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CONTENTS OF THIS NUMBER:

Acetylene Gas on a Canadian Railway ... 353
Bridge, Toronto, The York St. ... 354
Canadian Association of Stationary Engineers ... 366
Chatham Municipal Plant ... 356
Chemistry of Foundry Practice ... 360
Commercial Progress as Influenced by the Iron Industry ... 360
Drummond, President of Federated Canadian Mining Institute, Extracts from address of ... 359
Electric Flashes ... 363
Engine, The Steam ... 361
Industrial Notes ... 366
Iron Industry, Commercial Progress as Influenced by the ... 360
Marine News ... 369
Milling Machinery, Some Modern ... 347
Mineral Production of Canada, Bonus of ... 371
Mining in Quebec ... 355
Montreal Island Belt-Line Railway ... 350
Motor Carriage, The ... 363
Ontario Land Surveyors ... 354
Personal ... 369
Piers, Steel Cylinder ... 355
Plumbing Appliances, Ventilation of ... 356
Pump, Centrifugal ... 358
Railway Engineering ... 341
Railway Matters ... 368
Railway, Montreal Island Belt-Line ... 350
Sewage Disposal through the Action of Bacteria ... 344
Sewage Purification, The Oxygen System of ... 346
Steam Engine, The ... 361
Ventilation of Plumbing Appliances ... 356
York St. Bridge, Toronto, The ... 354

WITH this issue Volume V. of the CANADIAN ENGINEER is completed. On application at this office an index of the year will be sent to any subscriber who wishes to bind the volume.

For THE CANADIAN ENGINEER.

RAILWAY ENGINEERING.*

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

CHAP. V.

ROADBED CONSTRUCTION.

ARTICLE 28.—LAYING OUT AND MEASURING WORK.

Cross-sections should be taken at such intervals that the prismoid between two adjacent ones will have planes as boundaries on a top surface with longitudinal convolutions only, extending in straight lines from one section to the other; to do this quickly and without unnecessary sections is a matter of experience and visual judgment, requiring the personal attention of the engineer. The slope stakes should be marked on one side with the cut or fill and on the other with the distance from the centre line; some engineers also write the station (chainage) on the slope stakes. These stakes are put in at every 100 feet in light work and on tangents, but on curves and heavy work they should be put in every 25 or 50 feet, depending on circumstances, and on all side-hill work liable to slip the sections should be carried up the hillside 200 or 300 feet to points beyond any danger of movement, and should be taken before excavation has been commenced.

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

There are two methods of keeping notes in use in Canada; in the first, each rod reading is entered in a separate line and the corresponding cut or fill reduced from the grade elevation; in the second method the difference between height of instrument and grade is called "grade rod," and the rod readings are subtracted mentally from it, and the corresponding cuts or fills are recorded, consecutively, on one line of the book in the form of fractions, with the distances from centre line as denominators. It is evident that the first method is more laborious and fills much more space in a note book, and is not so convenient for plotting, but, on the other hand, the reductions can be checked afterwards, and are legal documentary evidence, whereas the second method is entirely one of convenience and leaves great chances for error by careless mental subtraction, which cannot be duplicated, and the note books are, therefore, not very strong evidence in a law court.

Plate XXI

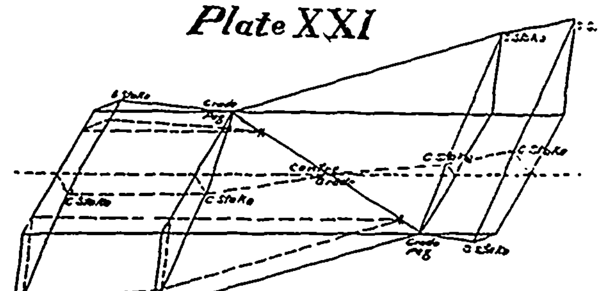

Fig. 76 Perspective of Cross-Sections adjacent to Grade Pegs.

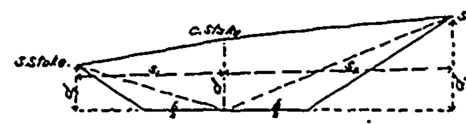

Fig. 77 Ordinary Three-level Section.

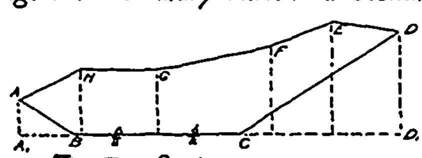

Fig. 78 Section on uneven ground.

