built of well burnt brick covered by a stone coping, and the use of monolithic concrete is especially adapted to this class of work, as it permits of the anchor bolts being buried in the concrete to any depth during construction. In any case the best class of work must be done, as the strains and thrusts acting are of higher intensity than in ordinary masonry, and the pedestal is not only under considerable vibration for so small a

mass, but may be put in tension on the windward side of high structures. The cost of stone pedestal masonry will vary with the conveniences for handling small quantities of large stones at each spot, and with the amount of cutting required, from $10 to $15 per cubic yard, whereas a very high class of concrete may be done for at the most $8 per yard as there is nothing to move from place to place but the plank molds and mortar box. The coping of concrete pedestals should be made very strong, say, 1 cement, 1½ sand, 3 stone, with a layer of 1 to 1 mortar for 1½ or 2 inches thick on the top and sides, put on at the same time as the rest is being built, and incorporated with it by vigorous trowelling and ramming, etc.

Plate XVI

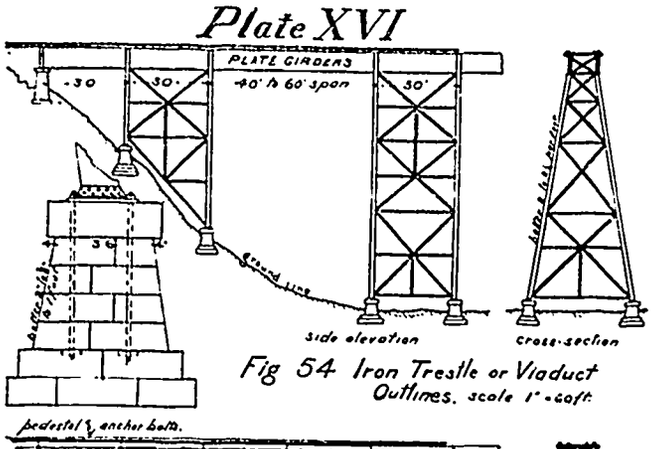


Fig 54 Iron Trestle or Viaduct Outlines. scale 1" = 60ft.

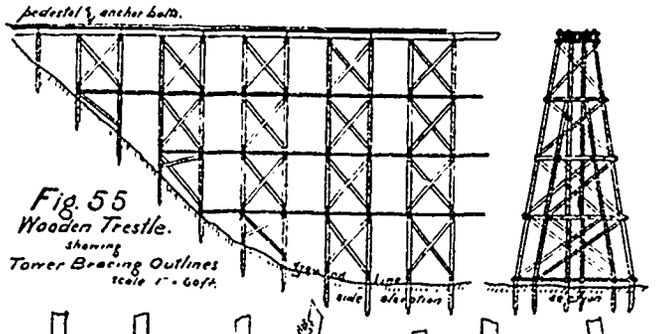
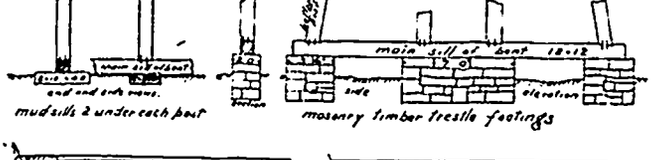


Fig. 55 Wooden Trestle. showing Tower Bracing Outlines scale 1" = 60ft.



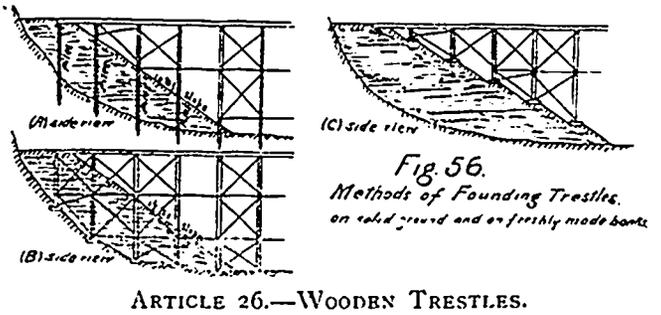


Fig. 56. Methods of Founding Trestles. on solid ground and on freshly made banks

ARTICLE 26.—WOODEN TRESTLES.

In America where timber is plentiful, cheap and widely distributed, where capital is often limited and construction hurried, and in inaccessible regions, the use of wooden trestles has been of great economic value. It is yet a factor not to despised; and although their design is apparently not very difficult, yet it should be thoroughly understood by the young railway engineer in its many phases at an early date in his practice. We have probably 100 feet per mile of railway in Canada, or about 300 miles altogether, and we may safely figure on a continual renewal of at least half of this every seven or eight years, which represents an annual drain on our forests for this purpose of perhaps 40,000,000 F.B M., while the other half will be replaced by earth, stone or iron as fast as it decays. Gradual separation and sizes of timber available have produced several distinct types, each of which has its advocates; the greatest diversity exists in every detail from floor to foundation, and will be discussed somewhat, in order to obtain a broad view of the various methods in use.

(*a*) *Foundations.* — These may be classed as (1) masonry footings, (2) piles, and (3) mudsills.

(1) Stone work suitable for culvert walls is used for the masonry footings and will cost about $4 per cubic yard; the heaviest and longest stones should be used for the top course, and the sill well bedded on it in mortar. It is not necessary to bolt the sills to the masonry if the timber bents are braced longitudinally; and, sometimes, where it is anticipated that an iron viaduct will replace the wooden one at the first renewal, it may pay to build the batter post pedestals under every alternate bent, of first-class pedestal masonry, which will serve as pedestals for the columns of the iron viaduct when needed (see Fig. 56).

(2) When foundations are deep or soft, or less expense is desirable, a pile is driven under each post of each bent, and the sills rest on and are drift-bolted or tenoned to the piles; for 15-foot bents and a 100-ton engine, a pile will carry one-quarter of the load on a bent when it penetrates less than about two inches under a blow from a 2,000-pound hammer dropping 25 feet; but if such a penetration cannot be obtained without great depth of pile-driving it may pay to use more piles. (See Fig. 55.) Whenever a trestle is less than 15 feet high, framed bents may be dispensed with, and the piles left driven up to the bottom of the caps on which the stringers rest, in which case the outer piles are driven to a slight batter, and then pulled in, as the cap is drifted on, to a total batter of two or three inches per foot, or if the bent is only five or six feet high the piles may be all driven vertical; in either case, the centre piles are five feet apart and directly under each rail; usually a pair of X or sway-braces is bolted onto each bent, but no longitudinal braces are necessary. It is not good practice to build these pile trestles over 15 feet high unless for temporary work, as the vibration from traffic loosens the piles, and the rot at the ground surface is rather rapid and wasteful of material cut off, in case of renewals.

(3) *Mud Sills or Bank Sills.*—These consist of six or eight short cross-sills under the main sill of each bent, the usual dimensions are 8x12 inches by 5 feet long laid on flat, unboxed, which facilitates shimming by means of planks or boards under the main sills, and the bents will not get out of plumb if longitudinal braces are used. (See Fig. 56.) Other special foundations are:—Cribwork filled with stone where there is a current of water, a grillage or floor of timber in case of soft submerged ground, and holes cut in the rock, carrying the ends of the posts without any sill on steep solid rock side hill.

(*b*) *The founding of end bents.*—This is generally a difficult problem, as the freshly made embankments at each end of the trestle settle rapidly. Fig. 56 shows the three methods in ordinary use. Of these (*A*) is undoubtedly the best, but most expensive, as pile driving on sloping banks costs considerable; such piling should be done after allowing the bank to settle as much as possible, and the piles should be well driven into the solid ground to prevent them being shoved out of place longitudinally. (*B*) This method is pernicious, the embankment always contorts the trestle, no matter how well braced, the posts rot off at the ground surface, and it is also expensive and often delays the construction of the embankment; it has little to recommend it, unless the whole trestle is to be soon filled in. (*C*) This is seemingly a flimsy method, but is found very satisfactory in mild climates at least. Each

bent is supported on eight or ten mudsills, and as the bank settles a bridge gang surfaces and relines the trestle by shimming between the bents and bank-sills; after a few months, when the bank has become firm, very little attention will be required, and it is always convenient for repair or renewal, and nothing rots but the mudsills. It has also the especial merit of providing an elastic and gradual approach from the rigid trestle to the sinking fresh bank, which the first and second methods do not present. It is the cheapest method, and its only demerit is that it is affected by frost in the spring in cold climates.

Plate XVII

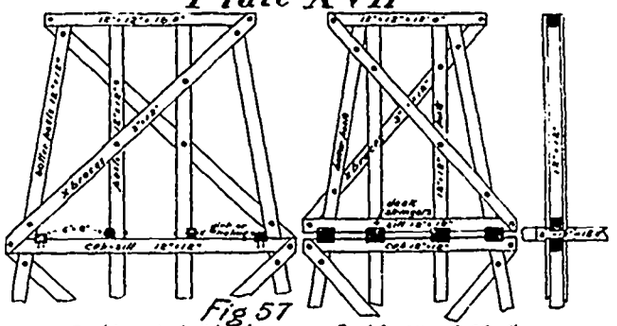


Fig 57

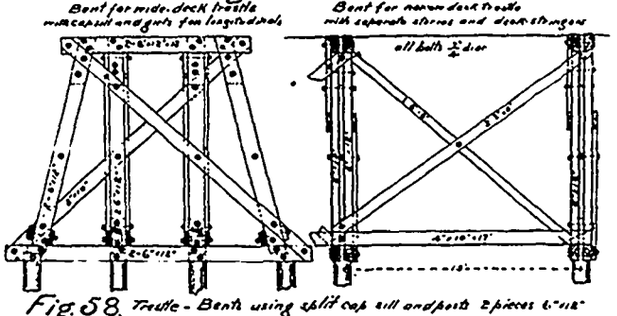


Fig 58. Trestle - Bent using split cap sill and posts 2 pieces 6"x12"

Fig 59. Methods of connecting posts with caps and sills.

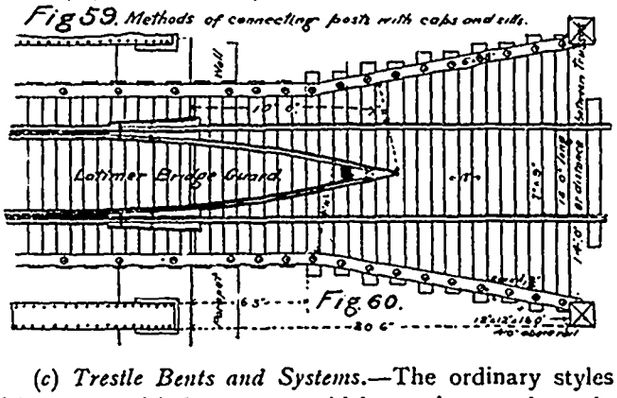


Fig 60.

(c) *Trestle Bents and Systems.*—The ordinary styles of bents are with four posts, which are increased to six posts in very high trestles, each story or deck being braced by one or two pairs of cross or sway braces—the plumb posts being five feet apart, and batter posts sloping at from two to three inches per foot.

The longitudinal braces consist of cross braces and horizontal ties. The former are so grouped as to form towers and spans alternately, but the horizontal ties run the entire length of the structure. Speaking generally, low trestles on tangents need very little longitudinal bracing, while high ones on sharp curves need very much; between these two, the extent, disposition and sizes of such bracing will be a matter for the judgment of the designer, but all such braces should be bolted and not spiked, as vibration from trains will soon loosen the latter, and even bolts from the same cause and from shrinkage of timber need to have their nuts tightened two or three times before the rust locks them into place. Sway braces may, however, be partially bolted and partially spiked with pressed spikes.

The posts, caps and sills are usually of solid timbers 10 inches by 10 inches, 10 inches by 12 inches or 12 inches by 12 inches in section, the latter being most common. (See Fig. 57.) And such timbers make the best structures; but large timbers are often hard to obtain at reasonable prices, and in such cases, the style shown in Fig. 58 is found satisfactory and is easy to repair and renew. The split caps, sills and posts are usually 6 inches by 12 inches well bolted together; but the cost of such bolting, and danger of some of the bolts working loose are objections to the system. On the other hand, water is not so apt to lodge or rot where timbers are so narrow. An extension of this system is the "cluster bent" trestle, the posts being of four pieces of 6 inches by 6 inches, breaking joint and bolted to split caps and sill, with the cross braces acting also as separators. This style is advisable only in localities where timber is obtainable only in small dimensions, and of poor quality, its advantage being facility of repair; while the trestle itself is not so stable or durable as if made with larger timbers.

(d) *Joints and Fastenings.*—Fig. 59 shows the best methods in use. The advantage of mortise and tenon work is the easiness with which repairs can be effected, but it is a favorite lodging place for water and one of the first points to rot in a trestle—a drip hole partly obviates this; mortise and tenon work costs about $1 per M.B.M., more to frame than other methods shown. The drift bolt and dowel method is superior to the first one in rigidity, durability and easiness of erection, but is hard work to tear down, while the third method, although not in common use, appears to be a very sensible joint; the fourth method is for temporary work only, and is fastened with 6 inch pressed spike which would work loose very soon; it is an expensive and clumsy joint, but saves timber from mutilation for a second using. Probably the best combination is a tenon at the top of posts and 2 dowels 8 inches by 1 inch diameter at the bottom, such a system avoids rot and enables posts to be easily renewed and replaced.

(e) *High Trestles.*—When trestles are higher than 20 to 25 feet more than one story or deck will be needed (see Fig. 57), these may be either in separate bents locked by deck stringers, or they may be in a continuous bent in which the sill of one bent becomes the cap of the one below, etc.; in the former case the four lines of deck stringers, about 8 inches by 12 inches, overlap and are boxed onto the caps and sills and gained into them, giving a lock joint. The structure is very rigid, is simple of erection and easy to repair, but needs more material than the latter method, in which the longitudinal bracing consists of four lines of girts or wallings about 6 inches by 8 inches, which are butt-jointed and boxed about 3 inches on to the caps or posts and also bolted; this method saves one cap and some timber in the longitudinals also, and the upper and lower sway braces may be fastened by the same bolt at the cap-sill, but the trestle is a little harder to erect and much harder to repair, it is, however, on the whole probably the preferable method of the two.

(f) *Floor Systems of Trestles.*—The floor consists of stringers, ties and guard rails, and should be completed by adding some form of bridge guard like that shown on Fig. 60, by which trucks not too far off centre may be brought back to direction and probably placed again on the rails, or, at any rate, carried safely across the structure.

In Canada the wide-decked trestle, with two main

nests of stringers and two jack stringers supporting ties 12 feet to 14 feet long, is generally used on standard gauge roads, partly to give room for snowplows inside the guard rails and partly for additional safety; this is nowadays further supplemented by two lines of guard rails, of which the inner ones are faced with angle iron fastened by countersunk screws.

The sizes of guard rails and ties are shown in Figs. 61 to 65; but it is a growing feeling that ties cannot be spaced too close for safety to prevent bunching in case o derailment. They should not be more than 6 ins. apart clear at most and preferably 4 ins., and every fourth or fifth tie should be spiked to the stringers, and all boxed from ½ in. to 1 in. on to them. There are some, however, who claim that if ties are kept spaced by the guard rail, and are boxed down on to the stringers, that any further fastening is unnecessary, ties should be of oak or some durable hardwood, which will hold track spikes.

Plate XVIII

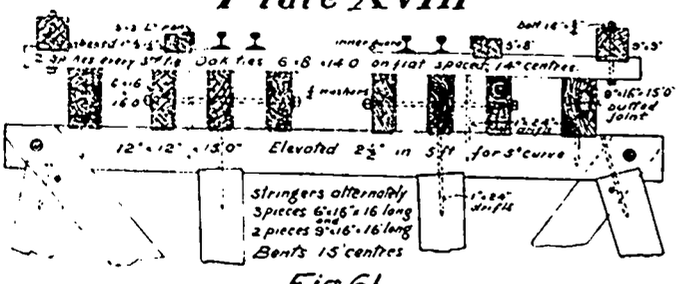


Fig. 61

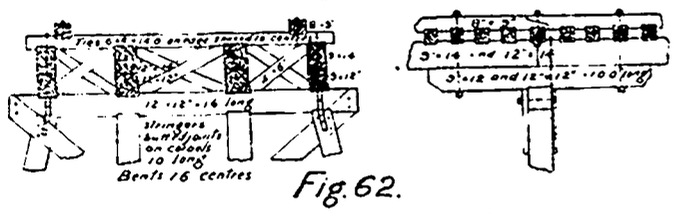


Fig. 62.

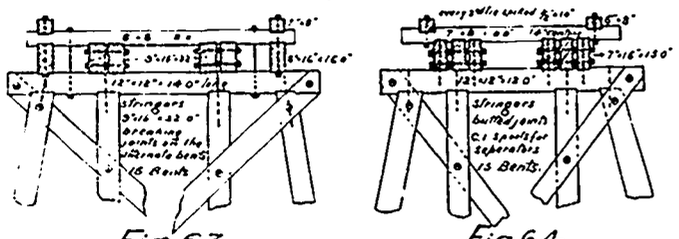


Fig. 63. Fig 64.

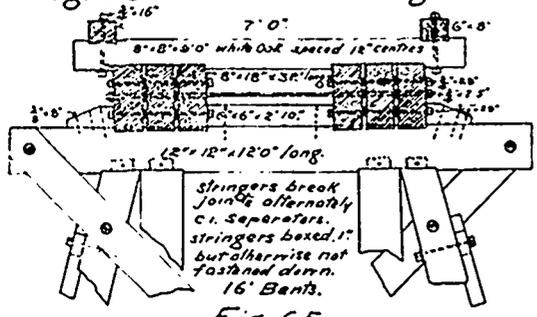


Fig. 65

Cross Sections of Trestle Floors.

The guard rails should be of pine, or some durable wood that will not warp, and boxed down about 1½ inches on to the ties, so as to hold them apart, as well as to act as guard rails. They should be bolted on outer ones and spiked on inner ones to about every fifth tie. There are various styles of stringers; that shown on Fig. 61 is now almost standard for Canada. It consists of alternate groups of two and three stringers in two nests, one under each rail. These stringers are long enough to lap one foot and rest twelve inches on the caps, and are bolted together, but separated by cast washers to prevent rot, and each nest is drift bolted down to the caps. The outer or jack stringers carry very little of the load and are butt jointed, and also drift-bolted to the caps. The style shown in Fig. 62 is practically obsolete, being considered rather top heavy and demanding too heavy timbers; the corbels also give a very uncertain aid to the strength of the stringers. The style shown in Fig. 63 is used considerably in the United States. The stringers are 32 feet long, alternating with butt joints, and make a very stiff floor; but such large timbers are hard to obtain and harder to take in and out during renewals. One advantage, however, is that all ties will have the same boxings, while in Fig. 61, the length of boxing varies with each alternate bent—but the method of fastening the ties to the caps by long bolts is objectionable, such bolts will spring loose, and the heads would be cut off by the wheels of a derailed train. In the greater part of the United States, the narrow decked trestle, such as shown in Figs. 64 and 65 is very much used, there is an evident economy, the bents being narrower, the jack stringers omitted and only one guard rail, and that one close to the steel rails. It is claimed that such trestles with reraiding guards at each end, close spaced ties, and with an inside steel rail guard, are as safe as wider ones, and that a train which would derail so badly as to get outside the inner guards would leave the trestle anyway. Such floors are sometimes drift bolted down, or as in Fig. 65, held in place by a system of braces and rods—such a method having the advantage of facility of renewals.

(*g*) *Elevating Trestle Floors on Curves.* — This will amount to from a half-inch to five-eighths inch in five feet per degree of curve, and may be accomplished in various ways which are given in order of merit.

(1) Framing the bent with cap inclined to the required slope.

(2) Inserting an elevation or secondary cap on top of a level bent cap, and notching it down to suit the curve.

(3) Notching the main cap on light curves to receive the stringers.

(4) Placing blocks longitudinally under the ties and on top of the stringers.

(5) Sawing specially sloping ties.

(6) Placing strips or blocks under the steel rail but on top of the ties.

The sloping ties are, apparently desirable, but in renewals such a varied assortment is needed for trestles on various degrees of curve that it is an intolerable nuisance.

(*h*) The cost of trestle work is about as follows:

Cast-iron washers, etc...2c. per lb.
Iron bolts, etc. .....5c. per lb.
Framing and erection ..$6 per M.B.M. (drift bolted).
" " ..$7 " " (mortise and tenon).
Cost of timber .....$17 to $27 per M.B.M.

A very ordinary price for timber now being $30 per M.B.M. in place, including iron; but in designing structures of this nature, by having due regard to the dimensions of timber which can be most readily obtained in any locality, the price may be held down, often somewhat lower than this, while sometimes a special price is put on stringers, which should be designed for the loads intended, and carefully inspected to see that they are up to the requirements, as they are the only members of the structure ever strained to their limit.

(*k*) *Quantities of Timber in Trestles.*—For very important and high structures, tables are of little value; but for ordinary use the following will give quite approximate quantities:—

TABLE XVI.

APPROXIMATE QUANTITY OF TIMBER IN TRESTLES PER 100 LINEAL FEET FOR VARIOUS HEIGHTS.

Narrow Deck, Timbers 10 in. x 10 in			Lake Erie and Western.		Wide Deck, Timbers 12 in. x 12 in.	
Height	F.B.M.		Height.	F.B.M.	Height.	F.B.M.
15 feet	17,000	1 story.	17 feet	19,400	10 feet	25,700
25 "	22,000		22 "	22,000	20 "	30,500
35 "	25,000		27 "	26,650	30 "	38,600
45 "	34 000,	2 stories.	32 "	29,640	40 "	47,000
55 "	44,000		37 "	34,780	50 "	55,200
65 "	50,000	3 stories.	42 "	38,080		
75 "	56,000		48 "	43,920		

WILLIAM OGILVIE, THE CANADIAN EXPLORER.

William Ogilvie, Assistant Astronomer to the Dominion Government, was born in Ottawa, April 7th, 1846, when that city was known as Bytown, and before it had become the capital of Canada. In early life he had very slender opportunities of education. Apart from the fact that the family were not in affluent circumstances, his father, though a worthy and sturdy Presbyterian, had imbibed the idea that every boy should not merely be self-made, but self-made without school education. He had read in a favorite book of the Smiles' "Self Help" order, of a

The Lancefield Abell Co. Photo.
WILLIAM OGILVIE.

poor boy who could not afford a lamp at night, and studied with a borrowed book, standing under the light of a corner lamp, and he fancied that his son should go through the same process in order to achieve success in life. The mother, however, took a more sympathetic view of her son's difficulties and ambitions, and it was through her influence that the youth, when he made up his mind to become a surveyor, was given a chance to devote his whole time, for about three months, to home study to prepare himself for his future profession. He apprenticed himself to a local surveyor, and in spite of poor and insufficient text-books, and his service under a man who having obtained a surveyor's commission at a time when the standard of qualification was very low, had no literary instinct, and rather discouraged book learning in those under him, Mr. Ogilvie successfully passed his examination, and was commissioned as surveyor on the 12th July, 1869. From the proceeds of his own labors the young man was enabled to continue and extend his self-education, and the small local practice he obtained showed such intelligent and correct work that he attracted the notice of Surveyor-General Denis. At this time a number of long-standing disputes among landowners near Ottawa came to a head. There had been a good deal of vagueness in the law bearing on these cases, and the tangle was rendered worse by differences in the interpretation of the law between the officials of the Department and the Cabinet. Mr. Ogilvie, who had already been instrumental in settling a number of disputes between neighboring land owners for whom he had done professional work, was now called in by the Government, and his interpretation of the law was not only sustained by the Minister of Justice, but his plan for settling the disputes among the aggrieved farmers was accepted on both sides. In spite of jealousies and intrigues against him, the intelligence and sound judgment shown by Mr. Ogilvie in the cases in question resulted in his being called on in 1875 to do regular work for the Government, and in 1882 he began that career of exploration which has reflected honor on the Canadian nationality and placed his name in the very first rank of modern explorers. His first work was done in connecting the great Peace River region with the Dominion Land Survey system, which occupied the years 1882 and 1883. In 1884 he made an exploratory survey of the Athabasca and Peace rivers and in the following year he surveyed the Canadian Pacific Railway at British Columbia as a base line for the land surveys of the railway belt. In 1886 he was engaged on longitude work by electric telegraph. In the years 1887 and 1888 he made the exploratory survey of the Yukon, Porcupine and McKenzie Rivers which was to add so much to his fame by reason of the gold discoveries, of which, at that early date, he realized the value. In 1890 he was engaged in astronomical work in connection with the northern boundary of the Province of Quebec. In this expedition a canoe journey of 1,500 miles was made to James Bay and the East Main River, a great deal of valuable geographical information being added to our knowledge of these regions by Mr. Ogilvie, who at the same time carried on astronomical work by observations of the lunar culminations there. The importance of his geographical work in opening to the ken of the world new tracts of country of continental vastness became recognized in Great Britain as well as in Canada, and in the spring of 1891 he was awarded the Murchison medal of the Royal Geographical Society for having made the most important explorations in the world at that period; his services in surveying the Canadian North-West Territories being particularly mentioned in the award. In the same year he made an exploratory examination of the north-east portion of British Columbia, and in the following year was occupied with surveys around Prince Albert, Sask. In 1893 he was engaged on important work in connection with the delimitation of the international boundary line between Canada and Alaska, and this work, with the Taku expedition in Northern British Columbia in 1894-5, and the projection of the 141st meridian through the Yukon in 1896-7, gave him a wide knowledge, not only of the great alluvial gold fields of the Canadian Yukon, but of the conditions of life among the miners and traders, and a greater insight into the general resources of this great northern land than is possessed by any living man.

In these later expeditions, Mr. Ogilvie was called on to do all sorts of work for all sorts of people. If a miners'

dispute arose, he was appealed to as umpire; if any man was suffering wrong, he besought Ogilvie's aid in obtaining his rights. His decisions were accepted without dispute, and the secret of his influence throughout this time of gold madness was that his motives were above suspicion, his judgments always founded on common sense, and that he took no part in the universal grab for wealth. In all the wild excitement following the fabulous finds of gold, there was one man who kept his head and went on with his scientific work as if all the gold lying about him was accounted, like silver in the days of Solomon, of no more value than the stones of the street It is one of the admirable traits of this noble type of Canadian official that he has remained impregnable to the sinister suggestions of avarice though confronted with so many temptations; and one of the highest tributes paid him in this respect was by a New York paper, known for its anti-Canadian prejudices. A strong sidelight is thrown on this phase of his character by a British Columbia paper, which thus speaks of Mr. Ogilvie's relations to the miners.

