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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.

ART. 15.—WATERWAYS.

The construction engineer, after retracing the centre line, and checking levels, and establishing additional B. M.'s, if necessary, should verify and complete the list of structures fixed upon by the survey party.

The class of structure will depend upon the money and material available, but its cross-section, if it is a waterway, will depend on the *maximum* flow of water it is expected to carry, while if it is a cattle pass or public crossing, its *minimum* dimensions will be fixed by law. Many causes affect the maximum flow of water across a railway roadbed, at a given point, besides the drainage area; in the case of small streams or local watersheds, the building of the roadbed, and consequent roadbed and catch-water ditching, will concentrate the flow, from quite a large area, in a culvert that would naturally have had much less flow to accommodate; this should be anticipated. Then, again, the construction of a railway in a new country will induce such activity as will cause large tracts of forests to be cleared off, and in a few years these cultivated areas will allow storm waters to pass off more rapidly than when the same area was in forest, which should therefore be anticipated and provided for. If the drainage area is in a nearly level country, water will arrive at a given point more gradually than if the slope of the country is abrupt; and also the shape of the drainage area and distribution of tributaries has a marked effect on the maximum flow. If a long stream has few and small branches, the maximum flow will be much less than where there are more and larger tributaries and less main streams, the total area being the same, especially if they empty just above the railway. In this case the flood water from all of them may arrive about the same time. Stony ground, also, sheds water much more rapidly than mellow and highly cultivated ground, and small areas are more liable to *abnormal* floods than large ones, because cloud bursts seldom occupy large tracts of country.

All such considerations should be weighed along with that of acreage, which should be determined, roughly, by personal examination, for every area large or small draining toward and across the railway under construction. There are several empyrical formulæ, purporting to connect the square feet of waterway required with the acreage drained, but they, necessarily, contain a co-efficient which varies with so many causes, such as those just given, as to make them difficult of application, even leaving out of question, the variation in rainfall in different localities. Indeed, it is the greatest rainfall for short periods that is the most important factor, and records of this are usually deficient.

The carrying capacity of a box or arch culvert may be made a maximum by digging straight wide approaches and offtake ditches, and by building flaring wings at each end to avoid contraction, and may be abnormally increased by designing it to carry a head of four or five feet of water in an emergency, which of course, increases the velocity—this, however, is hardly safe practice.

Baker's "Masonry Construction" has these formulæ:

(1) *Myer's.*—Area of waterway in square feet = $C \sqrt[2]{\text{drainage area in acres}}$. In which $C = 1$ for rolling prairie, $1\frac{1}{2}$ for hilly ground, 4 for rocky precipitous ground. This formula, Baker considers, will give too large results for small areas, and too small results for large ones.

(2) *Talbot's.*—Area of waterway in square feet = $C \sqrt[4]{(\text{Drainage area in acres})^3}$. In which, $C = \frac{2}{3}$ to 1 for rocky precipitous ground, $\frac{1}{3}$ for rolling ground, landing floods and snow at same time, and $\frac{1}{6}$ to $\frac{1}{8}$ for long narrow valleys with little or no snow. This formula, used with judgment, will probably give as good results as can be expected, where there are so many varying conditions.

Aside from any data as to acreage, etc., the high water mark at some narrow point in the channel may be noted, information from old residents as to abnormal freshets gathered, the waterway under any existing highway bridges measured, and any other influences noted bearing on the maximum flow, such as the rain records for

* This series of papers will be issued in book form as soon as they have appeared in THE CANADIAN ENGINEER.

past years for the nearest weather station, and the probability of the maximum flow being increased by clearing the country, if at present in forest, etc.

It is best to err on the large side, although some engineer has said that if a road has no wash-outs from too small waterways now and then, the structures are too large for ultimate economy.

ART. 16.—STRUCTURES FOR SHALLOW EMBANKMENTS.

The first consideration is to get water across the roadbed and away from it as quickly as possible, this is an axiom of good drainage. To do this where the embankment is from 6 inches to 2 feet deep, and the drainage area only nominal, is often a puzzle. We do not wish to leave an opening in the track, and pipes or stonework are impossible; the usual course is to fill in the pocket above the bank and drain through the track by track boxes (Plate 1, Fig. 20), or where there is from 18 inches to 3 feet of a bank in place of an open culvert which some engineers put in, a plank box (Plate 1, Fig. 21) is preferable, as it can be replaced easily when rotten, will stand the vibration of trains, and does not leave any opening in the track. Sometimes with a very slight drainage area, a blind or French drain is used, which consists of small flat stones placed so as to give a triangular opening of, say 6 inches high x 8 inches wide, but such a waterway is liable to get choked up with leaves, etc., and cannot be depended on indefinitely.

When we come to banks of from 3 feet to 6 feet in depth it is usual to employ iron, terra-cotta or concrete pipes if the waterway is small, and when a heavy flow of water necessitates it, open culverts of from 4 feet to 8 feet span. These latter may be of timber, stone, concrete or brick, but should always be surmounted by an ordinary trestle floor. The use of stringers only is an abomination and a death trap, which should not be tolerated.

Culvert Pipes.—The use of double-strength, well-burnt sewer pipe for culverts has increased rapidly of late years in certain sections. They fill a certain want, either where stone is scarce or absent, and at points distant from water or rail communication, as the cost of teaming is small compared with that of iron pipes. In a country subject to severe frost certain precautions must be taken to avoid water settling under or in the pipes, which will crack them in freezing. The grade must be ample, care taken to have the grade convex longitudinally of the pipe, rather than concave, the joints made watertight with cement mortar, and headwalls built at each end with deep aprons, to avoid having any water flow along the pipe outside of it. In southern localities of the United States, America, pipes are used more freely and carelessly, head walls and joint filling are omitted, or only a timber headwall used, but such omissions will invite trouble in Canada.

Again, if the bank is shallow, the same care is hardly necessary in ramming back the filling around the sides of the pipe before loose dumping is commenced as if it is a deep one, but in either case care should always be taken to cut a concave bed for the pipe to rest in and grooves for the spigot joints, or otherwise the load will all come on isolated spots, and the pipe will tend to crack into four segments, bulging out at the sides and down at the crown. If the bottom is solid rock or bouldery, the condition is worse, and breakage can only be avoided by filling in some soft clay well rammed to bed the pipes in, or, better still, to bed the pipe half-way in cheap concrete, as shown on Plate I., Fig. 22. This figure also shows design for a headwall and paving at the lower end. The spigot ends of the sections are always laid up grade. As with other more important structures, pipes should be laid at such a depth that the outlet ditch leads the water to a safe distance with a gentle grade, so as to prevent undermining the lower end.

In place of sewer pipes of clay, there have been isolated attempts at using concrete pipes, but only sporadically. The choice would be entirely a matter of cost. On the other hand, the use of cast-iron culvert pipes is quite common. They can be made up to six or eight feet in diameter, the lengths decreasing as the diameter increases, so as to keep down the weight of a segment. If carefully coated with tar mixture rusting is very slow; and although such pipes are not used often during construction, owing to their great weight, which is against them in hauling by teams, they have a special function which is for use, when their transportation can be by train, in replacing wooden box culverts by drawing through

Plate. I. Scale 1 in. = 8 ft

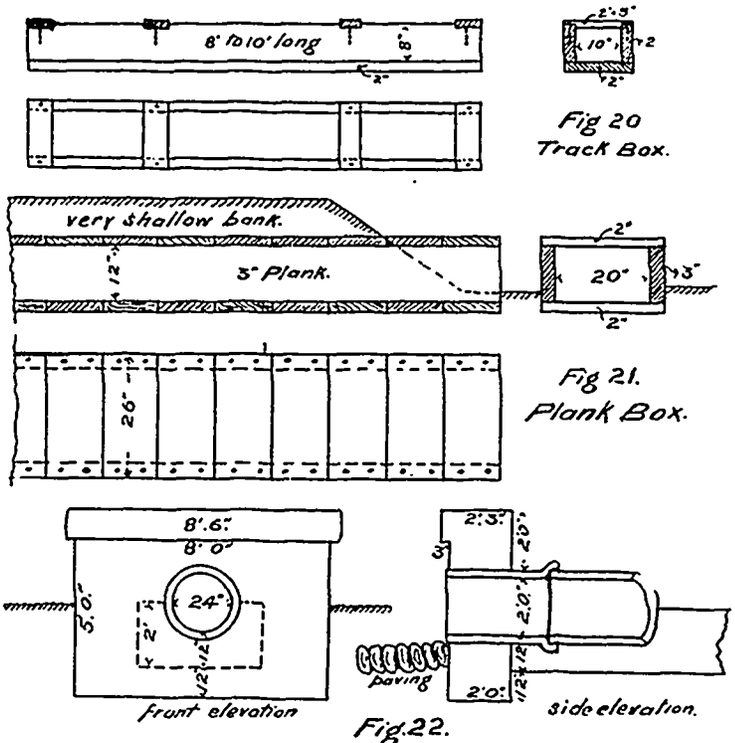
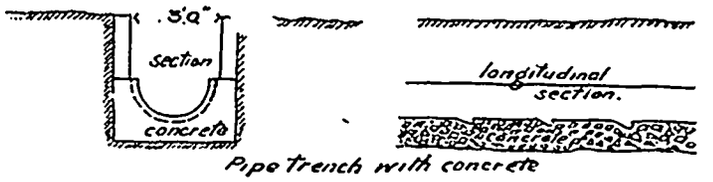


Fig 20 Track Box.

Fig 21. Plank Box.

Fig. 22. Head wall for Iron or Terra-Cotta pipes.



Pipe trench with concrete

when the wooden one is about decayed, and in case this has been anticipated the wooden box culverts will have been made larger than necessary, sufficient to allow of this being done. Cast iron pipes will be laid in the same manner as sewer pipes, except that the joints should in this case be caulked and leaded as with water pipes, although sometimes this is omitted; the cost per foot for cast iron and sewer pipes at the nearest railway depot to the structure will vary somewhat with the locality, but will be approximately as follows:

TABLE XII.

APPROXIMATE COST OF PIPES (NOT INCLUDING LAYING.)

Diameter.	Sewer Pipe. Cost per foot.	Cast-iron Pipe. Cost per foot.	
12-inch	35cts.	$1 15	This does not include cost of hauling, laying, headwalls or foundations.
18-inch	70 "	1 90	
2 feet	$1 30	3 00	
3 feet		4 80	
4 feet		8 00	

The difference of cost, as shown in the table, the less cost of handling and laying of the sewer pipe and its absolute freedom from corrosion will always be greatly in favor of its adoption where well-burnt, salt-glazed, double-strength sewer pipes can be obtained within reasonable length of railroad and team-haul.

Open Culverts.—Where a large flow of water is to be carried across a shallow bank some engineers use two or three lines of pipes, but the danger of this method lies in the possibility of debris collecting around the middle walls and gradually choking up the waterway. This can be guarded against by building a screen or paling some distance above the entrance, which catches the debris. Generally speaking, however, a large stream and shallow bank demands an open culvert. In many cases these may answer the double purpose of waterway and cattle guard, or waterway and cattle-pass, for giving passage for cattle under the track. Such structures may be of timber, stone, concrete or brick walls, capped with stone; but whatever kind may be used, they should be decked with a complete trestle floor, such as to make them safe for derailed trains to pass over. And indeed, latterly, some roads are adopting a solid timber floor, on which the ordinary road ballast is laid, or better still, a floor of discarded steel rails, laid longitudinally, filled in with concrete and covered with ballast; in either case the roadbed is continuous, and free from danger by derailment or fire, and presents a more elastic and uniform bearing for the track ties.

On Plate II. (Figs. 23 and 24) are shown plans for a 6-foot open culvert of timber or stone. If the bank were deeper, the stone walls would need to be thicker, being designed as level retaining walls, and the timber culvert would need a more thorough system of interior struts, etc., for stability. If the embankment cross-section were to show a rapid descent just at the mouth of the culvert, it would be more economical to place the stepped wings at right angles to the walls, in the form of head walls, about six feet from the centre line. This is not done, ordinarily because less economical, less stable, and subject to vibration and thrust from the train.

The timber open culverts should be well drift-bolted in each course, and have the stringers also notched down slightly and drift-bolted to the walls—the mud sills well sunk into the solid earth, and preferably with paving between them and a sheet piling apron at each end to prevent under-flow and undermining, as shown on Plate IV. (Fig. 28.) If the foundations are not good, a structure, on piles, similar to the one shown on Plate III. (Fig. 25), will need to be used. The earth being retained by a layer of four inches to six inches cedar flatted on three sides, and the two walls held vertical by drift-bolting and notching down the stringers, or if necessary, by additional struts placed from top to top of piles as shown in the figure. The use of high-framed timber openings on mud-sills, lagged behind with cedar like that in Fig. 25 is not advised, they are not stable and are liable to be undermined. Wherever a depth sufficient for cattle passes or farmers' undercrossings is required, it is better to put the structure on well driven piles extending up to grade, if a stone opening cannot be afforded.

The valid objections to open culverts with vertical walls are:

(*a*) That the structure being fixed in elevation, offers a rigid support to the track which, on banks, and on freshly made ones particularly is elastic and settles down for several years, and rises and falls with the frost; therefore, at such structures there is more or less of a hump, and always a poor piece of track.

(*b*) That in case of the timber culverts, the lagging behind the piles rots quickly, and is rather awkward to replace.

These considerations have led to the use, especially in the southern United States, of a form of structure shown on Plate III. (Fig. 26), which consists of two bents of piles, or two frame bents on pile foundations, with three 15 foot spans of trestle floor, having the two end supports made of mudsills resting well on to the banks. It is probable that 45 feet of trestle floor is not appreciably more dangerous than 15 feet of it, and the only valid objection to this form of structure is that the frost will heave the ends out of surface in climates like that of Canada or the northern United States, but its openness for repairs, the elasticity

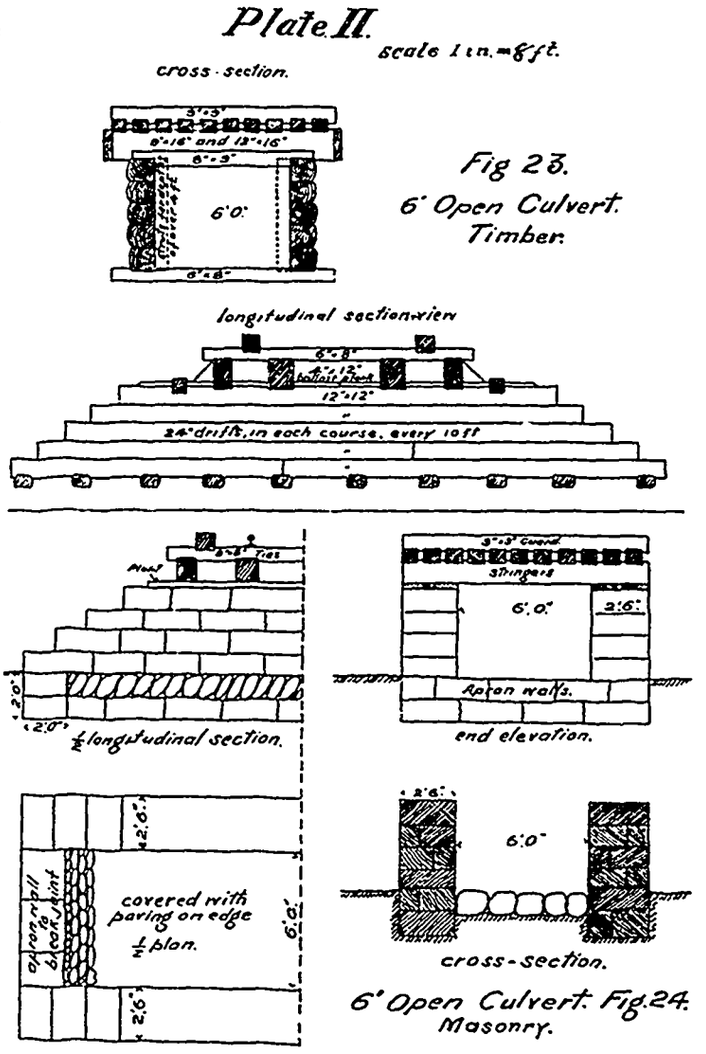


Fig 23. 6' Open Culvert. Timber.

6' Open Culvert. Fig. 24. Masonry.

of the ends which rise and fall with the embankments, its freedom from rot, except the easily replaced mudsills, and the possibility of an enlarged waterway by rip-rapping the sloping banks, to allow for an exceptional flood, are all points much in favor of such a structure. This structure is evidently limited to banks less than eight feet high.

The class of masonry for open culvert walls will need to be superior, owing to the effects of vibration from the trains, to avoid part of which oak planks should be placed under the ends of the stringers. The class usually specified is second-class bridge masonry, and will cost from $8 to $10 per cubic yard upward, depending on the quantities in each structure and total quantity in the contract. The economy of rubble concrete walls capped with a stone coping is being now recognised.

The cost of structures of these styles will be approximately as given in Table XIII., taking masonry at $10 per cubic yard, including foundations; paving at $3 per cubic yard; sawn timber at $30 per M.B.M., in place including iron; cedar lagging and timber walls at $25 per M.B.M. in place, and piling at 30 cents per lineal foot, driven, say, 10 feet into the ground.

TABLE XIII.

APPROXIMATE COST OF OPEN CULVERTS.

Structure.	Height of Waterway.	Clear span in feet being 6 feet.	8 feet.	10 feet.	12 feet.	15 feet.
		$	$	$	$	$
Timber opening.	4 feet.	106	116	126	135	148
Timber walls.	6 "	157	167	177	186	201
(Fig. 23.)	8 "	212	222	233	243	259
Timber opening,	4 feet.	110	118	125	133	145
piles and lagging.	6 "	144	152	158	167	179
(Fig. 25.)	8 "	168	176	183	191	203
Three span.	4 feet.			170	203	251
Opening on piles.	6 "				208	256
(Fig. 26.)	8 "					267
Stone opening.	4 feet.	317	341	365	389	426
Trestle floor.	6 "	457	481	505	529	566
(Fig. 24.)	8 "	608	632	656	680	717

From which it is evident that piles with lagging are slightly the cheapest, except with the smallest height and span, and that at 8 feet high and 15 feet span the three-span opening comes to about the same as the other timber structures. The cost of the stone opening is from two to three times as great as the timber ones in first cost, at $10 per cubic yard, but in many cases this could be materially reduced by using concrete at $6 to $8 per cubic yard, at which price a very superior quality can be made even in small quantities. An interesting feature of this table is the deduction that the length of span affects the cost so slightly, it will hardly pay to risk anything in size of waterway for such trifling economies.

ARTICLE 17.—SMALL WATERWAYS WITH HEAVY EMBANKMENTS.

Under these conditions pipes may still be used, if care is taken in laying them; up to any height, if the waterway is very small; but for cross-section areas of four square feet to twenty square feet, the structure commonly used is the box culvert, which may be made of timber, stone, concrete or brick. The two latter, however, being used, usually, in the arch form, as otherwise stone covers are necessary.

Timber Box Culverts.—These are used where cheap structures are desired, or often in undeveloped districts where construction is hurried, timber plentiful, and stone scarce, they should not be put under embankments more than 12 feet to 15 feet high, unless built large enough to admit iron pipes that will carry the rainfall after the timber culvert has begun to decay, which will be in six to twelve years, depending on the timber, etc. If the bank is a shallow one, it will not be very expensive to replace the decayed timber culvert by another similar one, or by a stone box culvert, at a time when stone can be cheaply delivered by rail and the company can afford the outlay, and if the covers are made long, as in Plate IV. (Fig. 27), they will hold up for a year or so after the side timbers have started to rot. Of the two styles shown, the one (Fig. 28) is superior in some respects. It is fastened by iron drift bolts, instead of oak tree nails. It has a row of sheet piling driven at the ends to prevent underflow and undermining, and has solid paving laid between the mud-sills, all of which are distinct improvements. For such structures, probably, cedar is the most durable wood, and pine next. A distinct advantage of timber box culverts is that on soft swampy foundations, all that is necessary is to make a wide solid floor of timber instead of mud-sills, and even lay this floor on several sills running lengthwise of the culvert to distribute the loads over the whole area. Even though some settlement should occur, the elasticity of the timber will save the structure from damage, whereas with a stone or brick culvert any serious settlement means destruction to the masonry.

Stone Box Culverts.—Typical plans are given (Figs. 29, 30, 31, 32) on Plates IV. V. and VI. to illustrate essential differences in stone box culverts.

(*a*) Fig. 30, Plate V., shows a solid stone floor under walls and for paving, while the others have the walls independent, which is much preferable because the loads are carried symmetrically to the foundation, *i.e.*, the centres of pressure are opposite the centres of resistance, because the paving may become dislodged without the walls being injured and because the walls may, if desired, be carried lower than the paving, as in Fig. 29.

Plate III

scale 1 in. = 8 ft.

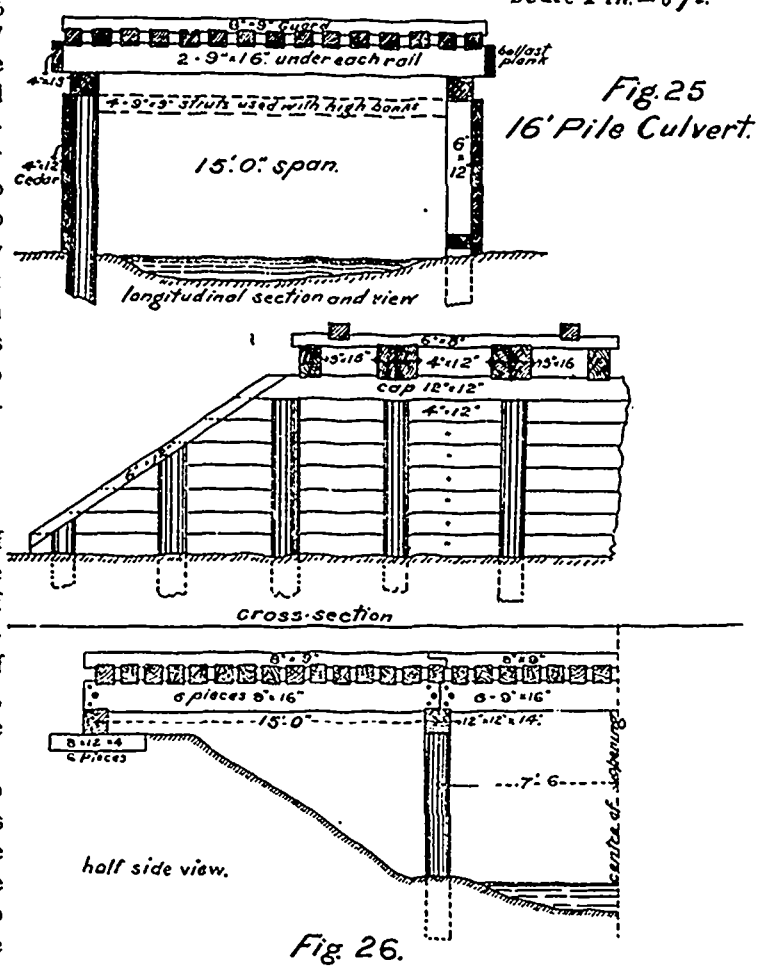


Fig. 25
16' Pile Culvert.

Fig. 26.
Three-span Opening.
(in place of one 15' span pile culvert.)

(*b*) Figs. 30 and 32 show head-walls while the others have straight-stepped wings, the latter is better practice because no amount of sliding or thrusting of any kind from above, can dislodge more than the parapet wall, which is only an ornament, whereas head-walls as in Figs. 30 and 32 can be easily cracked or thrown down by slides in the embankment.

(*c*) Fig. 31 illustrates the use of corbelling where a wide span is required and stone for long, heavy covers is scarce, this method may be developed into a complete gothic.

(*d*) Fig. 29 has a distinctive feature in the *well* formed by the projecting upper wings, which will effectually prevent blocking the mouth with debris, because if any collects here it will merely form a dam, over which the water will pass safely and fall into the well thus formed, whereas

with the other styles shown a complete blockade might occur; this is a matter of importance in wooded countries.

Stone culverts in cold climates are laid in cement mortar, including covers, and the paving is flushed with grout until full; and in all climates apron walls should be sunk two feet to three feet at each end, to prevent leakage along and under the walls and paving, otherwise the action of frost and undermining will both be destructive; but in mild climates such culverts are usually laid dry, and if attention is paid to the bonding and laying, the structure may last indefinitely. This class of work is shown on Fig. 32. Wherever the fall is rapid, paving should be laid beyond the lower end, as in Fig. 30, and may even consist of a very heavy flat stone floor, if the grade of the culvert is excessive. Culverts should, of course, be laid to the natural cross section, no matter how steep—in order to get the outlet low enough to prevent undermining, the direction of the discharging stream, in plan, is immaterial—water will get away somehow, but, in profile, there should never be an increase in the rate of fall, just below the lower end, unless on solid rock. If the foundation bed is solid, the cove which holds up the paving may be left of correct height to carry it, but if the foundation is poor, it will be best to build first a layer of concrete one foot to two feet thick, and commence masonry work and paving on this, or, in case the foundation is always to be under water, a grillage (platform) of timber will be suitable, as in timber box culverts.

Weak foundations are often the cause of failure on stone culverts, and all doubtful ones should be tested by the engineer himself, by driving an iron bar down in several places, but it is best to be on the safe side; a little

Plate V.

scale 1 in-8 ft.

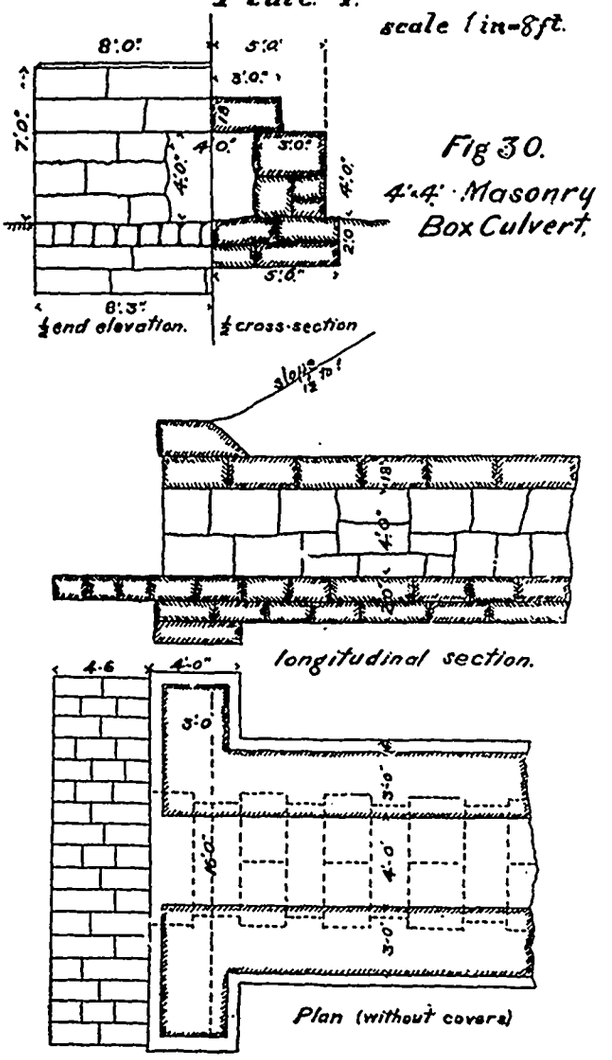


Fig 30.
4'x4' Masonry Box Culvert.