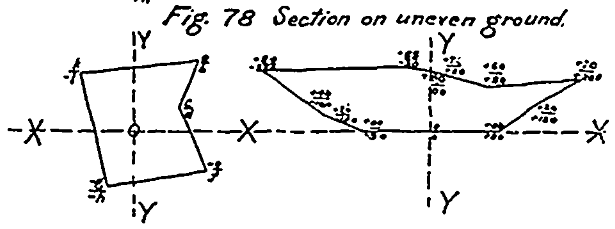

Fig. 79 Eckel's Formula with application to Sections.

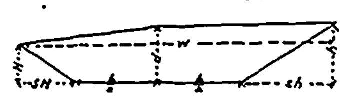

Fig. 80 Prismoidal Formula Diagram.

The following are notes of surface levels of Figure 80 taken by both methods:

(1) ENGLISH METHOD.

Station.	B. S.	H. of I.	F. S.	Int. S.	Ground.	Grade.	Cut.	Fill.	Remarks.
102....	..	311.20	..	10.2	301.0	293.0	8.0	..	..
2 R..	..	..	..	10.7	300.5	..	7.5	..	..
8 R..	..	..	..	12.2	299.0	..	6.0	..	..
20 R..	..	..	..	11.2	300.0	..	7.0	..	S. S.
3 L .	..	..	..	9.7	301.5	..	8.5	..	..
22 L..	..	..	..	10.2	301.0	..	8.0	..	S. S.

(II) United States Method.

Station.	B.S.	H. of I.	F.S.	Grade.	Grade rod.	Left.	Centre.	Right.
102...	...	311.20	...	293.0	18.2	(s.s.) $\frac{+8.0}{22.0}$ $\frac{+8.5}{3.0}$	$\frac{+8.0}{0.0}$	$\frac{+7.5}{2.0} + \frac{6.0}{8.0} + \frac{7.0}{20.0}$ (s.s.)

The greater simplicity and convenience of the second method commend it to general use in spite of its drawbacks.

On some roads it is customary to take sections after the work is done, and pay for the actual quantities excavated; in others, the slope lines are adhered to and every endeavor is toward the full section taken out. It is probable, however, that the former method is more satisfactory to all concerned, although giving a little extra work to the engineering staff.

Structures need to be staked out twice, once for the foundation pit and again for the laying out of masonry, and of course, on all important structures, measurements and levels are given very frequently as the work progresses, both as an aid and a check to the contractors. A separate note book called a "structure book" should be used, and in it recorded, from day to day, notes of actual sizes, heights and measurements of all structures, and a duplicate office copy also kept up to date for fear of losing the field book. This structure book should include notes on all timber, stone and iron structural work, and will be a valuable aid in case of disputes involving quantities, it will also enable a large scaled profile being made for the maintenance department showing the exact chainage and elevation of each foundation and portion of structure. The necessity for absolute accuracy in laying out, measuring and calculating the quantities in all structures and grading cannot be too firmly impressed on the young engineer; all office calculations should be done in duplicate and preferably by different persons, as one cannot be very sure of a check on one's own work.

Cross Section Areas may be calculated in at least three or four ways, (1) where only a three-level section is taken, as in Fig. 77, the area of the section is evidently made up of triangles and is:

$$\text{Area} = \left(d \times \frac{S_1 + S_2}{2}\right) + \left(\frac{b}{2} + \frac{d_1 + d_2}{2}\right) \text{........(1)}$$

(2) On rougher ground where more than three surface readings are necessary this method fails and must be replaced by more tedious ones, quite ordinarily Fig. 78 illustrates the one adopted, and consists in taking out the sum of all the trapezoidal areas, $A.A._1 D._1 D.E.F.G.H.A.$ and deducting the area of the two triangles $A.A._1 B.$ and $D.D._1 C.$

(3) By careful plotting, irregular areas can be taken out quite accurately with a polar planimeter.