"While admitting that the investment of three hundred dollars a few months ago in a grub stake for two men, taking in exchange a half interest in their claims, would have resulted in his being worth a million dollars to-day, Mr. Ogilvie modestly disclaimed any credit for refusing to invest, and it is almost certain that had he known at the time, beyond any possibility of doubt, tha the investment of the $300 would have been as profitable as it has proved, his course of action would have been the same. 'I had to act up there as a sort of arbitrator, and I was not willing,' said he, 'to place myself in a position where my personal interests might have influenced my judgment." 'Regret it?' Mr. Ogilvie continued, 'no, not for a moment. As for money, I have plenty to satisfy me during my life, and I cannot take any away with me out of this world. As for my boys, they must work their way, as I have done, and they will be all the better men for it.'"

An interesting testimony to his perfect fairness to all the miners, irrespective of nationality, was recently given at San Francisco, when he was on his way home from the Yukon. A number of returned American miners sought him out and presented him with a valuable gold watch, in gratitude for his just administration of the affairs of he Klondyke.

A study of the accompanying portrait reveals a face indicative of great determination and administrative ability tempered with benevolence. We believe that Ogilvie is a greater explorer than H. M. Stanley. Without any of the harshness and arrogance that marked Stanley's methods, Ogilvie has, though not making any noise in a literary sense, accomplished greater work, and posterity will be brought to admit it.

In the twenty-two years during which he has been in the Government service he has traveled 75,000 miles by rail, 14,000 by steamer (mostly by the crude river crafts in use in the Canadian North-West), 8,500 by canoe, 9,500 on foot and 4,000 by cart or buckboard, making a total of 111,000 miles traversed on his official journeys. Difficulties such as Stanley and other travelers have depicted in dramatic colors have been passed over by Ogilvie without a word in his reports, and if the full story of his vast and lonely journey could be told it would make most valuable material for the future history of the great north land of Canada. It is very distasteful to him, however, to dwell on his own achievements, and it is only from his official reports, made as a matter of duty to the Government, that we can piece together some notion of his deeds. Once only did Mr. Ogilvie condescend to give a popular record of some of his work, and this was in the *Canadian Magazine*, for which he wrote a series of sketches under the heading of "Down the Yukon and up the McKenzie," and "In North-West Wilds," which appeared in 1893-4. The narrative of these remarkable travels is so simply told and yet so instructive and entertaining that all who have read them have wished for more. In one part of his first ketch he pauses in one of those days of 20 hours Arctic

WILLIAM OGILVIE, FROM PHOTOGRAPH TAKEN ABOUT 1889.

darkness to reflect "more than 2,500 miles were still lying between us and the nearest railway station, nearly all of which had to be got over on foot or by paddle"—a simple statement, but how eloquent of trial adventure, and enduring patience! In his sketch of the exploration of the great Mackenzie basin, he gives us a picture of daily life at Fort Nelson. One of the incidents is best told in his own words:

"There were two very old Indian women living at the Fort on such food as they got from the (Hudson Bay) Company's employees. One was totally blind, and the other nearly so. A half-witted Indian boy cut their wood and attended to their wants, and by way of compensation they shared their food with him. No one knew their age, but they had lived a long time for natives, as evidenced by their wrinkled faces, lustreless eyes, and toothless mouths. Their clothing was very scant and very dirty, their hut 'a thing of shreds and patches,' little better than none; their food was often scant, and their fire low. You fancy them utterly miserable, but they were not. I called on them daily with some food, a bit of tobacco, and a few lumps of sugar. This would put them into wonderful humor, especially the sugar. The blind one would hold her sugar in her hand, occasionally licking a lump, and exclaiming, 'Eh, Shugow,' (sugar) in a tone which bespoke complete ecstasy. The feast always wound up with a jocular discussion by these ancient dames as to which of them would secure me for their sweetheart. They invariably appealed to myself to decide between them, each meanwhile affecting all the airs of a pronounced flirt, displaying her charms with the most ludicrous poses, which convulsed me with laughter. The manner in which I parried these requests for a choice between them amused them highly, and who could refuse to brighten the lives of such poor old creatures with a little harmless pleasantry? Once the blind one, through the aid of the interpreter, told me her life story, how she had lost several husbands and all her children by death, had no friends alive that she knew of, and was waiting patiently

to join the lost ones in the Great Beyond. Her poor old wrinkled face and sightless eyes bespoke acute sorrow during the recital, especially when she expressed her desire to lay down the burden of her life. I have never elsewhere seen such squalid poverty accompanied by such childish cheerfulness."

This is an admirable bit of word painting, which, while it brings before us a vivid view of aboriginal life as it really is, to us reveals the tenderness and sympathy of the man.

One who knows Mr. Ogilvie intimately, gave the writer this estimate of his character: "He has a high sense of honor and strong judicial mind; careful practical generalship, enabling him to execute difficult undertakings and secure large results where most men would utterly fail; faithfulness to trust and scorn of anything underhand; energy and endurance, especially a capacity for protracted, constant labor. Add to these qualities his genuine good nature, his great knowledge of men and life, especially frontier life, and you have a man who is easily first among Canadian explorers, and I believe that only his modesty and disinclination to be 'boomed' has kept him from world-wide fame."

SILVER IN THE OTTAWA VALLEY.*

On Calumet Island, in the Ottawa River, some research work was done last year on the deposits of blende and galena, noted there for some years, and mining licenses were gra. d on several lots. On lots IV½, N.W. 10 and 11, the old Russell property, Charles B. Watts and others, of Toronto, have prospected from the end of last winter, with 10 to 15 men; some work was done on this mine by the first proprietors, who established the presence of important deposits of blende and galena, an assay of which gave zinc, 40 per cent.; lead, 12 per cent.; silver, 15 ounces per ton. The actual works have brought to light new indications, especially on lot 10 near the line of 11, where at a depth of 45 feet a deposit of blende several feet thick can be followed for a distance of 80 feet, from which 200 tons were extracted, 50 of which are still at the mine. It was on lot 11, near the line of 12, that a deposit of galena was worked two years ago.

Charles Meyer and others, of Belgium, under the name of the Grand Calumet Mining Co., control the properties IV½ S. 9½, S. 10 and 12, and have prospected since spring with six or seven men. On lot IV., 12, in the vicinity of the pocket of galena above mentioned, they sank a .ial shaft, which was not more than fifteen feet down in September. The surface indications show a bar carrying blende and numerous specks of galena. The same company has also prospected on lots 9 and 10, where some blende was found. On 10, galena in fine grains is found in the diorite. I understand that if the prospects are satisfactory this company will arrange for the regular working of this mine, and will establish concentration works. It intends to work this winter with steam engines and drills. On the central part of lot IV., 9, Colin Campbell has cleared away the surface and laid bare a remarkable exposure of solid blende, with a width of 40 feet by 12. It is probable that this ore body has greater extension, as the rock has only been laid bare on this part, and the walls are not visible. In the south-east part of the same deposit there is also a fine indication of galena, of which a sample, taken by J. Obalski, and assayed, gave 103.82 ounces of silver and strong traces of gold, the whole representing $60 worth of precious metals. On lot 8 of the same range he also prospected and found indications of blende disseminated in the quartzite. He has worked since this summer with four men only.

The southern part of Calumet Island where these deposits are found, belongs to a strip of rock called the Upper Laurentian by the Geological Survey; the northern part is Laurentian. A mineral band seems to exist there, accompanying an eruption of diorite running in a N.N.W. direction, as shown by the croppings and rusty rocks, and by the few prospects above mentioned. The width of this band does not seem to be less than 200 to 300 feet, and it is claimed that indications have been found between lots IV, 3, and VII, 27, where the seam ores have been noted, thus giving a course of about four miles. The ore body is of blende, slightly mixed with galena, and carrying a percentage of silver to the extent of about 15 ounces to the ton. Occasionally, the galena occurs alone, as on lots IV, 8, 11, when its proportion of silver rises to 146 ounces per ton, according to assays which I caused to be made, and even more according to other assays; small threads of native silver are also found. It is impossible to say to what depths these deposits extend, but it is possible that the galena grows more abundant, when they would become profitable to work. The shipping points are at Clark Station and at Campbell Bay, on the Pontiac and Pacific Junction Railway, at six or eight miles from the mines. The ground is not very rough, is partly occupied by farmers and supplied with good roads. The Government still owns the mining rights of a portion of this territory, as well as the rights everywhere to the precious metals.

* Extracted from the report of J. Obalski, C.E., to the Commissioner of Colonization and Mines of the Province of Quebec.

THE MOTOR CAR INDUSTRY.

The interview with Dr. Doolittle, which was published in the January issue of the ENGINEER, gives a very valuable outline of the present condition of the motor industry in Britain. None of the points he touched upon were elaborated, as the subject is such a many-sided one that it would require too much space. One criticism he made, however—namely, the exploitation of the industry by professional promoters for revenue purposes only—deserves fuller mention.

The Great Horseless Carriage Company, one of the off-shoots of the British Motor Syndicate, has been the victim of the most malign manipulation by promoters, and as a result its affairs are in a tangle. It is difficult to understand how level-headed Englishmen could have been wheedled into investing their money in a concern which had no business basis, the agreement upon which the company was formed having been so worded that it had no right to new patents issued since May, 1896. This means that, with their charter powers, the company must make carriages only from old patents that have been superseded; that it cannot make Daimler motors nor De Dion motors—these two being the most popular at the present time in Britain; nor can it make any cycle motors whatever. It is doubtful whether it can make a motor carriage to-day that would sell. In the course of litigation it has appeared that H. J. Lawson was the promoter and the sole acting director of the Great Horseless Carriage Company, and he had virtually also control over the British Motor Syndicate.

A committee of the Great Horseless Carriage shareholders has been formed to consider plans for the future of the company. Their report is lengthy and intricate, and need not be followed, except so far as it touches the main point dealt with in our interview in reference to the position of the motor car industry. For the purpose

of enquiring into the future of the industry some members of the committee went to Paris, where (never having been under government restrictions) the industry was making progress at the time prior to the passing of the English Act in Nov., 1896. They went through several large factories, each employing some hundreds of hands, and in most cases with order books full for many months ahead, and preparations for many large motors to increase the output. The principal motors in use were the Daimler, manufactured for vehicles by Panhard-Levassor & Peugeot, and the De Dion for tricycles, in which latter much business will certainly be done. A little attachment to their tricycles to hold two people is just out and becoming popular. It is also said that motor traction is being adapted to the French navy, postal service and army. The members of the committee returned quite satisfied with the progress and future of the industry in France. A visit was then paid to Coventry, where the Daimler Co. is now turning out several motors weekly; the Beeston Cycle Co. are making the De Dion tricycles, and the Humber Co. is starting with a regular output. Electric cabs are running satisfactorily in London, and a mail motor van is now undergoing long distance tests. In Scotland a line of motor cabs at Hamilton is working successfully, another at Blackpool, England, and cars are now under construction for two other lines to be opened in Scotland. There is of course a great deal of prejudice to contend with, but notwithstanding this the facts showed to the committee's satisfaction that the industry has come to stay; and the committee expresses the conviction that so soon as motor vehicles with all the latest improvements are turned out in quantity from the regular patents to enable them to be put on the market at reasonable prices, a motor manufacturing company will pay.

For THE CANADIAN ENGINEER.

DISPOSAL OF TOWNS' REFUSE.

BY W. M. WATSON.

(Continued from last issue.)

At Liverpool, Eng., the refuse destructors are of the Manlove, Alliott & Fryers slow combustion type, divided into cells (as the furnaces are called in England) about 2½ feet wide and 5 feet from front to rear. The refuse, which is of a very objectionable and filthy kind, is fed from the top, through holes at the rear end of furnace; the smoke and fumes from the fire are drawn off at the same place and pass over the damp, green refuse before entering the flues, for the purpose of drying the rubbish prior to arriving at the fire grate to be burnt. Only natural draught is applied by using a long chimney, and the temperature of the fires seldom exceeds 700° Fahr. On this ground the gases and fumes drawn off the fires must be cremated by passing them through a high temperature furnace, called a Jones' cremator, before being allowed to pass up the chimney to be discharged into the atmosphere. The weight of refuse, or garbage, which consists of mixed night soil, ashes, sweepings from paved streets, and house garbage, is reduced by 67 per cent. by the process of burning, yet the residue of clinker and ashes is not burnt sufficiently hard, and, therefore, of small value for ballast, etc. They have the same type of furnaces at Birkenhead, but have so altered the designs of the smoke flues that in place of being discharged at the rear end and the heat passing over the wet rubbish to assist in drying it, preparatory to being placed on the furnace, the fumes and gases are drawn out at the front near the clinkering door, with the object of compelling the fumes cast off by the roasting refuse to pass over the body of fire on its way to the collecting flues. This method partly consumes the poisonous gases. At Salford they also use the Manlove & Co. type, which they have so altered that they have increased the daily consumption of refuse by making a slight alteration in the feeding holes, and constructing their flues in a way that the flames and gases are collected and pass out at the centre of each cell or furnace, in place of being discharged at the rear or at the front end, as before explained. This method is stated by visitors and experts to be the most perfect low temperature, slow combustion furnace, working by natural draughts. But a great many of these furnaces are being made into high temperature furnaces of over 2,000° F., by applying forced draughts. Sometimes fans are used, but raw air is not the draught suited to burn rubbish, because the dry air forces part of the foul fumes forward past both the fire and combustion chambers, unburnt. When a mixed steam and air blower is used, the steam attracts and absorbs the poisonous fumes, and together with the heat of the furnace, destroys or purifies them, so that the gases can be freely discharged into the atmosphere without the aid of a fuel-burning cremator or a tall chimney.

By the slow combustion process, only seven tons can be burnt in 24 hours. When a strong forced draught is properly introduced with a few detail alterations, as much as 15 tons can be burnt in the same space of time, making a harder and better burnt clinker and ash, and reducing the weight of the residuum to about 25 per cent., while the low temperature process can only reduce it to 33 per cent. At the rural village of Withington, the destructors were built from their own surveyor's designs. They consist of six low temperature furnaces, a fume cremator, a chimney 150 feet high, engine, boiler, dynamo, motor mill' etc., the total cost being £3,400. At the bottom of the chimney stack double wire screens are fixed to prevent anything unburnt from being drawn up the chimney. At Cambridge they use Manlove's Destructors, and use the heat for generating steam that creates power sufficient to pump the town's sewage. They also have a dual system at Baildon. Their refuse destructor is of a slow combustion type, with a low temperature, so that the rubbish, ashes, night soil and garbage are only carbonized *and not burnt to an ash.* Each cell or furnace place is fed in at the rear of the fire bars, the rubbish sliding down an inclined plate from the tipping floor. The air or smoke pipes are carefully and mechanically adjusted in a way that the fire is almost smokeless, because loss of smoke means loss of carbon. They are fixed in the side walls near the front door, drawing sufficient to give the furnaces the right quantity of air to allow the refuse to carbonize, but not to burn sufficiently to make smoke. The residuum is a mixture of soft clinker, cinders and powdered charcoal, which are carbonized in this way under a patent for the purpose of using the residuum for a filtrate to purify the town's sewage, it being found to be the most suitable material. In this way Baildon cleans and purifies the town's sewage with the foul refuse, thus using one public nuisance to destroy another.

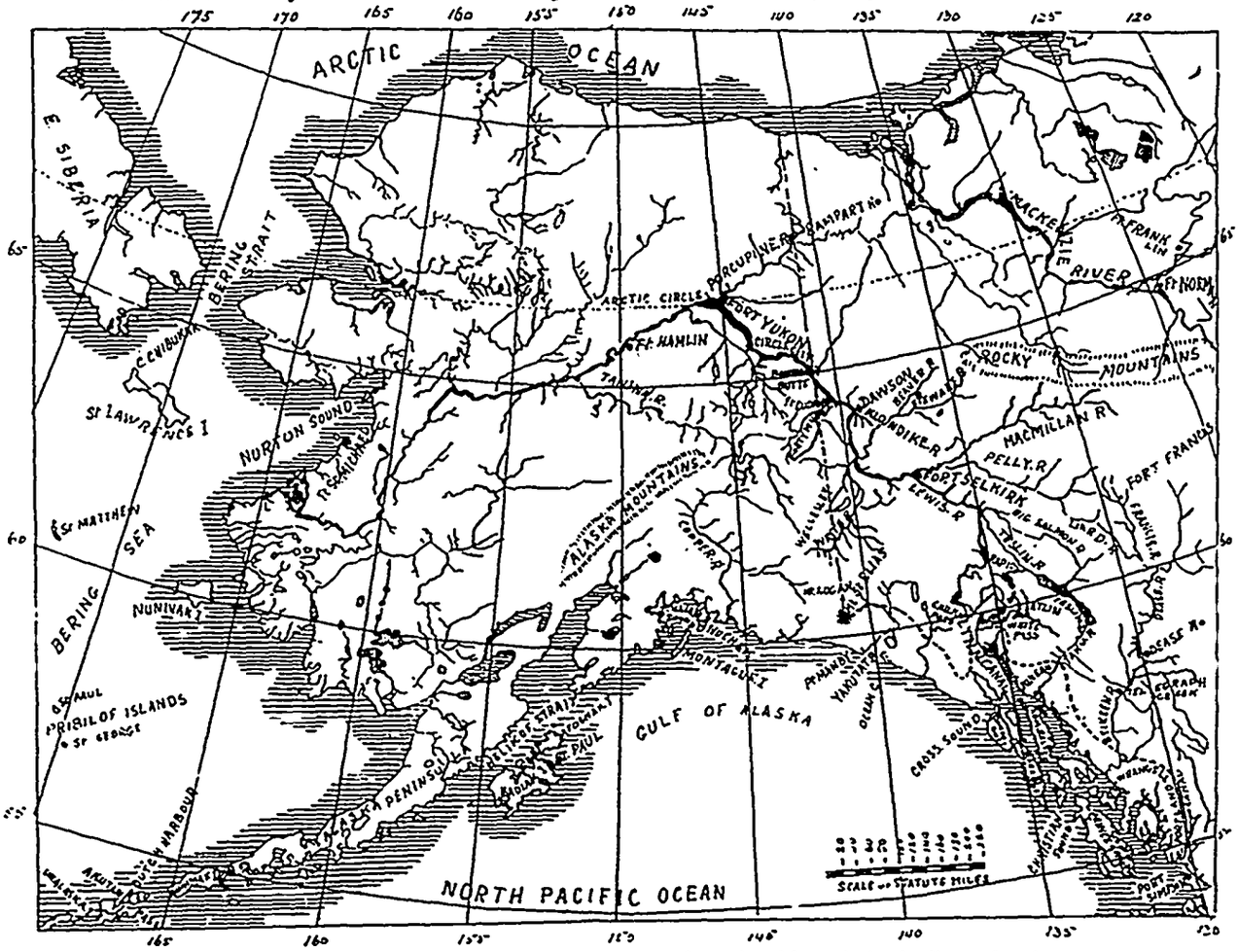
The Bradford corporation has the Manlove, Alliott & Co. furnaces, improved and altered to come up to the times, and as I before pointed out in the January issue, the fumes from the drying refuses pass over the fire, up through holes in the firebrick screen (which forms the arch over the fire) near the door, then through its own combustion chambers, passing along to the large collecting vault, thence through the flues to the steam boilers, from them through the economizers, afterwards finally passing out at the chimney. The combustion chambers and large vault

being always near a white heat, the gases from all the twenty furnaces get reburnt and well mixed together, causing a high temperature and an increase in the number of units of heat useful for steam raising purposes, proving that plenty of good brick work, well put together, scientifically arranged, so that it divides the particles and mixes the gases, expanding and increasing them, is a good investment because it largely assists in extracting all the injurious fumes from the discharged gases and nearly doubles the number of units of heat used for raising steam.

(To be continued.)

CANADA HOLDS HER OWN.

The question of how best to reach the golden North has been decided by the Dominion Government, after consideration of the reports of engineers W. T. Jennings, Wm. Ogilvie, and others. The press of the United States has been most active in suggesting methods by which Canadians might be harrassed on their way to mine Canadian gold on Canadian lands. It has been found possible to make entry through United States ports troublesome and expensive—the people of Seattle and other western towns have thought that in this way they could capture the outfitting trade. The natural result has followed, and the Dominion Government has chartered a railway which will give us an all Canadian route to the Yukon country. Reference to the accompanying map of Alaska and the Yukon territory shows us the stretch of 150 miles between Telegraph Creek and Teslin Lake, which the McKenzie and Mann railway is to cover. The mouth of the Stikine River, as it is now officially known, is in the United States, but the free and uninterrupted navigation of the river, and every other on the coast, is guaranteed to British subjects by treaty.



metals produced from the lands alienated to the company, as compared with 10 per cent imposed upon ordinary placer mining. The contractors are not to receive a cash subsidy, but, on the other hand, are required to put up a deposit of a quarter of a million of dollars as a guarantee for the execution of their contracts. No portion of the beds or of the banks for 25 feet on each side of high-water mark shall pass to the contractors under any selection of lands to be made under the agreement. The shores and all landing places, few and far between in that rugged, rock-ribbed country, and therefore very valuable, are withheld, and the free rights of passage and use along all navigable or floatable streams may not be impeded or obstructed by the company, and are absolutely reserved to the people. In case the contractors divert any stream from its natural channel, they must provide an equally convenient navigable or floatable channel in lieu. All mining claims held and recorded by free miners within any block of land selected by the contractors, shall be excepted from the grant, and shall not pass to the contractors. The tolls to be collected on the railway between Stikine River and

The details of the agreement between the Dominion Government and McKenzie & Mann, as given to the public, is summarized below: The agreement provides for the construction of a railway from the Stikine River, in British Columbia, near the mouth of Telegraph Creek, Glenora, or the mouth of the Clear Water River, northward to Teslin Lake, a distance of about 150 miles, thus giving connection with the Lewis or Yukon River, and an all-Canadian rail and steamboat route from a port on the Pacific coast to Dawson City. This road must be completed and in operation by September 1 next. The contractors must also construct a practical sleigh road from the mouth of the Stikine River to Teslin Lake, and provide suitable shelters and stopping places for travelers at intervals of not more than 25 miles along this road, and the road and shelters must be available for use not later than six weeks from now. The contractors must also provide steamboat transport of freight and passengers between Teslin Lake and Dawson City. The Government proposes to grant 25,000 acres a mile of mineral lands, or 3,750,000 acres in all, to the contractors. The lands shall be selected from the Klondyke provisional district, and from that part of the North-West Territories lying west of the Mackenzie River and Liard River and north of the 60th parallel of latitude. But it is provided that all arable land shall be reserved. It is also provided that in determining the selection of lands for the contractors, each alternate block shall be reserved for the Government. In addition a royalty of 1 per cent. will be laid upon all the precious

Teslin Lake will be first fixed by the Governor-General-in-Council, and, as so fixed, shall not be liable to reduction for four years. They shall then be reduced by 25 per cent., and after the road has been operated for seven years there shall be a reduction of 25 per cent. on the tolls as previously reduced, and after the road has been ten years in operation the tolls shall be subject to the general railway law of Canada in that behalf. The lands granted shall be free from taxation for ten years, except municipal taxation by an incorporated city, town or village within the Klondyke provisional district. When any ten continuous miles of the railway have been completed, the contractors may select 92,168 acres, or two blocks of land, and these blocks shall thereupon be reserved from sale or location, or free miners' claims, and on completion, from time to time, of any other ten miles, the contractors shall have the right to select two additional blocks, and on the completion of the railway, the blocks so reserved shall be granted to the contractors, with the exception of any existing free miners' claims, which shall be held inviolate. For five years from Sept. 1st, 1898, no line of railway shall be authorized by Parliament to be constructed from Lynn Canal, or from any point near the international boundary between Canada and Alaska into the Yukon, nor shall any aid in money or land be granted to any other contractors for this purpose. Moreover, during ten years from Sept. 1st, 1898, the contractors shall be given the preference in any aid the Government may see fit to grant towards the building of a line of railway from the Stikine River to an ocean port in British Columbia, provided they are willing to undertake the construction within a reasonable time.

MACHINES.*

A machine is an instrument by means of which a force applied a one point is able to exert at some other point a force differing in direction and intensity It has been usual in treating of simple machines to call the force applied power; but the word power is now in use with an entirely different meaning, and so we shall accordingly speak of the applied force as the effort. The force exerted, or effective resistance overcome is usually called the weight. This resistance may be the earth's attraction, as in raising a heavy body, or it may be the molecular attractions between the particles of a body, as in stamping metal or dividing wood, or it may be friction, as in drawing a heavy body along a rough road. Besides the effective resistance, the effort is employed in overcoming the internal resistances, chiefly due to friction between the different parts of the machine. The effort may be just sufficient to overcome these two kinds of resistance, or it may be excess of what is necessary, or it may be too small. If just sufficient, the machine once in motion will remain uniformly so, or if it be at rest, it will be on the point of moving, and the force applied or effort will be in equilibrium with the effective and internal resistances. If the effort be in excess, the machine will be set in motion and continue to move with an accelerated motion. If the effort be too small, it will not be able to move the machine, and if the machine be already in motion it will gradually come to rest. When the effort is just sufficient to overcome the resistance, the ratio of the resistance to the effort is called the modulus of the machine. In this case, it is evident from the law of conservation of energy, that the work done by the effort has its equivalent in the work done against the effective resistance to be overcome, and against the resistance due to the friction between the parts. This is the general law of machines in motion or in equilibrium.

The ratio of the effective resistance, which we call simply resistance to the effort, is equal to the ratio between the distance through which the effort acts, and the distance through which the resistance is overcome in the same time, or, in other words, is equal to the velocities of the points of application of the effort and resistance; or, if we take equal distances and uniform motion, we see that what is gained in force is lost in time.