Plate IV

scale 1 in-8 ft.

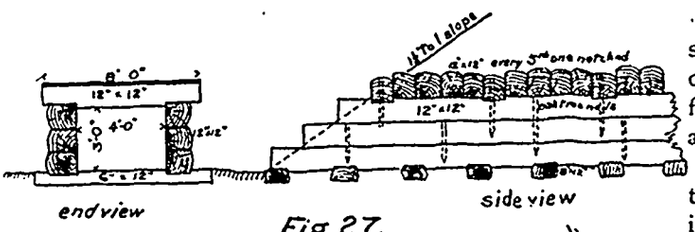


Fig. 27.
3'x4' Timber Culvert.

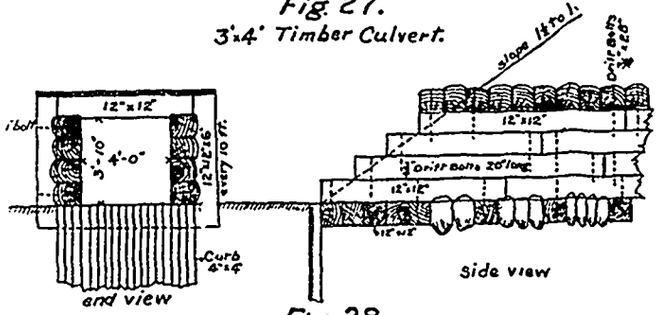


Fig. 28.
4'x4' Timber Culvert.
(C.P.R.)

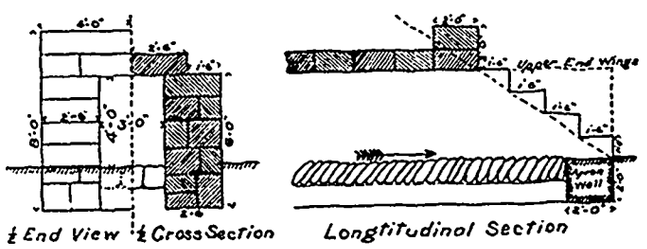


Fig. 29.
3'x4' Masonry Box Culvert.

sediment on the paving will do no harm, and will be swept out at each storm, whereas if the discharge end is too high, first a hole is worn, and finally the lower end is undermined and falls down.

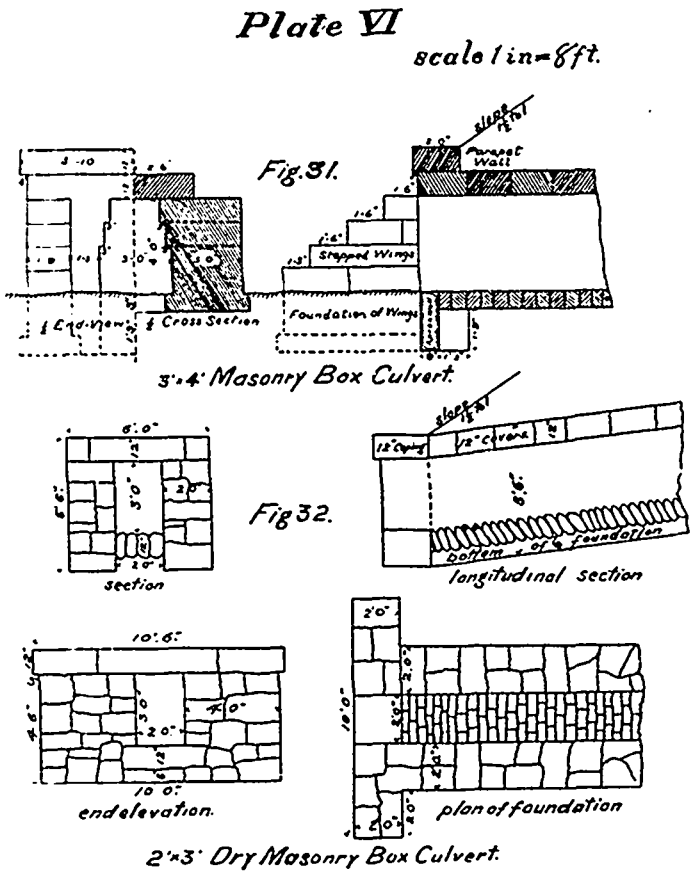
If possible, culverts should be located at right angles to the centre line, and this can usually be done by diverting the entering stream, and using the material in the embankment adjacent. Skewed structures are expensive in many ways, more particularly, however, with arched culverts. The inspection of stone culverts during construction should be a rigid one, as rascally work can be hidden quicker in this class of masonry than in any other. Especially inspect the covers as to soundness and proper bearing on the walls, which should be from 9 inches on small culverts to 15 inches for large ones; they should have full bearings at each end, and be well spauled and mortared at the joints, to keep out earth and water. In bringing embankments against all culverts, care must be taken not to shove them over; filling should, if possible, be carried on on both sides at the same time, but if not, then earth should be shovelled over, up to the level of the top of the covers, before a high bank is brought forward. These remarks apply more particularly to arched culverts. The use of solid concrete box culverts to take the place of masonry ones is on the increase. They can be built cheaper, and when a knowledge of the science of cements and proper concrete making is more general, such construction will be largely adopted.

Specification for Stone Box Culverts laid in mortar.—"Culvert masonry shall be built of good, sound, large, flat-bedded stones, laid on their natural and horizontal beds. The stones used must not be less than three feet in

area of bed, nor less than eight inches thick, and must be hammer-dressed so as to give good beds with half-inch joints or less. Headers shall be built in the wall from front to back, alternately, at least one in every five feet of wall and frequently in the rise of the wall. The least width of bed for stretchers shall be twelve inches. In larger structures, all stones must be heavier in proportion, every attention must be paid to produce good bond, and to give the whole a strong, neat, workmanlike finish. All dimensions must be according to plans, but these may be varied if the engineer so requires."

"The paving shall be of stone set on edge, twelve inches deep, packed solid, of an even face, and inclined in direction of the stream."

"The mortar shall consist of one part good quality Portland cement to three parts of clean sharp sand, and all joints, beds and interstices shall be carefully filled with mortar and packed solid—the exterior faces and interior of barrel shall have all joints raked and pointed with mortar, consisting of one part cement to one part sand."



Cost of Box Culverts.—Taking timber in place, including iron and foundations at $25 per M.B.M., culvert masonry at $6 per cubic yard, and paving at $3 per cubic yard, including foundations The cost of box culverts according to figures (28) timber, and (29) masonry, are given in table XIV.

TABLE XIV.

APPROXIMATE COST OF BOX CULVERTS (16 FOOT EMBANKMENTS)

Structure.	Waterway.	Total cost for depth of top of paving below subgrade. 10 ft.	20 ft.	30 ft.	40 ft.	50 ft.	60 ft.
		$	$	$	$	$	$
Timber Box..... Fig. 28.	2' x 3' high	183	306	429	552	675	798
"	3' x 3' "	213	356	500	643	787	931
"	3' x 4' "	234	397	560	723	886	1,049
"	4' x 4' "	263	446	629	812	995	1,178
"	4' x 5' "	281	483	686	888	1,091	1,294
Stone Box ..... Fig. 29.	2' x 3' "	254	420	587	754	920	1,086
"	3' x 3' "	267	444	620	797	974	1,151
"	3' x 4' "	364	607	851	1,094	1,338	1,582
"	4' x 4' "	385	645	905	1,165	1,425	1,685
"	4' x 5' "	501	848	1,195	1,542	1,889	2,236

From which table it is evident that the stone culverts increase in cost much more rapidly than the timber ones, owing to the necessary increase in the thickness of the stone walls, being estimated at 2 feet, 2½ feet and 3 feet thick for culverts 3 feet, 4 feet and 5 feet high (in the clear) respectively. It does not pay, evidently, to build small timber culverts, other things being equal.

For THE CANADIAN ENGINEER.

THE DISPOSAL OF TOWNS' REFUSE.

BY W. M. WATSON, TORONTO.

An efficient refuse destructor is a desirable adjunct to the sanitary equipment of towns, and it is cheering to observe that the science of designing and the methods of constructing refuse furnaces has lately made rapid improvements, with the result that any kind of towns' refuse, including excrement, can be quickly and thoroughly burnt without the assistance of fuel. However foul and loathsome the material that is consumed may be, the fumes and smoke will be totally burnt up, instead of being discharged into the atmosphere, which was formerly the rule. A large amount of heat at a temperature of about 2,000° F. is created, which may be used to raise steam for generating electricity for pumping sewage, grinding mortar, crushing stone and clinkers, or any other useful or profitable purpose. Thus ensuring a saving of public health and money.

Some years since Professor Kennedy jokingly asked "How much steam could be raised from a pound of muck," meaning wet filthy refuse, street sweepings, excrements, etc. Geo. Watson, engineer, Leeds, England, and many others have during the past ten years clearly demonstrated that a furnace can be built that will raise one pound of steam for every pound of refuse destroyed, and maintain pressure of 140 pounds.

By studying the laws of creation we find that everything must be active to be useful, and that when activity ceases vitality ceases also, and whether the substance be a living body, or a volume of water, air or gas, when activity stops it becomes offensive and useless. Moreover, every thing created, however mean, small, or repulsive it may appear to us, is for some specific purpose. This is just what is done by gathering up the rejected refuse and filth of towns, and handling them in such a way that the poisonous gases they generate are destroyed and the unhealthy material turned to profitable account.

There are several kinds of refuse. In many towns there are privy pits, or the pail system of water closets, the contents of which have to be disposed of. The scrapings of macadamized roads are suitable only to mix with earth on productive land. Broken glass and crockery can be crushed small and used in place of marble or granite chips for mixing with concrete or asphalt work. Old tin after passing through the fire and the solder has been melted off, can be sold to manufacturing chemists or iron works along with the scrap iron picked out. The brass, copper, lead, and other valuable metals can find a ready and profitable market. Old paper and cotton rags can be easily made into common brown paper by erecting a small mill adjoining the destructor plant, as in Chelsea, Eng., without creating a nuisance, or jeopardizing the public health. The woolen rags may be steamed and afterwards

sold to woolen or shoddy manufacturers. Old boots find a German market, where they are brought to a pulp and molded into trays and fancy ornaments. Old rubbers can be reduced and made over into useful articles. Whole bottles may be cleaned and sold for use. The blood from slaughtered animals can be manufactured into various materials and for several chemical purposes. The fat is rendered into tallow, and the excrements manufactured into a portable inoffensive and valuable manure. The ashes should be sieved through a quarter-inch mesh, and then immersed in water, resieved and the clinkers sorted out, and the residue will then be a fuel almost equal to coal. This goes by the name of washed carbon. The dust dropping through the sieve may be mixed with the contents of privy pits, or the sweepings from paved streets, and sold for manure with the crushed bones. Objectionable material of all kinds that cannot be handled without risk to health, should be consumed in the destructor along with the vegetable and fibrous garbage.

The town council of Cardiff, Wales, has estimated the quantity of each kind of refuse collected in one year, and its selling value in that town :—

Broken crockery, 157 long tons, at	1 shilling	.....	£ 7	17 0
Scrap iron, 60 long tons, at	30 "	.....	90	0 0
Old tins, 227 long tons, at.....	20 "	.....	227	0 0
Broken glass, 137 long tons, at....	30 "	.....	205	10 0
Straw and fibrous, 927 long tons, at	20 "	.....	927	0 0
Waste paper, 1,232 long tons, at..	40 "	.....	2,464	0 0
Rags, 113 long tons, at	60 "	.....	339	0 0
Coal and coke, 240 long tons, at..	5 "	.....	60	0 0
Small cinders, 18,334 long tons, at	2½ "	.....	2,291	15 0
Fine dust, 5,611 long tons—No value.				
Animal and vegetable refuse made into a special manure. 1,325 tons, at	20 "	.....	1,325	0 0
Bones, 138 tons, at	75 "	.....	517	10 0
Bottles, 12,500 dozen, at 3d. per doz.		.....	156	5 0
			£8,610	17 0

In addition to these, there is the heat generated in the destructor furnace, which will raise steam that can be used for power, and is useful in many other ways. The residue from the furnace can be used for building foundations for roads and sidewalks, making cement slabs suitable for paving, etc.; in fact, everything can be made to serve some useful purpose. Bad meats, fish and flesh of all kinds, can be ground and steam-dried by a revolving machine that reduces it to a fine dry powder, making a fertilizer of great value. All this can be done by experienced workpeople in works situated in the centre of a dense population, without the slightest injury to their health; but such works would be a danger and a nuisance, besides a bill of costs to the town, if they were not intelligently managed, with strict rules and cleanliness. From the financial side of refuse disposal, there appears to be nothing to hinder towns from paying a considerable amount of their management expenses from the rubbish the inhabitants throw away, and that gathered in the streets.

Along with an engineer, who for twelve years has been in charge of large boilers and engines where the steam is raised from wet sawdust and the bark from wet saw logs, I visited the West and East End Toronto refuse destructors, which, when properly named, are roasting ovens. They are built on the bakers' oven pattern, but in place of the floors being brick, they are covered by a coarse fire grate having an ash-pit underneath. There is one oven about eight yards long and three yards wide erected on each side of the chimney. At the end (and on the same level of each oven) furthest from the chimney, there are three coal furnaces, and either one or two on each side, making at least five in all for each oven. These are fired with coal, the fiery gases from all the furnaces enter the oven and make a bee line to the chimney, keeping the crown of the arch at a blood-red heat during their passage across the length of the oven to the outlet flues. And it is safe to assume that the heat from the coal fire enters the chimney at nearly the same temperature that it leaves the fire, which to my mind is a wilful waste of fuel. Destroying the refuse seems to be a secondary consideration here, and the destructors or ovens are not worked to anywhere near their capacity. They only handle the most inflammable portion of the city's refuse. The workmen say they cannot do more, because the chimneys cannot stand the heat. If this is so, the heat ought to be put to some useful purpose and not wasted in the atmosphere. The workmen might do a fair amount of work and place the garbage in the ovens at periods of not over thirty minutes each, in place of twice or thrice each day, keeping the receptacle nearly full and equally spread over the whole of the fire bars. By charging in that way the top layer would be drying and the bottom would be at a fierce heat, and the ovens would easily carbonize and even burn fierce enough to make clinkers without the aid of the present coal furnaces. Why they use coal can only be answered by assuming that they prefer the expense. When I was at the West End destructor not half the grates were properly covered, and they were broken and out of place, so that there were holes that a boy might creep through, and the whole surroundings were dirty, disorderly and unhealthy. At the East End destructor everything was clean and tidy. There was no reason apparently why it should ever be dirty, for there was very little in the ovens, nothing whatever on the filling floors, and nothing about the place but the attendants, with the doors fastened. If the Toronto destructors are a sample and a precedent for our smaller towns to copy, the consumption of coal will be sure to increase.

There are about five kinds of high-class refuse destructors on the market worthy of notice, each having some good points, and when erected by careful workmen, with good brick and fire-clay, are almost everlasting, and seldom need repairs. When erecting brickwork that will have to resist a fierce heat, the fire-clay mortar should be boiled and used hot, about the thickness of cream, and each brick should be made to fit tight to its neighbor throughout the full width so that a knife blade cannot penetrate. I have seen some of these destructors in working order, and will try and explain them before I finish this subject, but will first explain that simpler methods of disposing of garbage to profit can be used. To my mind the fibrous and vegetable garbage similar to what appears to be burnt in Toronto, and what is necessary to be burnt in most of our small towns, together with bad meat, fish, etc., could be burnt and used in exactly the same way that steam is raised to drive saw-mills by burning the heavy, wet sawdust and log bark, and if garbage is not so inflammable as the wet sawdust, a forced draft could be introduced under the fire-bars that would increase the combustion. It is only a matter of making suitable grate and blast arrangements.

Cook's system is used for destroying the bagasse or refuse from the sugar-cane crushing machines which contains over 60 per cent. of water, 6 per cent. of sugar, and the balance fibrous wood, and the heavy wet sawdust and bark from the cutting of sawlogs direct from the pond, which are little more inflammable, if any, than the light refuse collected from the dust bins of a town, or such garbage and refuse as cannot be used for manure, or roadbeds, or filling useless cavities.

Cook's furnaces which raise steam to run the factories without the use and expense of other fuel are constructed

in the following way: "All the boilers needed are set side by side on the same level, at an elevation sufficient to allow of a deep fire-box and ash-pit, and room enough for an iron barrow to stand under the bottom of the ash-pit doors, all below the bottom of the outer shell of the boiler. In the front of each boiler, a firebrick fire-box is built about four feet square, or six feet long by four feet wide. The grate bars are fixed about four feet below the point where the hot gases leave the vault to pass under the boiler. At the extreme end of the boiler, there is a combustion chamber; from this chamber the heat passes through the tubes in the boiler, after which it passes through and between the economizer or water heater, which supplies the boiler with hot water, then to the chimney, which it reaches at a temperature of about 600° F. I believe with the German scientist Seimens, that if the fire pit be some distance away from the face of the boiler that the fuel will give better results, because it will cause more flue room for the better mixing and combustion of the gases, especially if there are bridges thrown across the flue to break and split up the flames. It would improve the heat still more if a current of heated air could be introduced into the centre of this combustion chamber. It would help to re-burn the moving gases, and increase the heat of the flues. This could be done by carrying an air flue through the centre of the fire box walls. A small 2-inch pipe would do, and it would take sufficient heat from the hot bricks to warm the air passing through. This fire box is extended over four feet above the point where the heated gases leave the fire vault, to pass out towards the boiler. Some of the vaults are covered with heavy iron plates having hinged doors that can be lifted, and a horse cart or railway car load of refuse tipped in at once. However wet the refuse may be, it dries quickly, and the steam it throws off is drawn down and consumed by the fierce heat at the bottom of the fire box, and in the carrying flues, so that before it is lowered down to a point parallel with the boiler flue, it becomes a red burning mass, and another wagon load is tipped in on the top of it. So the process should go on continually night and day when using towns' refuse and garbage.

I have explained this furnace arrangement sufficiently for the reader to understand its advantages, which comes in short to this: that any town can run its own electrical lighting plant, sell electrical power to its manufacturers, pump its supply of water or lift its sewages by erecting suitable plants and using the garbage, refuse and sweepings of the town for fuel, thereby purifying the town's atmosphere, increasing its sanitary qualities, and reducing the sufferings of its inhabitants from disease. The fumes and smoke of the furnace can be completely burnt by having properly arranged flues and secondary combustion chambers, and by using a good steam blast, which, according to Mr. Estcourt's (the public analyst) report, raises the carbonic acid gas from 2 to 14 per cent. The analyst's report of gases generated from rough towns' refuse, including ashes, excrement, sweepings, etc., is carbonic acid 14.6, oxygen 5.4, nitrogen 80.0. The value of coal is about 14.200 units of heat for each pound of coal, which will evaporate 14.70 pounds of water. Two and a-half pounds of dry wood of any kind, of dried bagasse, or dried tanbark, have the same steam-raising quality as one pound of coal. Straw, 3¾ pounds; peat, when dry, two pounds, is equal to one pound of coal. I have been told that the horse street railway of Chicago supplied the fuel used for raising steam to run the cable road from the horse litter, with the addition of a small quantity of coal.

The rough wet refuse or garbage collected in towns during wet weather, or excrements mixed with coal ashes or dust and droppings swept from paved streets will contain about 60 to 70 per cent. of moisture, and taking that into consideration, the value of town refuse is about ten pounds of refuse, equal to one pound of coal for steam raising purposes. The total amount of refuse averages about two pounds per head, per day, the year round, equal to seventy-three pounds of coal per head, per year. This, allowing the population of Toronto city to be 190,000, would make the refuse, if burnt in a first-class destructor with the latest designs of steam blowers, equal to 13,870,000 pounds, or 6,935 short tons of coal per year, or 19 tons per day, which is abundance of heat to raise enough steam to pump our water supply, saving the city over $28,000 per year. The pumping station is both a central and suitable place to build a destructor of first-class type, easy to get at; for the carts could go level off the Brock street bridge on to the top of the furnaces to deliver their loads.

To be continued.

REPORT OF THE CANADIAN DEEP WATERWAYS COMMISSION.

The agitation for deep waterways from the Great Lakes to the Atlantic by other than existing routes, has been going on for many years. The first convention to discuss plans of the proposed work was held at Burlington, Vt., in 1849, where it was proposed to connect Lake Champlain with the St. Lawrence by a canal larger than the Chambly. The Caughnawaga Canal was surveyed by the Government some forty years ago, but opposition on the Canadian side, and the fact that no similar outlet existed from Lake Champlain to the Hudson, prevented the construction of this work.

After a dozen conventions had been held, at various United States cities and in the lake region, a Deep Waterways Convention was called by the city of Toronto, in 1894, to which representatives from the United States lake cities were invited. The International Deep Waterways Association was formed, which held its first convention at Cleveland in 1895, and from whose proceedings the Act of Congress creating an International Commission originated.

It is impossible to convey, within reasonable space, an adequate idea of the extraordinary development of inland water transportation on the upper lakes—which, for rapidity, extent, economy and efficiency, has no counterpart even on the ocean. More than half of the best steamships of the United States are imprisoned above Niagara Falls, and more than half of the tonnage built in the United States in 1896 was launched upon the lakes. This inland water commerce has built up twelve cities on the southern shores above Niagara, five of which have over 200,000 population, one over a million, and the remainder above 20,000 each, and within these same limits there are 27 dry docks, the largest of which is on Lake Superior and is 560 feet long, 50 feet wide, with 18 feet water. There are 63 life-saving stations upon these lakes, ten of which are Canadian. Of the 53 United States lake stations, all but five are above Niagara. The economy of this inland water transportation is the result of deep water primarily, and, in the second place, of practically unlimited dimensions in other respects for the vessel; there being but the lift of one lock (of ample dimensions) to reach Lake Superior, and none at all between Buffalo and Chicago.

The large cargo steamers, with triple expansion engines, show a coal consumption (for the best practice) of 2 lbs. per developed horse-power per hour. Actual runs give four-fifths of an ounce of coal per mile consumed per

ton of cargo carried. Economy results from special port facilities, by which loading and also discharging is effected largely by mechanical means. A typical freight steamer is 432 feet over all, 48 feet beam and 28 feet depth (180 feet too long, 4 feet too wide and much too deep for the Welland Canal) and is double bottomed, with compartments into which water ballast can be admitted or pumped out; with triple expansion engines, cylinders 24, 39 and 63 inches in diameter and 7 feet stroke, supplied from boilers carrying 160 pounds working pressure. It carries over 5,000 gross tons iron ore on 16 feet 10 inches draught of water. The total United States lake feet (including that upon Lake Champlain) in June, 1896, was nearly 3,000 vessels of about 1,300,000 registered tonnage, over 1,800 of which are steamers with about one million registered tonnage. There are 300 of these above Niagara (embracing all the finest vessels of the lakes) which are too long to pass the Welland Canal locks. More than half of these are built of steel and iron, and, of the last fifty built, forty-one were of steel and only nine of wood.

The traffic in iron ore is the chief feature of the lake trade. It is estimated that 75,000,000, tons of ore have been transported on the lakes in the past ten years. Sixty per cent. of the iron ore used in the United States is carried on the lakes. The lumber and coal trade come next in volume to the ore trade. Every reduction in transport charges will enormously increase the amount exported. Each reduction extends the area of cultivation in those districts (like the Dakotas and the Canadian prairies), which are dependent on the Lake Superior route, and also extends the area of attraction towards the lake route from the more southern districts having a choice of routes to the Atlantic. The unfortunate position which Montrea occupies, owing largely to the shallowness of the present waterways, is shown by this statement from the report. All of Buffalo's ten million barrels of flour came by lake. Of Montreal's million and a half, only 133,000 barrels came by the St. Lawrence, while 267,000 barrels went to Ogdensburg by water. Of the total movement to tide-water of 150,000,000 bushels of wheat and flour, Montreal received about 11 per cent. Of the total movement to tide water of 107,000,000 bushels of corn, Montreal received about 6 per cent. Of the total 19,035,377 barrels of flour received at tide-water, North Atlantic, Montreal received 8 per cent. Buffalo has 52 elevators including transfer and floating ones, 16 million bushels storage capacity, and 6 million bushels elevating capacity in 24 hours. The transfer charges there upon wheat are $1\frac{1}{8}$ cents per bushel, and in New York $1\frac{3}{8}$ cents.

Experience with large vessels on Lake Erie between 1880 and 1890, and up to date, having been to reduce previous rates of freight between Buffalo and Lakes Superior and Michigan, about one-half (representing many millions of dollars saved in transportation charges), has convinced the representatives of the capital engaged in the commerce of the upper lakes, that an extension of deep water to the Atlantic seaboard will effect an annual saving of more millions than will be required to pay the interest on the cost of such a work, great as that may be. It is also evident from the foregoing that such a waterway would only be undertaken upon the best route to New York, and Canada's interest in the question is, whether that will be an international one. There is only one international route possible, says the report, which is that via the St. Lawrence and Lake Champlain, which is also one which permits of the extension of this deep water system to Montreal, and thence to Europe, on the shortest possible line. This fact, together with the consideration that the St. Lawrence-Champlain route gives the greatest extent of wide and deep water, the least mileage of artificial channel, and the minimum of lockage, has given rise to this International Commission. Canada's interest in such a waterway is only second to that of the United States. It would give an opportunity of doing what our canals were intended to do, but have failed to do; that is, to obtain the maximum amount of the western trade for the St. Lawrence route; and, in addition, it would afford a most direct navigation upon the largest scale between Montreal (as well as the Ottawa) and Lake Champlain, with its New England frontier, and with the Hudson River and New York, as also the most economical connection possible with Chicago, Duluth, and Fort William, on Lake Superior.