(4) By Eckel's formula, which can be used without plotting the sections, and is equally adapted to the easiest or most difficult rectilinear areas. This formula, which is mathematically correct, is: "If the corners of any rectilinear polygon be referenced by rectangular co ordinates to any origin, then if the ordinate of every corner be multiplied by the abscissa of the next corner, and so on around the polygon, and these products added together; and if the ordinate of every corner be again taken and multiplied by the abscissa of the next corner, passing around the polygon in the *reverse* direction, and these products added together, then the area of the polygon is equal to one-half of the difference of these two sums." As an example, in Fig. 79 the area of the polygon is

$$\tfrac{1}{2}\{[(a \times d) + (c \times f) + (-ex - h) + -g \times -l) + (k \times b)] - [(a \times -l) + (k \times -h) + (-g \times f) + (-c \times d) + (c \times b)]\} \text{ .... (2)}$$

or,

$$\tfrac{1}{2}\{(a \times d) + (c \times f) + (c \times h) + (g \times l) + (k \times b) + (a \times l) + (k \times h) + (g \times f + (c \times d) - (c \times b)\} \text{ .... (3)}$$

In which great care must be taken to use the correct plus and minus signs. In railway work, this is much simplified by having all the area above the axis $XX.$, and in very irregular areas, which are met with in cuts that have slipped in as in Fig. 79, the area can be quickly taken out, thus, as follows:—

$$\text{Section} = \frac{+8.0}{-22.0}.\ \frac{+8.5}{-3.0}.\ \frac{+8.0}{0.0}.\ \frac{+7.5}{+2.0}.\ \frac{+6.0}{+8.0}.\ \frac{+7.0}{+20.0}.$$

$$\frac{+3.0}{+13.0}\ \frac{+0.0}{+9.0}.\ \frac{+0.0}{0.0}.\ \frac{+0.0}{-9.0}.\ \frac{+2.0}{-14.0}.\ \frac{+4.0}{-16.0}.\ \frac{+8.0}{-22.0}$$

$$\text{Area} = \tfrac{1}{2}\{-24.0 + 16.0 + 60.0 + 120.0 + 91.0 + 27.0 - 32.0 - 88.0 + 128.0 + 56.0 + 18.0 - 60.0 - 56.0 - 12.0 + 24.0 + 187.0\} = 227.5 \text{ square feet.}$$

Thus arriving at a correct result without plotting sections, and by a mechanical sort of process, which is a safe one to place in the hands of a comparatively unintelligent rodman; for the purpose of checking calculations, it is not appreciably more or less rapid than by taking out areas by method. (2)

QUANTITIES.

The use of tables and diagrams is a great aid in taking out approximate quantities, so that in various handbooks may be found the volume of 100 foot prismoids of level sections, of various heights, slopes and widths of road-bed, and this has been extended in Wellington's earthwork diagrams, etc., by giving the volumes of 100 foot prismoids where the sections, although not level, are of the three-level type, having a separate height at the centre and each slope stake, and as in easy sections this is all that is taken the diagrams are very useful. More accurate calculations of volumes of excavation or embankment may be made in three ways: (1) The prismoidal formula, which is the only one that is mathematically correct, is as follows:—

$$\text{Volume} = L \times \frac{A + 4A_1 + A_2}{6} \text{ .... (4)}$$

Where L = length of prismoid A and A_2 = end areas and A_1 = middle area (which must be calculated by interpolating the middle heights).

A proof of this formula may be found in any mathematical text book, but a neat adaptation of the formula for three-level sections is given by Mr. G. H. White in *Engineering News*, April, 1895 (see Fig. 80).

$$\text{Volume} = \tfrac{1}{6} L\left\{A + 4A_1 + A_2\right\} =$$

$$\tfrac{1}{6} L \left\{\left(\frac{W.d}{2}\right) + \left(\frac{b}{2} \cdot \frac{H+h}{2}\right) + \left(\frac{W_2.d_2}{2}\right) + \left(\frac{b}{2}\frac{H_2+h_2}{2}\right) + 4\left[\tfrac{1}{2}\left(\frac{W+W_2}{2} \cdot \frac{d+d_2}{2}\right) + \frac{b}{2}\frac{\left(\frac{H+H_2}{2} + \frac{h+h_2}{2}\right)}{2}\right]\right\} \text{ ...... (5)}$$

$$= \tfrac{1}{6} L \left\{\left(\frac{W.d}{2} + \frac{W.d}{2} + \frac{W.d_2}{2}\right) + \left(\frac{W_2 d_2}{2} + \frac{W_2 d}{2} + \frac{W_2 d_2}{2}\right) + \frac{b}{4}\left(H + H_2 + h + h_2 + 2H + 2H_2 + 2h + 2h_2\right)\right. \text{ ....(6)}$$

$$= \tfrac{1}{6} L \left\{W\left(d + \frac{d^2}{2}\right) + W_2\left(d_2 + \frac{d}{2}\right) + \tfrac{3}{4}b(H + H_2 + h + h_2)\right. \text{ .... (7)}$$