Simple machines, sometimes called the mechanical powers, may be considered under three heads: 1. A solid body movable around a fixed point; 2. A flexible string; 3. A hard inclined surface. Under No. 1 come machines acting on a lever, and wheel and axle, such as the crowbar, etc. In this case the difference between the power and fulcrum is greater than the difference between the fulcrum and weight. In the case of the wheelbarrow, row boat, etc., the power is at one end, the fulcrum at the other, and the weight between the two. In the human arm the weight is at one end, the fulcrum at the other, and the power between. Under No. 2 come pulleys. In the case of the single pulley the power exerted must be equal to the weight; it simply changes the direction of the force. Where more than one pulley is used, as in one block, the first one would support the whole weight, which we will say is 100 lbs.; the second pulley would support one-half of what is supported by the first, or 50 lbs.; the third would hold or support one-half of what is supported by the second, or 25 lbs. The force, therefore, required to lift the 100 lbs. would only be equal to 25 lbs., but, as it has been already said, what is gained in force is lost in time. No 3, inclined surfaces, including the wedge and screw. To take a weight up an inclined plane, the weight and height must be equal to the power and length. In the screw the power and circumference equals the weight and distance between threads.

* A paper read before the Hamilton Branch, C.A.S.E., by Jas. Gill, teacher of Physics, in the Normal College and Collegiate Institute, Hamilton, Ont.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the metal imports from Great Britain during December, 1896, 1897, and the twelve months to December, 1896-1897.

	Month of Dec.,		Twelve months ending Dec.,	
	1896	1897.	1896.	1897.
Hardware and cutlery	£3,557	£4,327	£62,382	£68,144
Pig iron	60	225	28,026	9,434
Bar, etc.	386	263	15,540	8,892
Railroad	36	..	174,470	45,789
Hoops, sheets, etc.	2,473	112	49,435	77,935
Galvanized sheets	1 606	5,185	56,013	57,955
Tin plates	31,217	7,149	184,043	224,570
Cast, wrought, etc., iron	1,528	4,625	49,286	36,604
Old (for re-manufacture)	..	170	15,758	7,854
Steel	3,001	3,946	88,394	55,902
Lead	1,777	978	18,128	28,370
Tin, unwrought	1,152	3,356	21,103	20,725
Cement	8	2,701	32,731	22,498

TESTS OF CAST-IRON COLUMNS.*

We present herewith a report of the tests of full-sized cast-iron columns recently conducted by the Department of Buildings of New York city at the works of the Phœnix Bridge Co., Phœnixville, Pa., under the direction of W. W. Ewing, of the department. The tests began on Dec. 15th at 1 p.m., and were finished on December 21st. The machine used was the testing machine at the Phœnix works. To ensure the accuracy of the tests, the Building Department arranged a comparison of the Phœnix machine with the famous Emery machine in the United States Arsenal at Watertown, Mass. On December 30-31, 1896, a series of compression tests was made at Watertown upon a soft steel Phœnix column built by the Phœnix Iron Company especially for these tests. It was made of eight segments riveted together, forming a round column 21 feet long, inside diameter 14⅝ inches, thickness of metal 1⅛ inches, area of section 75 3 square inches, total weight of 5,485 lbs. The calculated safe load was 530 tons. The column was shipped to Watertown Arsenal and carefully tested in the Government machine shops at that place. Marks were made 26 inches from the ends, that is, 200 inches between marks, and a form of roller extensometer reading to 1-10,000 inches, was employed, to take all measurements. In applying the load constant increments were used. Certain additional loads were applied, corresponding with those to be applied later in the Phœnix machine. The column was then returned to Phœnixville, and the tests repeated in the Phœnix machine. The conditions were reproduced as nearly as possible: the same series of readings were taken, using the same extensometer. The results of the two tests are shown in Tables I. and II.

The gauge used to calibrate the Phœnix machine was a mercury column instrument, manufactured by Thomas Shaw, of Philadelphia, Pa., and numbered 5,447, was calibrated to read in pounds per square inch, and ranged from 0 to 220 lbs. The pressure used in the cylinder of the hydraulic testing machine is received on a diaphragm and transmitted to the lower end of the double-headed piston, whose upper end, of much greater diameter, is surmounted by another diaphragm, above which is a reservoir of mercury, and a mercury column of small bore. The actual tests were made with a higher reading mercury column which was compared with instrument No. 5,447 at the time of the tests, and afterwards by the maker of both instruments.

From the figures thus obtained the following computation of the calibration of the Phœnix testing machine was made and included in Mr. Ewing's report:

Let P = unit load in Watertown machine.

l = compression in ins. due to P.

P' = unit load in Phœnix machine.

l' = compression in ins. due P'.

P = 1 lb., l = .00000008g1, and l' = .0002432916.

If $P : P' = 1 : l'$

$$\text{then } \frac{P}{P'} = \frac{l}{l'}, \text{ and } P' = \frac{P l'}{l}$$

$$P' = \frac{.0002432916}{.00000008g1} = 2,730.54 \text{ lbs.}$$

* Reprinted from the *Engineering News*.

This figure indicates that each unit on the gauge must be multiplied by 2,730, to obtain the pressure exerted in lbs.

TABLE II.

COMPRESSION TESTS OF CAST-IRON COLUMNS MADE FOR THE DEPARTMENT OF BUILDINGS, NEW YORK CITY, IN 1896, BY GUS. C. HENNING, M. AM. SOC. M. E.

No.	Length.	Outside diameter, inches.	Thickness — Maximum.	Thickness — Minimum.	Thickness — Average.	Breaking load, actual gauge-reading, lbs.	Sectional area, sq. inches.	Breaking load per sq. in. lbs.	*Corrected breaking load per sq. inch.
1	147¾ inches.	8	13-16	⅝	¾	520,000	17 08	30,400	25,840
2	150 "	9	1⅛	¾	1	630,000	25 t4	25,100	21,340
3	162 "	12	1	1	1	1,250,000	34.25	36,200	30,770
4	159¾ "	14	1⅛	¾	1	1,226,000	39.84	30,700	26,100

* The figures in this column are obtained by deducting 15 per cent. from those in the preceding column, for friction of the machine.

We come now to consider the results of the breaking tests of the cast iron columns. Ten columns were tested, six of them being 15 feet 10¼ inches long, 15 inches diameter, and from 1 to 1 3-16 inches thick; two were 13 feet 4 inches long, 8 inches diameter, and two were 10 feet long and 6 inches diameter. A condensed table of results, Table III., is given herewith, the last two columns of which are from our own calculations, and are not given in the Building Department report, which gives only the actual data obtained without drawing any conclusions.

From the observations reported by Mr. Ewing, we quote as follows:

Column 1—Column suddenly broke under a total load of 1,356,000 lbs. into 10 pieces; the fractured surface began about 3 feet 4 inches (average) from the bottom.

The quality of metal was medium grain; foundry dirt and blowholes were quite numerous; in one place the foundry dirt extended half way through the metal; in another place, there was a thin layer of foundry dirt and honey-comb midway between the inner and outer surfaces; between this layer and the two surfaces, the metal was perfectly sound: this layer of foundry dirt contributed to the weakness of the column, as was evident from an inspection of the fractured surface.

The column sheared at an angle of about 30° with an element of the surface, and about 45° with a normal to the surface, inside of the layer of foundry dirt, above referred to only. This layer of foundry dirt extended about 6 inches around (circumference) on column. At another fractured surface where no defects occurred, the metal sheared along a spiral course about 45° with an element of the surface, and at an angle of 45° with a normal to the surface; this surface was about 15 inches long.

Column 2.—The column crushed near the lower end, many of the pieces being quite small; the bottom flange was left intact, the fractured surface beginning at the top of the flange or 13¼ inches from the faced end of the column and extending around the shaft in an irregular manner, reaching 5 inches away from bottom flange in one place.

The shaft of the column above the fractured portion was found to be permanently sprung ½-inch in a distance of 9 feet 4 inches along shaft. The quality of metal at bottom of column, where fracture occurred, was medium grain and quite uniform in grain. Considerable quantities of foundry dirt was found at fractured surfaces and where the column crushed into small pieces, the foundry dirt extended all the way through in many spots.

The shaft sheared in several places at an angle of about 45° to the elements of the surface of the column parallel with its axis, the fractured surface following a sort of spiral path around the shaft. The metal at the same time sheared through at an angle of from 30° to 45°, with a normal to the surface of column.

Column B 2.—The fractured portion of column was below the centre, beginning 3 feet 9 inches from bottom and 6 feet 6 inches from top of column. Quality of metal rather course, but quite uniform. Flaws occurred in spots, but not bad. There was evidence of shear at 45°, the same as in preceding columns.

Column B 4.—The quality of metal was rather coarse in centre of shell, and somewhat finer toward the surfaces. Cinders and slag in considerable quantity, two bad spots nearly opposite at bottom of column where metal was poor; one of these was 5 inches long on outside (around column) and extending about half way through the metal On the opposite side the defective portion was 4 inches wide on inside, and extended for one-third to two-thirds the way through the metal. There were indications of shear at about 45°, similar to cases previously noted, at the bottom, where the column broke into

TABLE I.

RESULTS OF BREAKING TESTS OF CAST-IRON COLUMNS.

Column No.	Length.	Outside diameter.	Thickness — Maximum.	Thickness — Least.	Thickness — Average.	Location of break.	Breaking load, lbs.	Compression.	Character of metal at fracture.	Sectional area.	Breaking load per sq. in. of area, lbs.
I.	190¼ ins.	15 ins.	1	1	1	About 3 ft. 4 ins. from bottom.	1,356,000	.....	Medium grain; *a* blowholes and dirt.	43.98	30,830
II.	190¼ ins.	15 ins.	1 5-16	1	1⅛	Bet. 1 and 5 ins. from bottom.	1,330,000	.....	Medium grain: *b* fairly uniform, spots of dry dirt.	48.03	27,700
B 2.	190¼ ins.	15 ins.	1¼	1	1⅛	Bet. 3¼ feet from bottom and 6½ ft. from top.	1,198,000	2½ ins. bet. 150,000 and 1.108,000.	Coarse, but uni- *c* form; a few flaws.	48.03	24,900
B 4.	190¼ ins.	15⅛ ins.	1 7-32	1	1⅛	Betweeen bottom and one-third up from bottom	1,246,000	2¼ ins, bet. 150,000 and 1,246,000.	Coarse in centre; *d* finer on outside: cinders and slag.	49.48	25,200
5.	190¼ ins.	15 ins.	1 11-16	1	1 11-64	At bottom flange.	1,632,000	2 5-16 ins. in 8 ft. 3 ins.	Fine grain and *e* uniform where no flaws occur'd.	50.84	32,100
6.	190¼ ins.	15 ins.	1¼	1⅛	1 3-16	No break; permanent set of 1 3-16 ins. in 8 feet.	Over 2,082,000	⅜-in. betw'n 232,000 and 1,108,000	No break. *f*	51.52	Over 40,400
XVI.	160 ins.	Bet. 8¼ and 7¾ ins.	1¼	⅝	1	Where chaplet was placed at middle and at ends.	651,000	.....	Metal g'd; me-*g* dium grain.	21.99	31,900
XVII.	160 ins.	8 ins.	1 3-32	1	1 3-64	At middle and ends.	612,800	.....	Fine grain, uni-*h* form, and free from flaws.	22.87	26,800
7.	120 ins.	6 1-16ins.	1 5-32	1⅛	1 9-64	At middle and each end.	400,000	.....	Good even grain, *i* no flaws.	17.64	22,700
8.	120 ins.	6 3-32 ins.	1⅛	1 1-16	1 7-64	At middle and each end.	455,200	.....	Fine grain, uni-*j* form, and free from flaws.	17.37	26,300

REMARKS.—*a*. One place, foundry dirt extended half way through; another place, foundry dirt and honeycomb between inner and outer surface.

b. At a pressure of 1,302,000 a slip of some kind occurred, which dropped the pressure to 1,275,000; again run up until break occurred. Upper portion sprung ½-inch in 9 feet 4 inches.

c. At 1,108,000 column sprung badly; movement recorded under compression.

d. Bad spots, cinder pockets and blowholes near middle of column; small cracks in necking near top; column given a permanent set.

e. Flaws and foundry dirt at point of break; load was carried as high as 1,803,000. The dummy head against which column rested was found broken after the test; this may have had something to to do with character of break.

f. Pressure run up to 1,108,000 and released. It was again run up to 2,082,000, released and run up to 2,033,000. Column could not be broken; capacity machine reached.

g. At time of breaking, column had a vertical deflection of 3 9-16 inches and a horizontal deflection of 1¼ inches; fracture seemed due to flexure.

h. Vertical deflection, 4¼ inches; horizontal, 7-32 inches.

i. Vertical deflection, 3¼ inches; horizontal deflection, 1 17-32 inches.

j. Vertical deflection, 3 inches; horizontal deflection, ⅝ inch.

small pieces, The total number of pieces was 15. The fractured surface revealed many cinder pocket and blowholes near middle of column. Small cracks were observed in the necking near top of column.

Column 5.—Column broke into 14 pieces; all fractures occurred below the lower necking on column and broke through bottom flange. The permanent set in the shaft between the upper and lower necking was $2\frac{5}{8}$ ins. in 8 ft. 3 ins.; the upper part of the shaft above the necking remained perfectly straight after the test. Flaws were found in fractured surfaces near bottom, of foundry dirt. One bad flaw about 5 ins. wide and 4 ins. high (long) on outside, extending three-fifths of the way through. Quality of metal was rather fine grain and very uniform where no flaws occurred. Part of the shaft remained intact to end, and part of flange was left on. After the test, it was found that a dummy head against which the end of the column bore, was broken in such a way that the load on the column was eccentric after the head gave out; the nature of the fracture sustains this belief.

Column 6.—The test was discontinued when a load of 2,033,000 lbs. had been reached, the capacity of the machine having been reached. The permanent set of the column after it was removed from the testing machine was $\frac{1}{32}$-in. in a length of 8 feet 5 ins. The concave side, after the test, was about 90° from the joints of the flack, and undoubtedly was the top of the column as cast in the mold.

Column XVI.—One fracture occurred at a point where the chaplet for holding down the core was imbedded into the metal of the column. the metal outside of the chaplet was $\frac{7}{16}$-inch thick, and the chaplet 3-16-inch metal. The cast metal did not adhere to the chaplet. The column broke into six pieces (at middle and at each end). The fracture at the middle was nearly square off, and very near the exact middle point between the two ends. The fractures were about one foot from each end and irregular in outline. The metal was good, of medium grain. Wires were attached to the shaft of the column, 6 feet 6 inches from bottom, and ran perpendicular to the axis of the column, one horizontally and one vertically. These were carried to the outside of the building in which the tests were being made, and the actual vertical and horizontal deflections of the column were observed in conjunction with the corresponding loads. There was no evidence of shear at the fractured surfaces, as in the case of the larger columns. Failure seemed to result primarily from flexure.

Column XVII.—The column broke into eight pieces, the fractured points being at the middle and near each end. Quality of metal at fractured surfaces was fine grain, uniform and free from flaws.

Column 7 was broken into four pieces, the fractures being 3 inches to one side of the middle of the column and near each end. The quality of the metal was good, even medium grain, with no flaws.

Column 8.—The quality of metal was fine grain, uniform and free from flaws. The column broke into four pieces, fractures being at middle and near ends; broke off nearly square at each point; no signs of shear in metal.

Two of the 15-inch columns tested, Nos. B 2 and B 4, were taken from the Ireland Building, which it will be remembered, collapsed August 8th, 1895. The four remaining 15-inch columns were made from drawings prepared by the Department of buildings of New York city, and were as nearly as possible duplicates of the Ireland columns.

The columns marked I. and II. were made by the Jackson Iron Works, New York city, of their ordinary run of metal. They were cast while other columns were being cast, with no knowledge of their ultimate use. The two marked 5 and 6 were made by the Healy Iron Works, Brooklyn, N.Y., who were informed of what the columns were wanted for. The drawings for the 6-inch and 8-inch columns were also made by the department.

All the columns broken were, we understand, fair samples of the ast-iron column used in buildings in New York city, and regularly passed by the Building Department as coming within the provisions of the law.

The building law of the city of New York says:

"The strength of all columns and posts shall be computed according to Gordon's formulæ, and the crushing weights in pounds, to the square inch of section, for following materials, shall be taken as the co-efficient in said formulæ, namely: Cast-iron, 80,000. . . . The factors of safety shall be as one to four for all posts, columns and other vertical supports when of wrought-iron or rolled steel, and as one to five for other materials, subject to a compressive strain."

Applying Gordon's formula* with the co-efficient 80,000, as above required, in the numerator, and 400 (which is not given in the law, but is given in Haswell's Pocket Book, to which reference is made) in the denominator, we have

$$S = A \frac{80{,}000}{1 + \frac{l^2}{400\,d^2}}$$

* Mechanics' and Engineers' Pocket Book, Chas. H. Haswell, 1897, p. 768.

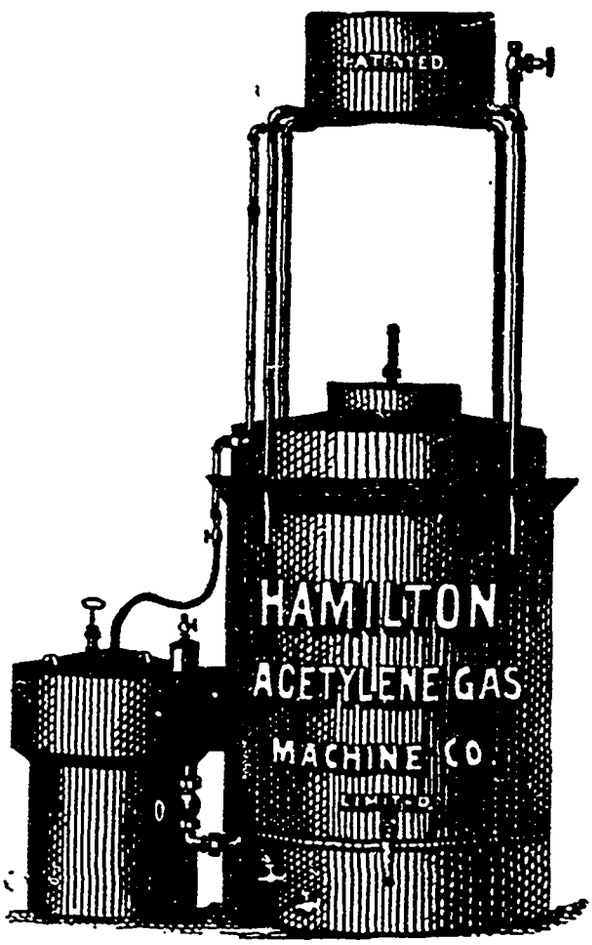
in which S is the breaking load, A = sectional area in sq. ins., l = length, and d = diameter of the column in inches.

For the 15-in. columns we have l = 190 ins., d = 15 ins., S = 57,143 A. For the 8-in. columns, l = 160 ins., d = 8 ins., S = 40,000 A. For the 6 in. columns, l = 120 ins., d = 6 ins., S = 40,000 A. That is, by the New York law, the 15-in. columns would be calculated to have a breaking strength of 57,143 lbs. per sq. in., while the actual tests show that their strength was only from 24,900 lbs. to something over 40,400 lbs. per sq. in. The 6 and 8-in. columns would be calculated to have a breaking strength of 40,000 lbs. per sq. in., while their actual breaking strength was only from 22,700 to 31,900 lbs. If such columns as these are loaded in buildings with the loads which the law allows, the factor of safety, instead of being 5, as required in the law, is actually in some cases more than 2. This is also borne out by the results obtained during similar tests conducted about a year ago by the Department of Buildings with full-sized cast-iron columns. The dimensions and results of these tests are given in Table IV. The values given in the column headed "Breaking load" are in round numbers, hence the breaking loads per square inch of area are correct to the hundreds as given.

A NEW ACETYLENE GAS GENERATOR.

The Hamilton Acetylene Gas Machine Co. having acquired the rights of a new acetylene gas generator invented in Welland, has established a factory at 228 King Street East, Hamilton, where it is now turning out large numbers of the machines, for which there is an active and growing demand.

A rough sketch of this machine is presented herewith. The water for feeding the carbide is taken into a tank above the gas holder, and this tank is kept full by means of a ball-cock attachment such as is used in a water closet tank. From here the water is fed to the car-



bide chamber shown to the left of the foot of the gas-holder. The holder is much the same in principle as a coal gas holder, and has the usual water-seal. As the gas is exhausted from the holder, a small bar which projects over the edge of the roof of the holder, catches the arm of a lever valve, and as it descends the valve is opened and the water starts to flow from the upper tank through a rubber pipe into the carbide chamber. The jet of water does not fall in one spot on the carbide, but is distributed over the material in a spray on all sides from a nozzle. When gas is thus generated by the water, the acetylene fills the holder, but when full the excess of pressure is relieved either by the top of the holder striking a spring valve and so

opening an outlet to the waste gas pipe which leads outside the building; or by an internal pipe, the lower end of which is lifted above the water-seal before the holder is full to excess. Two small cocks at the bottom of the holder let off the water that may gather from condensation; and when the carbide chamber needs re-charging a cock is turned in the gas supply pipe to prevent the gas from returning out of the holder. The carbide is held in the chamber by a wire cage in which receptacle it may be agitated by a shaker which can be operated by an outside handle.

The following are the special claims put forth for this machine by its manufacturers: (1) It is perfectly automatic in its action, and makes gas equal to the consumption only. This they claim above all other machines that are in the market. (2) It is not dependent upon the gas pressure to regulate the supply of water to the carbide, consequently the pressure upon all parts of the machine is at all times equal and does not exceed the amount necessary to supply the burners, viz., one and one-quarter ounces per square inch; it is therefore absolutely safe. (3) It mechanically regulates the quantity of water that is from time to time automatically brought in contact with the carbide, as the consumption requires, so that gas cannot be generated beyond the capacity of the machine. (4) The generator is so constructed that the carbide can be added and the ashes instantly removed without loss of gas, without shovelling any ashes, and without unscrewing any parts of the generator with a wrench or otherwise. All we have to do is to lift the cover off the generator and lift out the vessel and dump contents, then re-charge with carbide Joints are all water joints. We challenge any other machine on these points. (5) A generator holding from 30 to 50 pounds of carbide will supply gas for a large dwelling house or store sufficient to last two or three weeks, and will require little, if any, attention.

The company is in possession of a number of very gratifying testimonials from users of the machines, and claims to have the cheapest machine in the market.

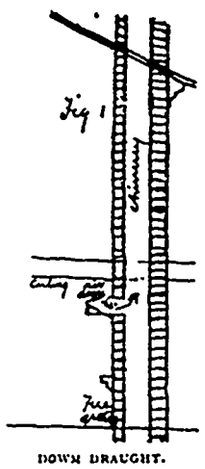
The president of the company is Dr. George S. Bingham, and the secretary, A. J. Seguin.

For THE CANADIAN ENGINEER.

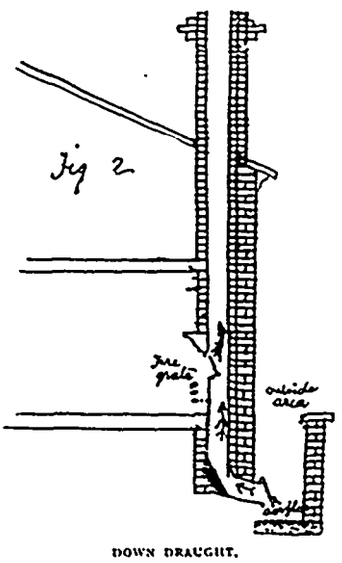
DOWN DRAUGHT IN DOMESTIC CHIMNEYS.

BY W. M. WATSON, TORONTO.

In answer to your query—what will prevent cold air passing down the chimney into your parlor, through the open fire-grate? I may first state the reasons for air doing so, are, because the room is of higher temperature than the outside atmosphere, or even the air contained in the chimney shaft, and the brick work forming the inner

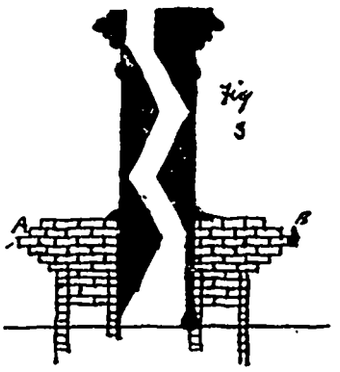


DOWN DRAUGHT.



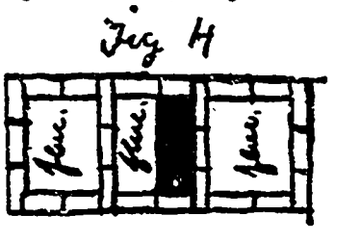
DOWN DRAUGHT.

wall of the shaft. Second, because probably your chimney is built straight and vertical from your grate to the head of the flue, without having any proper bend or goose neck offset, to prevent weight of the heavy, cold, outside air from passing down the full length of the chimney; thus providing an easy route for the outside atmosphere to secure heat by entering and mixing with the air of the parlor. You might possibly prevent it by ventilating your room near the ceiling, through and into the offending flue. This would cool your room, but supply warmth to the inner brickwork of the flue and its contents of air. Your opening, if you adopt that plan, should have the mouth or opening looking up towards the ceiling. If your flue extends down to the basement or cellar where the air is near the same temperature as the air above the roof, then you can stop the nuisance by making an opening that will circulate the air from the cold basement to the housetop by way of the chimney flue, causing always an upward current through the shaft. By fitting proper doors, when a fire is needed in



DOWN DRAUGHT.

the parlor, the door at end of flue in basement or outside can be closed, and the one behind the fire grate opened and again reversed when no fire is needed, see figure 2: or third, it might be remedied by making



DOWN DRAUGHT.

a chimney top of galvanized sheet iron similar to sketch 3 and 4 with a bent flue, to take the weight and pressure of the heavy outside air, and act in place of the goose-neck or offset, that should always be constructed near the head of every chimney-flue serving a dwelling-house.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

The annual meeting of the Canadian Society of Civil Engineers was held in Montreal, January 11th. The first business was the election of scrutineers. J. W. Heckman, T. W. Lesage and James Ewing were elected scrutineers of the ballot for the election of officers and members of council; H. B. Stuart and W. G. Matheson, of the ballot for the nominating committee; F. L. Somerville. J. S. Vinden and L. G. Papineau, of the ballot for amendment and by-laws, proposed by members, and J. W. McCarthy, L. J. Maven, and L. A. Amos, for the ballot for amendment to by-laws proposed by the council.