In a preliminary report made to the Government in March, 1896, the commission reported that the canal from Lake Erie to Lake Ontario would be most advantageously built in United States territory, as satisfactory plans could not be prepared for a channel of the contemplated dimensions to follow the summit level of the present Welland Canal. To attempt this, the work would have to be largely done in winter at greatly increased cost, and its execution would interfere with the free working of the existing line of navigation and endanger its structures. It is, therefore, to be presumed that an enlargement necessarily involving such risks would not be sanctioned by the Government.

The series of canals between the Galops Rapids and Lake St. Francis are being built for fourteen foot navigation along the north shore of the river, and are now, as a whole, well advanced towards completion. From his knowledge of the location and construction of these canals, Thos. Monro, C.E., considers it to be quite inadmissible to permit an attempt to be made to deepen them to twenty feet or more, for similar reasons to those above stated in reference to the Welland Canal. A reconnaissance has been made, and a few levels taken serves to indicate that the United States, or south side of the St. Lawrence, offers a fair site for a deep waterway from the head of the Galops to Lake St. Francis, opposite Cornwall.

The proposed deep water channel passes in Lake St. Francis from McKie's Point to Hungry Bay, where the St. Francis-Champlain Canal is to leave the lake. The line which it is proposed to follow between Lake St. Francis and Lake Champlain runs in an easterly direction across the depressions or valleys of the St. Louis and Chateauguay rivers, and after skirting the high ground near Ste. Philomene, bends almost due east and strikes for St. Johns on the Richelieu River—the total length of main canal being about 50 miles.

The final report of the commission, made after a meeting with the United States Deep Waterways Commissioners, at which the final report of that body was also presented to the joint commission, asserted the entire feasibility of constructing a deep waterway adequate to any scale of navigation which may be required between the several great lakes and the sea-board; and, also, that it will be wise to provide for securing a channel of a navigable depth of not less than 28 feet.

"The most eligible route" is declared to be by the Niagara River, and by canal, on the east side, from Tonawanda to Olcott on Lake Ontario; that the sea-board may be reached (from Lake Ontario) by the St. Lawrence River; and that the American sea-board may be reached by the St. Lawrence River, and via Lake Champlain to the Hudson River, or by way of the Oswego, Oneida-Mohawk Valley and the Hudson River. The impossi-

bility of the Oswego route, which has been set forth by Major Symons, will be found on another page. The report is signed by O. A. Howland, Thos. Munro, Thos. C. Keefer.

OUR RECORD.

DOMINION OF CANADA: PROVINCE OF ONTARIO. County of York. To wit: } In the matter of the circulation of THE CANADIAN ENGINEER.

I, *Alfred Wesley Law, of the city of Toronto, in the* county of York, do solemnly declare that—

1. I am the secretary-treasurer of the Monetary Times Printing Company of Canada, Limited, which company prints THE CANADIAN ENGINEER for Biggar, Samuel & Company, and as such have personal knowledge of the matters herein deposed to.

2. That the following statement correctly shows the number of copies of THE CANADIAN ENGINEER printed and mailed on the dates hereinafter mentioned, that is to say.

Date of Issue				Copies Printed and Mailed.
Volume III.,	No. 1,	May,	1895	2,000
"	" 2,	June,	"	2,000
"	" 3,	July,	"	2,100
"	" 4,	Aug.,	"	2,200
"	" 5,	Sept.,	"	2,400
"	" 6,	Oct.,	"	2,400
"	" 7,	Nov.,	"	2,500
"	" 8,	Dec.,	"	2,600
"	" 9,	Jan.,	1896	3,500
"	" 10,	Feb.,	"	3,000
"	" 11,	March,	"	3,100
"	" 12,	April,	"	3,150
Volume IV.,	" 1,	May,	"	3,250
"	" 2,	June,	"	3,450
"	" 3,	July,	"	3,600
"	" 4,	Aug.,	"	3,450
"	" 5,	Sept.,	"	3,975
"	" 6,	Oct.,	"	3,725
"	" 7,	Nov.,	"	3,800
"	" 8,	Dec.,	"	4,050
"	" 9,	Jan.,	1897	4,100
"	" 10,	Feb.,	"	4,350
"	" 11,	March,	"	4,350
"	" 12,	April,	"	4,350
Volume V.,	" 1,	May,	"	4,350
"	" 2,	June,	"	4,000
"	" 3,	July,	"	4,350
"	" 4,	Aug.,	"	4,400
"	" 5,	Sept.,	"	4,500
"	" 6,	Oct.,	"	4,400
"	" 7,	Nov.,	"	4,600

And I make this solemn declaration conscientiously believing it to be true, and knowing that it is of the same force and effect as if made under oath and by virtue of "The Canada Evidence Act, 1893."

A. W. LAW.

Declared before me at the city of Toronto, in the county of York, this fourth day of November, A.D. 1897.

W. H. MOORE,
Commissioner, etc.

To each of the first two persons sending us The CANADIAN ENGINEER of September, 1893, we will pay 50 cents, or one year's subscription.

A GREATER THAN STANLEY.

Canada has all reason to be proud of William Ogilvie, assistant astronomer to the Dominion Government. As we will be prepared to show in another issue, Mr. Ogilvie, as an explorer, is a greater man than Henry M. Stanley, the African explorer, because he has encountered and surmounted greater difficulties, has traversed a greater extent of unknown country, has opened a greater field for colonization, and pointed the road to greater wealth. More than this, he is absolutely free from that insufferable egotism which made Stanley personally offensive to many who knew him and had to serve under him.

Mr. Ogilvie has returned to Ottawa, where he is now busy preparing his special report, to be published early next year. On his way through Toronto he favored THE CANADIAN ENGINEER with a short conversation, some points in which were repeated at his most interesting talk before the Canadian Institute. One of the valuable points which he was generous enough to give to the mining readers of THE CANADIAN ENGINEER refers to the mechanics of mining in the Yukon. As the climate of the Klondyke may be said, to use the words of a pioneer, to be "nine months winter and three months late in the fall," hydraulic mining is out of the question. Where the thermometer ranges below zero so long, and the rivers are beds of ice, quartz mining will have to be conducted on a new plan. He suggests, therefore, a system of dry crushing, and a separation of the gold by a modification of Edison's plan of magnetic iron ore extraction. Of course, the magnet has no attraction for gold; but the gravity element of Edison's plan could be used by having chutes from which the crushings would be ejected, the greater gravity of the gold causing the precious metal to be thrown farther than the particles of rock, so that the greater part of the gold would be found in a heap at one end. There would be an intermediate space in which more or less gold would be found mixed with the rock, but this could be treated by the present amalgam process. An alternative plan might be a process of winnowing. Mr. Ogilvie gives the idea of the gravity system for the benefit of miners, leaving it to the mechanical engineers to work out the details of the machinery. Another very valuable suggestion he makes, which can be applied to the present placer mines, is the use of steam instead of fire in thawing the ground. The following conditions prevail in the placer diggings all through the Klondyke: for the first six to twelve feet the miner goes down through what is called "muck," that is, decayed leaves, and other vegetable matter, embedded in a network of tree trunks and branches. Then coarse gravel is encountered several feet in depth, and at the bottom of this gravel, lying on the more or less crumbled flags of the so-called bed-rock, the gold is found, nearly all of it lying within two to four feet of the rock surface. Now all this material of muck and gravel is frozen solid at all times of the year, and has to be thawed out foot by foot by building fires each day, the daily fire only penetrating the distance of about a foot. When the rock is reached the miner thaws a tunnel horizontally along the surface of the rock in the direction where the best pay gold is found, but it is not safe to penetrate more than twenty or thirty feet in either direction from the vertical shaft because the tunnel cannot be ventilated. Now, the use of steam in thawing the gravel would not develop any poisonous carbonic acid gas, but in fact would help purify the air, while the steam thawing would enormously increase the amount of work that could be done in a day. All that would be required in this process is a simple type of boiler, and a steam hose-pipe and nozzle. Mr. Ogilvie

proposes to demonstrate the advantages of this plan by having a sample steam thawing outfit manufactured and tested.

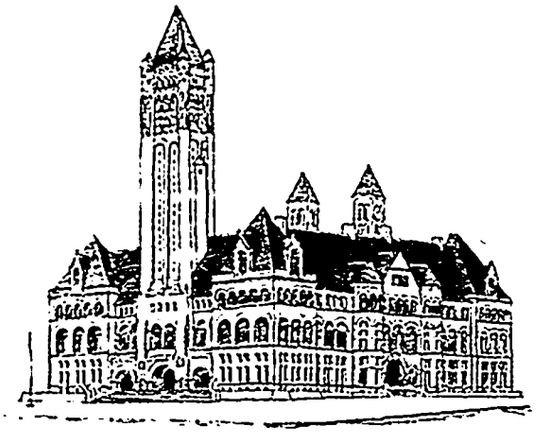
An important point brought out by Mr. Ogilvie, but which is not generally known, is that, by the treaty between Great Britain and Russia in 1825, all the bays, inlets and rivers extending through the Alaskan strip are open freely to navigation by Great Britain forever, so that there can never be any question of the right of Canadians to the use of the Skagway and other water inlets to the Klondyke.

In an area of thirty-five miles long by fifteen miles wide in the Klondyke, Mr. Ogilvie assures us that there are at least $100,000,000 worth of alluvial gold, and as he has proved that the pioneer miners of this region were Canadians or Old Country men, he believes that this vast wealth should be got by Canadians and kept in this country. This is the true spirit, and if the majority of Canadians were of the Ogilvie stamp, not much of the wealth of the Klondyke would be lost to Canada. The available timber of the Klondyke is being rapidly used up, but it is comforting to know from Mr. Ogilvie that over a large extent of country there are frequent outcroppings of semi-bituminous coal of a good serviceable character, and providentially these large seams of coal run parallel with the gold deposits, many of them being right along the river, where mining can be carried on cheaply. Still another remarkable fact is, that along with the coal and gold in convenient proximity, there are ample deposits of limestone, affording all the flux wanted in smelting. Both coal mining and quartz mining will commence in 1898, when at least 100,000 men will be working in the Yukon region. Cone Hill, in the Yukon, appears to be one vast mountain of gold-bearing quartz, far surpassing the Treadwell mine in richness. Some samples of quartz gold, which Mr. Ogilvie tested in a hand mortar, yielded as high as $1,000 per ton. In addition to the gold and coal, galena has been found in various places, and in the serpentine rock there is much low grade asbestos. Besides these minerals, an Indian recently brought in a block of pure copper, and when the source of this can be found another element of great value in these days of electricity will be disclosed. Of course, everyone will not get rich who goes to the Yukon. It will take energy and perseverance to develop these resources, but Canadians, with the help of British capital, are the people to do it.

TORONTO'S FOLLY.

"*I will not give such a permit to the Mayor himself, nor to any member of the council.*" Reply of E. J. Lennox, to a representative of THE CANADIAN ENGINEER, who asked for a permit to view the new city buildings in order to write an article, which was to be one of a series on the municipal works and plant. The reason given was: "*The plans are being changed from time to time as obstacles arise,*" and further, "*I have the right to make such changes as I see fit.*"

At this time when the annual inquiry into the new Toronto city buildings and the city architect is being carried on, and public attention is being centred on the building operations, being conducted under lock and key on Queen Street, it has been thought wise to go somewhat into the history of the whole matter. It is unpleasant to tell the people of Toronto that the many delays in construction have not been made entirely that we might have a better city hall. It is harder still to discover that the city must pay much more before the building is completed, but it is hardest of all to find out that even then it will not be the pearl among city buildings we had fancied. Much credit has been given to the architect for the beauty of the design. We will give him less in future, however, when we study the elevation of the Pittsburg, Pa., Court House and County Buildings, which appears side by side with that of the Toronto City Hall on this page. Had the people of Toronto all visited Pittsburg in the last twelve years as Mr. Lennox has, they would, probably, have wanted the tower in the centre of the building, as it is at Pittsburg, instead of looking down Bay street, which



CITY AND COUNTY BUILDINGS, PITTSBURGH, PA.

is the reason given for moving the one in Toronto. The whole mass of the building is very like, but is still unlike the work of the great Richardson, at Pittsburg. Where is the grand simplicity, the enormous scale, the perfect symmetry? It will always be a matter of regret to the people of Toronto, that Mr. Lennox did not go to Pittsburg oftener, stay longer, and "study" harder.

In 1884 it was decided to erect a new court house in Toronto. On December 20th of that year circulars were sent out to the architects calling for plans to be placed in competition, the author of the successful plan to be given the erection of the building. The cost of the proposed court house was limited to $200,000. None of the plans that were found desirable were within the sum stated, and all were returned to the authors and a new competition announced in May, 1886. The plan prepared by E. J. Lennox, the famous "No. 7," was accepted; the cost to be $200,000. It may here be stated that about the date at which all plans entered for the competition should have been filed, a delay of two weeks was granted, and for this step on the part of the committee no satisfactory reason has ever been given. At this time Ald. T. Hunter, who

TORONTO MUNICIPAL & COUNTY BUILDINGS
E. J. LENNOX ARCHITECT

was subsequently clerk of the works for many years under Mr. Lennox, was chairman of the Court House Committee.

The court house to cost $200,000 was proceeded with and the contract for the excavations and foundations was let to Lionel Yorke, and when it was seen that this portion of the building alone was costing $111,000 a halt was called and the new scheme of incorporating the city hall with the new court house was brought forward. W. H. Howland, then mayor, in a message dated Feb. 15th, 1886, points out that the unsanitary condition of the city hall and the lack of accommodation there will shortly render a new building necessary. He says that the required building can be incorporated with the court house, "the expense will probably not exceed $100,000 in addition to the cost of the court house, while a new city hall on a new site, built independently would probably cost $300,000 or more." He adds: "It will not delay construction of the court house as the architect, etc."

The architect was instructed to prepare plans for the combined buildings. In April, 1887, the issue of debentures to the amount of $750,000 was authorized by the ratepayers, which was in addition to $300,000 already issued—the whole to be employed in building the combined court house, city hall, and police court. It was deemed advisable to examine the plans to see if all the requirements of the architect's instructions had been fully complied with. The committee of council wished to appoint an expert, to have the architect appoint another, and the third by mutual agreement. The city nominated Matthew Sheard, but on his stating that his fee would be $1,000 for such examination, the project is lost sight of in the minutes of council for some time, but presently emerges in the form of a laudatory report on the plans by J. J. Withrow, Thos. Snarr, and Ex Ald. E. Galley. They had been instructed "to examine and report upon the specifications for the new court house and city hall buildings, as to their fully describing and specifying the different qualities of workmanship, materials, etc., also to report upon the different grades of stone available for the said building." These experts stated that they had "made a careful examination of plans and sections to find if they showed as fully as they should the manner in which the work was to be executed." Their examination included "excavation, masonry, rubble, cut stone, brick work, drainage (partial), carpenter and joiners' work, copper and galvanized iron work, and roof tiling." There was doubt in their minds only as to the clearness of the specification in the matter of the sources from which the building stone was to be obtained. This report as to the satisfactory nature of the plans was dated February 7th, 1887. When a representative of THE CANADIAN ENGINEER called on the architect, November 30th, 1897, he was informed that he would not be admitted to the building to make any observations, "AS THE PLANS WERE BEING CHANGED."

Joseph Wright, of the Bennett & Wright Co., and W. J. Burroughes, were employed to make a further report on certain portions of the plans. They conclude a lengthy and most laudatory report thus: "We find that the plans and specifications, as now prepared, are of a similar description of work as is now being adopted in other large public buildings through the United States, and we are of the opinion that if the work is carried out as set forth in the plans and specifications, that the city will receive a first-class job of plumbing, gas, heating and ventilating works, and one that will give general satisfaction." It is sad to reflect that it is these very plans of the heating and ventilating plant upon which Mr Lennox is now making such changes as are from time to time desirable. It must worry Mr. Wright to be engaged upon a work which was in the first place so carefully planned and specified, and which is now being changed. It is to be hoped that the sum of $107,925 which the city has contracted to pay the Bennett & Wright Co. for this plumbing, etc., over and above the $80,000 which was the amount of the tender opened Sept. 6th, 1888, will mitigate the annoyance caused by any change.

Report No. 4 of the Court House Committee, Sept. 6th, 1888, states that the following tenders were received and opened:—

Masonry, etc., Elliott & Neelon	$838,061 47
Copper, galvanized iron, etc., Douglas & Co.	7,900 00
Painting, etc., A. M Browne & Co.	21,212 00
Plastering, C. R Rundle	82,374 00
Wrought iron, etc., Dominion Bridge Company	91,150 00
Roofing, G. Duthy & Son	34,450 00
Carpenter R. Dennis	149,887 00
Plumbing, etc.,	80,000 00
Contingencies (estimated)	25,000 00
Furniture, architect (estimated)	75,000 00
	$1,405,034 47

Of these the masonry, copper work, painting, plastering, iron work and roofing, were let, and upon almost all of these the city has rendered itself liable to damages, owing to delays occasioned in filling these contracts which have arisen from time to time by reason of the action of the city or its architect.

The contracts, dated July 27th, 1889, require the work to be completed in three and a half years.

The delays were occasioned in the most various ways. The contractors charge that they did not receive the detail drawings from the architect in as short time as they should have done, and it has been established that when supplied the plans were in many cases defective. For instance, the foundation plan was found not to correspond with the excavation plan The ground floor plan would not fit the basement plan, etc. The truth of this statement can be ascertained by examining the original drawings. Even at this time the plans were changed as "obstacles presented themselves." The contractor for the masonry was confined to one quarry, and its output was found unsuitable in some respects. The Credit Valley Quarry Co. which supplied the greystone found the demand exceeded its supply, and a fresh quarry had to be opened near Orangeville, Ont. The works were kept shut down for a large part of each year. The appropriations were exhausted and new ones had to be awaited. Recourse was had to litigation. Some of the contracts were let at much later periods than the rest, it being argued that during the delay prices might fall and the city would benefit. (The manner in which this worked out has already been shown in connection with the plumbing contract.)

Ald. E. A. Macdonald moved, seconded by Ald. J. Tait, May 17th, 1889, "that in view of the fact that the ratepayers are being called upon to vote upon a by-law to provide an additional sum of $600,000 for the erection of a combined court house and municipal building, and whereas the people have already voted $1,050,000 for that purpose, and whereas the public have no better assurance now that the $1,650,000 will complete the proposed buildings than they had that the initial appropriation of $300,000 would do so, etc., etc." Lost.

As the matter stands to day, the people of Toronto are asked to vote a further large sum in the face of the heavy expenditures already made, of the fact that Mr. Lennox is still changing the plans, and that the original contractors, all and sundry, have undoubtedly rights of action against the city for damages, amounting in the aggregate to many times the proposed first cost of the building.

(To be continued in next issue.)

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

ANNUAL DINNER, TORONTO NO. 1.

The 11th annual dinner of Toronto No. 1, C.A.S.E., was held at the Richardson house on Thanksgiving eve, and was in some respects the most successful yet held. Over 100 sat down to a well-filled and well-served table, and Mr. Richardson was complimented on the excellence of the provision he had made for the happiness of his guests. The chair was occupied by President G. C. Mooring, with his Worship Mayor Shaw in the place of honor. In introducing the toast list, President Mooring welcomed the members, and recalled the progress made by the association since the time, eleven years ago, when about a dozen of them met in Bro. Wickens' house to organize for work on the lines which time had shown were so successful. He then gave the "Queen," which was enthusiastically received with "God Save the Queen." "Canada, our Home," was coupled with the name of Geo. Anderson, of the Royal Oil Company, who gave an interesting account of his recent visit to Japan as Trade Commissioner for the Canadian Government. The last address he had given on the subject of Canada was in Yokohama, where the name of our country had been received with special honor. There, and in other Japanese cities, on the occasion of his addresses before commercial audiences, the flags of Britain and Japan were draped together, and on one occasion it was shown in fireworks with the skill and effect for which the Japanese pyrotechnists are noted. Everywhere he went information on Canada was eagerly sought, and if Canadian merchants and manufacturers had enterprise enough to take advantage of their opportunities, an immense trade would be developed between this country and Japan in the next few years. On his way to Japan he passed through British Columbia, and was greatly struck with the vast natural resources of that province. On a visit to one of the canneries he saw two scows brought up, loaded with 24,000 salmon each, and the contents of both scows were to be boiled and canned that afternoon. In going through the Douglas fir woods he saw a tree 300 feet high, 11 feet in diameter, and 90 feet high before the first limb was reached. As to the mineral wealth of British Columbia, he heard it stated in England that capital to the extent of £250,000,000 was now waiting investment in Canada, chiefly in British Columbia. In Manitoba the wheat exports alone were valued at $17,000,000, and of other grains, $3,000,000. The combined exports and imports of Canada now amounted to $260,000,000, which were greater per head of population than any other country, and it was a fact also that we spent more per head of population on education than any country in the world. In reviewing the extension of the ocean transportation facilities of Canada, it was a grand thing to be able to say that one could start at Yokohama, Japan, sail across the Pacific to Vancouver, and thence by rail to St. John or Halifax, and on by steamer across the Atlantic to Liverpool, entirely by Canadian steamships and railways. George Grant then roused the enthusiasm of the audience by his rendering of Godfrey's song, "Land of the Maple." At this point Mayor Shaw came in, and was received with tumultuous cheers. Harry Brown sang "Beer," which was encored. The toast, "Toronto, Our City," was replied to by Mayor Shaw, who apologized for the lateness of his arrival, by explaining that he had already been to two or three meetings, and expected to attend three more before he reached home that night. He came to thank the association for the honor they had done him in inviting him to reply to the toast of "Our City." He was himself born in Toronto, and if anyone had reason to be proud of the city it was he. For 13 years the people of Toronto had retained him as their chosen representative in the Council, and the aldermen, chosen by the people, had in turn elected him to the Mayor's chair, and he had this much faith in their appreciation of him that he believed they would elect him to the same honor in January next, and that he would have the pleasure of opening the grand new city buildings, which would be finished within the year. He referred to the compliments passed upon the Queen's Own Regiment that morning by General and Lady Gascoigne. He looked on Toronto as the fairest city in Canada, and considered it one of the best governed cities in the world. He did not consider the factories of a city so essential as some other things, but held that if more attention was paid to our streets, and some attractive drives made, that these attractions, with our unrivalled educational facilities and climate, etc., would make Toronto famous as a summer resort for Americans and others. He referred to the proposed big new hotel, and said that Toronto was growing surely, if slowly, and that the gloom of the former real estate collapse was now disappearing. James Fax, the comic singer, who has always been a favorite among the engineers, then gave a song, which was heartily encored. "The Manufacturers" was proposed, coupled with the names of John J. Main, of the Can. Heine Safety Boiler Co., F. H. Leonard, of the Toronto Electric Motor Co., and James McLaughlin, of the Queen City Oil Co. After a good song by John Lester, Mr. Main replied, and said that judging from the enquiries for steam power, manufacturers had a good year before them. He took issue with Mr. Anderson as to the possibilities of Canadian trade with Japan, and did not see how Canadian manufacturers could compete with a people who lived on rice and worked for a few cents a day. Neither did he agree with the theory of the Mayor that Toronto's prosperity depended on summer visitors. He considered the establishment of factories of far more consequence, as new industries would bring a permanent population of more value to a city's various interests. As for the interests of the country at large, if the Government saw to it that such products as nickel were not only mined, but smelted and manufactured in Canada, instead of being shipped out in a crude state to enrich foreign corporations, it would be much better than contemplating visions of imaginary foreign trade. Mr. Leonard followed, and said that while he agreed to the policy of beautifying a city, it took the wealth of manufacturers and the labor of mechanics to accomplish these results. He did not feel at home in discussing questions of manufacturing outside his line of business, but on the subject of electricity he could say that there never was a time when so many important electrical developments were being made as within the past few years, and the progress made by Canada would surprise even many who are quite familiar with the subject. In Montreal, for instance, the electrical developments were second only to those of Niagara. The Lachine Rapids plant, just finished, and the Chambly plant, now in process of construction, were great electrical works which would advance the industries of Montreal in a wonderful way. For instance, a development in which he was personally concerned, was the transformation of the large steam plant of the Hochelaga mill, of the Dominion Cotton Mills Co.—the largest cotton mill in Canada—into an electrical plant. The mills were at present operated by three steam engines, aggregating 1,800 h.p., and these were to be replaced by a plant of 1,500 electrical h.p., the power being conveyed to the mills from the Lachine Company's powerhouse and transformed at the mills, where it would be distributed over the various departments of carding, preparing, spinning, and weaving, by motors connected direct to the line shafts, from which the carding machines, spinning frames, and looms were to be operated. By doing away with much of the present shafting, counter shafting, etc., now used in transmitting power to the different departments, losses ranging from 20 to 60 per cent. could be saved, and the successful issue of this work would result in many other improvements of a like nature in the power plants of the city. But as in ordinary cases water under a low head would not pay, and as power can be developed in a city like Toronto as low as $17 to $19 per h.p. per year from coal, there was no reason why industrial development should not go on steadily here. Steam was a good prime mover, and could always be depended on. He had seldom the privilege of speaking to an audience of people who controlled so much power as this, and he thanked them for the honor done him in being called on in connection with this toast. Mr. McLaughlin, in a short speech, said he had had the pleasure of being at these dinners for several years past, and was happy to be with the engineers once more. He regretted that owing to a slight indisposition the president of his company could not also be with them to-night. In considering their present position, his thoughts went back to the early part of this century, when the lot of the working man and mechanic was so gloomy. From a position which was a sort of slavery the working man had advanced till now, when many a man had more comforts than their masters of half a century ago. He pointed out that the exports of Canada had increased from $57,000,000 in 1886, to $121,000,000 in 1896, the trade returns at the present time showing exports of $3,000,000 more than the imports. He thought Canada was prepared to go the world over in trade and manufactures. After a well-rendered comic song by Bro. Thomas Eversfield, the "Educational Interests"

was proposed, coupled with the names of Prof. Galbraith, of the School of Practical Science, and A. G. Horwood, secretary of the Toronto Technical School. Bro. W. G. Blackgrove sang "Out on the Deep," which elicited a hearty encore. Prof. Galbraith said that as he had for the past ten years responded to this toast at this association's dinners, the honor might now be given into abler hands. In the work of technical education we were apt to overlook its social influence in giving so much attention to the practical side of the question. Once there was a great gulf between the uneducated and the educated man, but now, through technical education, all are being brought to the same level, the theoretical man being at one end, and the practical man at the other. Thus by technical education we are not only gaining knowledge, but drawing men closer together. Messrs. Fax and Grant then sang, to the great delight of the audience, a topical duet, with the refrain "Goodness Gracious," in which the following allusions were made to the association, the verses having been composed during the evening by Mr. Fax:

I've just heard some news which will cause you to say,
O ! good gracious !
The engineers flourish and prosper to-day,
Goodness gracious !
Just ten years ago they were hobble-de-hoys,
And as a society, just a few boys;
Now nothing on earth shakes their equipoise,
Gracious, good-goodness! Goodness gracious!