The meeting was then adjourned in order that the members might avail themselves of the invitation of the Royal Electric Co. and the Chambly Power Co., to visit the works, now nearly complete, at Chambly, Que. The Grand Trunk and Vermont Central railways provided a special train, and upwards of 130 members of the society took part in the excursion. On their arrival they were received by S. T. Willet, president of the Chambly Co., and Senator Thibaudeau, president, and W. H. Browne, general manager, of the Royal Electric Co. It is unnecessary to add anything to the illustrated description of this plant in our December number, except that the visiting engineers expressed their high approval of the work, and their sense of its commercial importance. After the inspection luncheon was served in the switchboard chamber, where speeches were made by the Mayor of Chambly, S. T. Willet. G. H. Duggan, Senator Thibaudeau, W. H. Browne, P. St. George, J. A. L. Strathy, and W. McLea Walbank. While at Chambly some of the visitors took the opportunity to visit the old fort built by Mons. de Chambly, in 1711. On the return journey to Montreal, the train was stopped at the Victoria Bridge, so that the members, might have an opportunity of inspecting the superstructure in process of erection there. In the evening, the annual banquet was held at Windsor Hotel and was largely attended. C. E. W. Dodwell, of Halifax, acted as toast master, and his genial originality and ready wit contributed much towards making the dinner, what it certainly was, the most successful and enjoyable one ever held. The adjourned meeting was resumed at about 10.30 a.m., on Wednesday. In the

absence of T. C. Keefer, C.M.G., President, and Messrs. Jennings and Thompson, vice-presidents, G. H. Duggan occupied the chair The secretary, Prof C H McLeod, read the report of the Council for 1897, which was as follows:

ROLL OF THE SOCIETY.

The elections comprised eight members, fourteen associate members, one associate, and fourteen students. Ten associate members have been transferred to the class of members, and four students to the class of associate member. Resignations have been received from two members, one associate and one student. The deaths have been.

Members—Alan MacDougall, H. F. Perley and D. A. Stewart.

Associate members—James R. Peddar and H. L. Langevin.

Associate—John H. R. Molson.

At present the membership stands as follows:

	Non Res.	Res.	Total.
Honorary members	6	2	8
Members	231	53	284
Associate members	115	30	145
Associates	28	13	41
Students	99	35	134
Total			628

At the same date last year:

	Non Res.	Res.	Total.
Honorary members	6	2	8
Members	218	53	271
Associate members	115	30	145
Associates	27	15	42
Students	94	31	125
Total			591

It will be seen that the number of members, associate members and students, i.e., the active membership of the society, has increased during the year. The total increase in the membership of all classes is thirty-seven. At the time of the last annual general meeting there were eight new applications, and at the present time there are nine applications for admission into the society.

The eleventh annual meeting was called to order at 10 o'clock a.m. Tuesday, Jan. 12th. 1897. Herbert Wallis, president, in the chair. Fifteen ordinary meetings were held during the year, at which the following papers were read: A New and Cheap Method of Dressing Car Wheels, by R. Atkinson, M. Can.Soc. C.E.; Fraser Valley Reclamation, by R. E. Palmer, Assoc. M. Can. Soc. C.E.; The Old Albion Mines Railway, by the late D. A. Stewart, M. Can. Soc. C.E.; The Separate System of Sewerage in Ontario, by Willis Chipman, M. Can. Soc. C.E.; Fortifications, by C. R. F. Coutlee, Assoc.-M. Soc. C.E.: Results of Experiments on the Strength of White Pine, Red Pine, Hemlock and Spruce, by Prof. H. T. Bovey, LL.D., M. Can. Soc. C.E.; Sewage by Subsoil Irrigation, by E. Mohun. M. Can. Soc. C.E.; Impulse Water Wheels, by J. T. Farmer, student Can. Soc. C.E. Abstracts have also been read on the following subjects: 1. Water Power, its Generation and Transmission; 2. Water Power of Caratunk Falls; 3. The Transverse Strength of Beams, 4. The Underpinning of Heavy Buildings; 5. Methods and Results of Stadia Surveying, 6 The Liverpool Water Works; ; Relative Tests of Cast Iron and Strength of Cast Iron; 8. The New Water Scoop of the Pennsylvania Railway; 9. Water Power and Compressed Air Transmission Plant for the North Star Mining Co ; 10. Foundations of Tall Buildings; 11. Solar Work in Surveying, 12. Through Barren Lands; 13. Comparative Tests of Steam Boilers with Different Kinds of Coal; 14. Paint as a Protection for Iron; 15. Inclined-Plane Railways; 16. 100 Feet Standard of Length of Boston Water Works; 17. The Manufacture and use of Sand Cement; 18. Some Experiments on the Condensation of Steam; 19. An Electrical Method of Measuring the Temperature of a Metal Surface on which Steam is Condensing. A series of lectures on the "Transmission of Power by Compressed Air, Gas and Steam," by Prof. J. T. Nicolson, B.Sc., M. Can. Soc. C.E., and Prof. R. J. Durley, B.Sc., Assoc.M.Can.Soc.C.E., were delivered during February and March of this year. The lectures were illustrated by lantern projection, and attracted very large audiences. They are now published in condensed form in Vol. XI., Part I., and constitute a valuable contribution to the published transactions of the society. An illustrated lecture on "Cantilever Bridges," by Mr. J. A. L. Waddell, Ma. E., bridge engineer, of Kansas City, Mo., was delivered at the meeting of October 28th.

The accommodation of the society has been enlarged during the year. The council at its first meeting appointed a committee on Dominion Legislation, but the committee has not deemed the time opportune to take any action. The several provincial committees on legislation, as constituted last year, were re-appointed. During the year additions have been made to these committees owing to the death of two of the members and the resignation of others. The committees are now constituted as follows: Nova Scotia—M. Murphy, C. E. W. Dodwell, W. R. Butler, W. G. Matheson and H. S. Poole. New Brunswick—P. S. Archibald and Hurd Peters. Quebec—St. George Boswell, L. A. Vallee and E. Marceau. Ontario—W. T. Jennings, M. J. Butler, Willis Chipman and W. G. Thompson. Manitoba—H. N. Ruttan, G. H. Webster and J. Woodman. N.-W. Provinces—W. D. Barclay, G. A. Stewart and W. I. Thompson. British Columbia—G. A. Keefer, H. J. Cambie, A. J. Hill, H. Abbott and F. C. Gamble.

In October the council appointed H. Wallis, W. J. Sproule and C. H. McLeod, a special Central Committee on Legislation with power to add to its number H. Irwin has been added to the committee. Since its appointment this committee has, in conference with the Quebec Provincial Committee, given a large amount of time to the promotion of legislation in Quebec. In Nova Scotia the Provincial Act was, in January last, passed through the Lower House, but consideration of it was deferred in the Legislative Council, and it will be necessary to reintroduce the bill during the session which will open some time in January.

At the first meeting of Council W. J. Sproule resigned, and his place was filled by the appointment of E. Marceau. On June 8th C. H. Rust was appointed a member of council to fill the place made vacant by the death of Alan MacDougall. On October 12th G. H. Duggan was appointed a vice-president in the place of Prof. H. T. Bovey, resigned, and W. J. Sproule was elected to the council to replace G. H. Duggan.

Signed. T. C. KEEFER, President.
C. H. McLEOD, Sec'y.

This, together with the treasurer's report, and that of the Library Committee, was adopted. Some discussion on the arrears in subscriptions followed the treasurer's report, motions were made and withdrawn, and finally the council was left to use its own discretion in individual cases as formerly. K. W. Blackwell, the treasurer, referring to the legacy of $500 left by the late H. G. C. Ketchum, said that the council felt it had no power to dispose of it, and thought that the meeting might specify the purpose to which it was to be devoted. Herbert Wallis, in reporting progress on behalf of the Committee on Legislation, said that after a great expenditure of time and energy in Quebec, the Close Corporation bill had passed and, notwithstanding some alterations, the bill was now substantially in the form they had labored for all along. This scheme is not a selfish thing. It will benefit those who come after us, said Mr. Wallis, by materially raising the status of civil engineers. Our secretary (Prof. C. H. McLeod), has labored splendidly, and our connection with McGill University has been of undoubted value. Nor must we forget the great credit due to Messrs. Marceau, Boswell, Vallee, Irwin and Sproule. The bill awaits only the sanction of the Lieutenant-Governor to become law. He heartily congratulated the society. Some desultory remarks followed on the subject of the bill, and the secretary announced that some copies of it had been printed, and could be seen at any time by members of the society. The chairman, G. H. Duggan, said he thought the incoming council would like some instructions how to proceed in other matters connected with legislation.

The chairman then called on Prof. Butler for his report on standard measures. The secretary then asked simply that the powers of this committee be continued. The report of the Committee on the Gzowski Medal was received. It recommended that the medal be awarded to Prof. S. L. Fortier, B.Sc., Montreal, for his paper on "The Storage of Water in Earthen Reservoirs."

W. J. Sproule then proposed the following resolution: "That it is in the interests of the engineering profession that the method of doing professional work, for giving advice, for a remuneration estimated by a percentage of the cost of the work to be constructed, is not in the best interests of the profession, nor for the clients of engineers, that its tendency is

immoral, and that this method should be discontinued as soon as possible, and that the attention of all the members be directed in a special manner to this resolution." He said: This is a big question, I know, but not new to many engineers. I believe that the practice is wrong in every respect. That the engineer should be influenced by the idea that the more he makes the work cost, the more comes into his pocket, is only human after all. I do not pretend by any means that all are influenced by mercenary motives, but since the way is open, it is not surprising that weak individuals sometimes fall into such a natural trap. In the case of many small municipalities where possibly some member cannot even read or write (and there are such), what would be the effect of such a known fact on a designing engineer? This motion was opposed in a fluent and vigorous speech by J. M. McCarthy, who said that such enormities as Mr. Sproule wished to render impossible were no more common in the civil engineering profession than in any other, and might be left to work their own punishment from the popular judgment. He gave some pertinent reasons why the present method should continue to govern professional services. The motion, which was seconded by F. F. Miller, was lost on division.

The scrutineers of the ballot for amendments to by-laws announced the result of the ballot for the amendments proposed by the council. Article 28 was the first attacked. It is as follows: There shall be a council, consisting of the president, vice-president, treasurer, secretary, honorary councillors and councillors, and of this council five shall constitute a quorum. The members of council shall retain their position until their successors have been appointed. It was proposed to leave out the word "secretary" in the second line, and to add to the article "the secretary to be appointed by the council." Lost. Article 35 was the second. It provides that the nominating committee shall draw up a list of voting members qualified to fill the various offices, specifying that of secretary amongst the others, the entire list to consist of 34 names. It was proposed to leave out the word "secretary" and exclude that position from the list of councillors. Lost. Article 19 was the third. This provides that each student shall pay $2 per annum. It was proposed to amend this so that each non-resident student should pay $2 and each resident student $3 per annum. Lost. The fourth proposal was for a new by-law, as follows: Every new member as associate member shall upon admission to the society, pay a fee of $20. but no additional payment other than the increased annual subscription shall be due from an associate member upon his transfer to membership, which was adopted.

The amendments proposed by the members were all carried. The first referred to by-law No. 27, which is: The officers of the society shall consist of a president, three vice-presidents, a treasurer, a secretary, a librarian; the past presidents, who shall be styled honorary councillors, and fifteen councillors. Of the fifteen councillors, not more than three may be associate members. The words "last three surviving" are to be inserted before the words "past presidents," and the words "who continue to be members," inserted immediately after the words "past presidents." Article 34 provides for the appointment by the council of committees of five each on finance and the library, without regard to the number which shall form a quorum on each committee. The amendment is that three shall form a quorum. By-law No. 35 is amended to agree with the amendments to No. 27, and will be as follows.

"A nominating committee of eight voting members elected annually and of the last three surviving presidents, who continue to be members, shall draw up a list of names of such voting members as in its opinion are qualified to fill the offices of president, vice-presidents, treasurer, secretary, librarian, and councillors for the ensuing year, and who shall previously to their names being entered upon the list, have signified to the committee in writing their willingness to accept their several nominations."

H. Irwin said that from time to time outside members had complained that they were not represented on the council. This ought to be remedied. Members all over the country should send in a list of those whom they thought ought to be on the committee It is very difficult for the local committee to choose. H. Peters thought that there might be some difficulty about this. Still, while all acknowledge the rights of Montreal, other societies move their annual meetings from place to place. Would it not be desirable for the civil engineers? It would undoubtedly extend their influence. He gave notice that at the next annual meeting he would move that the annual meetings be held in different places. W. J. Sproule thought that this object would be sufficiently met by a summer convention, one of which had been held. An important consideration is that all the records of the society are in Montreal.

The scrutineers then announced the result of the ballot for the election of officers, which resulted as follows: President, W. G. McN. Thompson, of St. Catharines, Vice-Presidents, K. W. Blackwell, P. W. St. George, H. D. Lumsden; Secretary, Prof. C. H. McLeod; Treasurer, H. Irwin.

Members of Council—H. N. Ruttan, Duncan McPherson, C. E. W. Dodwell, G. H. Duggan, E. H. Keating, St. George Boswell, J. H. Shanley, C. B. Smith, J. D. Barnett, F. C. Gamble, J. Galbraith, Hurd Peters, W. McLea Walbank, J. L. N. Coste.

P. W. St. George expressed the thanks of Mr. Thompson, who was unavoidably absent, and also his own for election to their respective honors. The secretary then announced that the retiring president, T. C. Keefer, C.M.C., had sent an address on "The Progress of Engineering Works during the last ten years, and of Water Works in particular." This was read by C. S. W. Dodwell, and will be found reported upon another page.

In proposing a vote of thanks, Jno Kennedy said: "I have much pleasure in proposing a vote of thanks to our president, Mr. Keefer, whose absence we all regret very much. We owe him a great deal. The society honored itself as well as Mr. Keefer in electing him as president for the second time, and much of the success of the society to-day is due to his kind interest in it during the past ten years. Mr. Keefer has been honored by our Queen and by his profession, and I am sure I am speaking for every individual member, not only of the society, but of the profession at large, when I say that all the honor and more is due to him. I say again, therefore, that it gives me great pleasure to propose a vote of thanks to Mr. Keefer for his very interesting address just read, and for his services as president of our society. This was seconded by H. Peters and carried by a standing vote. The meeting terminated with votes of thanks to the Royal Electric Co. at Chambly, the G.T. and C.V. railways, the scrutineers, the Hon. Messrs. Attwater, Duffy, and the other gentlemen who assisted in passing the Close Corporation bill at Quebec, to Prof. C. H. McLeod for his valuable services in the same direction, to the treasurer, K. W. Blackwell, to the St. Lawrence Cement Co., and to the curator of the fort at Chambly.

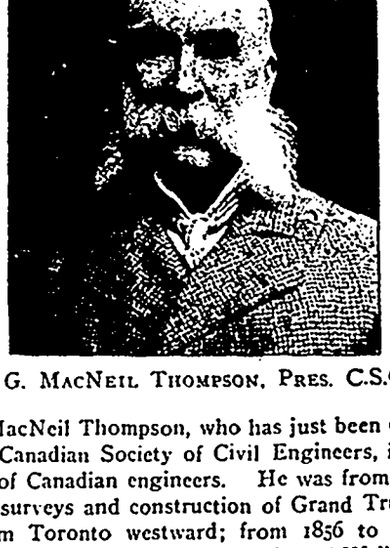
At the regular meeting, held January 20th, P. W. St. George, vice-president in the chair, the secretary announced applications for admission from Chas Biggar, of Ottawa; H. F. Duck, Toronto; J. W. Fraser, Ottawa; Lewis Skaife, Montreal: for transfer from W. P. Morrison, Halifax; C. C. Wonsfold, New Westminster; students, G. A. Beauchand, E. Lorne-Bond, H. D. Pariseau, L. F. Gagon, H. L. St. George, F. T. St. George, all of Montreal.

A letter was read from Herbert Wallis, announcing the gift of a fire basket and fender for the accommodation of members in the new smoking-room, which, together with a reading-room, has recently been added. It was suggested that something should be done to celebrate the opening of these rooms. Prof. Nicholson suggested an exhibition of slides, illustrating great engineering works. Other members wished this to be followed by something free and easy for once, and in consequence a committee, composed of Profs. McLeod, Nicholson, and Durley, and Messrs. McCarthy and Loveless, was appointed to make the necessary arrangements for a smoking concert.

Prof. Nicholson then read the abstracts of two papers on "Some Experiments on the Condensation of Steam," and "An Electrical Method of Measuring the Temperature of a Metal Surface on which Steam is Condensing." The former by Profs. Callendar and Nicholson, and the latter by Prof. Callendar alone. Prof. Durley said that these papers were likely to impress any hearer of them with the great care and skill displayed by the experimenters, but he thought that the results would hardly appeal at first sight to the practical man. He would ask under what circumstances is the rate of condensation less than that given, and what would be the probable effect if the steam had been allowed to pass through as a current of considerable speeds. To which Prof. Nicholson replied that he could not say off-hand what was the velocity of the steam. The speed was considerably varied, and he could not say that

he found the rate of condensation attributable in any way to the rate of velocity.

J. Farmer, Ma.E., was then called upon for his paper on "Impulse Water Wheels." H. Irwin said he had not much to do with this class of work, but that it was fast coming to the fore, especially in mining districts. Prof. Durley had hinted that Prof. Nicholson had not shown the immediate practical advantage of his experiments. He (H. Irwin) greatly objected to the careless use of the word "practical." Very many men who claim to be considered practical are not practical at all. The theorist may be in advance of the customs of the day, but often the more practical for that very reason. Water wheels had been in use in older countries by "practical men," for a hundred years, and during all this time they had been losing half their power. The advance made in recent years was due largely to such comparatively isolated investigations. Prof. Durley quite agreed with H. Irwin, and meant not that Prof. Nicholson's investigations were without practical value, but it would have been interesting if Prof. Nicholson had shown their direct effect upon the practical use of water wheels. Mr. Farmer says that the higher the speed of the wheel the greater the arc of action. Has the high-speed wheel a greater arc than the low-speed one? Mr. Farmer replied that the arc of action was intended to refer to the time during which the water really acted on the bucket. Prof. Nicholson expressed his appreciation of the value of the paper. He had seen much written upon this subject, but the paper under discussion was the first to give accurate information. On the subject of the arc of action: did Mr. Farmer say whether a number of jets —say three or four—were ever used on the same wheel at different angles to get rid of the friction of the bearings? Mr. Farmer: "Yes. It is given in the Pelton catalogue." Prof. Nicholson: "Could not the defect of these wheels be got over by—say 15 jets?" Mr. Farmer: "It has its limits. He doubted whether more than five or six could be put in advantageously." Prof. Nicholson: "It would be interesting to make experiments with the throttling gate close to the jet." He again thanked Mr. Farmer. Prof. Durley proposed a vote of thanks to the writer of the paper. Mr. Farmer expressed his thanks, and wished that the experiments had been more complete, and the results more definite.



W. G. MacNeil Thompson, Pres. C.S.C.E.

W. G. MacNeil Thompson, who has just been elected president of the Canadian Society of Civil Engineers, is one of the best-known of Canadian engineers. He was from 1852 to 1856 engaged on surveys and construction of Grand Trunk Railway, Canada, from Toronto westward; from 1856 to 1859 he was resident engineer surveys and construction of Welland Railway. From 1859 to 1860, contractors' engineer and agent on River du Loup section Grand Trunk Railway, Canada; from 1860 to 1863, contractors' engineer and agent on reconstruction of Northern Railway of Canada; from 1863 to 1864, engineer and manager for Dyphusys Cassen Mining Co. of North Wales; from 1864 to 1868, engineer and agent for contractor of Ceylon Government railway from Colombo to Kandy; from 1868 to 1872, engineer on surveys and construction of Intercolonial Railway, Canada; from 1872, engineer in charge of survey of Lake St. Louie; from 1872 to 1889, resident engineer southern division Welland Canal enlargement to 14 feet; from 1889 to 1891, resident engineer Sault Ste. Marie Canal, Ontario; from 1891 to 1894, superintending engineer Sault Ste. Marie and Welland canals. At present Mr. Thompson is superintending engineer Welland canals. Mr. Thompson was elected M. Inst C.E., 1877; M. Am. Soc. C.E., 1879; M. Can. Soc. C.E., 1891; Associate Am. Inst. E.E., 1887.

J. L. N. Coste, C.E.

Jean Louis Napoleon Coste, Chief Engineer of the Department of Public Works, who was elected member of council of the Society of Civil Engineers for the year 1898 at the annual meeting, held on the 12th of January, was born in Amherstburg, Ontario, on the 31st July, 1867. He is the eldest son of N. A. Coste, one of the collaborators of M de Lesseps, in the construction of the Suez Canal, and of Mathilde Robidoux, a descendant of one of the men who came from Brittany with Jacques Cartier. Mr. Coste received his technical education in France, and was afterwards articled to the late Sir James Brunlees, past president of the Institution of Civil Engineers of England, with whom he remained several years on various maritime works, returning to Canada in 1883, when he was immediately employed on the staff of Mr. Smellie, then Chief Engineer of the Canadian Pacific Railway in Montreal. In November of that year Mr. Coste was appointed on the staff of the chief engineer of Public Works, and was placed in charge of works in Ontario, Quebec, and Manitoba. In July, 1892, Mr. Coste was appointed to his present position, that of Chief Engineer of Public Works, and as such has charge of the following works: (1) Construction of, and repairs to, wharves, piers and breakwaters built by the Federal Government in the Dominion of Canada. (2) The construction and repairs of all river works. (3) The dredging in harbors and navigable rivers. (4) The construction and administration of graving docks. (5) The construction, maintenance and administration of the slides and booms on the Ottawa, St. Maurice and Trent Rivers. (6) The construction and maintenance of inter-provincial bridges, and of all federal bridges in the North-West Territories. (7) The direction of all hydrographic surveys made by the department. (8) The preparation of all reports on the proposed construction by private enterprise of all works in or over navigable rivers.

WATER POWER IN CANADA.*

Having been honored by re-election to the presidency, after an interval of ten years, I desire to thank you most heartily for this renewal of your confidence, and at the same time to congratulate the society upon its record in this the first ten years of its existence, during which total membership and revenue have increased about fifty per cent. Unlike our predecessors in England and America, we, as the offspring of later times, have encountered no early period of suspended animation, but have advanced steadily, if not rapidly, in numerical strength, and maintained satisfactory financial stability. If we have not progressed proportionately in public usefulness or mutual enlightenment, it may be ascribed (in some measure at least) to the fact that some from whom much could be expected are too closely occupied with daily duties to contribute, as they might otherwise do, to our "transactions." Some may be too modest, and some too old, or possibly too indolent.

If, however, we have held our own as we have done in these recent years (which embrace several of world-wide depression), our prospects for the future seem brighter than when we began our organization in 1887. Then our great railway systems were practically completed; and, although this was the case with our enlarged canal systems only as regards the Welland, the work on the St. Lawrence was in an inert condition. Ample leisure was then afforded Canadian engineers for organization, amusement or foreign travel.

Now, however, there is a decided change in our position at home and abroad. Canada is now a colony of national importance, the largest independent member of a world-wide Empire, and none have contributed more to this advanced position than engineers of every class embraced in our society, which, while it excludes none, is composed almost entirely of the constructive rather than the destructive order.

In 1887 Canada was not a mining country; now, recent discoveries over a wide extent of our vast Dominion have brought the mining engineer to the front, and with him the hydraulic and electrical engineer, because water power is almost

* Being the president's address at the Annual Meeting of the Canadian Society of Civil Engineers, Jan. 12th, 1893.

universal in our mining regions from Labrador to Alaska. Our vast prairies, where is grown the most valuable quality of the most important cereal, have hitherto been unable to attract much foreign interest, though accessible to all nations; but the recent discovery of gold has been of such a character as to invite world-wide attention. Its influence (however temporary) cannot fail to produce increased agricultural development in our great North-west.

Since the birth of our society water power has attained a position of immense importance, o[illegible] to electrical transmission, which has given rise to new industries only possible where there is cheap and abundant water power, which also secures cheap intense electricity.

The rapid extension of the pulp industry in Canada is one of the results of cheap water power coupled with our abundant supply of raw material, easy reach of navigation, of rail, and the best markets, but the more recent electro-chemical industries are the exclusive products of cheap intense electricity. Here (as in mining) is a new field for the chemical, electrical, hydraulic and railway engineer. I include the chemist among the engineers, because I regard him as such, with the electrician, the hydraulic or mining engineer, producers though not creators of power, and, it may be, the chemical force is more potent than any other. If dynamite is a chemical compound the power-maker or discoverer is worthy to be numbered with the power user.

An electro-chemical industry of recent origin has been established in Canada by the discoverer, a Canadian chemical engineer, Thos. L. Willson. This is the manufacture of calcic carbide for the production of acetylene gas by means of electricity produced by the abundant water power of the Welland canal at Merritton, where the manufacture in commercial quantity was first started in 1896, and from whence the product has already been shipped to England, France, Germany, Italy, Australia and South Africa.

Another electro-chemical manufacture in which our profession is interested (on water power ground), which also depends on cheap electricity, is that of aluminum, for which the raw material is so widely distributed, but for which, as with the carbide, abundant and cheap water power is indispensable.

In view of its importance, owing to its wide distribution over Canadian territory, from the Atlantic seaboard to the Rocky Mountains, where no coal is found, and on account of its vastly enhanced value since the discovery of high voltage transmission, even where it is within the coal fields, I have chosen water power as the subject of some observations for the annual address.

I have heretofore drawn attention to this widely-distributed power outside of our coal regions, as to some extent a substitute for coal, upon the assumption of local application of power in both cases, whether water or steam, and then the vast difference presented itself that with the last the power could be taken to the work, while with the other the work must be taken to the power; for there was no thought then of electrical transmission. The utilization of water power would be very slight and very slow if under the old conditions of advance into the forest (as in the agricultural portions of the valley of the St. Lawrence), because our greatest extent of water power is in the mountainous and sometimes barren regions, not inviting to agriculture, though most favorable for the accumulation, maintenance and uniform distribution of water power throughout the year.

In considering the question of water power generally, and in comparison with steam, it may first be mentioned that while electrical transmission (where practicable) has enabled it to take the place of steam in many situations, the choice in others depends upon the work to be done, as well as upon the cost of fuel. For transmission purposes there are only the questions of the sufficiency and permanence of the power and its superior economy; but for lumber manufacture, although ample water power is at hand, and there is with it no question of ice difficulties, it is found in many cases that steam is preferable, because the mill site may be chosen in the best position for manufacture, shipment and storage of logs, and the waste material furnishes fuel for power. The cost and maintenance of a mill dam in many situations, with the necessary piers and booms for the logs, the damage and risk to mills, etc., during floods, are reasons urged (in addition to the questions of site and fuel) in favor of steam for this industry. But for other purposes the site of the water power (perhaps in a gorge) is unfavorable for many industries on account of difficulty of access and want of service ground; and here is the value of electric transmission of water power.

When adopting water power, one of the most important considerations is the possible need of future enlargement. Where all the water power of a stream of any point is secured by a dam, and this power can be drawn upon from time to time until the whole is applied, we have only to consider cost, and maintenance in the first place, even though the additional power must thereafter be obtained by coal, or transmission (when this last is commercially practicable), not only because the water power is sufficient for many years, but as far as it goes, it is more economical than any other. But if only part of the available water power is needed, and provision for the future must be postponed for financial reasons, then the question of how any future addition can be made without interruption becomes important in proportion to the purpose for which the power is required. If for water supply or electric light, either the original dimensions must be far beyond present wants, or there must be the power of duplication without interference with existing conditions, or else temporary power for this purpose on a sufficient scale, or permanent, if made auxiliary for future deficiency of water. Such considerations affect the question of the economy of water power for certain purposes and under certain conditions where a periodical increase of power must be provided for. It altogether depends upon local conditions whether an artificial water power, as it may be called, will be worth what it costs for any purpose; and more particularly if this is one in which power must be reserved for future needs. Temporary employment of surplus power could not be counted upon to build up permanent industries.

Electrical demand and transmission have created a "boom" in water power, under which in some cases the schemes proposed may become financial failures. There is evidently a limit to the distance to which water can be artificially conducted in order to reach a fall under the most favorable conditions of route. For power purposes the only useful portion of the aqueduct is that which lies below the surface level of water in it, and the value of this is in direct proportion to its size, and therefore, its cost, which includes the cost of all required work above this level. The longer the aqueduct the higher must be the fall which it secures, and the lower the fall the larger must be its dimensions and cost if it is to be efficient. Whether it will be profitable in either case depends upon the cost. Such natural dams of rock as those of Niagara, Sault Ste. Marie, Rat Portage, the Chaudiere, the Chats and others on the Ottawa are natural water powers of the first order; but the artificial powers created by our canals (apart from cost of every canal adjunct to the water channel) would never have been undertaken for water power purposes. There is a popular superstition that there is more in water than its weight, because that weight is felt "all over" as well as on the bottom, and a tendency to ascribe to it a fictitious value. This has possibly something to do with some projects.

In water power the discovery of lowest possible head level is of the first importance, and the one often of the greatest difficulty where this is not controlled by a dam, which (wherever practicable) is the only certain means of fixing it. When a dam does not exist, or is not obtainable, recourse is had to legend and the "oldest inhabitant," who has seldom proved old enough for the occasion. Our canal engineers have, with the best information, found their mitre sills in many cases very much higher than they intended them to be, because the river had gone very much lower than it had ever been said to have done. To secure at all times a required depth it seems necessary to add about three feet to the "oldest inhabitant." When, over fifty years ago, the Government first constructed timber slides on tributaries of the Ottawa, in the absence of any knowledge of the local range of water level, the mouths of these were found so high after the first flood that the timber could not be floated into them until a dam was built for this purpose.

The high-water level is more easily provided against, and is often more important in connection with the tail-race in fixing the wheel level, where the discharge is into a reach subject to great variation, like that below the Chaudiere Falls, where the extreme range between high and low water exceeds twenty-five feet; which, though of short duration, is about three times as great as the same range above these falls. Where the wheels

would be affected, as this is always the case at the season when the rise is greatest at the head, provision may be made to utilize this temporary increase of head level so as to maintain the necessary power during back water.

Where unceasing operation of power is required in our climate, duplication and separation of flumes (and it may be in some cases of tail-race) may, where practicable, warrant the additional cost in thus securing reserve power (as well as of machinery) when any particular channel has a surfeit of ice; as well as by so much contributing to a future enlargement.

Except upon our canals (where the least winter difficulties are experienced), our great water powers have been chiefly used as summer ones, in which the two independent questions connected with water power, viz.: the power of enlargement and extension without interruption, and the possible ice difficulties of a northern site, do not come in question. The large saw-mills have not worked in winter because their logs are frozen in. Before the railway reached them the mills stopped sawing when they could no longer ship their output, but, where they depend upon the water for their logs, whether they are worked by water or steam, they are idle in winter.

The coming of electricity, bringing with it the demand for winter power, has produced ice difficulties where they did not before exist, and were therefore not anticipated and not provided for, although winter water power, to a limited extent, had been in use. Increased power brought increased current, and this under certain conditions brought the submerged ice.

There is no question of more importance to our water powers than this one of uninterrupted operation in our northern districts where nearly all are located, and where (with perhaps the exception of the southern portion of our Pacific coast) ice in one form or another must be dealt with. It assails the moving water sometimes both from above and below, and, if undiscovered, chokes off the motive power.

In artificial channels the fixed surface ice above may diminish the water power by its increasing thickness and depression from superincumbent weight of snow saturated by winter rains and thaws, and, where these channels are fed from open water in which floating slush ice is moving, the latter may be drawn in to increase the throttling of the reduced water-way The situation is greatly complicated by winter fluctuations of the open water from which the mill-race is fed, and in which the "slush" or "anchor ice" is running, a not uncommon situation in northern rivers which cannot be conveniently dammed or where sufficently large receiving basins cannot be created so that "slush" or "anchor ice" will not enter and travel through the mill pond to reach the flumes.

The ice question can be more fully appreciated by what has taken place in connection with water powers at Montreal and Ottawa. In the first case, the aqueduct of the Montreal water works, five miles in length, almost entirely in excavation, is fed from the St. Lawrence above the Lachine Rapids, where there is a smooth, swift current which prevents the freezing over in winter, but is often covered with "slush" or "anchor ice" when that is running. The Lachine Rapids below the intake of this aqueduct are of that ragged character that temporary ice dams often form and break away during the winter. These dams produce a sudden rise which extends to the aqueduct two miles above.

From the setting in of winter until March the river level steadily lowers, except when temporarily elevated by the ice dam, so that in the early spring there is the least depth of water at the intake, and the greatest depth of surface ice and saturated snow over the aqueduct, and the only water-way left is at the bottom where the width is least. The ordinary action of snowfalls, winter rains and thaws (the accumulations of three or four months) would of themselves seriously encroach upon the water-way in the widest part of its earth section, but these are (in this case) enormously increased by the sudden rise of the river while the ice is frozen to the aqueduct banks. This ice is overflowed before it can be lifted, and as these winter floods always occur during the severest weather, the overflowing water is immediately frozen, forcing the ice covering of the aqueduct further down until the half of more of the area of its water-way may be closed off.

These winter inundations seldom last long enough to send the river water far down the aqueduct, but their action at its mouth is all that is necessary to affect its power. The first one experienced was during the first winter the works were in operation. Nothing like it has taken place in the forty years which have since elapsed, and it was the only one which extended throughout the five miles of the aqueduct. In January, 1857, after nearly five days of below zero weather, in the middle of the night the water suddenly poured over the flumes in the wheel-house, sending an icy stream over the frozen surface of the ground for miles beyond. This ice-dam on the rapids caused a rise of four feet in a few hours at the aqueduct entrance. Years later this flood might have destroyed the usefulness of the aqueduct for the remainder of the winter, but the power then required was so small that winter difficulties did not arise until a later date, when the conditions were aggravated from another direction—below instead of above, and from another description of ice insidiously creeping into the winter-diminished water-way, due to the causes above described, and producing gradual suffocation. This did not take place until the combination of extreme low water in the river, extreme accumulation of surface ice and snow and increased draught to the wheels so quickened the current at the intake that it attracted the floating frasil or "anchor ice," which immediately that it touched the solid bordage ice at the aqueduct entrance was sucked under and soon arrested where the strangling process was slowly but surely closing the gap.

The lesson of this history is that in such situations, where anchor ice is wont to pass an intake basin is indispensable where possible, so large, wide and deep that the necessary supply for the power channel coming into it from the river will never create a current sufficient to attract the frasil. Anchor ice is only begotten in open water, and this in our climate always means water too swift to become self-freezing, and it will not leave this until enticed from the old paths by stronger currents. It is, therefore, only a question of cost to form a mill pond which it will not invade. Where this is limited, the boom which separates the river from the basin (forming a bordage to the ice cover of the latter) should be made deep enough to prevent the ice which is passing and crowding outside from being forced under it.

An enlargement of the aqueduct was undertaken twenty-five years ago, but it was not carried farther than seven-eighths of a mile from the entrance. It has prevented the incoming of anchor ice and enabled the aqueduct in high water winters to pump its full summer average. But, as the strength of a chain is that of its weakest link, so, for this purpose, the minimum power must be equal to the maximum wants, and auxiliary power will be required until the completion of the enlargement. Enlargement is not likely to be completed until the consumption is so increased that it will become cheaper to pump the whole by water power.

In high water mild winters when there is the minimum of ice obstruction, and an increased depth at its widest section, the aqueduct pumps its full summer average. Thus in March, 1890, it pumped 350 million gallons, while in March, 1893, it only pumped 46 millions, because when the river falls to a certain level all wheels are stopped to prevent further lowering of the ice in the aqueduct. This result would go to prove that, to meet our winter conditions in some situations, an increase of at least fifty per cent. on the necessary summer dimensions would be needed.

Until water power was required for pumping the city water supply, in 1874, there had been no important winter use of the power of the Chaudiere Falls. The large saw mills did not work after November. The few establishments on either side of the river where winter water power was used had no effect on the ice question, nor did the larger demands for the city pumping change the conditions in this respect. The advent of electricity, however, in which three large users of power engaged, revealed the fact that winter difficulties existed where they had not been anticipated. Fortunately, they have not yet seriously affected the city aqueduct, where, in the absence of auxiliary power or reservoir, they might produce a calamity.

The conditions at Ottawa differ from those at Montreal inasmuch as the aqueduct is fed from Nepean Bay, which is ice-covered in winter, and all the other mill-races upon the Ontario side draw under similar conditions. About a mile above these the foot of the Little Chaudiere Rapids is reached, and this is united with another rapid higher up, so that there is over a mile of open river in which anchor ice is manufactured and sent below in successive and frequent crops in severe winters. On the north, or Quebec side of the river, runs the only deep channel between the Little and Great Chaudiere. This is generally open water throughout the winter, and in it much of the anchor ice is carried into "the Kettle" and away from the mill ponds on either side. From this a subsidiary channel of considerably less depth crosses diagonally to Nepean Bay, discharging

into a depression in which there is a depth much greater than that of the channels leading into and out of it, and therefore a slower current. This is the point from which the supply to the city aqueduct is taken, and, in leaving it, the aqueduct begins between piers sixty feet apart placed in twenty feet of water, whereas the section through the rock after it leaves the river bank is only twenty feet wide with about thirteen feet depth of water. The excavation being entirely in rock, this aqueduct has the great advantage, for winter work, of having as great a width at the bottom as at the surface.

It was not known that any frasil passed through this bay under its ice covering, but it was believed that, if, and when it did, the slower current into the aqueduct would not attract it, and that it would pass outside in the main channel leading to the mills below. This has proved to be the case in the twenty-three years of the aqueduct's history, although there has been some frasil in the later years, causing a stoppage of the wheels on one occasion, for a few hours, by which stoppage its presence was first made known.

Unless anchor ice is expected and watched for, the first indication of its presence may be a sudden collapse of the water power. When the Montreal Aqueduct was first corked up at its mouth by anchor ice the wheels ran on until the five miles of canal was emptied, and the ice tumbled in, ruining it, as an aqueduct, for the time being. The same experience overtook the electrical power at Ottawa, and from the same causes, but under different conditions, emphasizing the necessity of local knowledge of bed as well as of the surface of the channels near and above the site of the power.

The whole Ontario side of the river bed is a submerged rocky plateau ten to thirty feet or more above the bottom of the north channel, so that if the river surface here at low water were lowered ten feet it would lay dry the greater portion of the southern half of the river bed, while there would still be deep water in all the north channel above the rim of "the kettle." As at Montreal, in a moderate and high water winter ice difficulties are not experienced, but, in very severe and low water winters, the thickened ice settles down on top of the shoals, reduces the depth and increases the current in the channels between them until one after another is invaded by frasil, coaxed in by the increasing draft towards the water power, and gradually shut off.

In these winters the output of anchor ice is a maximum, while the storage room beneath the field ice is reduced to the minimum. Moreover, as channel after channel is closed, the velocity in the remaining ones is so increased that the anchor ice is carried under miles (it may be) of an ice-covered surface, until it reaches the mill-races.

That anchor ice is carried long distances under the surface of an ice-covered river (or shallow lake with sufficient current) is proved by watching air holes near Montreal, where this ice is seen hurrying past, having come over the Lachine Rapids, below which none is formed after the river becomes ice covered.

On the other hand, in mild and high water winters there is the minimum of ice of all kinds, and the maximum depth of channel, and therefore the slower currents in them, so that anchor ice is arrested by friction under the field ice and frozen thereto, leaving some water-way underneath it.

The best way to fight anchor ice (which is the sole cause of the winter floods in the St. Lawrence) is to abolish it wherever this is practicable. It cannot be got rid of in the St. Lawrence, but could be at Ottawa by a dam at the Little Chaudiere. This could also be done in the Back River behind Montreal by a succession of dams, creating slack water (and water power) if this can be accomplished at a profitable outlay. On most of our tributary rivers this hoary enemy of water power can often be got rid of and a valuable water power created at the same time by means of one or more dams.

THE STEAM ENGINE GOVERNOR AND ITS REGULATION.*

The matter of governing steam engines for a uniform speed under the greatest variation of load and steam pressure, and the economy in the use of steam, is no doubt one of the principal features in steam engineering, and I believe the same is absorbing more thought and receiving more attention from the engineer and engine-builder than any other subject connected with the steam engine to-day. I will now endeavor to point out the fundamental principle upon which the governor acts, and why it acts. There are two principles on which governors are constructed, one known as the centrifugal, and the other inertia action. The ordinary centrifugal fly-ball governor consists principally of a pair of cast iron balls or weights, suspended on an arm and at an angle of about thirty degrees from its vertical axis, and made to revolve round its axis as free as possible, generally driven by a pair of mitre gears. This principle of fly-ball or centrifugal governor was embodied in the first governor invented by James Watt, which has been more resorted to than any other, but aside from this the governor has been so improved and altered, and reconstructed since his time as to be almost unrecognizable, but still the old principle is there, and nearly, if not all, the prominent defects which so materially interfere with its efficiency.

The three principal defects are: First, friction, second, unbalanced force, caused by the different position of the levers and arms; third, unequal resistance, offered to counteract the centrifugal force. Now we will take friction, the first. It may be said it has been fairly well overcome for the most practical purposes, so far as the builders are concerned, but much depends on the engineer, as it is his place to see that no excess friction is allowed through improper lubrication of the working parts and poorly packed valve stems, etc. Second, unbalanced force: This defect appears to be much more difficult to overcome, and is certainly a greater detriment to the action of the governor. Like other parts of the steam engine, some governors are designed much worse than others in this respect, but the best of them are a long way from being perfect, and the reason may be explained in this way: Suppose we take, for example, the ordinary centrifugal fly-ball governor, and assuming the balls are traveling around in their normal plane, and say the arms are now at an angle of 45 degrees and traveling through the path of a 12 circle. The engine is now running 100 revolutions per minute, and the mean effective pressure is 40 pounds. Now, so long as those conditions are left that way, and there is no change in the load, the speed of the engine will be most perfect, but we cannot maintain this, so we will suppose the first change to be that the steam pressure shown by the gauge is allowed to increase. Now then, the mean effective pressure shown by the gauge becomes greater, and the engine then begins to move faster, and the governor in turn. Now there has been a change. The balls have moved to a higher and wider plane. This change simply means that the line of force has become closer to right angles with the vertical axis of the governor, therefore traveling through a greater radius, and the line through the point of gravitation has become further away from the fulcrum, therefore the speed has to be increased to overcome the increased weight of gravity, caused by the change of angularity, and so the engine continues to increase in speed until enough momentum has been stored to balance the balls in their new position. So then it is quite consistent that the force that will support the balls in one plane will not support them in a higher one. Therefore, the speed of the engine must vary when controlled by such a governor. Third, unequal resistance offered to counteract the centrifugal force. This is sometimes applied by a lever and ball, and sometimes by a spring. Where the ball is used we still have the same trouble as in the fault of the second, namely, angularity; and where the spring is used it is much worse than the ball, because the tension of the spring increases as the spring is drawn out. For example: If we have a spring attached, and offered 20 lbs. resistance, when it was drawn out, say one inch. Supposing now that part of the load was thrown off, the balls would then have to be speeded up to a higher plane, say enough to cause the springs being drawn out another inch; then the spring would be holding 40 lbs., and of course the balls would have to be speeded fast enough to support this extra 20 lbs.; possibly this might mean two or three revolutions faster for the engine.

The object of applying resistance to the governor may be said to have two purposes. First, to assist the gravitation of the balls when coming to a lower plane. Second, to permit the changing of the speed of the engine by adjusting the ball or spring until the required speed is maintained. This resistance, however, has been made automatically adjustable by several inventors in the last few years. This has bettered matters considerably, but still the speed of the engine must

*A paper read before the Hamilton branch of the Canadian Association Stationary Engineers, by H G Mitchell, President Ontario Association Stationary Engineers.

change before the attachments are caused to act. So as it is, the engine has first felt the change of load, causing it to slow up in speed, then the governor feels the change, which in turn causes the attachment to act; therefore it is just a little too late in acting, as the speed has already slowed up, but if the governor had felt the change before the engine, then things would have been different; and so it is with the centrifugal governor that the momentum has to be increased to act one way, and decreased to act the other way. Now, I will leave the centrifugal governor and take up the other principle of governor, called inertia. As it would make this paper very lengthy to go fully into this, I will only endeavor to touch on a few principal points.

First, we will suppose the inertia to be connected on a shaft governor. The principal part of this apparatus consists of one straight arm with a fixed weight on each end, and pivoted in the centre to a fixed point of the wheel near the centre of the shaft, thus allowing the balls to move in a rotating direction only, and always in the same plane, thereby doing away with the troublesome change of angles, as well as the use of the centrifugal action. There is a spring attached to the arm about the centre of its radius and the other end to the rim of the pulley which surrounds the governor. This spring is used to offer resistance to the acting energy of the rotating weights, and also to assist the momentum in opening the valve. Now, it will be seen that when this apparatus is put in motion the pulley and engine will gradually advance ahead of the suspended weights and continue on so until the valve is adjusted to the proper cut-off to balance the load, and when any extra load is felt by the engine the weights will continue to go on in advance of the engine, thereby increasing the travel of the valve, and permitting a later cut-off. So with this apparatus there is no reversing of motion before the governor responds.

THE TORONTO CITY HALL.

There are some people of so critical a nature that they are invariably opposed to the course of action pursued by all those who are in authority over us. Like the Scotch elder, they can "aye object." These are useful, if objectionable people. They occasionally cause an arrest, which is a public service, and to be commended, even though the everlasting cries of "Stop Thief" disturb our after-dinner nap. The opposite class in the community believes that everything that is is right. He believes in the divine right of kings, aldermen and pickpockets He always votes for the Government, whatever it may be and is a man such as Cæsar likes, who "sleeps o' nights."

Between the critic who is never satisfied and the man whose creed is, "All's well in the world," THE CANADIAN ENGINEER wishes to pursue a middle course. To praise where we believe praise is due, and to blame where we believe cause for blame can be found; and there is the rub. To the end that we may discover if any cause for blame anywhere exists, we intend to ask a few questions, the answers to some of which would determine the fact. In another issue we will take up the question of praising the praiseworthy features, and they are many, of the city hall.

When Elliott & Neelon accepted the contract for the masonry work on the city hall at $838,061, did they expect to make a profit? If they did, how is it that the architect has spent all but a small sum of this amount, and has not yet quite completed the work called for under this contract?

Are we correctly informed that the execution of the work on the lines laid down in the specification upon which this contract was let would have left a very large profit?

Assuming that this profit would have been made by Elliott & Neelon, why has it not been made by the city?

Has the fact that there would have been some question as to whether Mr Lennox would have been paid his 4½ per cent. on the amount of the profit anything to do with the fact that it has disappeared?

The specifications call for a wall, which was practically a brick wall with a stone facing. As it stands to-day, the building is a stone building, whose walls are of stone with a brick lining.

Are we correctly informed, when we are told that there is 10,000 feet less radiating surface now in the building than the specifications for the heating plant called for? Such a change as this would, of course, only make a small difference in the total, amounting to between $3,000 and $4,000, and we understand that Mr. Lennox is empowered to make any changes that he may see fit.

Of course, such changes will be allowed for and may offset other changes which would otherwise figure as extras.

A short time ago when the architect was instructed to forthwith prepare plans for the dado of the entrance hall, he declined to do so on the ground that he had to accompany a contractor to the United States to select some appliances for the building. In the ten years in which the plans have been in course of alteration, it would appear possible to have prepared even alternative sets of such detailed drawings as these.

Does the architect journey to and fro, assisting all contractors to select their material, and if so, at whose expense?

THE NIAGARA POWER COMPANY.

We have all along expressed the hope that the Ontario Government would take some decided action to undo the great wrong which they committed when they handed over the water-power at Niagara Falls to an alien company, and one whose best interests were served by the least possible development on the Canadian side of the river The session has been allowed to pass and nothing has been done. The only indication of any intention or desire on the part of the Government to make of the resources of Ontario anything greater than a pleasure ground for the United States tourists, or dividend earners for United States capitalists, is the following letter written by the Hon. A. S. Hardy, Premier of Ontario, to F. W. Hill, mayor of Niagara Falls, Ont., a short time ago:

Toronto, Jan. 19 1898.

DEAR SIR,—In reply to your question as to whether it is the intention of the Government to grant to the Canadian Niagara Power Company an extension of time for either the beginning or completion of their work on this side of the Niagara River, I beg to say that in April, 1897, in reply to an application, the company was informed that the agreement made no provision for an extension of the time for either the beginning or the completion of the work, and that it did not appear possible to the Lieutenant-Governor-in-Council to grant such an extension. This appeared to be accepted by the company as final and conclusive, and no further application has been made since then. I feel quite at liberty to say that there is no change in the policy of the Government on this point, and that should a further application be made for an extension it is the intention of the Government to adher to this policy and to the terms of the contract.

I am, etc.,

Very truly yours,

A. S. HARDY.

F. W. HILL, ESQ., Mayor Niagara Falls, Ont.

The question still remains an open one, for so far the Company has complied with the terms of its contract, work was begun within the stipulated time, and the only hope of the promise contained in this letter being carried out, that the company does not carry out the work within the date set within the contract. It is merely a question whether it wishes to hold the monopoly or not; with the resources in men and money which the company can command, it would be possible to deliver the required number of horse-power within the time specified, but the performance of the work in the time which is now left would be exceedingly expensive, and could not be done to the best advantage

If the Niagara Falls monopoly wishes to retain the industry of southern Ontario in its death dealing grasp, it can do so. If it does not so wish Premier Hardy will not compel it. That is what the letter may be said to mean.

LITERARY NOTICES.

"British Columbia and the Canadian Yukon Year Book" for 1897, by R E Gosnell, Librarian and Secretary, Bureau of Statistics, Victoria, B.C., has just been issued. It is one of the most comprehensive works on British Columbia published in recent years It contains over 500 pages, eighty of which are occupied by representative illustrations There is a series of specially engraved maps, and eight lithographic diagrams illustrating British Columbian progress. A special chapter is devoted to Klondyke and the Canadian Yukon, with latest map issued, showing routes. The table of contents is arranged under headings, such as Historical Review, Parliamentary and Judicial, Municipal, Educational, Indians, Physical Characteristics, Forests, Fisheries, Agricultural, Mining, Sociological, Trade, Railways, Canadian Yukon, etc., etc. Price (postage free), in cloth, $2.50; in paper, $2.25. R. E. Gosnell, Librarian Legislative Assembly, Victoria, B.C.

We find in the Methodist Young People's paper *Onward* the following expressions about the Canadian press. Our readers will have no difficulty in recognizing the *Montreal Witness* as the paper specially referred to: "Nowhere, we think, is there a press of higher moral tone than that of our beloved country. It possesses, we think, the unique distinction of having a leading journal in its largest city which for over fifty years has been a moral crusader, a champion of reform. In all that time it has not published one liquor, or tobacco, or theatrical advertisement. At the sacrifice of much money it has stood true to its high principle, and stands foursquare, a tower of strength, against all the winds that blow."

ASSOCIATION OF ONTARIO LAND SURVEYORS.