Since then they've increased, both in numbers and strength,
And spread the land o'er in its width and its length,
To judge from this gathering, as now it appears,
We'll be overrun sure in the next dozen years.
And if they keep on we'll be all engineers.

To be at these gatherings, is always a treat,
A jollier lot very seldom you'll meet,
From President Mooring to Wickens to-day,
And men of their stamp, there is none will gainsay,
They meet to do good, and have come here to stay.

Mr. Horwood, on behalf of the Technical School, said he looked after the business end of the institution, and was not competent to speak of the technical part, but since the establishment of the school he had noticed the effect of technical education, not only on the mechanical classes, but upon the policy of the Government itself. When it was first started it was a matter of doubt whether a system of secondary education was a necessity, but the Minister of Education had modified his views on the subject so far as to introduce a bill to enable High School Boards and County Councils to establish technical branches as an extension of their present system. Technical education had a great future before it, and one way to give the manufacturers of the country supremacy, was to educate the mechanic. Referring to the remarks of Mr. McLaughlin, he thought there was still a good deal of slavery among the working classes, but he believed the development of machinery and inventions would bring about a reduction in the hours of labor to the advantage of both men and manufacturers. "The Executive," was coupled with the name of Bro. E. J. Philip, the executive president, who spoke of the progress of the association. The Canadian association was not as big as that of the United States, but it was making steady headway, and held what it got. He mentioned the conference to be held the following day between representatives of the Ontario Association of Stationary Engineers and the C.A.S.E., for the purpose of revising the draft bill for licensing steam engineers, which was to be submitted to the Dominion Parliament at its next session. The engineers in the chief cities, such as Montreal, Toronto, Hamilton, and Kingston, appeared to take most advantage of the benefits of the association, and in this connection he paid a high compliment to the Hamilton branch, which was now doing the best work in education of any of the local associations. That association had planned a series of open meetings for educational purposes, which was creditable alike to its members and their outside friends, and he hoped to see the example followed elsewhere. Harry Brown then sang "A Hot Time in the Old Town To-night." Bro. Wickens, who was greeted with "He's a Jolly Good Fellow," spoke to the toast of the "C.A.S.E." He felt proud to be called the father of the association. This was the only body in Canada whose members spent their own time and money in educating and improving themselves. The first plank in their platform was the educational one. They were not a labor union, as many outsiders supposed; indeed, they were neither afraid nor ashamed to take the best and smartest manufacturers or employers into the association, and many of these manufacturers had found that they could learn something from the association. He was proud to recall the fact, already alluded to this evening, that eleven years ago the Toronto association had its beginning in his parlor, when about a dozen gathered, while now the C.A.S.E. extends from Montreal to Winnipeg, and he was not exaggerating when he asserted that there was not one of the members within range of his personal knowledge but had benefited by the organization, both in mind and in pocket. The one thing the association required was a Dominion license law. If it was not safe for a marine engineer to carry 15 passengers in a boat to the Island without being qualified by license, it was surely not safe for a stationary engineer to have unlicensed control of a steam plant in a factory with 500 people working over the engine-room. After four attempts had been made in the Ontario Legislature a permissive law was passed authorizing an examining board of the Ontario Association of Stationary Engineers to grant certificates of competency, and under this law 750 certificates had been issued to date, some of the holders being now resident in other provinces, including Manitoba, Nova Scotia, New Brunswick, and Quebec. Another proof of the good work done by the C.A.S.E. was that the Toronto Technical School was the outcome of agitation by the members; it being at their solicitation that the first vote of $2,000 to found the institution was passed. Last year the attendance at the Technical School was 1,500, while the total attendance of the three Collegiate Institutes was only 30 more; while the cost of the latter per pupil was $36.50, against $6.60 per pupil at the Technical School. The Toronto branch of the C.A.S.E. had paid out $400 for lectures, etc., and now have a library and other property worth $600. After a song by Mr. Grant, the "Sister Associations" was proposed, coupled with the names of Robt. Mackie and Robt. C. Pettigrew, of the Hamilton branch. Bro. Mackie said that when any of the Hamilton boys came here they felt as if they belonged to Toronto, as there was always a true brotherhood existing between them. They often had visitors from the Toronto branch coming to Hamilton, and they were always welcome. The educational features were stronger in the Hamilton Association than ever before, and through the efforts of men like Bro. Pettigrew, who was himself a member of the city Board of School Trustees, they were having a series of most instructive meetings this winter. Bro. Pettigrew said he was glad to be present on this occasion to share the hospitalities of Toronto branch, and thanked the association for the honor done him in being called on. The Hamilton branch was not so large as that of Toronto, but it was increasing, both in the interest of the meetings and in membership, some new members having been initiated at the last meeting. The fortnightly open meetings which had been aranged for the winter season, were likely to be productive of much good. They had already had a most instructive lecture from Bro. Philip on "Condensers," and they hoped to have other subjects treated by visitors from Toronto in the future. "The Press" was replied to by E. B. Biggar, of THE CANADIAN ENGINEER, and T. S. Young, of the *Canadian Electrical News*. Bro. Mackie, of Hamilton, proposed the toast of "Toronto No. 1," complimenting President Mooring, who returned thanks, and then proposed the health of the host. Mr. Richardson responded in a well-turned and witty speech, in which he showed that he appreciated the value of factories as an element in the progress of a city like Toronto. As for a big new hotel, which one of the speakers urged, he thought that might safely be deferred until some of the existing hotels were able to pay running expenses. The company broke up with "God Save the Queen," at 1.30 a.m. The dinner committee consisted of Bros. Samuel Thompson, James Huggett, C. Moseley, Thos. Eversfield (chairman), and Geo. Thompson (secretary), who did their work to the general satisfaction.

Toronto, No. 1, C.A.S.E., had the meeting hall destroyed by fire on the night of November 30th. The loss will amount to about $200, being chiefly upon the furniture. We hope the members and their friends will all rally to the aid of the society and once more place the society in possession of models, etc., to take the place of those destroyed.

On Thanksgiving Day a combined meeting of Toronto, No. 1, C.A.S.E., the executive committee of the C.A.S.E., and the Ontario Association of Stationary Engineers was held in Toronto to consider the steps necessary to secure legislation along the lines of the bill brought up at the last session of the Dominion Parliament. It was decided to push the bill in the same form as last year. Circulars are to be sent out to all branches of the C.A.S.E., and to all the members of the Ontario Association, urging them to bring all possible influence to bear on the different members of Parliament to secure the passing of the bill.

The Hamilton branch of this association held an open meeting in the hall, on Tuesday, Nov. 8th, President Wm. Norris in the chair. The meeting was well attended, and very interesting. Instead of having a regular paper read, a number of questions taken from the question-box were answered by some of the members present. President Norris explained the difference between an alternating dynamo and a constant current dynamo. He expected a paper going more thoroughly into the subject would be read later on in the season. He also made a few interesting remarks on the construction and use of magnets. Geo. Macki gave the formula, and explained the method of ascertaining the amount of horse-power to be used by an engine in increasing or decreasing the number of revolutions per minute. He also satisfactorily answered a question on the supporting power of stays. The open meetings in connection with this society here are very interesting and instructive, and are well attended.

HOW TO MEASURE.*

BY W. H. BALLARD.

In measuring anything it must be compared with a standard, the measurement of which is known. Examples of common standards are pounds, yards, etc. Although it is generally the case, it is not necessary that that which we measure is greater than the standard. In measuring a surface or area, we take a small portion of the surface (it may be anything, a square foot, yard, etc.), and compare the extent of the whole surface, which we do not know, with that which we do know. For instance, take a surface 12 ft. square and mark off one square yard in the corner; four of these squares would reach from one side to the other, and form a strip one yard wide, and if this strip is repeated until the whole surface is covered, the measurement of the area will be found by multiplying the number of strips by the number of square yards contained in each. No matter how far extended the surface may be, it is measured by this process. Whatever you start multiplying by, the result must be, if by feet, the result will be in feet, and if by yards the result will be in yards. The same principle is used in measuring any figure, large or small. To take a proportion we have to start with something which we definitely understand. In measuring solids we start with the cubic inch, foot, or yard.

This brings us to the second point. In the first place, it was shown that measurement consists in comparison. Secondly, it consists in comparing with something else of the same kind. If weight is to be measured, it must be compared with a certain definitely understood weight, such as a pound, etc. Value is measured by the dollar; area, by the square foot or yard; volume, by cubic inches, feet, or yards; length, by something which contains a certain known length; if any moving object passes through a certain space in a certain time, it is a measure of velocity. The surface of a cone is measured by multiplying the length of the slant line by half the surface of the base. To find the cubic contents of a cone, first find the area of the base, and go through the process of finding the volume of a cylinder, then divide by three, as a cone equals exactly one-third of the cylinder.

A simple way to find the height of a smokestack is by comparing the length of its shadow and comparing it with the shadow of some object of which we know the length. The Imperial standard of measurement is a bar about 40 or 42 inches long at two points, on which there are two gold plugs, and the difference between these points is the Imperial standard yard. In all measurements of length the yard is the standard. Measurements were originally made by comparing objects with parts of the human body, such as the length of the hand, etc.; and land was measured by the length of the foot-step. The standard of weight is made to depend on the standard of time. All measurements have reference to the three fundamental units—time, weight, and length.

*A paper read before the Hamilton Branch Canadian Association of Stationary Engineers at an open meeting, Nov. 23rd, 1897.

THE GOLDEN NORTH.

It is easy to be brave in the presence of topographical and climatic difficulties on the printed pages, and as easy to overcome them—in fancy. The difficulties of Klondyke travel have already given pause to the crowd of inexperienced persons who rushed to the gold fields without due reflection, and with but little knowledge. Numbers who failed to reach the end of their journey are now the impatient citizens of Juneau, Skagway, Dyea, and St. Michael's, and those who have succeeded in reaching the mines have found that for the present gold is by no means the commodity of greatest value. That the deposits cover a vast area, and are unusually rich, is now established beyond cavil. According to Wm. Ogilvie, the gold-bearing zone extends from Cassiar, or probably Cariboo, following the general trend of the coast line through the head of the Hootalinqua, the Pelly, Stewart, Klondyke, Forty Mile, and across the international boundary to Circle City. The width varies from 10 to 150 miles. If this fact were supported by geological theory only, the great wealth of the recently-discovered placers would reasonably suggest that nearly all the gold was massed in a comparatively small area; but the statement is made on the authority of many actual discoveries of the metal in different places within this zone. Enough is already known of the neighborhood of Dawson City, and Cassiar is regarded almost as a dream of the past; but so recently as the end of October, Charles Law reported new and rich placers in the north-west portions of the Cassiar district, east of Teslin Lake, and the discovery of extremely valuable gold-bearing quartz. The placers themselves have been found to justify all that has been said of them. On Bonanza Creek there are about 100 claims that will certainly yield from $250,000 to $500,000 each, and on the Eldorado there are about 30 claims that will possibly average $1,000,000 each. Mr. Ogilvie expresses his settled conviction that the claims on these two creeks alone will yield close on $70,000,000 before they are exhausted. An old American miner, speaking of the wealth of these creeks to Mr. Ogilvie, said that the diggings in the Circle City district, which were once thought very rich, were merely Chinese diggings compared with them, and were outshone by single claims on the Eldorado. In the neighborhood of these there are many splendid prospects, which have yet to prove their actual value. Goldbottom, Hunker, and Last Chance creeks are known to be of immense value, and three branches of the Indian River—Dominion, Quartz and Silver Creeks, are reported to be second only to the Bonanza and Eldorado.

Hitherto luck has played an important part in the location of claims. It does not by any means follow that a claim next to one of the wealthiest will yield anything remarkable. Mr. Ogilvie tells of two men who had toiled for 42 years in the Yukon, never making more than a living, who came to own No. 24 Eldorado, and on cleaning up $11,000 each, decided to return home and end their days in modest comfort. The very next claim to theirs was owned by a young man who went in last summer, and who has already extracted more than the two old men own between them. Many of the now famous placers had been prospected before their real value became known. The Klondyke itself was run over in 1887, and again in 1893, but the wealth of its creeks remained hidden until 1896, when three men, named Henderson, Swanson, and Munson, announced their most extraordinary find, and thousands of persons last year walked over the neighborhood of Skookum Gulch, ignorant of the fact that under the moss lay a deposit of coarse gold, from which a miner could take in a day as much as a skilled mechanic could earn by a year's labor in a large city.

In the majority of cases, however, mining entails very hard work, and it must be remembered that the methods of prospecting for placers and lodes usually adopted are often inapplicable in the Yukon. The deposits of gold are usually covered with silt, to a depth of from eight to twenty feet, which was deposited on the top of the gold-bearing layer after the stream had ceased, as a rushing torrent, to tear the exposed metal from its rocky bed; and the discovery of such placers will entail a vast amount of patient labor. It is sometimes necessary to dig twenty, and even thirty holes, at about the rate of a foot a day, before pay dirt is struck. Mr. Ogilvie mentions a case in which a man had dug eleven holes without finding anything. Notwithstanding this, some others retained their confindence in the claim, and paid $2,500 for a half interest in it.

The discovery of Cone Hill, which seemed to be one extensive block of rich quartz, is already known to our readers, but we may add that it produces from $5 to $7 a ton, and there are six other quartz claims in the neighborhood of Forty Mile and Dawson. A Montana expert miner has located two claims about 40 miles up the river, which produce from $3 to $11 per ton, and on Bear Creek is another, which Mr. Ogilvie rates as one of the best properties in the country, while on Gold Bottom Creek there is a claim from which specimens treated merely by a hand mortar, produce from $100 to $1,000 to the ton. Quartz has been reported in other places by Dr. Dawson and the mother lode remains to be discovered. Bitter disappointment or bewildering success may await the discoverer; but enough is already known to make it certain that quartz mining will become an industry directly the facilities for transportation are increased.

The Minister of the Interior was so impressed with the need of this during his recent visit to the confines of the Yukon district, that he took the earliest opportunity on his return to give public assurance of the purpose of the Government to make the most complete arrangements possible. All the routes have now been traversed by Government agents, and we may expect soon to hear of some permanent plan for the easiest and cheapest transport, not only of gold, but of all the wealth of the Yukon, through Canadian territory. There are proposals for railways, tramways, cable ways, or wagon roads, along every known route to the neighborhood of the mines—from the coast, or from the central portions of British Columbia and Alberta. Steamers are to ply the Mackenzie and Porcupine, the Yukon and the Stickeen, wagon roads and railways are to connect the C P R. and the head waters of the Pelly and the Hootalinqua, and cableways and tramways are already in course of construction over the passes.

The route which seems to recommend itself to the Canadian Government is that by the Stickeen River. In this case the steamboats, which leave Victoria every few days, will carry you through the Seymour Narrows to Port Simpson, the most northerly Canadian port on the Pacific, and thence to Fort Wrangell. From here you ascend the Stickeen River to Telegraph Creek. There a portage of 150 miles to the head of Teslin Lake is necessary. This portage runs through an undulating and fairly well wooded country, where natural hay might be found for a limited number of horses, and has recently been surveyed, with the object of constructing a railway from Telegraph Creek to Teslin Lake. On arrival at the head of the lake, lumber is cut from the trees in the neighborhood, for making the boats which must transport you down the lake, a distance of 80 miles, and thence down the Hootalinqua to its junction with the Lewes, a further distance of 125 miles: and then on down the Lewes to the Pelly or Yukon. The distance from Victoria to Dawson City by this route is approximately 1,600 miles.

It should be remembered that Hudson Bay traders have been in the habit of entering the Yukon district from British Columbia, entirely over land, for years. Many travelers have recently chosen this route, and one of the police parties was sent that way, with instructions to report upon it. A company has been incorporated under a British Columbia charter, which proposes to build a toll road from Edmonton to St. John, on the Peace River, thence to Lake Teshudy, then across country to the Liard, and then along the Frances to the head waters of the Pelly. J. B. Powell, the promoter of this company, asserts that passengers will reach the Pelly River two weeks after leaving Edmonton.

SHIP V. BARGE CANALS.

The reconstruction of the map of North America, so that the products of the northern part of the United States might find their way to the Atlantic seaboard without passing through the territory of a foreign power, is a problem which has been much dwelt upon by the numerous statesmen of the United States for many years past. Failing to annex the St. Lawrence route, engineers have been called upon to construct one. In a former issue of THE CANADIAN ENGINEER we discussed the different routes by which it was considered possible to build a waterway from Lake Erie to the Hudson River. Of the three leading ones discussed, the engineer instructed by the United States Government to make a report on the subject, Major T. Symons, goes into the merits of that by way of Oswego alone. In this scheme a new canal would be constructed from Lake Erie to Lake Ontario, and from Oswego on Lake Ontario, to the Hudson River. Major Symons, however, only discusses this plan in order to show how impracticable it is. The lowest estimate of cost which he considers at all is $200,000,000, and annual cost of maintenance he believes would be at least $2,000,000. In this rough estimate of the cost little account is taken of the fact that the Mohawk Valley would be flooded, and enormous damages result to the New York Central Railway and other powerful corporations. The expenditure on impounding works for the storage of water in the Adirondacks would also amount to a vast sum.

LITUYA BAY, LOOKING N. N.-E. MT. FAIRWEATHER TO THE LEFT, AND MT. LITUYA TO THE RIGHT.

The whole project may therefore be dismissed from the public mind as being something which is too expensive for even the people of the United States.

In laying aside the proposed ship canal, however, Major Symons urges strongly the enlargement of the present Erie Canal, so as to give passage for barges 200 feet long, 30 feet broad, and drawing 10 feet of water; that the locks be reduced in number, and arranged to give passage to two boats at one lock, with mechanical lifts to replace flights of locks where advisable; the business to be conducted by fleets consisting of one steam barge and three motorless consorts, running between Buffalo and New York; the barges to be strong enough for running on the Great Lakes. Major Symons claims that if a ship canal were built the business would not be done in large lake or ocean vessels, but in barges and boats which could be equally well accommodated in a canal of less size. He furnishes a vast number of statistics and a great many tables in

support of the above propositions. We have only room for reference to the following: Estimated cost, Chicago to New York, including lake freight, 1.37 cents per bushel, transfer charges 2-3 of a cent per bushel, and 10 per cent. profit on cost of transportation between Buffalo and New York:

	Cents.
By ship canal, in 5,000-ton vessels, per bushel	4.46
By 1,500-ton barge canal, with semi-independent motive power and consorts, per bushel	3.05

If what Major Symons claims is true, the present outlay on the St. Lawrence canals is not a necessity; but if barge canals are all that the traffic requires, why is the St. Lawrence route at present comparatively deserted, the Ottawa canals hardly ever in use, and the locks of the Rideau system rotting in idleness?

THE CHAMBLY POWER PLANT.*

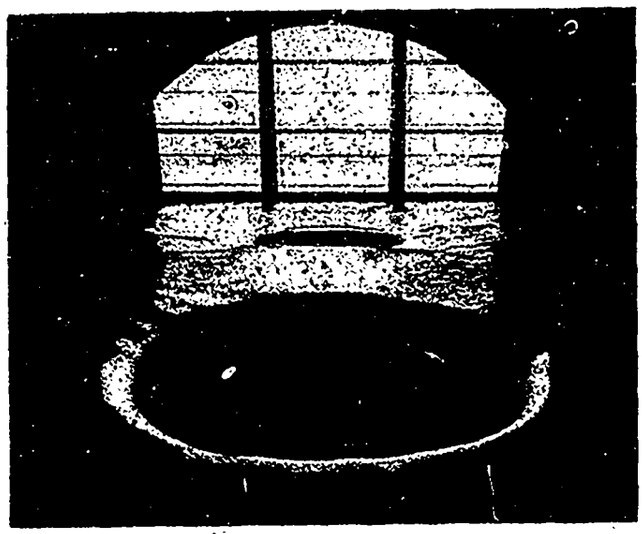
Four important long-distance transmission plants using water power as the prime mover have recently attracted much attention. While two of these plants, Chambly and Mechanicsville, are quite alike in their salient features, they are widely different from the other two at Bakersfield, Cal., and Three Rivers, Que., and among them is represented a wide variety of engineering. There can be no doubt that the application of water power for electrical generation and transmission is a rapidly developing art, and that in many places in the country hitherto unproductive streams may now be turned to good account by means of electrical transmission of power. Taking all these plants together perhaps the most striking feature to electricians of the older class is the enormous potentials which they employ, and the extreme simplicity of the means by which these are controlled and handled. It apparently needed the example of the Niagara installation to induce the investment of large capital in enterprises of this character. Despite its glaring defects of engineering the Niagara plant still stands foremost as a representative installation, and its unquestioned success has been the means of widely encouraging the establishment of similar plants. It is pleasant to be able to entirely commend the work that has been done on some of the new installations. Perhaps it is fair to say that, in many respects, the plant at Chambly is one of the most carefully planned and best designed that has yet been constructed. While many engineers will feel at first some doubts about the propriety of running dynamos below the water level of the forebay, it seems that it should be easily possible to guard against anything short of an absolute overflow of water over the crest of the dam at a point above the dynamos. With any reasonable variety of hydraulic engineering this casualty could be placed in the category of visitations of Providence, since it is possible to guard against every conceivable variety of accident which would make such an overflow possible. Dampness is no longer such an enemy to insulation as it was in the older days, but it would have been

TWO STEP DAM FROM BELOW, SHOWING TAIL RACES AND FLUMES.

perhaps equally easy to use a type of wheels with vertical shafts and put the dynamos high and dry above the water level.

*Reprinted from the *Electrical World*, New York.

Whatever may be said about the electrical features of these installations it cannot be denied that the hydraulic engineering at Chambly is of the very highest class. It seems that the means adopted must secure the highest possible efficiency, and it would be difficult to conceive of more beautifully simple and direct mechanism than that employed. The only feature of their work about which the hydraulic engineers may feel any doubts is the method of governing employed. The physical difficulties in the way of governing water wheels are very great, and this is especially true in turbines in which a large volume



FLUMES AND DRAFT TUBES BEFORE TURBINES WERE SET.

of water in motion, possessing enormous inertia, has to be handled through the agency of gates, themselves necessarily heavy and difficult to move. There seems to be no escape from this particular feature of water-power work, and the engineers who have designed the governors in use at present are to be congratulated upon having accomplished such excellent results under such difficult conditions. The simultaneous construction in this country of half a dozen or more plants of the largest size and highest class for long-distance power transmission can be regarded as very gratifying evidence of the success which has marked previous installations. It also points to the not distant day when any water power, of any considerable size, within transmission range of a centre of population, will be utilized in this way. What this means to the citizens of towns the greater part of whose power is brought in in this way is hard to realize at first. It is possible that successful long-distance transmission of power of this kind may result in smokeless cities, as it certainly will result in the cheapening of power and its small sub-division and application to many uses to which it is not now applied. In this way, as notably heretofore in the case of the electric light and the electric street railway, electrical engineering has had a direct influence upon the social environment for the greatest good.

In a recent number of the London *Electrician* a list of some large installations in America in erection and under contemplation is given, and the question asked: "What will we do with it all?" referring, of course, to the vast powers. It may be proper here to say that there is no country in the world which can absorb so much power or find so many uses for it as this. The development of a great power at any point produces an industrial condition which shortly results in the establishment there of works which find it to their benefit to seek cheaper power or different conditions. In this way there has grown up around Niagara Falls a great manufacturing city, which is rapidly extending. It is by no means visionary to hope for the establishment of similar great centres of industry within the working radius of electrical transmission from other such sources of power. The actual powers used in industries in the United States are probably much in excess of the total of all the available water power in the country, and the question asked by our contemporary seems to answer itself when this fact is considered.

Canada is a region of gigantic water powers, which have waited for the advent of electricity to be utilized for the many purposes to which they are applicable. Perhaps the finest installation for the development and transmission of the power

of falling water extant is that of the Chambly Manufacturing Company, at Richelieu village, Quebec At this point, about 25 miles distant from Montreal, the Richelieu River falls through a long series of rapids. From early days a wooden dam between Richelieu village on the one side of the river and Chambly on the other has been in existence, supplying power to a few small mills The new structure which takes its place is one of the finest examples of hydraulic engineering on the continent, consisting of a massive concrete dam, in which, as an integral part, is built the power-house, with a capacity of 20,000 horse-power.

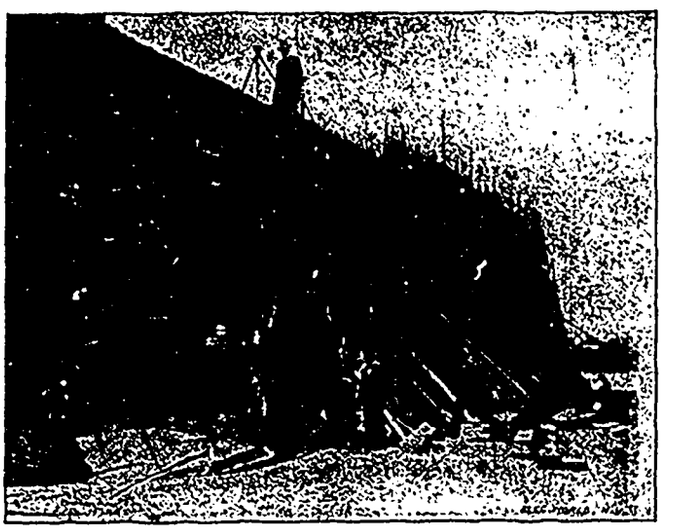
This dam is about 2,000 feet long, 6 feet wide at the crest, and constructed of a concrete composed of the broken rock of the river bed, mortared with sand from the vicinity and American cement. The back is vertical throughout, and the apron is curved so that the overflow water is discharged horizontally, obviating any destructive washing action at the base. A liberal use of one-half inch iron rods, incorporated with the mass of the concrete, gives great strength to the structure, and a surface dressing of neat cement insures the greatest impermeability. This is said to be not only the most carefully constructed but also the largest concrete dam on the continent. The dam consists of three portions, two of which run perdendicularly across the course of the river, while the third and middle part is parallel with it. In the lower third of the dam, and near the right bank of the river, is built the power-house. Here the dam consists of two levels, or steps, over which is built a structure of steel beams and brick walls, 308 by 51 feet, for the protection of the machinery The upper level, which is about 2 feet above the surface of the water in the lake, formed by the dam, will contain the switchboards and controlling devices and such offices as are necessary. In this part of the dam eight rooms, or flumes, each about 20 feet square and 10 feet high, are constructed, their arched openings being under the water level, for the reception of the wheels. These, of the horizontal-shaft pattern, number four in each flume, each wheel being 46 inches in diameter. These wheels are mounted tandem on one shaft in two pairs, between the wheels of each pair being a large cast-iron box communicating with the draft tubes, which extend through the solid concrete of the lower step of the dam to a point below the level of the tail water. The draft tubes are built of sheet steel, and are 9½ feet in diameter where they leave the boxes, and 10 feet at their outlet. The upper extremities of these being one behind the other, in the line of the shaft, necessitated their construction in a curious skew curve. This installation seems to run to superlatives, since these draft tubes are the largest ever constructed. Their bedding in concrete excludes all possibility of leakage, and it is confidently

CASINGS FOR FOUR TURBINES IN PLACE IN FLUME.

expected that the full advantages of the head of 28 feet will be realized by their use, although the wheels are but a few feet below the level of the intake water. Under this head, and at the speeed of 153 r.p.m., each wheel will develop 660 horse-power, or a total of 2,640 horse-power to each shaft and flume.