The following papers are expected to be read at the annual meeting of the Association of Ontario Land Surveyors: "Drainage," John H. Jones, O.L.S., Sarnia; "Irrigation Works on Dominion Lands," A. W. Ponton, O.L.S., Regina, Ass.; "Unrecorded Original Field Notes," J. J. Murphy, Crown Lands Department, Toronto; "Acetylene Gas and its Uses," V. M. Roberts, O.L.S., St. Catharines, "Evidence," M. J. Butler, O.L.S., LL.B., Napanee; "Lake Erie Survey, Otto J. Klotz, O.L.S., D.L.S., Ottawa; "Sudbury Water Works," S. V. Rorke, O.L.S., Sudbury; "Use of Field Tile for Large Drains," W. M. Davis, O.L.S., Woodstock; "The Economic Resources of the Hudson Bay District," J. W. Tyrrell, O.L.S., Hamilton; "Assessment Plans," P. S. Gibson, O.L.S., Willowdale; also papers by Jas Hutcheson, O.L.S., Guelph; F. W. Farncomb, O.L.S., London, and several others. The date of annual meeting of the association is fixed for 22nd February, but arrangements are being made to meet on that date *pro forma* and adjourn to 8th March. The Board of Examiners will hold its annual meeting at the Department of Crown Lands, beginning 14th February.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

On Saturday evening, January 15th, in Temperance Hall, Bathurst street, Toronto, Toronto Branch, No 2, C.A.S.E., was duly opened and the following officers installed by Executive President E. J. Philip, assisted by the officers of Toronto No. 1. Past President, P. Trowern, president, John Dixon, vice-president, John H. Venables; recording secretary, Thomas Graham, 570 King street west; financial secretary, J. Richardson, Treasurer, Joseph Hughes; finance committee, F. Tushingham, E. Thomas, T. L. Holmes; trustees, John Dixon, J. McMulken, P. Trowern; conductor, M. Connolly; doorkeeper, H. Brown. Immediately after the installation ceremonies were over President Dixon delivered his maiden speech, and, in conclusion, invited the visiting brethren from Toronto No. 1 to partake of refreshments, which were duly appreciated and ample justice done to the elaborate supper, which was served by the wives and daughters of the officers. After the usual toasts, speeches and songs, the gathering dispersed with the singing of "Auld Lang Syne."

The regular meeting of Toronto No. 1, C.A.S.E., was held January 19th. There was a large attendance, and one initiation. The committee appointed to get up the annual At-Home and reopening of the hall reported that all arrangements had been completed to hold the At-Home on Thursday evening, Feb. 3rd. A general good time is guaranteed. Tickets, 25 cents. There is to be a concert, refreshments, dancing, and other amusements. The trustees reported that they would have to draw on the association funds, the insurance allowance not being enough to finish furnishing and decorating the hall, but when complete the engineers will certainly have one of the finest suites of rooms in the city. Bro. Wickens will continue his paper on the "Indicator" at the regular open meeting on Tuesday, February 8th. All engineers and manufacturers are invited to be present.

—We have received the fifty-first volume of the Canadian Almanac from the publishers, Copp, Clark Co., Limited, Toronto. Besides being a directory of clergy, militia, Government officials, members of Parliament, county and municipal officers, schools and colleges, barristers and solicitors, and other public men, it is a compendium of information of all kinds relating to Canada. Some of the more prominent departments are: Short History of Canada, Tariff of Customs, Forms of Government throughout the World, Post Office Gazetteer, Masonic Lodges, Miscellaneous Societies, Historical Diary, Life Insurance. Some new features for 1898 are. Short Accounts of the British Army and the British Navy, with illustrations, also articles on the English Government, and Extradition and Pardons. Besides the above, with every copy of the Canadian Almanac for 1898 is presented a map of North America, beautifully engraved and printed in five colors. The price, 25 cents.

—W. B. McKenzie, chief engineer of the I.C.R. has an article in the New York *Engineering News* recently, on the "Tidal Marshes of the Bay of Fundy." Between the Bay of Fundy and the Strait of Northumberland lies a strip of low land 15 miles wide. During the post-tertiary submergence, this part of the country was 220 feet below its present level, and the Champlain and the Saxicava sands were being deposited on the sea bottom. Tides of the ordinary height, 10 to 15 feet perhaps, swept across into Northumberland Bay. Mr. McKenzie states floating ice was carried in both directions and has left its deep grooving on the bordering shore. Several shore terraces, now standing high above the sea, tell that the land rose spasmodically. When the "divide" appeared, the Isthmus of Chignecto was low, and the eastern part was no longer an island. The tidal wave was thrown back upon itself, and while recovering from the shock lost part of its load or sediment. Since then, the tides have been depositing this material and filling up the valleys and fresh water streams flowing into the Bay of Fundy, forming these great prairie-like salt marshes which now constitute much of the agricultural wealth of New Brunswick and Nova Scotia.

Industrial Notes.

THE Stempel Fire Extinguisher Company has removed from Berlin, Ont., to Toronto.

THE Paris Electro Plating Company, Paris, Ont., has sent its friends an attractive calendar.

THE employees of the Westinghouse Air Brake Co., Hamilton, Ont., are working 13 hours per day.

THE Stouffville, Ont., waterworks were tested January 14th, and gave complete satisfaction it is reported.

EDISON FITCH, Etchemin, Que., will shortly build a new woodworking factory, stone, 134 x 43 feet, to cost $12,400.

THE Stratford Bridge Co. is building a highway bridge 110 feet long at Greenfield, Waterloo county, Ont.; cost, $1,084.

HARVEY & Co., merchants, St. John's, Newfoundland, have started up their pulp factory, at Black River, Placentia Bay.

THE Goldie-McCulloch Co., Limited, Galt, Ont., will enlarge its offices and extend the molding shop, owing to the enlarging business.

THE by-law granting a bonus of $62,000 to the Abbott Rolling Mills Co. was carried in Kingston by a very large majority, Jan. 13th.

THE Smith Axle Works Co. is consolidating its business in Guelph, Ont, some carriage hardware formerly made in London being now manufactured there.

THE thirteenth annual meeting of the Illinois Society of Engineers and Surveyors, was held in the Court House, Peoria, Illinois, January 26th, 27th and 28th, 1898.

THE officers of the Halifax Board of Trade for the year are: President, Geo. Mitchell, M.P.P.; vice-presidents, W. A. Black and J. E. DeWolf; treasurer, H. G. Bauld.

A LICENSE has been granted the Norton Manufacturing Company, of Illinois, U.S.A., to manufacture and sell sheet-metal goods and other articles in the Province of Ontario.

MCOUAT & MCRAE, machinists, Lachute, Que., have put on extra hands to fill an order for six pulp grinders and other machinery for Hamelin & Ayres' new pulp mill in that town.

A. WATSON, A. and Wm. McLachlan, A. H. Deike, Elizabeth J. Deike and J. Mitchell, Guelph, Ont., have applied for incorporation as "The Guelph Acetylene and Gas Generator Co., Limited."

THE officers elected for the year by the South Kootenay Board of Trade, at Nelson, B.C., are: President, John A. Turner; vice-president, H. J. Evans; secretary-treasurer, H. B. Thompson.

THE officers of the Chatham, N.B., Board of Trade for the year are: W. S. Loggie, president; W. B. Snowball, vice-president; J. D. B. F. Mackenzie, secretary; George Stothart, treasurer.

WE have received a neat little calendar from the McLaren Belting Co., of Montreal and Toronto, accompanied by a handy price list of belting, card clothing, studs, pulleys, and the various other articles dealt in.

THE city of Belleville, Ont., is inviting correspondence with manufacturers desiring to establish new industries or extend existing ones. Liberal terms are available for substantial firms desiring a location in Belleville.

JOHN BENN, proprietor and manager of the dynamite works at Tweed, Ont., has sold out to Daniel Smith, Montreal. The new firm will be known as the Ontario Powder Works. Mr. Benn will be retained as manager.

THAT the goods manufactured by the Goldie & McCulloch Co., Limited, Galt, are gaining a wide reputation, is evidenced by the fact that the company has recently received an order from a London, England, firm for blocks and tackle.

THE sheriff took possession of the Toronto Junction Foundry Co., Limited, a short time ago, which was incorporated last year with an authorized capital of $24,000. Of this sum $8,700 was paid, but this proved insufficient. The business will be wound up.

LETTERS patent have been issued to J. Goodison, J. F. Lister, C. Mackenzie, E. F. Goodison and W. T. Goodison, Sarnia, as the John Goodison Thresher Company of Sarnia, Limited, to manufacture and sell threshing machines and agricultural implements, with a capital stock of $90,000.

THE company which is negotiating with St. John, N.B., for starting a pulp factory at Mispec, near St John, was registered at Edinburgh, in December. The directors are.—J. Galloway, W. Dixon, F. Wallace, P. Grosset and C. Anderson, all of Scotland. Registered office, Royal Bank Buildings, Leven, Fife.

BOWMANVILLE, Ont., will buy a fire engine.

WALLACEBURG, Ont., is to have a new $8,000 hotel.

THE Woodstock, Ont., town council will buy a fifteen-ton road roller.

LONDON, Ont., erected new buildings last year to the value of $270,000.

PORT COLBORNE, Ont., voted approval of the waterworks by-law last month.

THE new water system at Cowansville, Que., was satisfactorily tested recently.

THE Canada Switch and Spring Co., Montreal, has installed a Bessemer steel plant.

THE Hamilton, Ont., Waterworks Department shows a surplus for last year of $5,000.

SHELDON & SON, Aylmer, Ont., iron founders, are moving into larger premises, it is reported.

THE Berlin, Ont., Waterworks Company is going to put in a system in Waterloo, Ont., this season.

C. N. ROBERTS has been engaged to take charge of the waterworks pumping plant at Renfrew, Ont.

A GOOD roads convention was held at Sweetsburg, Que., last month, which was addressed by A. W. Campbell, the Ontario road instructor.

ELIAS ROGERS has been elected president of the Toronto Board of Trade by acclamation, and A. E. Kemp vice-president, also by acclamation.

THE Graham Nail Works, Toronto, has installed recently a 35 h.p. gas engine, which it is estimated will effect a large annual saving in running expenses.

EIGHT new elevators have been built on the line of the Calgary and Edmonton Railway in one hundred miles north of Red Deer during the past season.

HOUSE & FISK, Lansing, Mich., are corresponding with Galt Ont., about starting the manufacture of the Patterson acetylene gas generator in that town.

NEGOTIATIONS between the refiners of Petrolia and a group of English capitalists, looking towards the consolidation of the refining interests, are still going on.

W. J. KNOWLES, late vice-president of the Goold Bicycle Company, Brantford, Ont., is organizing a new company for the manufacture of bicycles in Canada

THE Kerr Engine Works, Walkerton, Ont., recently supplied the waterworks commission, Kaslo, B.C. five fire hydrants, nine 6-inch gate valves, four 3-inch gate valves, thirteen valve boxes.

THE tender of the Dominion Bridge Company for the erection of a new iron bridge over the St. Francis, in place of the old Aylmer bridge, Sherbrooke, Que., was $8,386; weight, 284,000 lbs. Accepted.

THE Chatham, Ont., Dredging Company has been notified by the township of Tilbury North that it has been awarded a contract for dredging Trembly Creek, which will amount to $4,000.

AS a result of favorable votes, last month, on by-laws to establish a House of Refuge in Bruce County, carried in Lucknow, Walkerton and Kincardine, such a building will no doubt be erected at an early date.

THERE was recently cast at the Londonderry, N.S., Iron Works, a pipe 42 inches in diameter, made of Nova Scotia iron, and weighing nearly three tons. It was ordered for a culvert on the P. E. Island Railway.

THE sources from which Rossland, B.C., proposes to secure a water supply are Stoney Creek, 470 gallons per minute, from an elevation of 375 feet, distance 4 miles, and Murphy Creek, 500 gallons per minute, from an elevation of 600 feet, distance 10 miles.

THE Maritime Sulphite Fibre Co. have completed a mill on the Canada dock, Chatham, N.B., for cutting, barking and preparing wood for the grinder in the pulp mill, and another similar mill is in course of construction. In operation each mill will employ about 25 hands.

IT has been decided to liquidate the Taylor Iron and Steel Co., Limited, Montreal The company was chartered about a year and a half ago to take over the business formerly carried on in boiler tubes and general steamfitters' supplies, by J. & H Taylor. The liabilities are under $10,000.

INCORPORATION has been granted to The Hamilton Acetylene Gas Machine Company, Limited, with a capital stock of $45,000, and these members. G S. Bingham, Mrs. A. Seguin, F. A. Carpenter, W. R. Moore and S. D Biggar, of Hamilton, and J. D. Forsyth, of Claremont, Ont.

AN English syndicate has been formed, it is said, to erect palatial hotels at Halifax, Montreal, Ottawa, Toronto and Niagara Falls. The plans also include a big hotel in London, England, that will cater to the colonial trade.

LETTERS patent have been issued to R. McDougall, Thomas McDougall, A. J. Oliver, R. McDougall, Jr., and Elsie McDougall, Galt, Ont., as the R. McDougall Company, Limited, to manufacture and sell hot-water, steam-heating and ventilating apparatus, and carry on business generally as iron founders.

THE Kingston and Montreal Forwarding Company has closed a contract for the construction of an elevator at Coteau Landing of a capacity of 500,000 bushels. The contractor is under heavy bonds to have the elevator ready to receive grain not later than May 10th next. There will also be a large warehouse in connection with the elevator.

C. H. TAYLOR, of the Taylor Hydraulic Air Compressor Co., Montreal, has returned from British Columbia, where he arranged for installation of a 500-h.p. plant, at Ainsworth, B.C. Contracts have been let and the work is rapidly progressing. The power is to be sold to mines within a radius of five miles of the compressor at a low rate.

THE gifts of W. C. McDonald to McGill University now amount to close on a million and a half dollars. The equipments of Mr. McDonald's three buildings are the most modern, as well as the finest, in America, and the endowments are such as contemplate their remaining always modern. These gifts make Montreal the envy of other cities.

C. H. ACTON BOND and Sanford Fleming Smith are the members of a new firm of architects in Toronto. Messrs. Bond and Smith have had several years' experience in New York, and are specially well qualified by their experience in that city to undertake the steel construction which is now so much employed in large buildings. The firm has at present four residences in Peterboro, Ont., and one in Ottawa under contract.

WE have received from P. S. Gibson & Sons, of Willowdale, Ont., the engineers of the Township of York, their report on the state of public works in the townships of Coleman, Todmorden, Deer Park, Bracondale, Swansea, Lambton Mills, Mount Dennis, North of Weston, Downsview, etc. It deals with needed extensions in sidewalks, the condition of those long in use, and lighting, and contains a pronouncement by the township solicitors on the responsibility for damage done by traction engines.

A. ROBILLARD, St. Andrews, Que., is the inventor of a new system of operating swing bridges for canals, railways, etc. It dispenses with the central shaft, or axle, as well as with the wheels. Instead of these, Mr. Robillard introduces a ball-bearing system. The surface friction is thus reduced to a minimum, requiring one man to operate it where it now requires several. Another feature of the invention is an automatic system of opening and closing the gates at the entrance to the bridge. As soon as the bridge commences to swing open, the gates close, and the movement which closes the bridge causes the gates to open.

THE fact that iron is being exported from the United States to Europe is said to be influencing the proprietors of the Nova Scotia Iron Works at Ferrona, in Pictou county, to discuss the removal of the works to Louisburg, Cape Breton. The original object in locating the works at Ferrona was to be alongside the deposit of ore supposed then to exist there, and also to be near coal and limestone. But the deposits of ore were not extensive, and now nearly all the ore used comes from the company's ore beds in Newfoundland. It is further said that Pictou county coal is not so well suited for smelting as is Cape Breton coal. In fact, the company made practical tests of the latter, with the result that they ordered something like 10,000 tons. This had to be taken from Louisburg to Pictou Landing by water, and then to Ferrona by rail. By locating at Louisburg the company would be alongside the kind of coal they require, and would be saved the haul by rail of their ore from Newfoundland They would also have an advantage over Alabama competitors in the matter of freight, the latter being handicapped with a haul of several hundred miles to the seaboard and a longer ocean journey. At the meeting of the company held at Halifax a short time ago, the project was discussed, we are told, in all its bearings. The authorities of Sydney, having heard of the possibility of removal, made proposals that Sydney, not Louisburg, should be chosen, because it offers advantages in point of situation, railway and shipping facilities, etc., fully as great as Louisburg, while a proposal of exemption from taxation, or cash bonus, has been made by resolution of the town council, to any "coal mining companies or other companies which will locate their workshops, offices and shipping piers on the peninsula of Sydney." If it should prove to be the intention of the company to locate their works in Cape Breton, with the object of making pig iron for export abroad, it would seem to be well placed and circumstanced for such an enterprise, either at Sydney or at Louisburg.

JOHN JOHNSTON, a lumberman of Orillia, is building a planing mill at Ahmic Harbor, Ont.

THE Mac Machine Company has decided to remove its plant from Trail to Rossland, B.C.

THE shareholders of the nail factory, St. John's, Nfld., received a dividend of 6 per cent. on last year's business.

THE G.T.R. foundry, employing about 75 to 100 men, in Hamilton, Ont., has been closed down; part of the plant will be removed to Montreal.

S. CARSLEY, dry goods merchant, Montreal, is going to rebuild the old Canada Life building, St. James street, Montreal, in white marble as a store.

THE officers of the Berlin, Ont., Board of Trade for the year are. President, C. K. Hagedorn; vice-president, G. V. Oberholtzer; secretary, J. S. Hoffman.

AT the annual meeting of the Brantford, Ont., Board of Trade, Henry Cockshutt was elected president; T. H Preston, vice-president; George Hately, secretary-treasurer.

A WRIT has been issued against the Welland, Ont., council of 1897, by the Waterous Engine Works Co., claiming damages for the non-fulfilment of the contract to purchase a fire engine.

G BROWN, Westmeath township, Renfrew county, Ont., has been awarded the contract for building the bridge across the Colounge River, near Colounge, Que. The contract price is said to be $6,000.

THE building of the Simcoe County House of Refuge was awarded to A. Tessier, of Penetanguishene, for $14,966, exclusive of plumbing and heating. J. R. Eaton's tender was $18,914, without the plumbing.

CORNWALL, ONT., and Hull, Que., are in correspondence with the Toronto Rubber Company, which proposes to remove its Port Dalhousie factory to some locality where a water-power of three or four hundred horse-power can be obtained The company pays out about $100,000 per annum in wages.

C W YOUNG, who has been president of the N.B. Granite Works at St. Stephen, N B for the past several years, has bought the business, and will run it under the same name. He has also bought the shot tower, which is situated near the mill, in which the shot necessary for the work of polishing the stone is manufactured.

THE engineering trades strike in England was ended at a meeting of the committees representing the federated employers and the allied trades unions on January 29th, when the result of the ballot accepting the employers' terms was communicated, and a formal agreement embodying the terms of the settlement was duly signed and arrangements were completed for a simultaneous resumption of work in all the federated workshops.

No. 13 St. Sacrament street, Montreal, in which the Montreal Stock Exchange is located, is to be rebuilt. David Ogilvie is the architect in charge, and the Dominion Bridge Company has already been awarded a contract to put a steel frame in the building, which will receive an additional story or two. The new walls and floors will be of marble and tiling. The woodwork is to be of white ash, and the elevators will be electrical. There will also be an ornamental iron stairway.

SIX important amendments to United States patent laws came into force on January 1st, 1898, which in substance are as follows: 1st A patent will not be granted to an applicant if the invention has been patented or described in any printed publication in any country before his invention or discovery thereof, or more than two years prior to his application. 2nd. A United States patent will not be granted to an inventor who has obtained a foreign patent, unless his United States application be made within seven months of the date of filing of the foreign application This clause, it will be noted, only applies when the foreign patent has actually issued, and is not merely applied for. 3rd. The application must be completed and prepared for examination within one year after the filing of the petition, and must be prosecuted within one year of the date of any official action thereon. 4th. The prior issue of a foreign patent will not now limit the United States patent to expire at the end of the legal term of the foreign patent. 5th. If an assignment, grant or conveyance be duly acknowledged before a proper officer, the certificate of such acknowledgment under the hand and seal of such officer will be *prima facie* evidence of the execution of such instrument. 6th. No damages can be collected for infringements of a patent occurring more than six years previous to the filing of a bill of complaint or the issuing of a writ. The second amendment referred to is of immediate importance to Canadian inventors, and it is desirable that they thoroughly understand it, so that on one hand they may make their United States applications in due time, and on the other be prepared to meet the attempts of unscrupulous United States firms to entice them into making worthless United States applications.

THE Page Wire Fence Co. has received an order from the Atlantic and Lake Superior Railway Co. for two hundred miles of standard railway fencing. This amount of fencing will make about thirty car loads.

Electric Flashes.

M. B. QUINN, Windsor Mills, Que., has built a flour mill which is operated by electricity.

IT is stated that the Royal Electric Co., Montreal, will shortly absorb the Montreal Gas Co

THE Canadian General Electric Co. has sent out to its friends a very handsome wall calendar showing a view of the works at Peterboro, Ont., and gold background.

COMMUNICATION by the new cable between Turk's Island and Halifax, by way of Bermuda, was established Jan. 17th, and business despatches are now being transmitted.

THOS. EDISON, JR., has planned an apparatus for generating electricity from the wave motion of the ocean by means of floats which would operate an air compressor.

THE corporation of Magog, Que., has placed an order with the Canadian General Electric Company for a 2,000-light alternator of their single phase, revolving armature compounded type.

THE Northey Manufacturing Company, of Toronto, has increased the capacity of its incandescent lighting plant recently purchased from the Canadian General Electric Company from 250 to 350 incandescent lamps.

THERE is a move on foot to get an electric railway service for the Island of Orleans, near Quebec. It is reported that a charter will be asked for at the next session to construct an electric railway around the island. The power is to be obtained from the Montmorency Falls.

MUCH surprise has been expressed in the trade because Hon. J. I. Tarte let the contract for four Westinghouse 40 horse-power electric motors, and four Worthington pumps, one of each of which are to be placed in the East, West, Centre and Langevin blocks of the Parliament Buildings, at Ottawa, to Ahearn & Soper, Ottawa, for $30,000, without calling for tenders.

THE street cars in Toronto have been equipped with a new appliance which does away almost entirely with the use of the immense snow sweepers. The digger is a contrivance that attaches to the machinery of the car, and by pressure from the motorman, digs down into the groove of the rail and cleans out the snow. It is the invention of Foreman Power of the Toronto Railway Company's car building shops.

IT is understood that Engineers Keating, Toronto; Pearson, New York, and Wanklyn, of the Montreal Street Railway, have visited the new Chambly works with a view to report upon the feasibility of using that power for the Montreal Street Railway, which, in producing its own power, reaches a rate very nearly $42, or $360,000 per annum, while the Chambly people have, it is said, offered to furnish the company with power at the reduced figure of $32, which would mean a great deal to the shareholders.

WORK was begun on the power house of the Hamilton Cataract Power Company, near Decew Falls, Jan. 8th, and it is being pushed towards completion. The building is to stand within a few feet of the edge of the stream, and above high water level, where the precipitous banks rise nearly 275 feet above the level of the stream. When completed, the power house will be 174 feet in length and 42 feet in width, and the walls 30 feet in height. It is to be constructed throughout of steel, faced with brick, and have concrete floors. The stone is quarried on the spot, and the cement is supplied by Battle Estate. Thorold Angus McDonald & Co., Hamilton, are contractors for the construction of the canal, power house, etc.

THE Guelph Light and Power Company has decided to replace the arc lighting machinery for supplying the street circuits with the latest and most approved machinery for the purpose, and has placed an order with the Canadian General Electric Company for an 80-light Brush arc machine, equipped with automatic regulator. These large Brush machines, of which eight having a capacity of 125 lights each, have been purchased by the Toronto Electric Light Company—four of the same size by the Montmorency Company of Quebec, and four for direct connection to synchronous motors by the Lachine Rapids Hydraulic and Land Company—are believed to represent the successful development of arc lighting machinery along the lines which have been established as approved practice in direct current and alternating work.

Now that the water works are assured for Port Colborne, Ont., an agitation is on foot for electric light.

MANAGER LEATHER, of the Hamilton Radial Electrical Railway, says his line will be extended to Bronte by May 1. The railway has been built into Burlington.

THE Toronto & Hamilton Electric Co., successors to Kay Electrical Mfg Co., reports that among recent sales are the following twenty machines to different parties Hallman & Co., Berlin, one 12 h.p motor; Toronto Cold Storage Co., one 50 lt dynamo; *Journal* Printing Co., St Catharines, Ont., one 5 h.p. motor. Geo. Membery, St Catharines, Ont., one 3 h p. motor, Toronto Ornamental Iron Co., one 1,000 gal. plater; Meakins & Co., Hamilton, one 1 h p. motor, R. N. Grundy, Guelph, one 200 gal. plater; Berlin, Ont., Felt Boot Co., one 150 lt dynamo, Victoria Wheel Works, Galt, Ont., one 150 lt. dynamo. Messrs A R Woodyatt & Co., Guelph, Ont., one 250 gal. plater J C. Harris, Toronto, one 7 h.p motor, McKinnon Building, Toronto, one 2 h p and one 10 H. & P direct connected motors and controllers; Garrioch & Goddard, Ottawa, one 2 h.p. and one 4 h.p. motor; Berlin Shirt and Collar Co., one 4 h.p. motor, D. W. Karn & Co., Woodstock, one automatic organ blowing machine, besides several machines in Victoria, B.C., and Woodstock, N.B.

A REPORT of the Commissioner of Inland Revenue dealing with the official inspection of weights and measures, gas and electric light, recently issued, contains sundry items of general interest. The progress which has been made in lighting by electricity is well illustrated by the statement that there were one hundred and eighty-seven electric light companies registered under the Inspection Act during the year ending on the thirtieth of June, 1897. The first in importance, measured by the number of lamps in use, and reckoning each arc light as equal to ten incandescent, is the Royal Electric Company, of Montreal, which heads the list with 1,450 arc and 58,000 incandescent lights, or a total equivalent to 72,500. The Ottawa Electric Company comes next with 550 arc and 57,240 incandescent lights respectively, or a total of 62,740. Third on the list is the Toronto Electric Light Company, with 1,400 arc and 45,000 incandescent lights, or a total of 59,000 The Montmorency Electric Power Company, of Quebec, follows with a total of 17,080 below which the figures decline rapidly. Contrary to what might reasonably be expected, only one company, and that with an evidently very limited patronage, is registered at Winnipeg During the year 3,208 electric light meters were presented for verification. Of these, 3,111 were passed, "as coming within the error tolerated by law," 698 are tabulated as actually "correct," and 1,633 others of these "verified" meters are classed as "fast."