The governing of the wheels will be by means of Giessler electro-mechanical governors. These are relay governors, the revolving balls actuating a small lever which closes electrical contact at speeds higher or lower than that for which the instrument is set. These contacts control electromagnets which operate clutches on the main shaft geared to the gate of each gang of wheels. It has proven an excellent and reliable governor in other large hydraulic installations.

At present only four of the eight sets of wheels are being installed, together with two 28-inch wheels, giving 750 horse-



BUILDING THE UPPER STEP OF POWER-HOUSE DAM, SHOWING MANHOLE TO FLUME AND ENTRANCES TO CABLEWAYS

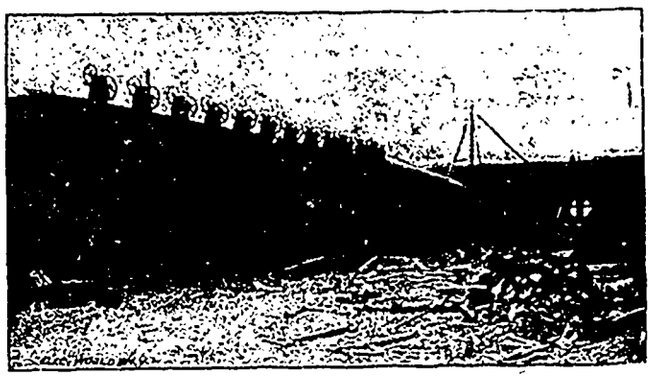
power for driving the exciters of the large dynamos. The whole of the hydraulic machinery was furnished by the Stilwell-Bierce & Smith-Vaile Company, Dayton, Ohio, and reflects much credit upon that concern by the solidity of its construction and the great accuracy with which the parts of the heavy wheels and draft tubes were assembled at Chambly by its constructing engineer, H. A. Wright.

The shaft of each gang of turbines passes out horizontally through a circular steel bearing plate on the down-stream vertical face of the upper step of the dam, and is directly connected to a 2,000-kw. generator, giving two-phase current at 60 cycles per second and 12,000 volts These machines are of the inductor type, having no moving wire. The inductor is about 10 feet in diameter, and of very massive construction. The single-circular field coil is wound on a brass spool of about 10 inches face by an equal depth, and completely surrounding the inductor. The armature is in two parts. The insulation of these armatures is necessarily most massive and substantial. All the dynamo machinery is now under construction by the Royal Electric Company, Montreal, from designs by the Stanley Electric Manufacturing Company, Pittsfield, Mass.

In the space above the flumes in the upper portion of the powerhouse dam a large conduit has been made for the reception of the leads from the dynamos to the switchboard. Lead-covered, rubber insulated cable will be used for these. In the walls of the power-house a number of large terra-cotta pipes, about 3 feet long, bent to a quarter circle, with the convexity upwards, have been built in, and through these the cables leading to the pole line will pass out without touching anything between the insulators inside and outside the building. Two pole lines will be constructed to Montreal, either one being sufficient to carry the load. This construction was adopted to minimize the chances of accidental breakdown, and to make repairs easily possible without danger to workmen. The poles are of chestnut, none being less than 40 feet long. Each pole carries two cross arms, the usual "square" for two-phase transmission being observed. The insulators are of a deeply petticoated porcelain type, somewhat similar to the Niagara pattern, but lacking the grooves for conducting away rain water. They are mounted on oak pins, having a steel rod in the centre of each. A line of barbed wire is run along the tips of the poles, and four similar lines are attached to the ends of the cross arms, all five being connected together and grounded by means of 8 feet of iron gas pipe at each pole. The line wire is bare, of 00 gauge, and is tied to the insulators by two pieces of No. 12 gauge soft copper wire. A short distance below the main line a short cross arm carries the two No. 12 copper wires of a telephone circuit. The main power trans-

mission line will end in the electric-light station of the Royal Electric Company, at Montreal, where 6,000 horse-power will be used for incandescent and arc lighting and direct-current motor service. The large two-phase generators now employed in that plant for incandescent lighting and power will be rewound as synchronous motors, and connected directly in the 12-000-volt circuit. These machines will then be belted by a system of countershafts to the arc light generators and other continuous-current machines of the station, to which they will furnish power. A group of static transformers of 150 kilowatts each will be aranged in the basement of the present station, reducing the line voltage of 12,000 for distribution over the present circuits at 1,000 and 2,000 volts, two-phase.

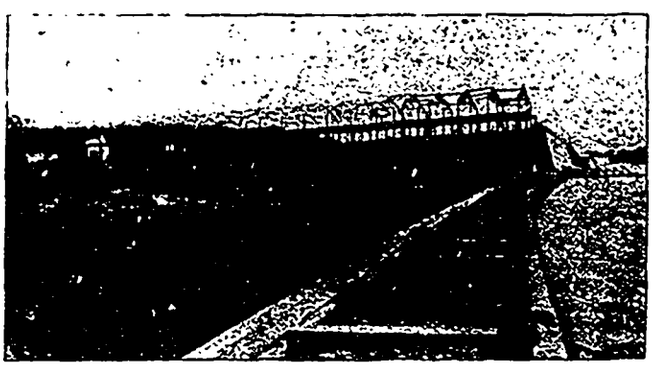
These transformers are now under construction at the works of the Royal Electric Company, Montreal. Their



UPPER SIDE OF DAM SHOWING WASTE GALES.

greatest feature of novelty is in the method of cooling employed. The transformer is set up in an iron case in the usual way, this being filled with oil for insulation, and the whole surrounded by a sheet-iron water jacket. As the plant in Montreal is some feet below the level of the Lachine Canal, from which water is obtained under a small gravity head, the water going to the condensers will be allowed to circulate around these transformers in the jackets, and it is expected that this arrangement will result in very effectual cooling.

The troubles with ice, which have been for so long a bugbear to many Canadian plants, are not expected to be at all serious at Chambly. The back water from the great dam will make a lake of still water at least 1½ miles long up the river, and, as this will freeze over the surface at the beginning of the season, no trouble whatever is expected from anchor ice. It is expected that floating ice in the spring thaws will clear the dam without trouble. It is a peculiarity of the Richelieu River, which is the outlet to Lake Champlain, that its current



DAM SHOWING POWER-HOUSE.

is comparatively steady throughout the year, and consequently no difficulties with freshets or low water are anticipated. The construction of the dam and other elements of the power development reflect great credit upon the engineer of the Chambly Manufacturing Company, J. G. Mecklin. The work is progressing at an extremely rapid rate, and the contracts call for the installation of all the hydraulic machinery and the completion of the dam by January 1 next. One of the dynamos is finished and the others are well under way, so it is likely that current will be turned on from this installation on time.

It is expected to deliver nearly 20,000 electrical horse-power from this plant in Montreal, when the total equipment is installed at Chambly.

APPLICATION OF ELECTRICITY TO STEAM RAILROADS.*

BY N. H. HEFT.

The New York, New Haven and Hartford Railroad Company owns and controls about 2,800 miles of main line railroad track in New York, Massachusetts, Rhode Island and Connecticut, of which about 16 miles are operated by electricity on the third rail system, and 14 miles on the overhead trolley system.

About three years ago, the New Haven Company found that various electric railways in its territory were gradually extending their operations into the field of interurban work, and that the company's passenger earnings were suffering accordingly. It was at once seen that by no ordinary methods of changing schedules or increasing speeds could this lost traffic be won back again, and, with characteristic knowledge and courage, President Clark and the New Haven directors determined to "steal the thunder" of its new competitors, and commenced a series of elaborate experiments in heavy electric railroading. It must be confessed that this decision was reached only after some misgivings. To the average railroad man, street railways have, until recently, seemed a pretty sort of toy, fit for apprentices in the art of transportation. Latterly, however, he has waked up to the fact that "the tail will wag the dog" unless some radical action is taken, particularly in suburban and short distance work, and, in the Eastern sections of the country anyway, railroad men have become modest enough to be willing to look with respect upon the great work which has been accomplished in street railroading.

The first line to be equipped by the New Haven Company was a purely summer road, operated for about four months in the year only, through a narrow peninsula running out from the main land on the Massachusetts Coast from Nantasket Junction to Pemberton, a distance of about seven miles of double track. This line was chosen partly because the main line operation would not be interfered with in case of trouble with the electric trains, and partly because of the existing heavy summer traffic which would put the new apparatus and the feasibility of the entire system to a severe test. An overhead trolley line was built, with centre pole construction, and everything made very strong and more substantial than was at that time found in any street railway work to our knowledge. At the time of construction of this overhead line, there were no suitable movable switches in the market, and we had to remodel and have built especially for our purpose those which we finally adopted. One feature, perhaps, worthy of note, is the connection of the overhead switch with the track switch in such a way that both are controlled by a single lever at the switch stand.

The line was operated for the first summer with excellent success, and, all fear of trouble having disappeared, an extension of 3.6 miles was made on the main line of the company's Plymouth division, from Nantasket Junction to East Weymouth, this section being operated by the third rail system. In December, 1896, we commenced work on a new line running from Berlin, Conn., through New Britain to Hartford, a distance of 12.3 miles, three miles of which, from Berlin to New Britain, is a double track, and the remainder, from New Britain to Hartford, a single track. A power station was built at Berlin at one end of this line, partly because of a desire to test transmission of power to a considerable distance, and partly because Berlin is the centre of several radiating lines, which may eventually be put in operation by electricity.

We have learned very thoroughly, in our street railway experience, the lesson of the importance to any transportation agency, working in a thickly populated territory, of uniform fares, and a frequent and regular train service—of a train service which requires no printed schedule to enable people to know when cars may be found in waiting. The time has come when every progressive railroad manager must recognize that new conditions and the new character of competition require a complete change of operating methods.

On its Nantasket Beach line, the New Haven Company gave, during the last summer, a regular half hour service from 6.30 in the morning until 11.30 at night. The fares charged on the Nantasket Beach line before the advent of electricity were ten cents from Pemberton to Nantasket and eighteen cents from Nantasket to East Weymouth, a total of twenty-eight cents from Pemberton to East Weymouth. With electric traction they have been placed at a uniform rate of five cents from Pemberton to Nantasket and five cents from Nantasket to East Weymouth. Under these new conditions the traffic has increased enormously on this line, the summer of 1895, the first of electrical operation, showing an increase of 92.6 per cent. over the previous summer in the number of passengers carried, the summer of 1896 showing 45.1 per cent. increase over 1895, while in the summer just passed, we have carried nearly three times as many passengers as

*Condensed from a paper read before the American Street Railway Association; Niagara Falls, N.Y., October, 1897.

in the last year of steam operation. The operation of the line from New Britain to Hartford was commenced in May last, with a regular half hour train schedule from 6 00 in the morning to 11.30 at night, and with a uniform fare of ten cents each way, instead of twenty-three cents, the former charge. The electric line carries through passengers only between Hartford and New Britain, the passengers for the five way stations being carried by the regular steam trains running on a parallel track. Sixteen trains each way per day are run, connecting with steam trains Under the conditions named on the Hartford-New Britain line we have carried, during the three summer months, 400 per cent more passengers than we carried through the corresponding months of last year.

I do not suppose that any but a trained railroad man can understand the impossibility of operating trains and maintaining schedules by steam locomotives in the way that has been done by electricity at Nantasket Beach this summer. There are several grades and a great many curves on the line. There are no excessively sharp curvatures or steep grades, and it is not here that the trouble has come. The difficulty is found in the fact that there are no less than seventeen stations on a line only 10.6 miles in length, or an average distance between stations of about six-tenths of a mile. To make a run of 10 miles with sixteen stops in twenty-six minutes: to be obliged to do this in order to connect with boats arriving at regular half hour intervals—are things which cannot possibly be accomplished by steam locomotives. The reason is found in the tremendous accelerating power of properly designed electric motors with rotary motion, as compared with reciprocal motion of steam locomotives. On this line, for example, a 60-ton train in running from Windermere to Allerton, a distance of only 1,800 feet, reaches a maximum speed of 31 miles per hour, while in the longer run from power station to Nantasket Junction, a distance still of but 5,808 feet, a maximum speed of 39 miles is reached. The entire distance is covered, in regular service, at an average speed of 24.6 miles per hour, including stops. Between Hartford and New Britain, the 9 3 miles distance is covered regularly by motor cars with two trailers in from 18 to 20 minutes, an average speed of from 28 to 30 miles per hour, while, with a special high-geared motor, a maximum speed of over 60 miles has been made; the entire distance of 9 3 miles being covered in 10 minutes. On this line, between Hartford and New Britain, a 52-ton train often reaches a maximum speed of 50 miles per hour. The current is cut off at twenty-nine grade crossings when single car trains are run.

The type of car selected for any good transportation service has a direct bearing upon the development of traffic and maximum gross receipts. It has been difficult for steam railroads to depart far from the long-established custom of closed passenger coaches of the present standard type, and to adopt open cars, on account of the disagreeable effect on passengers of the smoke and gases from engines This has naturally thrown a great deal of traffic to competing street railway lines running open cars in summer, on account of the much greater pleasure in riding. With electric operation, open cars in heavy railroad practice are possible, even at considerable speed, particularly if the front of the car is closed in with glass, and both at Nantasket Beach and on the Hartford-Berlin line, we have used heavy open cars with great success.

The motor car which we have so far used we do not consider, by any means, the final type, and even now, we have in mind plans o combination cars which we believe will be, on the whole, well adapted for railroad work. The present motor car is very heavily built, with floors of a height equal to that of our standard passenger coaches. It contains sixteen cross seats, capable of seating ninety-six passengers, and the entrance is from either side with three steps. Each car has two heavy railroad trucks, one of which is equipped with two 125-h.p. motors. The total weight of the motor car is 32 tons, and the trailer car of the same type weighs 25 tons. The motors which we have used up to date have been of a type common in heavy elevated railway work. These motors have often been in service for several consecutive days, making 324 miles each day, without apparent injury. We found the motors we are using already on the market when we commenced our experiments, and until recently no attempt has been made by us to specify changes. Under these circumstances, great credit is due the manufacturers for their efforts to meet the difficulties encountered. The experience gained with these motors has served as a basis for building larger and heavier types, better adapted for the severe work which they will be called upon to fulfill to meet our requirements. An important point which we shall specify in new motors is that they shall have the most perfect ventilation possible. The efforts of manufacturers have been hitherto directed towards completely encasing the motors, so as to make them waterproof, but in doing this, ventilation has been sacrificed. We have found it beneficial to blow out our motors several times during the day by means of a blast of air from a hose pipe connected to our air brake reservoir, but this is, at best, but a makeshift. It is very difficult to dispose of all the necessary cables, wires, brake rods and chains, air brake cylinders and apparatus, switches and other car-controlling mechanism in the limited space beneath the car floor, as may be readily imagined by those familiar with street railway work. As a consequence, there has always been more or less controversy between those responsible for the placing of the different portions of the equipment, as to who shall have the first right to a given space, perhaps hardly half a dozen square inches in section There is also more or less trouble with abraded wires, short circuited shoe hangers, etc., and for our future work, we are making an effort to simplify this mass of equipment mechanism by putting some of it, particularly the wires and cables, in a space between the true floor of the car and a false floor, several inches below, specially provided for the purpose,

For operating heavy trains of this character, where currents of from 500 to 1,000 amps are sometimes used, the controlling apparatus must be massive and strong in every part, and the greatest care must be taken to prevent arcing We have had no trouble with controlling apparatus on our regular equipments, and we consider this branch of the apparatus well perfected The danger to station and car apparatus from lightning discharges, which is so important a factor in street railroading where the overhead system is employed, is avoided in third rail work, since the third rail is so close to the ground that it is practically a lightning arrester itself throughout its whole length. The problem of braking, which is so important a one in street railroading, is found more so with us, since the train weights and speed are enormously greater. The regular Westinghouse air brake system, with engineer's valve, is used on our electric trains, but instead of steam air compressors, we have an electric motor compressor controlled by an automatic regulator, which has given excellent satisfaction.

Our experience with trolleys on the overhead line at Nantasket Beach, originally put in two years ago, has not been satisfactory. We find it quite impossible to prevent the destruction of trolley wheels by almost continual arcing when attempting to take from the wire the heavy current required in starting and during acceleration, as well as the smaller currents taken at the maximum speed. There has been a good deal of trouble, moreover, in keeping the trolley on the wire in making speed and taking curves, and many trolley poles have been broken The trolley difficulties have not interfered with the continuous operation of our line, but the cost of replacing wheels and poles has been rather large.

These difficulties have had an important influence in causing us to reach a decision in favor of the third rail. The contact shoes which take the current from the rail to the motor circuit have given, on the whole, good satisfaction, although they are occasionally carried away by the approach blocks at grade crossings when these blocks happen to be slightly misplaced, so that the shoes strike them at the wrong angle. The contact shoes are suspended by cast iron links, which are intended to be weak enough to allow the shoe to break away easily without doing damage to the framework of the car. The trail cars are also equipped with shoes, and connected with the circuits on the motor car by means of flexible couplings, and it is possible, therefore, when the cars are run in train, to bridge the longest gaps found at grade crossings and switches, so that it is not necessary to turn the current off on approaching these. This arrangement makes our trail cars independent of the motor car for heating and lighting.

Our third rail and return circuit experience will be of value, as we have made a wide departure from established methods. First is the question of insulation. The third rail has a potential of 600 volts above the ground, and rests upon creosoted wooden blocks doweled into the ties, its eaves being only 1⅝ inches above the tie. Now it frequently happens that water accumulates two inches or more in depth over the ties, and, if it were not for our experience to the contrary, we would naturally suppose that, under these circumstances, the line would be directly short-circuited between the third and service rails through the water, the distance being about two feet each way. Nevertheless, we have been able to operate our road without the slightest difficulty when this has happened, and nothing unusual has been noticed at the station, nor has the electrical output, as registered by the recording wattmeter, been abnormal. At Berlin we have watched the ammeter closely when we knew the tracks to be submerged in two places, 10 miles apart, during a heavy rain storm, and we have found that the leakage was almost imperceptible when both cars on the line were at rest and their air pumps out of circuit. At the same time the wattmeter was standing still. Of course, if a long length of track was submerged, the leakage might become serious, but we have yet to learn how much is necessary to accomplish this result. We aim to so connect our third rail lines and the service rail return, as to have a practically complete metallic circuit of extremely low resistance, as far as possible disconnected with the ground. We do not believe in grounding our track, and, though ground plates are placed at the

station, connected to our generator, by far the largest proportion of the return current comes through the cables connected directly with the track, the percentage coming from the ground plates being extremely small.

The joints of the third rail are bonded by long copper plates, firmly bolted to both sides of the joint, sixteen bolts being used in all. These copper plates are tinned before being put into position. Owing to the large area of contact surface, the presence of rust on this surface does not materially interfere with the conductivity of the joint, as shown by accurate tests. The service rails are bonded with the greatest care, four copper leaf bonds, having a cross section of copper equal in conductivity to that of the rail, being used. These bonds are inserted in the base of the rail instead of the web, so as to prevent breakage through play at the joints. The copper leaves are cast into end piece blocks in such a way as to weld them thoroughly together in the blocks. The latter are formed into a hollow cylinder, 1 inch in diameter, which passes through a hole in the flange, and by which a large area of contact is secured. Tapered pins are driven into the inside of this cylinder from the top of the flange, and the connection made is very perfect. The form of this service rail bond is shown in Fig 5 Careful tests have shown that the joints of both third and service rails have now a slightly greater conductivity than an equal length of the rails themselves. Some of the tests of our third-rail and service rail bonding and of the experiments which have led up to our present practice may be of interest, and are given below.

A few words about the danger of the third rail system would be, perhaps in order. There have been many cases of people who have stepped from the ground to the third rail without feeling the current, and anyone can step upon it from a dry tie without the slightest effect. On all except wet days, our employees work about it without trouble, avoiding, of course, putting themselves in direct contact with both service and third rails, but not infrequently "monkeying" with the current in such a way as to get shocks of more or less severity in a sort of horse play. On wet days, they refer to the third rail as being "lively," and are inclined to let it alone. Many of our employees have, however, received the heaviest shock possible to obtain, time after time, and care little about it, though those who are more influenced by electric shocks than others are sometimes thrown off their feet, but recover fully in a few minutes. We do not say that the third rail has no dangers, but we do not consider the danger as being at all serious or one which should interfere with the extension of the system. As a result of exceptional care which we have taken in bonding our third and service rails, we have found it unnecessary, in any third rail work so far done, to use copper feeders, in spite of the fact that we are obliged to transmit current from Berlin to Hartford, a distance, as before stated, of 12 3 miles, straight away from the power station. This work is made up as follows. From Berlin to New Britain, a distance of three miles, there is a complete double track electric road with two 100-lb third rails, and four 74-lb. service rails, all most carefully bonded as described above. From New Britain to Hartford, a distance of 9 3 miles, there is one complete electric track, with 100-lb. third rail and 70-lb service rails, all carefully bonded, in addition to which we have connected to the service rails of the electric track the rails of the second track, paralleling this the entire distance, at various places, in order to get the benefit of whatever conducting power there might be in this track connected only by its fish plates at the joints. As a result of this work, we are able to run two trains of 52 tons each on the New Britain and Hartford line, with an average loss of but 26½ per cent. The current output of the station at such a time averages about 300 amps., with a maximum flow of about 700 amps., at a pressure of 600 volts. Of course, if the service were heavier, so that more cars would be required, it would, undoubtedly, be necessary to reinforce the third rail with feeders. The method of bonding the third rail has already been described and illustrated in previous numbers of THE CANADIAN ENGINEER.

In our Nantasket Beach station we have installed two engine generator units of 800 h.p. and 550 k.w. capacity each. The steam is supplied by eight boilers of 200 h.p. rated capacity each. On heavy days both these engines are required, but on ordinary days but one only, and this is not fully loaded; the average loads being, perhaps, one-half the maximum. In the Berlin station we have installed two engine generators of 1,200 h.p. and 850 k.w. each. The steam is supplied by ten horizontal tubular boilers, of 200 h.p. each. One unit only is required in the practical operation of all the cars on the Berlin and Hartford lines, and the average power output is hardly one-fourth of the maximum capacity. In both stations our aim has been not to follow out any engineering fads, but to provide apparatus proved by long experience to be of the most simple and durable character. The details of piping and arrangement of steam apparatus have been so thoroughly described in the technical papers that it is unnecessary to refer to them here. We are now running our Nantasket plant condensing and our Berlin plant non-condensing, the loads in the latter being too light to make condensing profitable. In spite of the fact that these general conditions of operation do not point to a low cost of power, because of the fact that we are working neither station at anywhere near its full capacity, I suppose we are, as a matter of fact, producing power more cheaply than can be done in any power station in the country using coal as a fuel, the reason being that we are burning sparks. "Sparks," as we are accustomed to call them, are the half-consumed coal dumped from the extension front of locomotives at the company's various round houses. Nevertheless, there is a great deal of steam generating value in these sparks, as we have found by experience, and they are being carried on the company's cars to our stations at Berlin, Nantasket and Stamford, and charged to the electrical operation at the cost of freighting (including the usual profit to the company for transportation), plus the cost of loading and unloading, a total charge of seventy cents per ton delivered. In order to burn these sparks, we are obliged, of course, to make some changes in the furnace arrangements, chief among which is provision for the introduction of live steam under the grates, forming a blower or forced draft, as well as providing the water which, in decomposition, furnishes the oxygen and hydrogen gases, which increase greatly and facilitate the combustion of half-burned coal and add enormously to the furnace heat. We originally supposed that some form of shaking or self-cleaning grate would be necessary in burning sparks, but have found in practice that, with ordinary grates, together with the steam blower, there is no difficulty. In our experimental days it was thought that it might be necessary to use a proportion of ordinary soft coal with the sparks, and did so for a while, but it was not long before our firemen were educated to burn sparks only with entire ease, and no other kind of fuel is now used by us. Of course, we have to use a greater weight of this half-consumed coal than would be the case with new coal, but still the economy is great, as a good quality of run-of-mine coal costs us in Connecticut about $3 per ton delivered at power station.

A few figures as to the cost of power at Stamford may be of interest. This station furnishes current for our street railway system at Stamford and for lighting our railroad stations with 350 incandescent lamps. We are operating one engine only, of 500 h.p. total capacity, direct connected to one 300 k.w. generator. In the boiler room are six 200 h p. boilers. For the first six months of full operation with sparks only, the total cost of fuel for this station amounted to three mills per horse power hour, or four mills per kilowatt hour. For so small a station, and one where the average amount of power developed is hardly more than one-third the rated capacity of the engine, I believe this to be a low figure. We have recently made, for our own information, for use in larger plants, special tests of the cost of power developed in this way, using for this purpose a water rheostat, in order to load the engine up to more nearly its full capacity. As a result of these tests, we find the cost of fuel for power, with the use of coal, to be 3.2 mills per horse power hour, or 4.2 mills per kilowatt hour. With the use of sparks, the cost is reduced to 1.9 mills per horse-power hour, or 2.5 mills per kilowatt hour. At our Nantasket power station this season the cost of fuel, with the use of coal, has averaged 4.2 mills per horse-power hour, or 5.6 mills per kilowatt hour, while, with the use of sparks, the cost has been 2.1 mills per horse-power hour, or 2 8 per kilowatt hour. As before stated, our Berlin plant has not been run as economically thus far as it will be when a greater load is put on the engines, and it will seem to be in the interest of economy to run compound condensing. At this station, the cost of fuel, with the use of coal, has been nine mills per horse-power hour, or 12 mills per kilowatt hour. Using sparks as fuel has reduced this cost to three mills per horse-power, or four mills per kilowatt hour. It is very difficult, of course, if not impossible, to make any direct comparisons between the cost of motive power for electric railroading and that for steam railroading, on account of the different way in which the trains are made up. The best criterion would be the cost of motive power per ton-mile hauled, but even here the results would be of little value on account of the wide difference in conditions, and, as a matter of fact, we have never attempted to make such comparisons.

BOILER INCRUSTATION.

When natural waters containing dissolved and suspended foreign impurities are fed to steam boilers for the purpose of generating steam, the fixed and non-volatile nature of these matters insures their remaining behind in the boiler, where subjected to high temperature of heat they finally become baked and firmly attached to the tubes and shell, forming boiler scale, which prevents the water from coming in contact with the iron and by resisting and obstructing the passage of the heat to the water, not only occasions a great loss of fuel, but imperils the boiler to burning, blistering and bagging, and threatens explosions. It is of obvious importance, that the purest feed-waters obtainable should always be selected; but water is seldom found entirely pure.

Steam users who are troubled with scale in their boilers should always consult with some reputable and responsible chemist who has made this subject his special study. His success depends, not only upon a knowledge of water chemistry, but in a great degree must also depend upon a thorough knowledge of practical boiler operation, and the peculiarities and special features of every design of steam boiler met with on the market; therefore, it will readily be admitted, that much discrimination should be shown in selecting any particular chemist to meet this requirement. Many engineers resort to the plan of removing boiler scale by the use of the pick, hammer and chisel, but this is a temporary relief, and does much to weaken the iron The skin formed on iron during its process of manufacture, is its strongest part, and affords the metal its best protection against oxidation and corrosion.

Some engineers, owing to the parsimony of their employers, use their own chemical formulas to prevent scale in their boilers, rather than undergo the arduous task of cleaning their boilers by hand. This practice cannot be too strongly condemned, as the steam boiler is a very poor place to start up an experimental chemical laboratory; besides, these engineers will seldom meet with success, as their knowledge of chemistry is too limited, while often they are ignorant as to the character of their feed-water and the nature of its impurities which form scale in their boilers.

Distilled mineral oils have of late years been much used for this purpose. Aside from the danger incident to the presence of these inflammable oils in manufacturing establishments, from risk of fire, the makers of Lord's Boiler Compounds claim, these oils promote leakage of the boiler parts, the burning and crystallization of the material and overheating of the plates. Some engineers claim that when oil is intelligently used these evil effects can be obviated. These oils are very penetrating, as is seen in their removal of rust from tools; and in penetrating the boiler joints, they so lubricate these parts that the forces of expansion and contraction easily cause them to leak badly. Besides, oil tends to throw down the scale in large fragments, which accumulate over the furnace plates, producing overheating, bulging and blistering, while seriously obstructing the circulating currents. Oil, when it works its way back of boiler scale, detaches the scale, which falls off, and brings in contact the practically cold water in the boiler with the overheated plates on which the scale was attached. Engineers should always consult with some chemist in these matters, and Geo. W. Lord, the maker of the celebrated Lord's Boiler Compounds, is said to be a competent party with whom to correspond. Mr. Lord is represented in Canada by C. E Grant, 13 St. John St., Montreal.

ACETYLENE IN MANITOBA.

The following regulations for the use of acetylene gas have been published by the fire underwriters of Manitoba:

(1) No generator shall be located in any building where insurance policies cover that can generate gas under a greater pressure than that sufficient to distribute it through the pipes of a building, or under a greater pressure than that used with ordinary city gas.

(2) Each generator must be properly designed, and have sufficient capacity for the work it has to do, and must be made in such manner and of such materials as to insure durability and stability

(3) Each burner burning one cubic foot of gas per hour shall have at least one pound of carbide for its supply in the generator when first loaded, to prevent too rapid generation of gas.

(4) No generator shall be installed, the maximum capacity of which is less than one pound of carbide for each one foot burner.

(5) Each generator must be so constructed that when the lights are extinguished the supply of water to the carbide, or the supply of carbide to the water, will cease automatically.

(6) Each generator must be provided with a connection leading out doors, which, in the event of an accidental over-production of gas, will convey such surplus to the outside air.

(7) The room in which the generator is placed shall be well ventilated, so that any escaping gas may not be confined in said room.

A SMALL DRY BATTERY.

Something of a novelty in the form of a dry battery has lately been submitted to us for examination by Tage Muller, of New York. This cell, which is very compact, stands about two and a half inches high, 1½ by ¾ inches broad. Upon connecting this small cell with an electric bell we obtained just as powerful a ring as a larger dry cell would have afforded. It was also tried on an induction coil with very good results, producing a perfectly steady and strong secondary current. Indeed we should say that it was a very good cell for this last named purpose as it is so light in weight and easily stowed away in the pocket until ready for use. The makers claim that a person starting on a trip for pleasure or otherwise, and wishing to take with him a small medical battery, could find no battery better or more convenient than one of these cells. It would be ready for use at a moment's notice, no difficulty as to chemicals or salts, no cleaning out after use, or any other inconvenience which may be found in many other forms of portable medical batteries. Then take the wire-man going to test out a circuit for warehouse telephones or something similar. To him this small battery would prove extremely handy. In conjunction with a testing gauge it could be placed in his pocket and carried about from place to place with the greatest ease. Of course we have only been able to give its good points as they have appeared to us in our tests. The life of the cell, etc, can only be found by constant use, but considering its small size and great strength, we can see no reason why it should not prove useful to both amateurs and professional men. The name of this cell, manufactured by Mr. Muller, is the "Unique Dry Battery No. 1."

CORUNDUM IN ONTARIO.

The following information on the deposits of corundum in Ontario is compiled from the Report of the Ontario Bureau of Mines for 1896:—

In October, 1896, Dr. G. M. Dawson, Director of the Geological Survey at Ottawa, communicated to the Ontario Government the discovery of corundum in the township of Carlow, in Hastings county. This discovery was made by W. F. Ferrier, of the Geological Survey. In 1893 Mr. Ferrier bought a number of specimens collected by John Stewart, formerly of Ottawa, amongst them being a package labelled "Pyroxene crystals, south part of Carlow," which were recognized as corundum. He was authorized in October to visit the township of Carlow to locate the mineral and determine the extent of the deposit. It was found to occur in a coarse-grained red, felspathic rock, having the appearance of a pegmatite. This rock, together with a red and brown micaceous gneiss, forms a perpendicular cliff from 80 to 100 feet high, at the base of a sloping mountain. The corundum-bearing rock runs into the gneiss side of the mountain along the strike, as well as occurring, as already stated, on the face of a cliff across the strike. Well developed crystals, often of large size, and generally of a grayish or brownish color, as well as irregular masses of the corundum, are thickly distributed through the rock, and the mineral was observed throughout this rock for a distance of about 300 feet across the strike, and traced along the strike more or less continuously for about 700 feet. The grain of the mineral varies with that of the rock. The quantity is not uniform throughout the mass, portions of the rock being more thickly studded with the crystals than others, and in places they seem to form "stringers" in the rock. The interest of the find lies not so much in the possibility of the discovery of the gem varieties of the mineral, ruby and sapphire, about which so much has been said, and which is improbable in view of the mode of occurrence, but in the fact that this is the first time that the mineral has been found to exist in Canada in any quantity, and that it is valuable as an abrasive material on account of its great hardness, which is in a pure mineral next to that of the diamond.

Corundum is an oxide of aluminium, the crystallized varieties being essentially pure, whilst the granular variety, to which the name "emery" is given, contains more or less impurities, chiefly magnetite and hematite. The transparent purer kinds of red and blue colors constitute the gems ruby and sapphire. These usually occur as rolled pebbles in river beds, or as crystals embedded in various rocks, such as limestone, as in the famous ruby mines of Burmah. Statistics show that as an abrasive material there is an extensive market for the corundum. The supply of the mineral in the United States comes chiefly from North Carolina and Georgia, small quantities of emery being also obtained in Westchester county, New York. The finer grades of emery continue to be imported from Turkey and Greece.

Since the present discovery was announced by the Geological Survey, numerous enquiries have been received regarding it, and samples have been furnished to interested parties. Some of these have been tested in the United States, and the corundum pronounced to be of the finest quality. Under instructions of the Commissioner of Crown Lands, a quantity of the mineral was taken out of the Carlow deposit and shipped to the works of the Hart Emery Wheel Company, at Hamilton, Ont., where a test was made of it; but the quantity treated was not sufficient for a satisfactory determination of its value. The report, however, was quite favorable regarding the abrasive qualities of the mineral. Numerous samples were distributed by the Bureau to mineral collectors in the Province, as well as to prospectors, and there is reason to believe that corundum occurs over a wide area in the eastern counties. An interesting discovery was made by George Bennett at a mica mine in the township of Methuen, samples of which have been examined by several experts. George F. Kunz, of New York City, describes it as in part of an excellent blue color, although not of sapphire value, but of abrasive value equal to

any that he has seen from South Carolina, Georgia or elsewhere. Dr. Coleman also made an examination of corundum and another curious mineral from the same location, and in a report upon them says: "The two specimens of corundum are of better appearance than those previously found in Ontario, lacking the soft, decomposed surface seen on former ones. They are also more translucent, and one of them approaches sapphire, having at some points an ultramarine blue color. The corundum is associated with a little muscovite. Both specimens show one well-marked cleavage, no doubt basal, and three less perfect cleavages corresponding to the planes of the chief rhombohedron. The main cleavage faces are striated in three directions, forming equilateral triangles in accordance with the less perfect rhombohedral cleavages. The blue specimen comes nearer to gem quality than any other specimen from Ontario which I have examined."

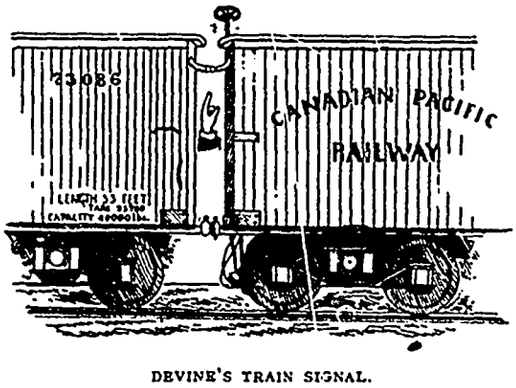
It is necessary that the mineral should be completely freed from the gangue, and this can only be accomplished by a special process. The corundum-bearing rock is first crushed, and then washed by means of sluice-boxes or revolving barrel-shaped cylinders, through which a stream of water passes. But this is not all, for if the fragments of corundum be examined, it will be found that a large proportion of them are coated with a micaceous mineral, having in many instances the composition of margarite, and resulting from the alteration of the corundum. This is removed by passing the mineral through another machine, which, in a form used at one of the principal Georgia mines contains two discs armed with points which are revolved with great rapidity, and soon wear away the soft coating. After undergoing this process the mineral is again washed, crushed and sifted to the various degrees of fineness required. Great care is necessary to prevent its reduction to "flour," as this has only a small value compared to that of the coarser grades. The purpose of all the manipulation it undergoes is to secure uniformity of hardness in the finished material.

Pending further investigation, the lands—which belong to the Crown—on which the corundum occurs in Carlow, have been withdrawn from sale by the Ontario Government, and it is hoped that the deposit will prove as valuable as the surface conditions seem to indicate. It is more than likely that this is not an isolated occurrence, but that other deposits will be found in the Hastings district, now that attention has been called to it. The circumstances attending the present discovery show that the mineral is liable to be passed over or mistaken for something else.

DEVINE'S AUTOMATIC ELECTRIC TRAIN SIGNAL.

The recent successful tests of a new electric train signal on the freight trains of the Canadian Pacific and the Grand Trunk railways have drawn the attention of railway men to the possibility of electric city supplanting compressed air for signalling purposes on moving trains. Every one knows that the present system of signalling on freights is very defective. There is a positive need of some means of rapid communication between front and rear trainmen in cases of accident. The bell-rope is a useless ornament, and, in fact, has been abolished on many American roads. In view of the frequent accidents on freight trains within the past few months, railway managers are awakening to the fact that a change must come in the methods of signalling. To continue the present state of affairs is very unfair to employees, who have lives to save, just as it must be unprofitable to the companies themselves, who suffer yearly losses in rolling stock and freight, amounting to large sums. While compressed air is doing valuable service on passenger trains, it is doubtful whether air will ever be applied to freights for signalling purposes. It is for this reason that we call the attention of railway men to this recently patented electric train signal. It has already given proof of its value and is worth inspection.

Two insulated wires run from end to end of the train, either as a weather-proof cable, like the ordinary bell-cord, or coupled between cars by insulated couplers, as shown in the illustration. The wires are connected to bells and batteries in the caboose and engine-cab, and are combined in such manner that front and rear trainmen may signal fore and aft at any time while a train is moving, or a signal may be given to both ends from any car in the train. A code of signals is furnished that puts the driver and conductor in constant communication on the longest freight. The main feature of the signal, however, is the circuit-closing device in the coupler between the cars. It consists of two metal U-shaped prongs, embedded in insulating material, and surmounted by flexible metal tongues, which are made to draw apart, at any time, without injury to themselves. When a train breaks in two, the wires on both ends of the separated cars are automatically short-circuited, thus ringing danger signals in the caboose and engine. The recent accidents at Napanee, Iroquois and Guelph Junction, where trains broke in two, causing much damage to rolling stock, would not have happened had they been equipped with this signal.



DEVINE'S TRAIN SIGNAL.

The following extract from the North Bay *Despatch* describes itself:

"Train 115, the fast Soo freight which runs from North Bay to Sault Ste. Marie, was equipped with this signal, on the 14th inst., and was tried in a thorough manner by Supt. Bury of this division, and he expressed himself by saying that this signal supplied a long felt want. Signals were exchanged between him and engineer, and between conductor and engineer, and in no instance did it fail."

REV. PROF. DEVINE.

The inventor, Rev. E. J. Devine, S. J., is a professor in St. Mary's College, Montreal, a gentleman who has a thorough knowledge of railways and railway organization. His patent rights are still in the market. The invention is a valuable one, and has undoubtedly a prosperous future before it as a safety appliance. Its adoption would give railway companies a further motive for applying to the Inter-State Commerce Commission for an extension of time in the matter of air-brake equipment.

STEAM, HYDRAULIC OR ELECTRIC ELEVATORS.

Editor THE CANADIAN ENGINEER.

SIR,—As the question of elevators for the new City Hall, Toronto, is now before the public, I think it would be in order to discuss the subject in THE CANADIAN ENGINEER. The first point to consider with reference to the City Hall is, which is the best kind of elevator for the conditions under which they are to operate, viz., steam, hydro-steam, hydraulic, or electric; the second question is, should the power be generated on the premises; third, the number of elevators; fourth, who is to get the contract.

The whole question being settled with due regard to the kind of traffic and the fluctuations of same, and due consideration being given to general surrounding conditions; the first question must be considered under separate heads, viz., first, cost, safety, reliability, economy, and cost of maintenance. The matter should be dealt with by the city the same as a private individual would deal with it. The question has been already thrashed out by two men who are considered the shrewdest business men in Ontario, and it is safe to say, they did not decide the question because they had an axe to grind; but the choice was made with due consideration of all points, and according to their condition, they chose fairly as well as wisely; the one deciding on electric, the other on hydraulic elevators. Which is the better kind of elevator for the City Hall is easily answered for several reasons, one of which requires no mechanical knowledge to understand. The manufacturers of all kinds of elevators say that the

plant for the City Hall should be hydraulic, except one, who only makes electric machines, who says it should be electric. Now, if a number of men, each tendering on both hydraulic and electric—it making no difference which side of their tender is accepted—say it should be one way, and one man who only tenders on electric, of necessity, says it should be the type he makes, he presents a conclusive argument against his machine.

Cost—The cost of an elevator plant, like any thing else, can be estimated in different ways and so arranged as to mislead the purchaser. This was certainly done in the city hall tenders, perhaps unintentionally, but as the aldermen are not all mechanics it is necessary to make the matter as plain as possible. The hydraulic elevator will cost less for a complete plant to install; it will also cost less to install the elevators without the power plant; this is a fact, although the tenders would appear to contradict this view at first sight.

Safety—First cost being less, the next reason is the hydraulic is safer than any other type, from the fact that in water you have something you know something about, and troubles from water are easily noticed, while with electric the least thing will render the plant useless The mechanism for handling the hydraulic is simplicity itself; if the mechanism in the car is moved it moves the main valve, depending on no auxiliary machinery to do the work, and if the valve be closed the elevators will stop, this is because water is practically a solid, and it is like cutting off an iron bar with the valve, thereby positively stopping the piston, which being a slow moving body, is easily brought to rest. In the electric elevator from the time the operator starts to apply the controlling machinery there is a cycle of changes before the car is stopped that is enough to turn a man's hair gray. In the modern up-to-date electric it is more complicated than in the earlier types; and there is more controlling mechanism to one electric than in ten of any other kind, this certainly does not tend to make it safe, for there are that many more chances of derangement. You also use power to stop the electric, as well as start and run it; the more simply an elevator can be started and stopped the safer it is.

Reliability.—In this respect the hydraulic is also best, for the same reasons as make it the safest; also the car in the hydraulic is the fastest moving part, the machinery being very slow and easily handled while in the electric the car is the slowest moving part, the machinery being very fast and complicated. It is subject to great wear and tear, and requires constant attention, the least thing putting it out of order while the hydraulic requires something to actually break to cause a shut down

Economy.—The hydraulic is the more economical of the two, from the fact that with a good pumping plant of a size that will keep it working moderately steadily, that is, a pump that would be far too small if it was pumping direct to the elevator, is used pumping into a pressure tank from which the elevator takes its water; this tank is partly filled with air, under the same pressure as the water. Under these conditions, when an elevator takes water the pressure falls in the tank a little, and the pumps slowly pump it up again to the pressure that its regulator is set for; if a number of elevators take water together, the accumulated energy stored in the tank is given out to help the pump, and the pump stores more while the elevators are coming down The pumps by this means are kept more constantly at work than is possible in an engine generating power for electric elevators, except possibly where a storage battery is used, and they have not been proved a success When an elevator starts, there is no shock to the pump, as the pressure falls very gradually, due to the expansion of the air in the storage tank. Now in the electric plant the machines must be large enough to start all the elevators at once; anything short of this is folly, and would eventually cause an accident. When the elevator takes current the shock is very great, being practically a dead short circuit for the time being, and as there is no reserve, the shock is not only felt by the motor, but also by the generator, the only difference being, the one shock is to a standing machine, while the other is to one running. Now, it is evident to any one that to run a power plant where the average load is only a very small percentage of the maximum, occasions a loss which is much greater than in one where the mean load nearly approaches the maximum. This is the case exactly with electric versus hydraulic elevators. If the steam consumption is measured on a good pumping plant running a certain number of hydraulic elevators, and the steam consumption of an engine running a dynamo supplying current to a like number of elevators under the same conditions, then the economy will be found on the side of the hydraulic The difficulty is, the electric men want to measure the current at the elevator for the electric plant, and the coal at the coal pile for the hydraulic.

Maintenance—It is hardly necessary to take up this question, as even the electric manufacturers acknowledge it costs less in the hydraulic than in electric, and it is of necessity so, for the same reason that the hydraulic is safer and more reliable. The only thing to wear in the hydraulic is the piston and valve leathers, while in the electric the expense of keeping high-speed electric machinery in repair is considerable. Weight is added to all this by due consideration being given to surrounding conditions.

Now, sir, as to whether the power be generated on the premises or not, I say "Yes!" The city has already spent a large amount of money in putting in eight boilers, and for the city not to run its own plant is to my mind like a man who builds a factory and lets it stand idle, and buys power from some other source One-fourth of this boiler capacity is ample to heat the buildings So if the boilers were put in, knowing the only work they were to do was to heat the building, it was a needless expense putting in so many. In a building where people are sitting writing continuously, it is necessary to have the steam on almost all the year round in some parts of the building, and for say seven months of the year the exhaust of the pump would do this and no more fuel would be used than if the steam were used direct from boilers the balance of the year; if the current for lighting is not generated on the premises live steam would have to be used in addition to the exhaust. If a lighting plant is put in, the exhaust from it, with the exhaust from the pump, will heat it 365 days each year, and during the time the heat is on the building it will require no more fuel than if the heat were off, if the building is piped up right—and I have no doubt it is, as the work was done by competent men.

As to the number of elevators, that will all depend on the amount of traffic, and if it is not to be greater than at the present city hall, it can be handled by three elevators, if hydraulic, with plenty of reserve for many years to come. The two elevators in the Freehold Loan building handle more passengers than the city hall elevators will have to do; and the elevators in the Simpson and Eaton buildings handle more passengers in one hour than the city hall will have to carry in a day. However, the number of elevators is something that nobody will find fault with.

As to who is to get the contract. This is a very important matter. With a private individual, it is settled on the merits of the article, and the advantages to be derived from giving it to a particular party in the way of mutual trade, it is in some cases considered; but it is nobody's business where a private party buys his goods, but with the city, or the country, there is also a principle involved. I don t purpose advocating the asking one man to tender, although I can produce good arguments for the city doing so, but I do say, the city should only allow Canadian firms to tender. The way the Canadian workmen are being treated by our neighbors to the south is a shame, in the light of the manner in which we are treating them, and the only way to bring them to their senses is, when a contract is open, that we can fill as well as they can, to exclude them by all means. But apart from all that, there is the principle of giving to the people who give to you. If the work is kept in Canada, it comes back to ourselves; if it goes out of the country, it is gone forever. When tenders were called for the new G.T.R. gates, at Niagara, the Canadian firms were told that they might tender on the gates for the Canadian side, but their tenders for the United States side would not be considered; but United States firms tendering were told that they could tender for both sides, and of necessity, anyone can build four gates cheaper than they can build two, consequently, the United States firm got the contract, although the Canadian tender was really the cheapest.

It is hard to understand why our people will continually run away to some other place to get what they want when they often have better at home. If Canadian firms got the same show to do work in the United States that we give to United States firms, then it would be only right to let them tender, but the last place they come for anything is Canada. We have United States elevators in this city, both hydraulic and electric, and we have others made by a home manufacturer, and if anyone who is not a bigot and prejudiced against them, no matter how good they may be, will only go to, say, the Bank of Commerce, for hydraulic, and size up both the elevators, and the way they were put in by a United States architect, and then go to the Union Station, or Eaton's, and see the Canadian hydraulic, and the way they are installed, it will be a revelation.

Surrounding Conditions.—The conditions would suggest a hydraulic plant, from the fact that the city has a very very costly building, which is not fire-proof; in fact, the upper parts of which are a fire trap. This requires the best fire protection attainable, which a good elevator pump gives, because, unlike a fire pump that stands for a year, and when a fire occurs it is found to be out of order, the elevator pump is running every day, and if it is not attended to every person coming into the building will know it, on account of the elevators not running; whereas a fire pump might be out of order, and no one would know it. And judging the city hall plant by the rest of the city, it will not be attended to any better than the law allows. The great fluctuations of traffic in a building like the city hall will be taken care of better by hydraulic than by electric elevators, because when the elevators stop the pump stops also, and all steam consumption ceases, and when the traffic is heavy the pumps will work practically all the time, but in an

electric plant the machine generating the power is running all the time, giving a percentage of loss, for it is either full load or no load. The great difficulty is that people are getting into the habit of thinking that if anything is electric it must be the best; that is true in some cases, but those who have had to do with electric elevators have found them to be Jonahs. Consumers of current usually think they are robbed, but when a man pays his bill for current for running his elevator he should laugh in his sleeve for he has got all, and more than all he has paid for. The electric elevator is a curse to a lighting station; they have hurt the incandescent lighting business more than anything else, so much so, that the Toronto company has put nearly all the elevators on a separate current. Now, if a large company has to do this, when an elevator adds such a small percentage of load to the station, it is plainly to be seen how much more it would affect a private plant. If the city will have electric elevators let them buy the power, as the Ontario Government does for the Parliament buildings, even if they can generate it as cheaply in connection with their lights.

Now I am by no means through with the question, but will not take up any more of your valuable space, except to say that if the city will have electric elevators, they need not go to the United States for them. The Robert Simpson Company's electric elevators are the best that are running in Toronto, and if they can handle the traffic of a department store, they can easily handle the traffic of the Court House and City Hall. I hope this matter will be taken up by engineers and dealt with in the interests of the Canadian workmen with fair play to all. Yours truly, E. J. PHILIP.

AN UNUSUALLY LARGE ELEVATOR.

An unusually large elevator has recently been put in the new building of the T. Eaton Company, cor. James and Louisa streets, Toronto. The cylinder is 26 inches in diameter and 24 feet long; the travel of the car is 60 feet; the car is built of steel, and is supported by ten ¾-inch steel cables, and has a platform 17 feet 6 inches by 10 feet. The carrying capacity of the elevator is seven tons, which is the largest elevator with rope machinery in the city. The purpose of the elevator is to be able to run a loaded wagon on to the car, and run it off at the floor where the material is to be unloaded, thus saving handling so many times. This elevator, as well as all the 12 elevators in the company's store, were built by the Fensom Elevator Company, Duke street, Toronto. This is the largest elevator plant in Canada, and it certainly is a credit to the company. The plant is most varied in the character of the work which it performs, from the smooth-running passenger elevator, handling thousands of passengers each day, and the fast-running freights, to the slow-running direct lifts; and last, but by no means least, this mammoth, which has lately been installed. Another novel feature on the T. Eaton Company's premises is the power grooming and clipping machines in the stable, that can clean or clip a horse in almost less time than it takes to tell it. These are driven by two 2 h.p. electric motors, built by the Toronto Electric Motor Co., as also a 15-h.p. motor for cutting and grinding feed. The stable building is heated by steam and lighted by electricity, and is equipped with Grennell sprinklers (dry system), and seven hundred and fifty feet of 2½-inch standard fire hose arranged on each floor. The capacity of the stable, as arranged at present, is one hundred horses.

THE DOHERTY IRON CASTINGS PROCESS.

The recent sale for a large sum, of the British patents of the Doherty process in iron foundry practice, will render a short description of the process of interest to our readers, especially as the discoverer is a native Canadian. The process consists in introducing into the tuyere (or mouthpiece by which the blast is brought into the cupola) a jet of steam, with the result that the casting is made finer in the grain, softer and tougher than is ordinarily the case, and this improvement applies, not only to castings made wholly from pig iron, but from scrap also, the loss being only two per cent. in some cases where scrap is used. It has long been known that humidity in the atmosphere has an effect in iron smelting, but it remained for Thomas Doherty, of Sarnia, by a happy accident to follow up this obscure and uncertain effect till the problem came within his control.