FROM the plant which the West Kootenay Electric Light and Power Company is erecting at Bonnington Falls, B.C., it is expected that transmission of power to the Rossland mines will be commenced early in February Robert Jamieson is general manager and engineer for the company. L A Campbell, engineer of the Canadian General Electric Company, is erecting the generators at the power plant. Bonnington Falls, where the power house is located, lies about 11 miles below Nelson, B C, on the Kootenay River. Water is conducted to the reservoir from the river by a canal 22 feet deep, cut out of the rock for a distance of 640 feet. The dam, which is of concrete, is 32 feet high and 18 feet thick at the base It extends across the fore-bay, some 54 feet, and is reinforced on the sides by abutments of concrete. The average rise of the Kootenay River is 22 feet, and the highest flood on record was 32 feet above the minimum height of the stream. From the fore-bay the water is carried to the turbine wheels by three steel pipes, two of which are nine feet in diameter, while the third is a foot larger. At present only the two former tubes will be used The wheels, which are two in number, are of the twin horizontal type, manufactured by the Stillwell-Beirce-Smith-Vaile Company of Dayton, Ohio, and will develop 1,250 horse-power each, so that their united force is 2,500 horse-power. The turbine wheels are attached direct to the generators. There are two generators, having together a capacity of 2,500 horse-power, made by the Canadian General Electric Company, and of the three-phase revolving field type, wound to generate at a voltage of 1,040. They operate at 180 revolutions per minute. The exciters used in connection with the generators are operated by two separate turbine wheels. The step-up transformers increase the voltage from 1,040 to 20,000. The current is conducted to the sub-station at Rossland over a three-wire line 30½ miles long. The local sub-station, which is situated on the Monte Cristo ground, is equipped with step-down transformers, which reduce the voltage from 20,000 to 2,080 volts. From the sub-station power will be conducted to the various mines which will utilize electricity for motive power. At present it is not intended to use electric drills, but instead it will operate the compressors, and the compressed air will be used throughout the mine as at present. Oliver Durant, the general manager of the Centre Star Mining Co., is the president of the power company.

Personal.

THOMAS J. LOCKE, of the Coast Railway engineering staff, has been appointed assistant engineer at Halifax, N.S.

R. B. MCCREARY has been appointed street engineer of Arnprior, at a salary of 30 cents per hour while on duty.

E. H. KEATING, C E., city engineer, Toronto, has resigned to become manager of the Toronto Street Railway.

J WOODMAN, Winnipeg, has been appointed engineer of the C P R, western division, *vice* D. A. Stewart, deceased.

JOHN MORROW, of the Machine Screw Company, Ingersoll, Ont., died last week, having been in ill health for two years.

W. J. SPROULE, assistant engineer to the Harbor Commissioners office, Montreal, has been elected mayor of St. Lambert, Que.

SIR CHARLES HUTTON GREGORY, the well-known engineer, and a former president of the Institution of Civil Engineers, Great Britain is dead.

H. W. TRUE has been appointed manager of the People's Heat and Light Co., Halifax, in succession to Peter Young, who goes to Pittsburg, Pa.

THOMAS MESTON, secretary-treasurer of the Hamilton Bridge Company, died at his home in Hamilton, Ont., a short time ago. He was 44 years of age.

THOMAS PETRS was instantly killed at Steinhoff & Gordon's stave and hoop mill, Wallaceburg, Ont., a short time ago, by being caught in a shaft. The body was terribly mangled.

ST. ANDREW'S SOCIETY, Dundas, Ont., has been reorganized, John Bertram president. The president has been given the custody of a genuine Burns' snuff box of mahogany wood.

ON December 22nd, Harry A. Moore, B.A., superintendent of the Electric Light and Power Company, Trenton, Ont., was married to Miss Charlotte Greenwood, of Whitby, Ont.

R. EVANS, foreman of the Niagara Falls Metal Works machine shop, has gone to London, Eng., to take a position at $2,000 per annum. The metal works are being worked overtime at present.

T. F. FOLEY, of the firm of Holliday & Foley, of the Stratford, Ont., Bridge and Iron Works, extensive bridge builders, died recently of scarlet fever. He was an esteemed and popular young business man.

F. G. B ALLAN, superintendent of cement works, Napanee Mills, Ont., had a very severe shaking up lately by falling into the mixer. When rescued he was holding on to one of the arms of this tremendous machine.

P. A. DICKENSON, for a number of years head electrician of the Brantford, Ont., Electric and Operating Co., is leaving the city to engage in mining operations with the Mineral Point Mining Co., of Ashcroft, B.C.

T. MATTHEWS, while at work at the axle works, Woodstock, recently, met with a painful accident. A piece of steel flew from the hammer and struck him on the arm between the elbow and the wrist. It lodged about two inches deep in the flesh.

CAPT. WM. HALL, the superintendent of the Le Roi mine, Rossland, B C., was killed, January 5th, by falling down the main shaft from the surface to the six hundred foot level. The body was terribly injured by the fall, and the remains were hardly recognizable.

DANIEL BOWERMAN, proprietor of Hallowell mills, about two miles east of Picton, Ont., was found dead in his mill last month. Marks of the cogs of a wheel were found on the side of his head. The wheel is supposed to have struck him while engaged in fixing the machinery.

ROBT. HEWITT, of the firm of R. Hewitt & Son, Phœnix Foundry Co., died at Markham Ont., a short time ago, of pneumonia, after a short illness. He was born in Cumberland county, England, in 1818, settled in Markham in 1855, and has conducted the business of the Phœnix Foundry for 30 years.

W. J. OLIVER, a pattern maker at the pulp mills at Sault Ste. Marie, Ont., crossed to the United States side one evening recently to attend a religious service. In going home he fell over the old Michigan canal bank to the lock chamber, a distance of fifty feet, and was killed. His family lives at Carleton Place, Ont.

FRANK RIDDELL, the foreman of the Imperial Oil Co.'s paraffine department at Petrolea, Ont., was presented a short time ago with a gold headed walking stick as a slight token of esteem by the employes. F. Ireland read the address, and W. Wilkinson made the presentation, while Bruce Dunlop acted as chairman.

An application for the city engineership of Toronto has been received from Stewart Howard, C.E., Montreal, who was formerly resident engineer in Toronto for the Northern Railway, and subsequently, while in the service of the C.P.R., designed and constructed the western entrance of that road into Montreal.

Arthur F White has gone from Toronto to England. For the past two years Mr White has been mechanical superintendent of the Hyslop tricycle factories, and was formerly lecturer in machine design on the Toronto Technical School staff. Mr. White has been engaged by a large firm in London, Eng., to install and operate a surveying plant, which he takes over with him from Hartford, Conn.

Jno Hunter, brassfounder, Halifax, N.S., died last month. He was about 78 years of age and had spent about half a century in Halifax. For a good many years he carried on business on Sackville street, with his son Edward, but he first opened on Hollis street with Robert Wright as his partner. The deceased, who was a native of Glasgow, Scotland, was a citizen much respected by all classes, and his death will be deeply regretted

George E. Drummond, of the Canada Iron Furnace Co., has returned from the old country, and one result of his trip is that considerable shipments of Canadian iron will be made to Great Britain and Germany It is very gratifying to know that the superior qualities of Radnor Forges iron for special purposes are now acknowledged abroad as well as in Canada. Mr. Drummond confirms the reports that Canada now occupies a larger place in the mind and heart of Great Britain than it ever did before, and the next few years should see a large development in Anglo-Canadian trade.

The popularity of F. P. Brothers, late chief of construction of the Montreal Street Railway, was demonstrated shortly before he left for Jamaica, where he will superintend the building of a new line, by a banquet tendered . . The general manager, F. L. Wanklyn, presided, and covers were set for over a hundred, which included representatives from all the departments. The speech of the evening was made by Supt. McDonald, who, in the course of his remarks, said that he would use a strong and more electric expression concerning Mr. Brothers, by stating that their best affections had been permanently grounded by the magnetic currents of his well known business tact, his ability and genial friendship. The superintendent, amid great enthusiasm, then presented Mr. Brothers with a handsome traveling bag. Mr. Brothers, whose health was drunk with musical honors, received a great ovation. Short congratulatory speeches were also made by Messrs. Blackwale, president of the Canada Switch Co., J. Ross, Major Laurie, R. Chapman, John Garth, Landers, Carter and Swan.

Marine News.

Lunenburg, N S., is to have a marine railway. The boiler, engine, etc., are now on the ground.

Thomas Gale & Sons, Cumberland Bay, N.S., are building a schooner 77 feet long. John Parker & Sons, of the same place, are also building a woodboat, keel 61 feet.

The British Columbia Iron Works, Vancouver, B C., have contracted to deliver two river steamers for the Hudson Bay Company, one in March, and the second on April 15th.

The Albion Iron Works, Victoria, B.C., have contracts for machinery for a number of vessels, including those for steamers which the C.P.N. Co. will place on the Yukon and Stickeen rivers.

As it will cost $20,000 to repair the steamer "Rosedale," its owners have abandoned it to the underwriters, who will hand it over to the Donnelly Wrecking Co., in payment for the work of saving the boat.

The first of the officers of the new Richelieu and Ontario Navigation Company's steamer "Toronto," has been appointed in the person of William Black, chief engineer of the steamer "Hamilton," who is to be chief engineer of the new boat.

The Polson Iron Works Company is preparing plans for a yacht for Timothy Eaton, Toronto. The boat will be 55 feet long by 8 feet beam, 3 feet 6 inches draught, and will run 16 miles an hour. It will have a steel frame and wood planking, and a triple expansion engine and tubular boiler. The yacht will be the handsomest boat on the Muskoka lakes.

Warren McCurdy, of St. Andrew's, N.B. has invented an electrical log. It is claimed to be accurate, not varying three-tenths between different trips recorded by it from light to light. The rotary log, instead of turning the line as in ordinary taffrail logs, communicates by a little cable with the steamer and registers in the captain's room. There can be dials, worked from the same log, in any part of the steamer.

A public meeting in Goderich, Ont., recently passed resolutions in favor of running a line of first-class steamers the coming season from Windsor to Sault Ste. Marie, calling at all the ports along the route.

Citizens of Annapolis, N.S., are forming a company to build a freight steamer to carry freight between Annapolis and St John, N B, calling at Bridgetown, Granville Ferry, Clementsport, Bear River and Digby.

Col. Anderson, of the Marine Department, Ottawa, was in Parry Sound not long ago, and visited Depot Harbor and Kilbear Point to inspect the locality for the Department with a view of building a new lighthouse at Kilbear, and range lights west of Kilbear and Depot Bay.

We have received a nicely got-up catalogue of boats fittings and appurtenances, to be had of the builder, Harold B. Rye, of Peterboro, Ont. He is perfectly familiar with all the details in the construction of a great variety of small boats, including family, pleasure and fishing skiffs; paddling, cruising and racing canoes; cat boats, etc. Those who are interested in the subject of prospecting canoes will do well to consult this catalogue, which gives the prices of many different styles.

The J. Bruce Hanly Engine Works, Midland, Ont., are building a 7 x 14 x 10-inch steeple compound engine for the Muskoka Navigation Company, Gravenhurst, and a 13 x 26 x 20-inch compound engine for James Playfair and Capt. Burke, who are themselves building the hull here for a general purpose tug. They are also overhauling a 18 x 36 x 32-inch steeple compound engine, re-boring cylinders, putting in new pistons, valve rods, etc., besides new brasses throughout. This is for the James Playfair Company, which is building the hull in their Midland shipyard, and intend her for open lake log towing.

Charles W. Ross, of the Railways and Canals Department, Ottawa, has secured a relic of some interest. It is a section of the mitre sill of an old canal lock built in 1780 by the Hudson Bay Company. The oak timber has therefore been for considerably over a hundred years under water, and yet is firm and solid. The section has not been touched by worms. The canal, which was half a mile in length, was built by the Hudson Bay Company to get past the Cascade Rapids in the St. Lawrence, but long since fell into disuse. It has a raise of about 13 feet, and contains three locks. The construction work was done by Col. Colter Mann.

Application will be made to the Parliament of Canada, at its next session, for an act to incorporate the Lake Superior and Rocky Mountains Navigation Company, to construct canals, from Lake Superior near Thunder Bay, thence following a chain of lakes and rivers across the height of land to Rainy Lake, and by way of Rainy River to the Lake of the Woods; from the Lake of the Woods along Rou seau River to the Red River; thence along Red River, Assiniboine River, Lake Manitoba and Lake Winnipegosis to Cedar Lake on the Saskatchewan River, or in the alternative from the Lake of the Woods by way of Winnipeg River, Lake Winnipeg and the Saskatchewan to the last mentioned point; and from Cedar Lake on the Saskatchewan River and Bow River to Calgary, in Alberta, and along its northern branch to Edmonton.

F. M. Rattenbury and others have given the contract to J. Stephens, of the Clyde shipyard, Victoria, B.C., for three new stern-wheeled steamers to ply on Lake Bennett. These vessels are to be ready for shipment north within thirty days. All three vessels will be stern-wheelers, 80 feet long, of 16 feet beam, and will have a draught of 18 inches when laden. They will be wooden boats and the machinery will be supplied by the Albion Iron Works. The contract for taking the hulls of the vessels into the lake will be distinct from that of either the furnishing of the machinery or the building of the hulls. A fourth steamer to be built at the Clyde yard will be a twin screw which J. Stephens has the contract from a Tacoma firm for constructing. It is intended for Teslin Lake.

A settlement has been effected between the parties in the suit of the Toronto Ferry Company for an injunction to restrain the city of Toronto from improving and maintaining the embankment protecting the intake pipe across the bay. This embankment caused stagnant water to accumulate in front of the Ferry Company's property and greatly depreciated it. By agreement the northern boundary of the Ferry Company's property is to be extended by means of piling to the conduit embankment opposite. The waterworks breakwater is to be extended southerly to the Ferry Company's property, and the area thus enclosed is to be filled in by the city with the sand pump. The city must undergo the expense of the piling, but the company must allow the city to use such piles on the eastern side of its property as become unnecessary by the proposed changes. The land thus made is to be used by the company in connection with their summer resort free of charges until the lease expires in the spring of 1901, when a renewal rent on a valuation basis shall be paid by the company. The company

on their part abandon all claims against the city for the silting up of their boat channel to the Point. They also forego all claims for past damages of any nature and consent to the issue of the order applied for to the Dominion Government, giving the city legal right to maintain the present embankment. Each party to the suit must sustain their own costs.

THE "Castilian," now building for H. & A. Allan, which will take her place on the Liverpool-Montreal route next spring, will have a registered tonnage of 8,800; her length will be 520 feet, and her beam 58 feet. She will have a speed of about fourteen and a half knots per hour, and passenger accommodation for 150 first cabin, 120 second cabin, and 800 steerage. The saloon, state rooms, and smoking room will be all located on the spar deck The music room, which will be located on the bridge deck, will afford accommodation for a large number of passengers. The smoking room is arranged with easy chairs, divans and small tables for card parties. Besides her passenger accommodation, the "Castilian" will carry a large amount of freight The freight accommodation will include refrigerators for perishable goods, and will be arranged so as to give different temperatures in the separate chambers.

Railway Matters.

THE T., H. & B. have given the contract for repairing their rolling stock to the Waterous Company, Brantford, Ont.

APPLICATION is made to the Dominion Parliament for a charter for a railway from Hull, Que., or Montreal to Rupert Bay.

THE C.P.R. has closed a contract for fifteen compound locomotives. They will be heavy and of the most modern design.

H. R. RIDOUT & Co., railway supplies, Montreal, have dissolved partnership, and a new firm has registered, composed of Edward H. Seale.

W. RUSSELL & Co. have been given the work of building the Pembroke Southern Railway from Pembroke, Ont., to Golden Lake, where it makes connection with the O A. & P.S R.

A DEPUTATION consisting of Hon. R. R. Dobell, J. G Scott and others waited on the Local Government recently, asking a charter to build a railway from Roberval to St. James' Bay, a distance of 300 miles, through a very rich country of the Lake St. John district. The assistance they ask is a grant of land

A BILL to incorporate the Niagara Tramway Company, with a capital stock of $50,000, has been introduced in the Assembly of the State of New York It is the intention of the company to string a wire across Niagara Falls and run a tramway from one side of the river to the other. It is designed to carry passengers and freight.

GEORGE GOODERHAM, W. R. Brock, Robert Davies, Hon. L. M. Jones and J Herbert Mason, are members of the committee of disinterested and public-spirited citizens whom Mayor Shaw, of Toronto, acting upon the suggestion in the letter of T. G. Blackstock to *The World*, has induced to consent to handle the question of the city building a railway from Toronto to James' Bay. The question whether the present lines of the C.P R. or the G.T.R. are to be utilized, or an entirely new line built, is the most important one the commission has to decide.

A DEPUTATION, representing the Commonwealth Mining Company, consisting of S. O. Shorey, J. C. Holden, Senator Thibaudeau, Montreal, J. R. Barber, Georgetown, Ont.; C. Riordon, Toronto, J. B. Powell, Nelson, B C., and others, waited on the Dominion Government recently. The company has a scheme for a stage line between Edmonton and Dawson City, in the Yukon, which they say can be traveled in about twelve days. The distance is about 1,500 miles. They propose to construct a trail all the way from Edmonton, and ask the Government to guarantee interest on bonds to the extent of $2,000 per mile for 1,500 miles.

THE Restigouche & Western Railway has completed arrangements for building the first 20 miles of the line. Malcolm & Ross are the contractors, and C L. B. Miles is chief engineer. The road will be from the I.C.R., at Campbellton, N B., to the St. John River at Grand Falls or St. Leonards, at either of which it connects with the C.P.R.; at St Leonards also with the Bangor & Aristook Railway. By bridging the Restigouche at Campbellton, it will connect with the Atlantic & Lake Superior to Gaspe. There will be 110 miles to build, through heavy timber, spruce and cedar, in abundance, and some fine tracts of farm lands, on ridges covered now by a wealth of rock maple.

THE Canadian Pacific Railway and Auguste Heinze have come to terms, and the agreement is that the Trail smelter, the railway from Robson to Trail, the short line from Trail to Rossland, and the lands received from the British Columbia Government as subsidies, are handed over to the Canadian Pacific Railway for the sum of $800,000 The narrow gauge from Rossland to Trail will at once be widened to the standard by the new owners, who will also make the grades much easier. The line from Robson to Trail is a standard gauge, is well built, and can be operated at once in connection with the system to which it now belongs.

THE Ontario Government voted the following railway bonuses at the last session: To the Ontario and Rainy River Railway, from a point at the westerly end of the 165 miles heretofore aided to a point at or near Fort Frances, a distance not exceeding 40 miles, a cash subsidy of $3,000 a mile—$120,000. To the Pembroke Southern Railway, between Pembroke and Golden Lake, from a point in the north-east part of the township of Alice to the north-eastern boundary of the said township, a distance of 3½ miles, a cash subsidy of $3,000 a mile—$10,000 To the Irondale, Bancroft and Ottawa Railway, from a point 45 miles from Irondale, at the end of the portion of the railway to which aid was granted in 1896, and thence due east for a distance of 10 miles, a cash subsidy of $3,000 a mile—$30,000. To the Bay of Quinte Railway, for such extension or branches of its projected and authorized line of railway north of the village of Tweed, as will not exceed thirty miles in all, and will enable the said company to connect its existing railway with the iron ore deposits lying northward of the said village of Tweed, in renewal of the amount granted to the Kingston, Napanee and Western Railway in the year 1893, a cash subsidy of $3,000 a mile—$90,000. To the James' Bay Railway, to aid in the construction of ninety miles of the said railway from Parry Sound to a point at or near Sudbury, $3,000 a mile for a distance not exceeding 40 miles ($120,000), and the unearned subsidy of $3,000 a mile for a distance not exceeding 50 miles, which was granted to the Nipissing and James' Bay Railway in 1889, which said unearned subsidy is hereby transferred to the James Bay Railway. (New vote, $120,000; transferred from other road, $150,000)—$270,000.

Mining Matters.

ACTIVE operations are going on at present in the Darling iron mine, Lanark County, Ont. Five thousand tons have already been taken out.

J. H S CASS, who is well known to the asbestos trade, is now carrying on business as the Cass Asbestos Mining Co., 97 St. James street, Montreal.

HALIFAX, N.S., papers have recently contained references to the reputed discovery of rich gold fields in Labrador. Some are said to rival the Klondyke in richness, but the reports are without confirmation.

AT a preliminary meeting of the B. C. Association of Mining Engineers, held in A. H. Holdich's office, Rossland, a month ago, a paper on mining laws by G. F. Monckton, Esq., of Vancouver, was read and discussed.

A NEW oil field promises to be opened at Point Edward, Ont. A test well has been put down, and oil struck at a depth of five hundred and forty-five feet. A company has been formed, and they intend sinking more wells at once.

THE negotiations between Sir William Van Horne and T. G. Shaughnessey, of the C.P.R., and Heinze and Warfield in reference to the purchase by the C.P.R. of Aug. Heinze's railway and smelter in Kootenay, have been practically concluded, and it can be stated that the property in question has been transferred to the C.P.R. interest.

ARCHIBALD BLUE, Ontario Department of Mines, was recently interviewed by Messrs Ashworth and Murray, of Sault Ste. Marie. They took up a claim in the Michipicoten district, and sunk a fifty-foot shaft. They report having struck a vein eight feet wide and nine feet deep, at a depth of fifty feet, which assayed $32 to the ton.

Two gold bricks from the Saw Bill mine have been on exhibition at Port Arthur, Ontario, recently. Their combined weight is 13½ lbs, and they are the result of 20 days running of the mill, crushing an average of 20 tons per day Manager Wiley says that putting in a 20-stamp mill will double the output of the mine, and only requires the services of half a dozen more men.

THE following have organized the Northern Yukon-Klondyke Mining Company, Limited: Hon. G. Bryson, jr., Fort Coulonge, Que.; J Gillies, D Gillies, M.P.P., Carleton Place, Ont.; W. Gillies, of the said place; J B Fraser, Ottawa; J. B. MacLaren, Buckingham, Que.; A. MacLaren, Buckingham; J. C. Cox, Liverpool, Eng.; J. H. Francis and G F. Francis, Pakenham, Ont.; J. W. Bryson, Fort Coulonge; W. H. A. Fraser, Westmeath, Ont.; H. Aylen, Ottawa; J. G. MacLaren, Ottawa; J. E. H. Barnet, Renfrew, Ont.

WM BLACKMORE, chief manager of the Crow's Nest Pass Coal Co., was in Montreal recently, and will leave for the scene of the company's operations at Coal Creek. Mr. Blackmore has visited the leading mining centres in Canada and the United States, and with the result that the most improved electric coal cutting machinery will be started in the Pass mines. Orders for machinery have already been given out in Montreal, Toronto and elsewhere to the value of $100,000, while the company will erect about fifty beehive cooking ovens at Coal Creek for the purpose of supplying the article to the proposed smelter at Robson, B.C.

H. L. SIMMONS has purchased twenty acres near Nakusp, B.C., for a smelter site, and has also secured the water rights in that vicinity for the use of the proposed smelter. It will, it is said, be a plant similar in some respects to the one at Trail. It is thought at Nakusp that Mr. Simmons is connected with the parties who are about to erect a smelter at Vancouver. This company, it is claimed, intends to erect smelters at several points in the Kootenay country, and to send the product of these plants to the central refinery, at Vancouver, for separation into the several metals that are in the matte.

THE following papers and subjects were presented and discussed at the meeting of the British Columbia Association of Mining Engineers, held in Badminton Hotel, Vancouver, a short time ago: "Notes on Mining Law and its Application to Mines and Mining Districts," by Frank C. Loring, M.E., Rossland; "The Possibilities of Smelting in British Columbia," by Robert R. Hedley, Nelson; "Notes on Southwest Kootenay Ore Bodies," by J. C. Gwillim, B.A. Sc., M.E., Slocan City; "Odd Notes on Mining," by A. H. Holdich, Nelson; "Mining Machinery in the Slocan," by Howard West, A.R.S.M., New Denver.

A SHAREHOLDER of the famous Le Roi mine received a letter from Rossland recently containing the following details regarding that great property: The mine continues to ship about 200 tons of ore per day to the Northport smelter. Recent returns show that the ore is going about 1.54 ounces in gold, 4 per cent. copper, and 3 ounces of silver; its monetary value being itemized as follows: Gold, 1.54 ounces at $20, or equal to $30.80; silver, 3 ounces at 57 cents, equal to $1.71; copper, 4 per cent. (80 lbs.)at 10¾ cents, equal to $8.60, or a total of $41.11. Estimating the product of the mine at 200 tons per day, the gross value of the ore raised daily is $8,222, or $246,000 per month, which in turn makes the gross yearly product of Le Roi mine $2,959,920.

RESERVE—CASSIAR DISTRICT.—Notice is hereby given that the under-mentioned tracts of land are reserved for Government purposes until further notice, viz.: 1. A belt of land, five miles in width, extending back from the shore line of the whole of that portion of Bennett Lake which lies within the province. 2. A belt of land, five miles in width, extending back from the shore line of the whole of that portion of Teslin Lake which lies within the province. 3. A belt of land commencing at a point five miles below Glenora, on the Stikine River; thence up the said river to a point five miles above Telegraph Creek, and having a width of five miles on each side of the said river. —Geo. B. Martin, Chief Commissioner of Lands and Works for the Province of British Columbia.

AT a meeting of the Peninsula Mining and Development Company, Limited, held at Windsor, Ont., Jan. 15th, all arrangements were made by the company for their expedition to the Klondyke, which will leave Windsor on February 15th, under the management of Major J. E. Johnson, of Leamington, Ont. The following gentlemen will accompany the Major: C. A. Hugheson, Ouvery; J. C. Burk, Blenheim; M. Toll, Ouvery; J. Coyne, Leamington; B. Noble, Leamington; D. Noble, Northridge; William Johnson, Essex; J. Lickman, Essex; J. C. Myres, Cottam; C. McApe, Cottam; J. Imeson, Wheatley; R. F. Leeming, Kingsville; D. Edwards, Coatsworth; F. Dawson, Coatsworth; Thomas Dancey, Coatsworth; W. Toll, George Lawrence, J. B. Lawrence, Blenheim. The expedition will go by Edmonton, and expects to reach the Yukon district in about two months.