When scrap is used in a foundry a large amount of the oxide of iron is carried off with the slag and lost, this loss being about 30 per cent. in ordinary practice. The introduction of the steam jet—in which the elements of hydrogen and oxygen exist—has the effect of producing a more strict form of metallic iron through the removal of the oxygen from the oxide. In his foundry in Sarnia, Mr. Doherty uses one part of second quality foundry pig and three parts of low-grade scrap with malleable to the extent of not more than 300 lbs. to the ton, the result being a stronger, softer, and more uniform casting than can be obtained in the old way. Various foundries that have adopted the process state that they have saved from $4 to $5 per ton, according to the kind and price of raw material used. Though the principle is the same in all cases, the application of Mr Doherty's process varies according to the work of the foundry, the iron used, and the purposes the castings are turned to, and judgment and experience will determine the success of its adoption in each case For example, one class of pig iron may contain a certain amount of silicon, carbon, phosphorous, manganese and sulphur; and another class contain exactly the same proportions of these substances, yet the two irons will not give the same casting, although melted in the same cupola and under the same conditions. Then we must arrive at the conclusion that there must be a variation in the metallic iron, and in our present state of knowledge chemistry cannot give the character of it, and the consequence is that we are never sure of the same results, even on the same analysis. There may be a variation of 10 per cent. in strength in the castings made from the two irons. Mr. Doherty believes that the introduction of steam produces a molecular change in the casting. This should be conclusive evidence that hydrogen is a powerful reducing agent, that its influence in reduction of the oxide of iron in an ordinary cupola plays a very important part, and aside from this most valuable feature it has other valuable functions, namely, softening and strengthening the castings.

THOMAS DOHERTY.

Thomas Doherty was born near Perth, Ont., in 1854. His grandfather was a British half-pay officer, who had settled in Bathurst township, and his mother was born in Manitoulin Island, when the island was almost a wilderness. Mr. Doherty's family came to Plympton, about 20 miles from Sarnia, where they settled as farmers, but had a small shop on the farm, in which the subject of our sketch picked up with a quick instinct a knowledge of mechanical matters. They moved to Watford, where they ran a small foundry and machine shop, at which they made threshers and other agricultural implements. When Mr. Doherty was 13 years old his father died and he was left to carry on the business—a great undertaking for one so young—but he succeeded well, and fifteen years ago moved to Sarnia and established the foundry business which he still carries on in that town. It was in 1894 that he discovered the process which has made his name so widely known in the iron founding world to-day. This discovery, like so many others, was the result of an accident. The blower had got overheated, and he sent a boy up on the roof to pour water down; the water was sucked into the cupola, and its conversion there into steam had, to his surprise, a marked effect for good on the iron; he began to study the cause, and the result was the process already described. The process is secured by 21 patents in Great Britain and various countries, a company having been formed to operate in England with a capital of £100,000, paying Mr. Doherty £30,000 cash and an interest to the extent of 12 per cent. in the company. This company is known as the Doherty Iron Castings Process, Limited, with offices at 32 Victoria street, London. In the United States a company called the Doherty Iron Castings Process Co., of Ridgway, Pa., has been formed, the company paying him $150,000 for his rights. The Canadian business will be controlled by Mr. Doherty himself. It will be of interest to mention that the patents for this process at first hung in doubt in Great Britain. The claim was in the use of hydrogen "in fixed proportions," and was exactly analogous to the patents for the cyanide process of gold extraction which were being contested in the courts. Cyanide had been used before for extracting gold, and hydrogen had been used in iron melting: but

neither had been commercially a success, because a knowledge of the proper proportions had not been gained. The validity of the cyanide patents having been upheld by the highest authorities in patent law, those of Mr Doherty's process became secure on the same grounds.

FACING TOOLS.

T. Draper of Petrolia, Ont., manufacturer of valve facing tools and ball valves, sends us his new descriptive circular containing cuts of the tools, which we reproduce here As will be readily seen from the cuts, the device is very simple, and it is claimed for the tools, that the work done by them is very accurate, and that valves dressed with them are perfectly tight Only a common bit brace is required to operate them, and this is at hand almost everywhere No more preparation is necessary than to put the tool in the brace and do the work.

SEAT FACER. VALVE FACER.
FIG. 1.

Fig. 1 shows a pair of the tools for repairing common globe valves. The seat facer or reamer is a section of a true ball or sphere, so that it makes a concave seat. The valve facer, for facing the disc, is so constructed that it makes a surface to fit accurately the surface formed by the seat facer.

Fig. 2 shows the tool for facing all flat-seated valves.

Fig. 3 is from a photo of the actual operation of repairing a globe valve

Figs. 4 and 5 show three positions of the valve facer in its revolution, They also show the valve disc *C* jammed tight against the part *D*, to prevent it turning, while being dressed.

JENKIN'S OR FLAT SEAT FACER.
FIG. 2.

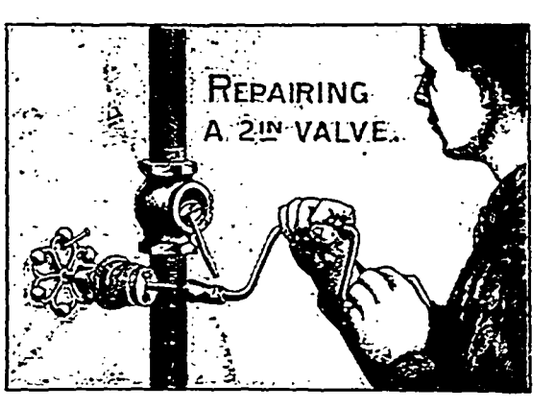


FIG. 3.

Note particularly that the tool travels in the direction indicated by the arrows. It swirls or sweeps around the disc. This pecular motion is obtained by having the driving shank bent, as shown in Fig. 5. This cup tool has an inner and an outer cutting edge, as will be seen by Fig. 1.

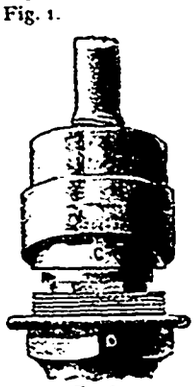


FIG 4.

These tools make practically a ball and socket joint, which is admitted to be the best form and the right principle. Mr. Draper informs us that he is continually making sales all over the United States and Canada, and that the numerous users report the tools to be very satisfactory His advertisement will be found in another part of this paper

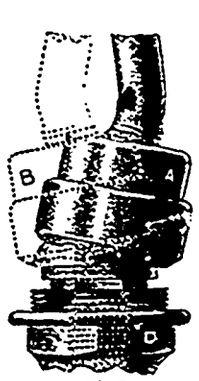


FIG 5

SPENCE & Co., file manufacturers, Hamilton, have put in a new file cutting machine, with a hammer of 160 lbs., one of the heaviest of the kind in Canada. The machine was made by Charles James, machinist, of the same city.

METAL IMPORTS FROM GREAT BRITAIN.

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

	Month of Oct..		Ten months ending Oct.,	
	1896	1897.	1896.	1897.
Hardware and cutlery	£6,296	£7,921	£53,163	£58,593
Pig iron	4,974	1,187	26,204	6,485
Bar, etc.	1,443	306	14,049	7,878
Railroad	13,756	6,885	171,909	45,776
Hoops, sheets, etc	6,919	15,307	42,677	71,261
Galvanized sheets	4,760	13,439	46,972	48,986
Tin plates	18,580	30 122	110,489	162,971
Cast, wrought, etc., iron	4,298	2,932	44,949	28.889
Old (for re-manufacture)	736	1,292	15,598	6,483
Steel	6,809	6,440	79,869	47,501
Lead	2,793	4,888	13,279	23,950
Tin, unwrought	1,861	1,169	13,577	14,983
Cement	6,445	2,880	31,031	18,491

WASHING AND BRIGHTENING STONE WALLS.

W. P. M., HALIFAX.—If you have the information, will you please answer through THE CANADIAN ENGINEER, giving a method of cleaning the soot and dirt which collects on the front of large freestone buildings, without going over the building with a tool. The soot is from soft coal and is driven in with the dampness.

ANSWER.—In removing soot from stone buildings nothing is so satisfactory as chisel work. For brightening up the stone walls brushes of steel wire are sometimes used, but this process does not penetrate far enough. Various washes and enamels have been used and advertised for this purpose, but we should advise you to be very chary about their use. In most cases they are composed of dilute solutions of muriatic acid. This preparation is often used to wash brick walls as well as stone, with the result that both mortar and stone are eaten into and crumble away. In many cases where architectural work has been spoiled, these washes are the unsuspected cause. Various kinds of enamels are also used, in which case the sooty surface is covered up by the application, but this enamel soon begins to wash off in patches, making the building look worse than before. Next to tooling cut stone architecture is rubbing them down with wet bricks of "grit" composed of any sandstone, washing off after the operation.

THE ELECTRIC RAILWAYS OF CANADA.

There are at present in Canada 569 miles of electric railway, exclusive of those of British Columbia. The valuable statistics compiled by George Johnson, the Dominion statistician, show that the train mileage run of these roads in 1896 was 21,917,151, and the number of passengers carried was 73,496,069. The total capital and bonded debt was $23.000,000. There were in use 947 motor cars, with 1,315 motors, 360 trailers, and 62 street sweepers and snow plows. The total number of hands employed was about 3,400. In the statistical year book for 1896 detailed returns are given of five electric railways reporting to the Department of Railways and Canals, as follows:

	Miles long	Train mileage run.	Paid up capital.
Berlin & Waterloo	2.75	66,000	$28,350
Ham., Grimsby & Beamsville	17	207,001	189,700
Montreal Park and Island	14 43	42,653	770,401
Niag. Falls Park and River	13.68	221,535	1,281,731
Oshawa	8.50	23,258	311,704

	Passengers carried.	Tons freight.	Earnings.	Expenses.
Berlin & Waterloo	205,000	.....	$ 8,200	$ 6,880
Ham., Grimsby & Beamsville	256,313	2,142	36,040	28,926
Montreal Park and Island	728,204	.....	56,446	55,879
Niag. Falls Park and River	474,552	.....	58,688	36,271
Oshawa	87,519	16,389	11,900	16,700

SEWAGE VENTILATION.

Editor CANADIAN ENGINEER:

SIR,—The *Canadian Architect and Builder* for November reports a paper read by J. W. Hughes, master plumber, of Montreal, before the American Public Health Association at Philadelphia, wherein Mr. Hughes enforces the systems and ideas of drain ventilation and construction so ably described in THE CANADIAN ENGINEER of April, September, and November, by W. M. Watson, master plumber, of Toronto. This is a good sign that the dangerous sanitary plumbing and drainage by-laws forced on the public by interested and selfish

persons and law makers will soon have done all the mischief it will be allowed to do. If this should meet the eye of Mr. Hughes, I might inform him that the by-laws controlling such matters for Brantford, Ont., will probably meet both Mr. Watson, Mr. Hughes, and every sanitarian's views who works for the good of the country. It is hoped that these two experienced sanitary plumbers will encourage still more of the kind to speak the truth boldly, and stop the scandalous and expensive abuse of the public health laws.

Yours truly,

A CONSTANT READER.

Toronto, Nov. 21st, 1897.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

At the regular meeting on Thursday, Nov. 11th, Prof. H. T. Bovey, LL.D., D.C.L., read a paper on the "Results of Experiments on the Strength of White Pine, Red Pine, Hemlock and Spruce." The paper was followed by an interesting discussion in which Messrs. Peterson, Smith, Irwin and Duggan took part.

The ballot sheets for the election of officers for next year are now in the hands of the voting members. They are accompanied by one or two amendments to by-laws, which will probably effect some changes in the conduct of the society. Under the present laws, all past presidents are *ex-officio* members of the board; and the number will, of course, be increased yearly. The voting members fear that the control of the society may soon pass out of their hands if some change is not made, and an amendment, signed by nineteen voting members, proposes that three of the past presidents be elected to the board, instead of all as at present. The office of secretary is also the subject of an amendment. At present the secretary is always a member of council. It is proposed to separate these offices.

Mining Matters.

THE Jenckes Machine Co., Sherbrooke, Que., reports British Columbia sales as very satisfactory.

HON. G E. FOSTER authorises the statement that Rothschilds offered half a million for the Olive mine, half cash and the remainder in stock. The offer was refused.

J C. MASON, Manager of the Hopewell gold mine, New Glasgow N.S., reports prospects at the mine bright. A 79 ounce brick was the result of a recent run of 21 days.

THOMAS WHITTAKER, 135 Bathurst street, Toronto, has a farm in the Nipissing district, Ont., on which he has discovered fire clay, extending over 15 acres, and ranging from twelve to fifteen feet in depth.

THE Hamilton Powder Co. is equipping its Nanaimo works with a new hoisting plant, having placed an order with the James Cooper Manufacturing Co., Limited, for a standard link motion hoisting engine.

THE Eustis Mining Co., Eustis, Que., has commenced sinking again in its shaft, and has placed an order with the Jenckes Machine Co., Sherbrooke, for special underground hoists to be worked by compressed air.

THE Winnipeg Mining and Smelting Co., Greenwood, B.C., is developing its property, and has installed a complete mining plant, purchased from the Rossland branch of the Jenckes Machine Co., Sherbrooke, Que.

THE Bonanza Nickel Mining Co., Limited, Sudbury, Ont., has placed an order with the Jenckes Machine Co., Sherbrooke, for a 10-stamp mill, complete, with two six-foot vanners. It is the intention to install this mill immediately.

BY a recent judicial decision in British Columbia it has been decided that no matter where a mining company may be incorporated, or under what terms it holds its charter, the transfer of its property in British Columbia is subject to the laws of British Columbia.

THE Sarnia *Observer* says the Bushnell Oil Company, Limited, is pushing things in Lambton county, and are thoroughly testing the territory in the vicinity of Sarnia to see if oil can be found in paying quantities. It is reported that extensive finds of both oil and gas have been made.

J. A. Bows reports to the Bureau of Mines from Wabigoon, under date of Nov. 14, on the district lying about eight miles south of Tache Station on the C.P.R., and around Shallow, Stormy and Long Lakes, and the Little Wabigoon River. Mr. Bows says in his letter: "From all appearances, I would think that it will prove one of the richest sections of the country."

THE New Goldfields of British Columbia Co. proposes to actively take up the development of its several properties in the Kootenay district, and is, at present, opening the Velvet mine, in which there are several promising showings. It has a new hoisting engine plant installed, which was supplied by the James Cooper Manufacturing Co., through the British Columbia agent, James D. Sword.

THE new mining district in Calumet Island, Ont., on the Ottawa River, is coming to the front: there has been some preliminary work done, and on the "Calumet" property this has opened up showings so promising, that the company has placed an order with the James Cooper Mfg. Co. for a complete drilling, hoisting, and pumping plant. Even if present indications only are a criterion, this will make one of the largest mines in Canada. The company, however, thinks that with depth it will prove even richer than the present assays disclose.

THE outlook for cheaper coal and coke in the East and West Kootenay districts is very promising: the reports from the West are that work has been proceeded with so actively on the Crow's Nest Pass Railway, that it has been graded to within 20 miles of Moyie Lake. Simultaneously, the Crow's Nest Pass Syndicate is engaged in prospecting work with the diamond drill outfit, which was ordered through the James Cooper Mfg. Co., Limited, and it is expected before the completion of the railway to have opened the property to such an extent as to supply the local demand at least.

THE absence of railway communication has retarded the opening up of the Boundary country to a great extent, but notwithstanding the difficulties that have to be surmounted in getting machinery in, several of the companies which have had enough preliminary work done to warrant their putting in a plant, have decided to haul their machinery in by wagon road. The Brandon and Golden Crown Mining Co. has decided to proceed actively with development work, and has placed an order with the James Cooper Manufacturing Co., for a complete hoisting, pumping and drilling plant, which is now on the ground. As soon as this is set up a large force of men will be put on the work.

Railway Matters.

THERE seems to be a strong probability that the G.T.R. will double track the line from Hamilton to Niagara Falls.

THE Ottawa and New York Railway Co. have offered to build their workshops in Ottawa if they are given a bonus of $100,000.

IT is said that the G.T.R. will have running rights over the new Toledo & Northwestern Railway, thus getting into the Ohio coal fields.

THE Grand Trunk Railway Company has sent cheques to Brantford amounting to $33,500, returning the car works bonus with interest.

SHIRLEY ONDERDONK, son of Andrew Onderdonk, the railway contractor of Hamilton, has gone to Alaska to assist in surveying a railroad.

THE Tilsonburg, Erie and Pacific R. R. is constructing a connection at Tilsonburg, Ont., with the M.C.R. and will build a $20,000 steel bridge across Otter Creek.

THE Lotbiniere and Megantic Railway Company is building a wharf 160 feet long at Cap a la Roche, Que., to facilitate the shipping pulp wood, bark, etc., from that section.

A SUB-COMMITTEE of the Montreal city council has recommended the granting of part of Victoria Square, Montreal, to the Grand Trunk Railway as a site for an office building.

THE Q.C.R Company are about to extend their shops at Newington, near Sherbrooke, Que., which will require an expenditure of not less than $70,000. The contracts have not yet been let.

A CHARTER is applied for by a company which proposes to build a railway from Cranbrook, B.C., to the North Star mine, thence to headwaters of St. Mary's River, and Kootenay and Arrow Lakes.

THE T. H. & B. took control of its own road on Dec. 1. The M.C.R. officials went out and the head office was transferred from Detroit to Hamilton, Ont. The new manager is E. Fisher, of Jackson, Michigan.

AN agreement has been signed between the Nova Scotia Midland Railway Company and the Nova Scotia and Federal Governments, by the terms of which each of the latter agree to subsidize the road to the extent of $3,200 per mile, for the construction of a railway from Windsor to Truro. W. G. Reid, of Montreal, has the contract to build the road, which is to be fifty miles in length.

THE bridge over the Columbia River carrying the Red Mountain tracks to Rossland, B.C., has been tested for traffic. It is a composite structure of wood and iron of six spans, in length about 2,000 feet.

AT the present time the Grand Trunk Railway System is having the heaviest run of freight in the memory of the oldest employees. The company has ordered the construction of a thousand new cars—500 in Detroit, and 500 in the Canadian shops.

THE G.T.R. is doing a good deal in the way of improving its property. An oil house will be erected at London, Ont., and a new roundhouse at Sarnia. The new Berlin station is to be completed by Christmas, and the capacity of the freight sheds at Wiarton is to be doubled.

THE Hudson's Bay and Pacific Railway Company has applied for an amendment to their charter, to abandon the projected line from Prince Albert to Calgary, and to establish instead, the branch between Prince Albert and Edmonton, and to a point at or near the Yellow Head Pass.

AN important innovation is being made on the Canadian portion of the Grand Trunk Railway system, in substituting compressed air for steam as a motive power in their shops. It is said to be cheaper than steam, and has been applied successfully in the shops at Toronto, Belleville, and other places.

A CURIOUS accident occurred on the Canadian Pacific, near London, Ont., the other day. An engine was running light to the repair shops just ahead of a train, when suddenly the axles broke, the sidebars fell from the sides, and the steel tires of the driving wheels broke in several places, causing a complete wreck of the engine.

STRATFORD, ONT., demands $25,000 from the Grand trunk, which is the amount which Stratford gave the railway company to erect and maintain a roundhouse in the place, and it is claimed that the Grand Trunk is breaking the agreement with Stratford by removing engines and crews from that place to Sarnia, where a new roundhouse is being built.

MR. HEINZE and the Canadian Pacific have failed to come to terms, and Sir William Van Horne has made the following statement: "It is absolutely necessary that we should reach Rossland with a line of our own, and we are under pledge to Rossland to do so. We would have preferred the purchase of the Trail Creek road, which could have been adapted to our purposes by a considerable expenditure, but we could not come to terms, and we are now obliged to go on with our own work."

THE CANADIAN ENGINEER has received a copy of the official report of the directors of the Grand Trunk Railway Company of Canada, together with the statement of accounts for the half year ending June 30th, 1897, which shows that the working expenses have been cut down from 71.34 per cent. of the gross receipts to 67.49 per cent. of the gross receipts for the corresponding half year. This decrease means a saving to the shareholders of £55,677. While the company's passenger traffic decreased during the six months by 0.12 per cent. the freight traffic increased by 1.49 per cent.

THE following have been elected directors of the Great Northern Railway: Messrs. P. Garneau, John Sharples, Frank Ross, V. Chateauvert, T H Deann, Jules Tessier, and Veasy Boswell. The annual report mentions the completion and acceptance of the ten-mile section constructed by Paquet and Fortin, from Grand Mere to Shawenegan, and a branch line built by the company and the Laurentine Pulp Company from the St Maurice to the latter's mill It also states that a bonus has been offered by the council of Three Rivers if the terminus and workshops of the road are placed there, and that the question must shortly be decided.

Marine News.

JAS. PLAYFAIR & SON, Midland, Ont., will build a large tug at Midland this winter.

RYAN & MACDONALD have been awarded a contract for sections 1 and 2 on the Soulanges Canal

STR. "JUBILEE" has been bought to run on the Pelee Island route by a Leamington, Ont., firm.

MACDONALD & MOFFAT are making satisfactory progress on the new $10,000 wharf at Pugwash, N.S.

THERE is talk of a new C P.R. steamer for Lake Memphremagog, between Newport, Georgeville and Magog, for the coming summer.—*Granby, Que., Leader.*

THE Montreal Transportation Company launched a new steel barge at Kingston, Ont., recently.

ST. JOHN, N.B., this winter, will have the heavy freight landed on her docks; Halifax will receive the mails.

THE str. "Empress of India" is to undergo extensive repairs and alterations, at Picton, Ont., this winter.

THE steamer "Sir S L. Tilley" is to have 60 feet added to her length of 180 feet, making her the full size of the Welland Canal locks.

THE Leaver Line Steamship Co. has chartered the "Gallia," which is about 450 feet in length, being as large as the "Parisian," and the "Bothnia."

HENRY FOLGER says there will be a daily service between Clayton, N Y., and Montreal, next season, with the possibility of extension to Quebec and the Saguenay.

THE Dominion Government is taking steps to improve the navigation of the Rainy River. It is also understood that the Fort Frances lock is to be at once improved.

AT Kingston, recently, the locomotive works turned out and launched a steel barge, the "Coburg," 180 feet long, 35 feet beam, and to carry 50,000 bushels on a draft of 11 feet.

MESSRS. TROOP & SON, of St. John, have placed an order in England for the building of a new steel steamer. She will be 300 feet long, 45 feet beam, and will be named the "Canada."

THE str. "Stranger," running between Valleyfield and Montreal, sunk in Lake St. Louis, recently, in 25 feet of water. The hands on board managed to get ashore after considerable hardship.

WM TWOHEY, a former lake captain, died recently in Toronto. He was in his eightieth year, and came to Canada from England in 1837. For many years he sailed between Toronto and Chicago.

THE steamer "Lakeside," St. Catharines, Ont., is to be sailed by Capt. N. J. Wigle next season, it is said, and it is reported that another boat will be put on the run along with the "Lakeside" between Toronto and St. Catharines.

SINCE his return from England, McLeod Stewart, Ottawa, announces that the building of the Ottawa Valley-Georgian Bay Canal will begin in the spring. The cost will be $15,000,000, and Sir Benjamin Baker will be consulting engineer.

IT is said at Vancouver, B.C., that the C.P.R. management intend to run the "Empress" steamers direct to Australia, by way of Honolulu and the Fiji Islands. Better boats will be put on the Japan route, and a weekly service will be substituted for a monthly one.

ROBT. BOWIE, N. Cossitt, T. Wilkinson, J. Grant, sr., D. Derbyshire, and Jas. Cumming, Brockville, Ont., are among those interested in the new boat to be built this winter for service between Brockville and Union Park, Thousand Islands. Davis & Son, Kingston, Ont., will, it is said, build the boat.

IT is proposed to build a steamer in Annapolis, N.S., this winter, to ply between St. John and points between Digby and Bridgetown, touching at Bridgetown, Round Hill, Annapolis, Grenville, Digby, Bear River and St. John. It is expected to put the new steamer in commission on April 1st, 1898.

THE Department of Railways and Canals has taken over the contract on the Soulanges Canal held by A. Stewart, Ottawa, and the work is being carried on under the control of the Government. The contract included sections 1 and 2, and comprised some heavy masonry work and the excavation and building of three large docks.

BESIDES the building of two large steamers for the Richelieu and Ontario Company for lake passenger traffic, at the Bertram Engine Works Co.'s shipyards, the iron grain steamer "Rosedale," belonging to Crangle & Hagarty, is to have a new hurricane deck. The iron steamer "Seguin," 200 feet long, will be lengthened about 40 feet.

THE Montreal papers have recently revived the old scheme of deepening the water in the channel below Montreal, not by dredging, but by building a dam at Deschambault, where the Richelieu rapids occur. This would, it is claimed, give an extra depth of eight or ten feet at Cap a la Roche, and from four to six feet extra water in Lake St. Peter.

THE new pier on the east side of the entrance to the harbor of Port Dalhousie, Ont., and the Welland Canal, the work on which has lately been successfully completed, is recently described in the St. Catharines *Journal*. It is thirty feet wide at the inner, sixty feet wide at the outer end, about five feet above high water mark, and 2,000 feet long. The first section of the work was done about five years ago by day labor, and the next year a section was let by tender to John Riley & Son, contractors, St. Catharines, who were followed next season by Battle & Newman, Thorold and St. Catharines. Last year the final section or end running into the lake was awarded to John Riley & Son. The work was under the supervision of W. G. Thompson, the resident

engineer and canal superintendent, and T. Crowley acted as overseer for the Government, with Thos Riley superintendent for the contractors. The work throughout was constructed of concrete, and cement was supplied by the Thorold Hydraulic Cement Works, estate of John Battle, proprietors.

WM. THOMSON & Co. have closed with Russell & Co., of Port Glasgow, for the construction of another steamer similar to the "Cheronea," "Platea" and "Arbela" (now building). She will be launched in April or May, and her dimensions will be as follows: Length of keel, 325 feet, breadth of beam, 48 feet, depth of hold, 26 feet 6 inches. She will be called the "Cunaxa." This vessel will be the fifth steamer added to the Messrs. Thomson's fleet.

FOUR of the passenger steamers sailing from Toronto were last season commanded by Picton men, says the *Times* of that town, namely: Captain Harry Solmes, of the new steel palace steamer "Corona"; Captain Robert Clapp, of that favorite steamer "Chicora"; Captain George O'Brien, of the favorite steamer "Empress of India"; Captain William Van Vlack, of the steam yacht "Cleopatra," also Captain Nelson Babbit, of the Toronto Ferry Company's line.

THE Bessemer Steamship Company, which is John D. Rockefeller's line of lake steamers and barges, has just closed a contract for the three largest ships on the lakes. The contract for these boats, one steamer and two consorts, was given to F. W. Wheeler & Co., Bay City, Mich., to be completed in May, 1898. The steamer's dimensions are 475 feet over all, 455 feet keel, fifty feet beam, and twenty-nine and a half feet deep. The engines will be quadruple expansion, the cylinders measuring twenty-eight, forty, fifty-nine, and eighty-five inches in diameter, with forty-two inches stroke. The barges will be 450 feet long, fifty feet beam, and twenty-eight and a half feet deep. They will carry 7,000 gross tons each. The boats will cost between five and six hundred thousand dollars. The Bessemer Company is figuring with other builders for two more boats of the same displacement for future delivery.

Electric Flashes.

NOBLE & BARBER, electrical contractors, have started in business in Montreal.

BRANTFORD, ONT., is making estimates on a civic lighting plant. The present lighting contract expires next year.

AT a meeting of the Stratford city council last month, it was decided to advertise the electric street railway franchise for sale.

THE Royal Electric Co. is shipping the Hamilton Electric Light and Power Co one of its single-phase 2,000 light alternators with station apparatus, etc.

THE successors to the electrical supply business of C. W. Henderson, Bleury street, Montreal, are Taylor, Telfer & Co., who will continue business at the same stand.

THE Kingsville Electric Light and Power Co. has placed an order with the Royal Electric Co. for a 50-light 6½ amp. arc machine, with lamps for lighting the streets of Kingsville, Ont.

ROBERVAL, QUE., is to have an electric light plant. B. A. Scott, who has the matter in charge, has placed an order for the Crocker special turbines with the Jenckes Machine Co., Sherbrooke, Que.

THE American Rattan Co. has just completed its new factory and is moving to the town of Walkerton, Ont. It has bought from the Royal Electric Co., for lighting the factory, a complete electric lighting equipment.

PREMIER TURNER, of the British Columbia Government, has stated that the Government is ready to assist the C.P.R. in constructing a telegraph line from Telegraph Creek, on the Stickeen River, to Teslin Lake, the head waters of the Yukon.

MOODIE & SON, Terrebonne, Que., agricultural implement manufacturers, have completed their new factory and are lighting the same throughout with electricity. The order for the electrical apparatus has been placed with the Royal Electric Co., Montreal.

THE St. Jerome Electric Light Co., St. Jerome, Que., has bought from the Royal Electric Co., and is installing in that town a 50 k. w. "S.K.C." two-phase alternating current dynamo, with Stanley transformers, etc. There will be 750 lights installed when it starts up.

THE Crystal Beach Electric Street Railway Company, Limited, has been incorporated. The directors of the company are: H. W. Olmsted, C. P. Olmsted, O. B. English, Oakfield; H. P. Thompson, Buffalo, N.Y.; L. Beecher, Batavia, N.Y., and A. O'Heir, Hamilton, Ont.

THE Hull, Que., Electric Company has purchased the Aylmer branch of the C.P.R., which is at present under lease, the price being in the neighborhood of $100,000. Since leasing the road the Hull Company has double-tracked it from Hull to Aylmer, and improved the roadbed.

THE Hamilton, Ont., Street Railway Company's receipts have decreased considerably this year, as compared with those of last year, the decrease being attributed to the increase of bicycles in the city. The returns for the quarter ending September 30th show a falling off. The total revenue for the quarter is nearly $4,000 less than in the same period last year.

THE Canadian General Electric Co is building a power house and a pumping station at the Peterborough works. The contracts have been let as follows: Iron and steel work, the Hamilton Bridge Co.: window frames, St. Lawrence Foundry, Toronto; galvanized iron work, Douglas Bros., Toronto.

A. G. FRASER, London, is suing the London Street Railway Company for $15,000 damages. He was pushed towards the edge of the platform, came in contact with one of the iron stays of the bridge the car was crossing, and fell a distance of about thirty feet. He claims the accident was due to the negligence of the company.

THE Windsor Electric Light and Power Co., Windsor, N.S., whose plant was destroyed by the late fire, has immediately started to rebuild, and has given an order to the Royal Electric Co. for apparatus and transformers, etc., consisting of "S.K.C." alternators and Stanley transformers. The ashes of the old station had hardly grown cold before the order for the new apparatus was placed.

GEO. C. RANKIN, London, promoter of the Chatham city and suburban electric railway, has withdrawn from the provisional company, Angus Sinclair, Chatham, taking his place. S. R. Miller and W. D. McRae, Detroit, have been elected to the board. The intention of the company is to secure the necessary amendment to their charter for the extension of the road north and south, and to push the work of construction.

THE Grand Trunk Railway has arrived at an agreement with the Hamilton Radial Railway Co. to allow the latter a crossing at Burlington, in return for the abolition of the level crossings over the G.T.R. line at Sherman avenue, and over the H. & N. W. division, near the beach. This gives the Radial a route into Oakville, Ont., and the extension will probably be built.

THE Canadian Cotton Mills Co., Milltown, N.B., has closed a contract with the Royal Electric Co. for a 30 k.w. "S.K.C." two-phase dynamo wound to deliver 110 volts to the service mains. Within the last eight weeks this is the third large manufacturing establishment to install one of these machines of the Royal Electric Co.'s make, the Penman Manufacturing Co., Paris, Ont., and the Cockshutt Plow Co., Brantford, being the other two.

JOHNSTON'S Electrical and Street Railway Directory for 1897 will be issued January 1st. This work contains complete and accurate lists of electric lighting companies, isolated plants, telephone, telegraph, street railway, and other electrical companies of the United States, Canada and Mexico, with full information regarding each, including the names of superintendents, purchasing agents, etc.; also lists of manufacturers of and dealers in electrical and street railway appliances.

THE Deschenes Electric Company, Limited, has taken out a license to supply electric light and power in the city of Ottawa and county of Carleton. The company, which was granted a charter in January, 1896, obtained from the Dominion Government the right to lay cables from the Ottawa River at the foot of the locks on both banks of the Rideau Canal to the canal basin, agreeing in return to supply electric current free for the lighting of the canal locks, basin, etc. The directors of the company are: W. J. Conroy, R. H. Conroy, Alex. Fraser, David Maclaren, and Charles Magee.

THE corporation of Fort William, Ont., is about to erect as complete an electric lighting plant as, perhaps, is in use in any town in Canada. There is being installed one 50-light 2,000 c. p. arc dynamo, with 35 double or all night lamps for lighting the streets of the town and the C. P. Railway yards, and for the incandescent service, and "S.K.C." alternating current dynamo with a capacity of 1,000 lights, with "Stanley" transformers throughout. The corporation expects to be in a position to furnish light by the 1st of January next. The electrical equipment has been bought from the Royal Electric Co., and the engines and boilers from the Robb Engineering Co., Amherstburg, N.S.

IN the case of Lepitre vs. the Citizens' Light Co., we mentioned the judgment against the company for $1,000. The details of the accident are as follows: The young man was employed one evening passing wires along a beam in a cellar, under which beam were wires

charged with electricity at the time, as they served for lighting purposes. The whole space between the live wire and those at which Lepitre was working was about fifteen inches, and having come in contact with the current, he was killed. The court held that the company must be held responsible as having been guilty of negligence in not properly insulating the wires when work was being done under such dangerous circumstances.

ACCORDING to the financial statement presented to the shareholders of the H, G & B Electric Railway at their last quarterly meeting held recently, the railway is making money. For the months of July, August and September there was an increase of $3,125.93 in passenger receipts, $342 in freight and $1,033 in express receipts over those of the corresponding quarter last year. The total receipts for the quarter were $16,913.87, as against $12,430.91 for July, August and September of 1896. In August of 1896, 29,192 passengers were carried, and in August of this year, 47,700; in September, 1896, 19,647, and September, 1897, 26,776 The expenditure for the quarter ending Sept 30th, this year, was $2,715 01 less than for the same quarter last year.

Personal.

WE are much pleased to hear of the restoration to health of Sir Casimir Gzowski, C E.

H. A. J. MCLEOD, C.E., will be the Government engineer in charge of the Drummond Counties Railway.

A. R. MACDONALD has been appointed superintendent of the Intercolonial Railway between Montreal and Levis, Que.

R. J. REED, the well known contractor, Montreal, who has been ill at his home in Montreal, left for California recently in a private car.

AT the International Geographical Congress held at St. Petersburg a short time ago, Mgr. Laflamme, rector of Laval University was elected one of the vice-presidents

JOHN CHISHOLM MACNAB, a member of the Red River expedition, civil engineer at Chatham, Ont., died at the home of his father, 111 Elgin street, Hamilton, recently. He was 46 years of age.

THE Toronto Technical School Board has appointed H. P. Elliott, a graduate of Toronto University and of the School of Practical Science, to the position of teacher of electricity and the steam engine.

GEO. H FROST, of the *Engineering News*, New York, was a fellow student of Dr. Robt. Bell of the Geological Survey, in civil engineering at McGill University, and graduated only a short time before Dr Bell.

THE death is announced at Jersey City Heights, recently, of Wm Moore, a former citizen of Quebec. He was engaged as city surveyor during the introduction of the first Quebec water works. Subsequently he was first manager of the old Quebec Street Railway, when he became manager of the Quebec Steamship Company, of which, in late years, he has been New York manager.

S J. TURKINGTON died recently in his 73rd year. The greater part of a very useful life was spent in railroad contracting. When the Grand Trunk Railway was building through the eastern portion of Ontario he superintended the construction of a large section for three years. He afterwards built a portion of the R.W. & O.R.R., the Lake Shore, the Midland, and also railroads in New Brunswick and the Southern States. On retiring from active contracting he settled in Mallorytown, Ont., and for five years discharged the duties of customs' officer, being relieved of office some three years ago.

THE death occurred at Montreal, November 14th, of Frederick Fairman, president of the Dominion Barb Wire Company. The sad event was the outcome of a cold contracted the previous week while superintending the construction of some new houses, and which developed into pneumonia Mr Fairman was born and received his early education in Gananoque, Ont., and graduated with considerable distinction from Victoria University, Cobourg. He entered the machinery and manufacturing firm of D S Abbott, Gananoque, and subsequently acquired an interest in the business, which he carried on until 1874. He was then for five years with the Montreal firm of Moreland, Watson & Co., when he bought a retail business in Waterloo, Ont. In 1882 Mr. Fairman returned to Montreal and entered into the partnership of Cooper & Fairman, which was dissolved three years later. It was at this time that Mr. Fairman accepted the presidency of the Dominion Barb Wire Company. He was also for a time connected with the Dominion Bridge Company.

INK that will adhere to glass is produced in the following way: Twenty parts of brown lacquer are dissolved in 150 parts of alcohol and mixed with a solution of thirty-five parts of borax in 250 parts of distilled water. The mixing should be done slowly, one part of methyl-violet being added. The ink thus produced is very lasting, and can be used to advantage instead of labels on glass bottles.

Brief, but Interesting.

THE Schwarz aluminum air ship, fitted with a benzine motor, was tested last month in Berlin, Germany, in the presence of a number of generals and others. The air ship rose to a great height, floated in the air for 12 minutes, and, at first, obeyed the man steering it, but later he was unable to steer it against the strong wind which prevailed. The experiment was considered to be partly successful.

The oldest piece of gold wire of which the world has any knowledge is a specimen made in Nineveh some 800 years B.C. Solid gold drawn wire is now, states *Science Siftings*, practically unknown in the trade. However, gold wire is made in the following manner: Silver rods are coated with gold in the proportion of 2 per cent. of gold to the weight of silver to be manipulated. When the gilding is performed the rods are about 1¾ inches in diameter by 2 feet 6 inches long, and weigh about 400 ounces each. The two metals are then drawn down together, first through steel dies, and afterward through drilled rubies or diamonds. The process of drilling the gems is kept a secret. A better idea of the minuteness of some of these borings may, however, be learned from the fact that the holes cannot be discerned by the naked eye, and only by the aid of a magnifying glass can one be convinced that they really exist. For the manufacture of silver and silver-gilt wires the silver is sometimes bored out and internal copper rods are inserted, and they are then drawn together. Wires as fine as a human hair, for example, .003 inch in diameter and even finer, can be gauged by instruments termed "micrometers." The scales for weighing the gold coin at the mint are so exquisitely fine that they can detect the most minute particle added to either side of the balance. There are fine woven wire gauzes and cloth, some of which are made with as many as 40,000 meshes to the square inch. The more delicate classes of wire find application in scientific instruments. So fine are these that it is difficult to get them measured; but the task has been accomplished, and platinum wire has been drawn $\frac{1}{10000}$ of an inch, and to even greater fineness. Aluminum wire has been drawn as fine as 10,500 yards to the ounce, a size too fine to be practically measured by any gauge or instrument.

Industrial Notes.

THE new flour mill at Goderich, Ont., is now in operation.

A START has been made in erecting the new flour mill at Wolfville, N.S.

A NEW $10,000 school building is to be built at once at Sackville, N.B.

A SEWAGE system for Pembroke, Ont., to cost $16,000, is under consideration.

AN engine is being placed in the Granby, Que., Rubber Co.'s machine shops.

THE E. B. Eddy Co., Hull, Que., is spending $20,000 in perfecting its fire protection system.

THE plant of the Vulcan Iron Works Co., Winnipeg, has been bought by John McKechnie

JOHN BERTRAM & SONS, Dundas, are very busy building heavy machinery for shipping abroad,

THE Boys' Home, Montreal, has received donations amounting to $8,000 to be expended in building.

FAVORABLE progress is being made on the piers for the Saskatchewan bridge at Edmonton, N.W T.

J. HONEYMAN and E. J. Watson, architects, are employed on the new school building, Rossland, B.C.

A BRIDGE to cost about $10,000 is proposed to connect Sydney, Cape Breton, with the Intercolonial pier.

AMONG the busy Hamilton concerns is the machine shop of Charles James, who is now turning out, among other work, 2,000 shoes for seed drills for the North-West. This firm has just put in a new 30-inch drilling machine from the well-known tool makers, John Bertram & Sons, Dundas, Ont.

THE Cappison Pipe and Boiler Covering Co. have recently supplied their Standard Abestos Magnesia sectional covering to various concerns, the orders aggregating nearly 12,000 feet. Among the mills so fitted up are the new mills of the Holland & Emery Lumber Co., who have recently removed from Michigan and built two large saw mills at Byng Inlet, on the site of the mills of the Georgian Bay Lumber Co., burnt some time ago. The new mills are fitted with band saws, circular saws, lath and shingle saws.

ANNAPOLIS, N S, has had plans for a sewage system prepared.

THE Granby, Que., last works are putting in a forty-five horse-power boiler and engine to run their works.

THE city of Sherbrooke, Que., and the Street Railway Co. will build a new bridge over the river St Francis.

WM. DAVIES & Co, Toronto, propose to establish a large pork-packing establishment in the Maritime Provinces.

A. THOMS, Fort William, Ont., has invented a seat for use in locomotive cabs which has a special arrangement of springs.

THE Jenckes Machine Co, Sherbrooke, Que., is building a 20 x 10 crusher for the Wilson Carbide Co., St. Catharines, Ont.

B. MOONEY & SONS, St John, N.B., have received a contract for a brick block of five buildings for T. R. Davison, Windsor, N.S.

THE Windsor, N S, Foundry Co has secured temporary premises and is carrying on business almost as usual. The works will be rebuilt.

PLANS have been prepared for the erection of a new theatre and opera house near St. John's gate, Quebec city. Its estimated cost is $60,000.

THE town of Kingsville have taken over the natural gas plant, which has been operated by a private company. The price was $18,000.

JAS. KAY, Aylmer, Que., has been appointed boiler inspector and issuer of engineers' and firemen's certificates in the Province of Quebec.

I MATHESON & Co., New Glasgow, N S., have recently shipped several car loads of buoys to the Pacific coast for the Dominion Government.

GEORGE MCARTHUR, St. John, N.B., has been awarded the contract for building Doran's Hotel, Windsor, N.S. The price is over $20,000.

AT the next session of the Ontario Legislature, the city of Toronto will ask an amendment of its charter enabling it to carry on the business of cold storage.

IT is said to be probable that the McClary Manufacturing Co., London, Ont., will establish a branch for the manufacture of enamel ware in St. John's, Que.

E. METHOT, of Cap St. Ignace, is intending rebuilding his saw mill and installing two 40 h.p. boilers, to be furnished by the Jenckes Machine Co., Sherbrooke.

THE city council of Sherbrooke is passing a by-law to raise $35,000, of which $15,000 is for a new bridge and $14,000 for the completion of the sewage system.

THERE is a good prospect of an hospital being built at Maniwaki, Que., as $10,000 has been raised already, and the Quebec Government is expected to make a grant.

GEO. ANDERSON, Canadian Trade Commissioner to Japan, reports a great demand in that country for boilers, engines and machinery generally.

MONTREAL manufacturers are to be obliged to abate the smoke nuisance. Where electric power is so easily obtained as in Montreal, there should be no trouble from smoke.

PETER REID, of Lemesurier, Que., is installing a new engine and boiler, bought from the Jenckes Machine Co., Sherbrooke, which will largely increase the capacity of his sawmill.

SPENCER & SPENCER, Frelighsburg, Que., are enlarging their saw-mill, and for this purpose have placed an order with the Jenckes Machine Co., Sherbrooke, for a 25-inch special Crocker turbine.

THE city of Hamilton, Ont., is offering the Heinze Pickle Co., Pittsburg, tax exemption for ten years and a reduced rate for water supply for the proposed Canadian branch.

THE Toronto Cold Storage Company, Limited, has been incorporated. The incorporators are. F. C. Jones, G. B. Jones, H. F. Darrell, Sarah Darrell, J. Massie, Toronto.

THE acetylene gas machine recently installed by James Boxall, in the R. C. Presbytery, Downeyville, Ont., has been tested, and gave satisfaction. It is a 20-light machine

THE Grand Trunk Railway has come to an agreement with the town of Collingwood, Ont., for the erection of an elevator there. The town will give twenty-five thousand dollars.

H. R. MCLELLAN, known as the pioneer lumberman of the Gulf of St. Lawrence, will shortly establish a lumber mill on the Marguerite River, where he controls large timber limits.

J W. WURTELE & Co, Ottawa, Ont., are making magnabestos sectional covering, which is claimed to effect a saving of 25 to 40 per cent. in fuel, by covering boilers, furnaces, etc.

BUILDING operations have not been begun by the Hamilton and Toronto Sewer Pipe Company, Hamilton, Ont., and it said that the company does not propose to build till next spring.

THE Victoria Foundry Co, Ottawa, Ont, manufacturers of water wheels, power house plants, rotary pumps, automatic hose reels, etc., report business improving and the general outlook bright.

THE business of Rogers, Robertson and Co., oil merchants, Montreal, has been amalgamated with that of the Bushnell Company, Limited, and Duncan Robertson becomes connected with the latter firm.

GILLIES BROS. are not only rebuilding their saw mills at Braeside, but will shortly build one at Madawaska, Ont., on the K. & P.R R, for the manufacture of cedar ties, shingles, basswood, elm and ash lumber.

W. H. MELDRUM has purchased the Paris rollers mills, at Paris, Ont., from Crane & Baird, of Toronto and Montreal. Wm. and J. G. Greey, Toronto, mill furnishers, are putting in plant of 200 barrels capacity.

THE Royal Victoria Hospital, which Lords Mountstephen and Strathcona presented to Montreal, at a cost of $2,000,000, has already grown too small, and the governors are considering plans for a $100,000 extension.

THE Canadian Engine and Locomotive Works, in Kingston, have been notified that they will get the contract to build three locomotives for the Intercolonial Railway Company. The company will tender for seven more.

THE Chicoutimi Pulp Co., Chicoutimi, Que., have decided to extend their mill, and have placed an order with the Jenckes Machine Co., Sherbrooke, for nine 10-plate screens, an additional Crocker turbine, and a 50 h.p. boiler.

THE Brothers of the Sacred Heart of Arthabaska purpose erecting a college building a hundred and fifty feet long, fifty feet wide, and four stories high, at St. Hyacinthe, Que. It will be built of stone and brick, and will cost about $50,000.

W. H. PERRIN, O. Carss, A. Foster, A. Patterson and J. R. Lavell, Smith's Falls, Ont., have been incorporated as The Perrin Plough Company of Smith's Falls, Limited, to manufacture agricultural implements. Capital nine thousand dollars.

THAT Canada may develop a large export trade in paper to Japan is evident from the fact that Taylor Bros., of the Don Paper Mills, Toronto, recently received an order from a Japanese importing firm at Yokohama, for 110 tons of paper.

THE firm of Major Bros & Co., Montreal, manufacturers of cardboard, tar paper, etc., contemplates moving to Cornwall, Ont. They would need a site of ten acres, with a water-power, and would build a paper mill employing forty to fifty hands.

BUSINESS is very brisk at the Calcium Carbide Works, Merritton, Ont. A car load of carbide was shipped recently to the Yukon, via New York, where it will be shipped around Cape Horn. Three car loads were also shipped to Europe and one to Mexico.

THE provisional directors of the Duryea Motor Co of Canada, Limited, which is applying for a Dominion charter, capital $250,000, are: S. Rogers, T. Eaton, Toronto; H. Edwards-Fiehen, New York, U.S.; G. H. Hewitt, Springfield, Mass., and G. W. Yarker, Toronto.

PRICE BROS., Quebec, have placed an order with the Jenckes Machine Co., Sherbrooke, for one of their special refuse burners, 18 feet in diameter, 120 feet high, for their Montmagny mill. This is the second burner of this size which the Jenckes Company has supplied them.

THE city council of Brantford, Ont., has voted $15,000 to buy from the Verity Plow Co. the premises recently burned. If the company accepts this offer, it will be obliged to go on with its business in Brantford. The works began to run regularly after the fire on Nov. 13th.

LAWN FARM, Mattoon, Ill., consisting of 250 acres, has been sold for $17,450 to Grand Chief P. M. Arthur, in trust for the benefit of the Brotherhood of Locomotive Engineers. It is the intention of the Brotherhood to establish a home for dependent engineers, their widows and orphans.

THE boiler of the Royal City saw mills, Vancouver, B.C., exploded at noon recently while the men were eating dinner around it. Several men were killed and many injured. The roof of the mill was blown off and the building wrecked. The noise of the explosion was heard outside of the city limits.

THE Acetylene Lighting Company, Limited, applies for a Dominion charter to carry on a lighting business in London, Ont. Proposed capital, $15,000. The incorporators are: W. J. Stinson, London, Ont.; C. S. Grosch, S. G. Grosch, Milverton, Ont.; M. M. Stinson, London; W. R. Stinson, St. Thomas, North Dakota, U.S.

THE large Jewell filters for the town of St. Hyacinth are being installed These filters were built throughout by the Jenckes Machine Co . of Sherbrooke, and the work reflects great credit on this firm.

H. ROBERTSON, J. Arnett, D. McLean, A. Spicer, I. Groh, W. E Roark, J. A. Rourke, R. Simpson, H. F. McDonald, T. Cain, A. Robertson, J F. Snowball, Shallow Lake, Ont., have been incorporated as the Shallow Lake Woodwork Manufacturing Company, Limited. Capital five thousand dollars.

THE purchase of a controlling interest in the Vancouver Gas Works by Wm Mackenzie, of Toronto, on behalf of a strong syndicate, is of interest and importance to our province's mining, says the *Mining Critic*, in view of the necessarily close connection of successful gas production with coal mining.

G A LANDON and F. A. Landon, manufacturers, and E. B. Landon, traveller, of Toronto, and James H Taylor and James Kellam, of Etobicoke, farmers, have letters patent to manufacture carriages and carriage supplies, under the name of the Carriage Specialty Co., of Toronto, Limited; capital, $20,000.

THE work on the Lawrencetown, N.S, water system is nearly completed, and will cost about $9,000. Two reservoirs have been constructed, the upper one at an elevation of 250 feet and the lower one 135 feet. The capacity of the latter is nearly 100,000 gallons Twelve hydrants will be placed in town and about fifty house services put in.

THE Goderich Boiler Works recently turned out a ditch digger, built somewhat after the plan of a dredge, having an endless chain on which are a number of knives and iron buckets. It is some 20 feet high and mounted on trucks 20 feet long and 10 feet wide. It was run by a threshing machine engine, and in clay or sandy soil made excellent time.

THE plans for the Nepean Point Bridge have been prepared under instructions from H. J. Beemer, president of the Ottawa and Gatineau and Pontiac and Pacific Junction Railways. Mr. Beemer has sent copies of the plans to various bridge contractors in Canada and the United States, and will ask for tenders at once.

ONE of the largest penstocks ever used in connection with the development of water powers in Canada is being built at the works of the Laurentian Pulp Co. Grande Mere, Que., on the St. Maurice River. The main penstock is 14 feet in diameter, made from 7-16 in. steel plate, 550 feet long, and with its branches has used in the neighborhood of three hundred tons of plate. The Jenckes Machine Co., Sherbrooke, Que., has this contract.

A PORTION of the assets of the Young Co., Limited, of Brampton, Ont., Soil Pipe Foundry amounting in value to $7,700, has been sold to the Toronto Hardware Company by the assignee, F. H. Lamb, of Hamilton. The building and plant remain unsold, and it is said that it is likely that the town of Brampton will have to take it over and add it to the collection of such things they have acquired by their system of liberal bonus giving.

ST. LAWRENCE Anchor Fence Company, Limited, applies for a Dominion charter to manufacture fences and gates, etc , in Montreal. Proposed capital, $20,000 The incorporators are. G. F. Benson, D. W. Campbell, W. L. Chipchase, G. J. Crowdy, W. Ewing, P. Galibert, J. L Gilmour, E K Greene, W A. C. Hamilton, J. Johnston, G. W. Lovejoy, M.D., F. G Lyman, and Hon. A. Thibaudeau, Montreal, A Dickson, Longue Pointe; J. M. Elder, M.D., Westmount, Que.

THE machinery of Paxton, Tate & Co., mill machinery manufacturers, Port Perry, Ont , has been sold to Adison Williams. This was nearly all the available assets of the firm, and, owing to secured claims, the ordinary creditors will receive nothing from the estate. The assets are expected to realize about $7,000, with liabilities of over $4,718 69, of which $1,103.59 are preferred securities held for $8,169 06. The Ontario Bank holds a secured claim for $6,900.

AT the sixth annual meeting of the Foundrymen's Association held at the Manufacturers' Club, Philadelphia, November 3rd, there was read a paper on the subject of "The Practical Value of the Various Metalloids in Cast Iron," by Malcolm McDowell, 606 E. 46th street, Chicago, Ill., who has a national reputation as a metallurgist. His paper was full of interest, and treated on the so-called semi-steel that is now being made by several foundries from cupola metal and poured in green sand; its tensile strength being about 40,000 lbs.