AN incident of great interest to the mining district of North Hastings, Ont., took place lately at the Belmont mine, near Marmora, Ont., now being operated by the Cordova Exploration Company, Limited, of Newcastle-on-Tyne, England, which was the official opening of the company's new stamp mill by Miss Grace Carscallen, daughter of A. W. Carscallen, M.P., who formerly owned and developed the property. The opening took place in the presence of a number of persons who had been invited by the general manager, David G. Kerr, Glasgow, Scotland, late superintendent of one of the mines of the same company in Norway, who came to take charge of the property on the 15th of August last. The mill was erected and the machinery built and put in place by the Wm. Hamilton Mfg. Co., Limited, of Peterboro, and speaks well for this firm, who are so widely and favorably known throughout the Dominion as mining machinery manufacturers. The construction was under the supervision of Richard Proutt, of Marmora. After the ceremony of opening and inspection was over, and after visiting the Assay Office, which is in charge of George Hardy, chemist, of Newcastle-on-Tyne, a young employee of the Cordova Exploration Company, the party were entertained to a sumptuous repast at the manager's residence.

THE ONTARIO RE-FORESTING COMMISSION.

During the recent session of the Ontario Legislature, the Commissioner of Crown Lands laid on the table the report of the Royal Commission appointed in June last to investigate the subject of "restoring and preserving the growth of white pine upon lands in the Province, which have been cleared or partially cleared by lumbering operations or by fire, and which are not adapted for agricultural purposes or for settlement." The commission consisted of E. W. Rathbun, president of the Rathbun Lumber Co.; John Bertram, president of the Collins Inlet Lumber Co.; J. B. McWilliams, superintendent of Forest Rangers; Alex. Kirkwood, of the Ontario Crown Lands Department and Thomas Southworth, Clerk of Forestry.

During the fall and summer the members of the commission visited the townships of Smith, Harvey, Galway and Burleigh, in the county of Peterboro; the territory along the north shore of Lake Nipissing, and down the Vermilion River, in the township of Louise; the country around Thessalon, Algoma Mills and Killarney; the townships of Carlyle and Humboldt, and other points on the north shore of Georgian Bay and in the neighborhood of Georgian Bay. The commissioners also inspected some of the territory on the north shore of Lake Superior and the country along the line of the Port Arthur, Duluth & Western Railway west of Port Arthur, in addition to taking a somewhat extensive trip through the Rainy River country, visiting also portions of the northern parts of Minnesota and Michigan in the United States.

Though the commission has not yet had time to examine minutely enough into local conditions to be able to submit detailed plans for the care and management of the areas visited, yet its investigations have been of a sufficiently technical nature to warrant them in coming to the conclusion that with sufficient areas set aside for the purpose, and with reasonable care and protection of the young and growing timber now upon them, the supply of merchantable timber in the Province of Ontario will be vastly augmented. The commissioners next score lumbermen for the reckless maner in which they have treated our forests. The former apparently limitless forest wealth of the province has led them to be incautious as to the safety of the forests, and the litter they have left lying about has fed the destructive fires that have always followed. These fires have destroyed the original growth, and in many cases paved the way for the springing up of a crop of other varieties more easily propagated. It has been found, however, that where any of the original trees survived the fire and produced seeds, the forest has eventually assumed the characteristics of the growth indigenous to the locality. The widely-entertained theory that the white pine on being cut away is invariably and permanently succeeded by a crop of inferior varieties, was completely disproved by the frequent instances observed in which tracts of flourishing young pine trees are growing up on cut-over land, and the prevalence of the idea can only be accounted for on the ground that fire has in so many cases completely exterminated the pine in all stages of growth. There seems to be no doubt that with the exclusion of fire, and the adoption of more intelligent and provident methods of lumbering, there would be no difficulty in securing a quick and sure production of the varieties of trees desired.

As a rule, after the fires the seeds of the aspen, poplar, birches and cotton woods, which are carried great distances by the wind, soon cover the burned over area, and a vigorous crop of these varieties springs up, and speedily occupies the ground. In most cases, however, a few pines have managed to survive the fire, and where this is the case their seeds are scattered and soon supplant the poplars and other inferior growths. In looking casually over one of these devastated tracts, the first impression conveyed is that poplar and other deciduous trees form the sole vegetation, but a closer inspection will reveal the presence of a large stock of young conifers, which in time will outgrow and drive the poplars into decadence. The commissioners put forward as an example of what results might be obtained, the township of Burleigh, in the county of Peterboro. The cutting of timber began here 50 years ago, the original forest being chiefly of excellent pine. About 33 years ago a colonization road was run through the township, and since then the lumbermen and the fires started by settlers have devastated the forest on the west side of a stream known as Eel's Creek. The frequent fires have burned over a large part of the soil and killed any pines that may have been left by the lumbermen, so that any national reforestation would be a very slow process.

Now, for the other picture. The east side of Eel's Creek presents an altogether different aspect. Viewed from the Burleigh road, it has the appearance of a thrifty young poplar forest, with a few young pine trees appearing on a level with the poplar. On closer examination, it was found that the young forest was largely composed of red and white pine. It was moreover learned that this portion of the forest had not been visited by fire since twenty-three years ago. The pines will, if protected from fire, soon overtop the poplars and assert the supremacy of their species. The conclusion arrived at was that within fifty years lumbering operations in this locality could be profitably resumed and the larger pine trees taken out, producing timber of a merchantable quality, and giving the younger trees a better chance to grow. Reasonably good forest conditions could, under proper regulations for cutting, be introduced and a continuous supply kept up. This statement as to the condition in the township of Burleigh may be taken as fairly typical of the course of natural forest regeneration in nearly all the fire-swept lands which came under the observance of the commissioners. Much of the forest lands now looked upon as of little use will yet, under proper protection, be very productive. The main feature of forest preservation must be protection from fire.

To the north of the height of land which sheds water into Hudson Bay, it was found that some timber lands had been burned over through the carelessness of Indians, but the Hudson Bay officials there had promised to help the Government in protecting the forests. The commissioners proceed to say that, though in earlier years the lumbermen confined their operations to taking out trees which measured at least 14 inches diameter at the butt, many rafts were observed to-day to consist of mere poles--six inches or so in diameter This practice should be promptly stopped by the Government

The commissioners give the following idea of the rate of growth of white pine: A young tree which would cut only one log 8 inches in diameter and 16 feet long, measuring 16 feet, board measure, would, if allowed to stand for thirty years, grow in diameter at the rate of one inch in five years—in some cases the growth is an inch in two years—and hence would give a butt of 14 inches diameter, 16 feet long, or 100 feet of lumber, board measure. In addition to this, however, this tree would have grown in height sufficiently to give two more logs, one, say of 11-inch, and one of 8-inch diameter, both 16 feet long, or a total of 164 feet, board measure, for the tree. Thus, a tree that required, perhaps, 40 years to make its first 16 feet of merchantable timber would in 30 years more have increased to 164 feet.

The commission suggests that a market should be secured for the "thinnings," which should be taken out where the timber stands too thick, and the idea is put forward that much of this apparently useless forest material might be utilized in the manufacture of pulp and small wood goods, or for the production of charcoal for smelting ores.

In conclusion, the commissioner recommends that—

1. The present system of fire ranging inaugurated by the Government in 1886 be extended so as to be compulsory on all the holders of timber berths; that all unlicensed timber land contiguous thereto be also protected by rangers employed by the Government and that all fire rangers be subjected to the inspection and control of the Department of Crown Lands

2 That the officials of the Hudson Bay Company be asked to cooperate with the Government in preparing and printing fire proclamations in the language of the Indians of the northern districts, to be posted along the canoe routes throughout the country

3. That for all unworked limits on which the ground rent shall be two years in default on the termination of the present license year, the license shall not be renewed, but the berths be held by the Crown as forest reserves.

4. That license-holders be not allowed to cut any trees for logs smaller than will measure 12 inches across the stump, two feet from the ground, unless under special forest conditions, with the sanction and under the supervision of the district forest ranger.

5. That the Government take power by Order-in-Council to withdraw from sale a location, and set aside, to be left in permanent Crown forest reserves, such areas of territory as are generally unsuitable for settlement, and yet valuable for growing timber.

FIRES OF THE MONTH.

Jan 12th—North-West Elevator Co.'s elevator, Cypress River, Man partly insured. — Jan. 13th—The Dominion Paper Box Co.'s building, Adelaide street, Toronto, loss, $50,000.——Jan. 17th—A. Merizzi's woolen mill, Napierville, Que., loss, $10,000.——Jan. 21st—Richelieu and Ontario Co.'s office, Montreal, damages, $800.——Jan. 23rd—The power house and car house of the Metropolitan Street Railway Co, Toronto; damages, $10,000, fully insured.——Feb. 1st —The Doherty organ factory, Clinton, Ont., damages, $75,000, insurance, $35,000.

—J. H. Still promises to have the St. Thomas electric street railway in operation before Dominion Day.

—The voting on a $25,000 system of waterworks for Mount Forest, Ont., took place January 20th, and resulted in the by-law being sustained by a majority of 49.

—The trustees of Havergal Ladies' College, Toronto, have taken out a permit for the erection of a three-story brick school building at 356 Jarvis street, to cost $35,000.

—Edward Hooper, Toronto, has taken out a permit for the erection of a five-story brick addition to the Grand Union Hotel at the corner of Front and Simcoe streets, Toronto, to cost $30,000.

—The Ontario Wind Engine and Pump Company has taken out a permit to erect a two-story brick machine shop and office at the southwest corner of Atlantic avenue and Liberty street, Toronto, to cost $3,000.

—It is stated upon good authority that the H., G. & B. electric railway will be run through to St. Catharines if the Decew Falls power scheme proves a success, so that the company can get power from that source.

—In view of the Canadian Pacific's decision to bring Toronto business round by Carleton Place a large number of new locomotives will be put into service on the line, orders for some forty new engines being now in the hands of locomotive builders

—The Polson Iron Works Company, Toronto, has secured the contract from an English syndicate for the building of a steamer to be used on the Yukon River She will be a stern-wheeler, dimensions 45 feet long and 9 feet beam, and will draw only 15 inches of water.

—The Ontario Government granted the sum of $35,000 towards the construction of an International railway bridge across the river St. Lawrence, at Cornwall, on the line of the Ottawa and New York Railway, provided that aid be granted also by the Government of Canada.

—A big scheme is on hand for the incorporation of the Montreal and Champlain Canal Co., which proposes to construct a canal from the St. Lawrence to the Richelieu River, a distance of 18 miles. The company is to have a capital of $6,000,000. Albert J. Corriveau is the promoter.

—There was a general strike of men employed by the Canadian Pacific Navigation steamers in British Columbia, February 2nd. They demanded an increase in wages in view of the rush to the Klondyke. Some of the strikers were placed under arrest charged with violating the laws governing the sailing of vessels. They appeared before the magistrate, who gave them the choice of going to work or jail. They chose the former

—The annual report has been issued of the Niagara Falls Park & River Railway. The report shows the number of passengers carried is away ahead of previous years. In 1896 the passengers carried numbered 497,000, in 1897 the number carried was 579,000, giving to the year 1897 an increase of 82,363 passengers over 1896 The Niagara Falls Park & River Railway was established in 1893, and has been a success ever since its inception. W. Phillips, who has completed his first year as acting manager of the road, was appointed general manager at an increased salary.

—The second inter-provincial conference of Canadian mining engineers and mine managers will be held in Montreal, under the auspices of the Federated Canadian Mining Institute, commencing Tuesday, March 1, and continuing the three following days. Some forty papers will be read and discussed by the members of the association. The proceedings of the conference, which will take place in the ladies' ordinary and other rooms of the Windsor Hotel, will be open to the public The annual banquet of the association will be held at the Windsor Hotel on the evening of Thursday, March 3rd.

—Although little or nothing has been said about it, the Chateauguay and Northern, or, as it is better known, the Bout de l'Ile Electric Railway Company, has done a very considerable amount of construction work during the season past. The system has been connected with the Canadian Pacific Railway freight yards, on Moreau street, Montreal, the meeting of the two roads being effected near the old North Shore freight office. This new branch, which brings the Chateauguay and Northern into immediate connection with the C P.R., embraces about 1½ miles of track, the rails being 60 lbs. to the yard, and extending all the way from Lasalle street to the Canadian Pacific yards, just mentioned, so that goods can now be billed from any part of the C.P.R. to any point on the electric road in question.

THE KNAPP ROLLER BOAT.

Editor CANADIAN ENGINEER :

SIR,—Now that the Knapp boat is laid up for the winter without a speed trial, it may be of interest to consider some of the points which have been made against her success. Foremost among these is the great wind question. It is claimed that wind pressure reduces the speed of the "Campania" from 560 to 180 knots a day. Is this the whole truth? I think not. A vessel of that class is submerged about 33 feet, or nearly two-thirds of her entire bulk. The air, through which the smaller portion of the vessel has to make its way, is some 700 times lighter than the water which resists the submerged portion. But the water in a high head or quarter wind acquires under the influence of the wind, a very rapid motion. This rapidly-moving water, weighing hundreds of tons, is hurled against the bows of the on-coming vessel. A vastly lighter body of air is at the same time opposing her upper works. But which has the greater effect in reducing her speed? Obviously 700 tons of water will retard her speed more than one ton of air. It is probable, may we not say certain, then, that the "Campania's" speed is reduced, not by the wind pressure on her upper works, but by the resistance of the rapidly-moving water against the submerged portion of her hull. The wind pressure in itself can add but very little to the retardation.

Now, discarding all other elements but those of water resistance, how will this affect the full-sized Knapp boat? To begin with, the immersion will be considerably less than one-half that of the "Campania." The serious resistance will therefore be diminished in that proportion. But this is not all advantage to the Knapp boat. The trials have shown that increase of water resistance produces increase of speed, thus completely reversing present conditions. The weight of water flung against the submerged portion, which is curving downwards and away from the on-coming wave, will tend to "sweep her legs from under her," just as a beam sea causes the staunchest boat to roll. But to roll is just what Mr. Knapp's boat is built to do. Consequently this terrible foe of present-day craft will be an actual friend to the new monster.

But how about the wind on the upper works? Here, indeed, there is a tremendous increase of surface to play upon. But here also another principle appears which may very possibly surprise the cock-sure prophets. If two moving bodies meet, the lighter of the two will be inevitably overcome by the heavier. Now the Knapp boat will weigh some 15,000 tons, and will present 112,500 square feet to the wind, less the submerged portion. Now in calm weather, at a speed of a mile a minute, the heaviest pressure of wind would be about 18 lbs. to the square foot, or, adding the resistance of a 40-mile gale, about 26 lbs. to the square foot. The weight of wind to be encountered would thus be about 1,012 tons in calm weather, or 1,462 tons in a 40-mile gale. What will happen to that 1,462 tons when 15,000 tons are thrown forcibly against it at the rate of a mile a minute? Which must give way? I imagine there can be no two answers to this problem.

But very competent engineers think that the surface presented to the wind would be more accurately represented by multiplying the length by one-half the diameter, for the reason that the shape of the boat and its peculiar motion would greatly reduce the retarding effect of the wind upon it. If this be admitted, the pressures given above must be divided by two, giving 506 tons wind resistance in calm weather, or 731 tons in a 40-mile gale, and with the boat going at a mile a minute. It will be seen, therefore, that everything against the boat is conceded in the above argument, while in what I am about to say I shall concede everything in favor of my examples.

It will doubtless be objected that the horse-power necessary to drive that 15,000 tons against 1,462 tons at the rate of 5,280 feet a minute will be so enormous that the boat could never carry it. To this the inventor replies that the momentum of his boat will be in itself sufficient to overcome wind resistance, and all his engines need do is to roll his boat *in* the water at that speed The weight of the boat and the aid of the resisting water will do the rest. But we are told "there is nothing in momentum." Fortunately that fact can be tested, because ships are not the only moving bodies which are confronted with wind resistance. Let us take then as a test the Holman engine, which recently ran at the rate of a mile in 28 seconds for a short distance, and made the whole mile in 32 seconds, or the Empire State express, which has a record of 34 seconds for a mile. It is noticeable in both cases that a long run was made first, in order to "get up speed;" in other words, to acquire momentum. The Empire State express traveled 17 miles for this purpose; the Holman engine, 3 miles. Both present approximately 120 square feet of area when driving directly against the wind. If the wind is slightly on the quarter, this area would be much increased. But let us take the smallest area for our purpose. Taking the speed at two miles an hour the wind pressure would be 4 1-3 tons upon the square surface area of the train, head on. Reduced to horse-power, this would be roughly 3,000 h.p. But the engine actually possesses only about 1,500 h.p., and this is mainly used in overcoming the mechanical resistance of the inertia of the train, and all the friction of the machinery. Here, then, is a problem for objectors. It is evident that power is required merely to move the train. It is also evident that the engine does not possess sufficient horse-power to overcome the wind resistance alone, as ordinarily calculated. Whence then does the power come that not only moves the train, but overcomes the wind pressure also, and speeds along at a rate of a little under or over two miles a minute? Mr. Knapp says it is gained from the momentum. The engineers say there is nothing in momentum, but they do not answer this curious problem. Until they can it is at least possible, perhaps even probable, that Mr. Knapp is right. What you say in your July number as to the limitation of the effective power of the engines is admitted by Mr. Knapp to be true, and he has all along objected that this was a wasteful mode of applying the power. He wishes to apply it direct to the axle by the action of cranks.

I may add that I know the inventor well, and have constantly discussed the boat with him for the last three years. I do not wish him to be held responsible, however, for anything I have said except when it is directly attributed to him.

ONE OF THOSE INTERESTED.

Kingston, Dec., 1897.

NOTE.—The writer of the above letter has, in starting out, evidently confused wave motion with current. If he goes out on Lake Ontario after a storm, when a dead swell is on, and drops a stick on the water, he will find that though the waves heave ever so high the stick does not move away, but swings back and forward with each undulation. Even in a gale the surface water blown along by the wind is only a shallow "skim," and never keeps pace with the undulations of the waves. All the arguments built on this misconception fall to the ground, and need not be discussed. The writer asks, "What will become of that 1,462 tons (wind pressure) when 15,000 tons (weight of boat) are thrown against it?" One might answer that question by asking what will become of the roller boat when, with motive power limited to the slight leverage obtained by the weight of the internal machinery, it is exposed with its 112,500 square feet of surface to a howling gale? Our correspondent talks of the momentum of his boat overcoming the wind resistance, but how will he get his momentum without power? And power he has not got, and cannot get a boat on this plan. He is equally wrong in his speculations on the speed of a railway train. It is power, and not momentum, that enables a train to get into motion on an up-grade against a gale of wind. A gentleman of wide experience and good judgment, both on marine and mechanical questions, and who has studied Mr. Knapp's boat, is of opinion that three to six miles per hour is all she is capable of even in a comparative calm. With regard to the arguments used by "One of those Interested," he says:

"The supposition that the movement of the water against the direction of the vessel would help it to go ahead is absurd. The current of a river would be analogous to such a movement of water (if it existed). Therefore, if the Knapp boat was rolling up a river, the more rapid the river the faster the boat would run up it! The certainty is that the same law would hold good as in the case of any vessel. The speed up the river along the land would be the ordinary speed of the boat in calm water, minus the miles per hour of the current against it. The illustration is given of a beam sea causing a boat to roll. But a beam sea rolls the boat away from the wave, not towards it: With reference to the action of wind on the upper works, the proposition is made that if two moving

bodies meet, the lighter will be overcome by the heavier. Quite so, but the speed of the heavier will be diminished in proportion to the weight of the lighter. Therefore, the heavier the wind the slower the boat working against it, and, of course, the larger the surface acted upon the greater the retardation. The error here is on assuming that the weight of the boat (15,000 tons) is any factor. It is not the weight of the boat versus the wind, but the power of the engines, whatever that may be, versus the power of the wind, with the uneven surface to act upon. But the success of the new departure must be judged by results. Taking the power put into the boat, the manner of its application, and the resistance of the peculiar form of the hull into consideration, it was estimated by experts and practical men that the speed in still water would be about four miles per hour This at the experimental trials proved to be the limit, thus demonstrating the accuracy of the calculations. The same power on a similar displacement with a scientifically shaped hull would have developed about 15 miles at least. But supposing a reasonable amount of speed had been obtained, what then? The monstrosity is incapable of fulfilling any one of the ordinary requirements of navigation. There can be no accommodation for passengers. It would be impossible to carry cargo in such a shape that it would not be ground to powder as it was rolled around. The vessel could not be brought to an anchor, if it became necessary. In fact a more utterly unpractical form of ship could not be devised, even if the inventor had had that in view as the sole object of his labors.

A contingency that the inventor cannot have considered as he talks of a mile a minute, and that is that at this speed, allowing 20 per cent. slip, the 20-foot hull would have to revolve 100 revolutions per minute, at which speed the centrifugal force would send the cargo through the ship's bottom, and if not accurately balanced, would shake the vessel to pieces.

In an interview with one of the Toronto papers, Mr. Knapp said he would not attempt to steam against a gale, but as winds move in cyclones where diameter is never more than 400 miles, he would just roll out of the boundary of one of these cyclones, and then go on. R. F. Stupart, Director of the Meteorological Service, has some knowledge of the character and extent of cyclonic movements of wind, and in reply to an enquiry on this matter, Mr. Stupart says. 'It sometimes happens that severe tropical cyclones are not more than 400 miles in diameter, and sometimes considerably less; it is seldom, however, that the storms occurring on the trans Atlantic and Pacific routes are less than 1,000 miles in diameter, and frequently they are much more. A southerly gale in advance of a storm centre will oftentimes begin to blow near the coast of Ireland, while in the rear of the same storm centre a north westerly gale is still blowing off the coast of Newfoundland. As these storms do not progress eastward at a greater average rate than 30 miles per hour, it will doubtless be possible for the roller boat when it acquires a speed of *sixty miles per hour*, to keep out of the bad weather."

ELEVATORS, HYDRAULIC V. ELECTRIC.

Editor CANADIAN ENGINEER:

In your January issue, P. W. Moses, consulting electrical engineer, of New York, takes exception to some of the statements in the article on elevators in the December issue. I can not see where Mr. Moses proves my statements to be incorrect, and therefore it is difficult to answer him. Also he is an expert, and the article was written for an engineer like myself, and I feel flattered that it was of such moment that it was taken up by a New York electrical engineer, but as Mr. Moses has given his opinion, I will try to follow him, and simply repeat what I stated before, and what are practical facts.

In the first place, I do know more about hydraulic than electrical elevators. I am as well acquainted with electrical elevators as I care to be, and I very likely know a great deal more about the generating end of the electrical plant than Mr. Moses does, not theoretically, but practically. It is easy to figure on any subject, but figures are not what we pay for; it is coal, oil, and repairs, with labor, interest, etc. Mr. Moses says that an engine and generator can be put in for $5,000. It can, but it is not enough, and will not purchase a plant large enough for five elevators, let alone a duplicate plant, whereas a first class compound pumping engine can be put in in duplicate large enough for five elevators for the sum of $5,000, and if the architect put in an electric generating plant in keeping with the rest of the building, it would not be a one-horse show that could be purchased for $5,000. I know what it costs to install generating apparatus, also hydraulic elevators, and if the proper specifications were got out, and the manufacturers thought that they would get a fair show, the five elevators could be installed in a first-class manner with pumping machinery, for $30,000. The elevators, if electric, cannot run off the lighting engines satisfactorily, no matter what Mr. Moses thinks, it is very seldom done, except in very large stations or where they have only one elevator.

In the matter of safety, Mr. Moses proves just what I stated, namely, that the electric is more complicated, which does not tend to safety, but is dangerous, for the electric devices that you are depending on often fail to work when you want them, because the current is off. He says that there is not an elaborate cycle of changes during the time of starting, and then goes on to describe the very changes I spoke of. The electric man says that all you have to do is to push the button in the car and it starts, but just trace out all that occurs from the time the button was pushed until the car was at full speed. Then watch the hydraulic apparatus. You move the hand-wheel and it moves the valve direct. Nothing could be simpler, but the electric is simple enough to anyone looking through electric spectacles. Mr. Moses says that the electric elevator does not appear complicated. It does not appear so, but it is very complicated. Just the same in comparison with hydraulic. Even when he compares the electric elevator with the hod-hoist, which, by the way, I think is an apt comparison. He states that they are in use in hundreds of New York buildings, and receive the least possible care and attention. That may be one of the reasons that they run so badly, or they may get the least possible care, and yet, that least possible may mean a great deal of work. A gentleman went to New York to look into elevators before installing a large plant, and everywhere that they had hydraulic the practical men around the plant spoke well of them, and where they had been electric, almost invariably they were dissatisfied, and said, "put in hydraulic by all means."

Mr. Moses also says that the comparative wear and tear is yet to be determined. It may be by Mr. Moses, but I can cite cases in Montreal, Buffalo, and Toronto, where electric elevators cost more for worn out parts in the first six months than any hydraulic would in two years, and he acknowledges that the life is shorter for the generating apparatus, and as that generating apparatus costs more than three times what the same size pumping plant would cost, it does matter a great deal. I will not go into figures, as I can prove by figures that the electric is the more economic as far as coal is concerned, but I also know that it costs more for repairs on certain electric elevators than it costs for current, and when material and labor are taken into account, the economy is on the side of the hydraulic.

I again make the statement that the plant should be the full capacity of the five elevators, and my practical experience as engineer of the Incandescent Light Company proves that, and anything short would be folly. My experience there proved to me also that nearly all the complaints from customers were due to elevators coming on when the load was light, and the company has since put them all on a separate circuit, thereby improving the lighting system wonderfully. When the load is heavy, the elevator adds such a small percentage that the effect is not noticed That is why the New York companies can run the electric elevator with practically no effect, as their load is heavy all the time.

In conclusion, I know more about the condition of Toronto and its City Hall than Mr. Moses does, and I could prove even to Mr. Moses that hydraulic elevators is what the City Hall should have, if he were anything but an electrical engineer. One of the proofs in the previous article was, that all the manufacturers making both kinds of elevators says they should be hydraulic, and only one, who makes only electric elevators, says they should be electric, and of necessity electrical engineers would say the same. Mr. Moses knows more about electricity than I do, no doubt, but he very likely has not the knowledge that the practical side of the question gives by long experience.

Toronto, Jan. 25th, 1898. ED. PHILIP.