and if we have a definite slope which we call s. (say $1\tfrac{1}{2}$ to 1 for earth, or $\tfrac{1}{4}$ to 1 for rock), we will have

$$H + H_2 + h + h_2 = W + \frac{W_2 - 2b}{s} \text{ .... (8)}$$

and the volume equation becomes

$$= \tfrac{1}{6} L \left\{W\left(d + \frac{d_2}{2}\right) + W_2\left(d_2 + \frac{d}{2}\right) + \tfrac{3}{4}\frac{b}{s}(W + W_2 - 2b)\right. \text{ .... (9)}$$

from which it will be seen that the volume may be obtained by having the slope stake distances of the two end sections (W and W_2), the centre cuts (d and d_2) the roadbed width (b), and slopes (s), thus eliminating the determination of the middle area from the calculation.

(2) Mean areas, which custom has established as the one to be ordinarily used, because of its simplicity, is merely, volume $= L \frac{A+A_2}{2}$ ....(10)

where A and A_2 are the two end areas, the error involved in this formula is $+ \frac{1}{6}L (h-h_2)^2 s$. Where h and h_2 are the two centre heights, and s=slope of earth work, it is evidently = zero when $h=h_2$ and increases with their difference.

(3) Middle area volume is given by

Volume $= L+A_1$ ....(11)

Where A_1 = area of section midway between the ends of the prismoid.

The error involved in this formula is $+\frac{1}{12} L(h-h_2)^2 s$, being one-half as much as in the formula for mean areas, and also disappearing.

When $h=h_2$—and although equation (11) is more accurate than equation (10), it is not used, because once the middle area has been determined, the prismoidal formula is easily applied and still more accurate. There is another reason why formula (10) is not objectionable, that, in general, the profile of a line is convex in cuts, and concave in fills, and any system of sections, no matter how carefully taken will, as an average, need a little allowance for this rotundity between sections.

At points where the cut changes to a fill there should be two grade pegs determined (see Fig. 76) and cross-sections taken at these points, this makes the first volumes in cut and fill always pyramidal, there is no necessity for a centre grade peg, unless the distance from one grade peg to the other is excessive.

Borrow pits should be carefully cross-sectioned from some well defined base line before excavation is permitted, and, if at all possible, it should be made imperative that these pits before being abandoned should be left in good shape for final cross-sections and for drainage; undrained borrow pits are unsightly, a menace to health, and difficult, often, of measurement. There is another matter in this connection which should be well attended to, *i.e.*, proper referencing of alignment hubs; this may be done by cross lines fixed by hubs, trees, etc., or by right-angled lines and steel tape measurements, but in whatever way accomplished, considerable judgment is required to place the references out of harm's way and at the same time reasonably available; in side-hill cross-sections made after excavation great precision is required in this respect to prevent serious error.

Article 29.—Methods of Payment and Classification of Materials, etc.

There are occasional instances of railway companies of some financial strength and progressive growth carrying on construction under their own management, with their own plant and by day labor, but such instances are not frequent, and in general we may look to responsible contractors for the rapid execution of this kind of work requiring experience, undertaking risk, and with considerable capital as plant continually wearing out. Occasionally such work is taken by contractors at so much per mile, within limits of curvature, grades, style and locality, but as the element of risk is great the price is correspondingly high. Only approximate estimates are furnished, and the experienced judgment of the contractor to size up the class of material to be met with is his chief reliance. Such contracts are apt to be made when the railway company and the contractors are more or less identical.

Again, at times, contracts are taken in which such as timber, stone and iron are specified as to quality and price *pro rata*, but the excavation is unclassified and an average price per cubic yard is given, the contractor again taking chances, and being, by this method, unable to alter the location, his risk is great and price high enough, on the whole, to cover the risk; this has led to what is, at present, the general method of letting contracts for excavation, namely, to define certain classes of material as rigidly as possible and fix prices for each class, the usual divisions are solid rock, loose rock, hard-pan and other cemented material, and earth. As the dividing lines between these classes are purely arbitrary they need to be defined for all possible contingencies, which is a difficult matter. An engineer is always, although in the employ of the railway company, more or less an arbitrator, and he should endeavor to be just to all; theoretically he should always live up to the strict letter of the contract, and ordinarily this is the only course to pursue, but there are cases in which contractors, in their eagerness to obtain contracts, take them at too low prices, or they may strike some very difficult cuts which will not classify very highly if the specifications are adhered to, and in such cases it is usual to allow percentage classifications based on a fair cost of doing the work, *e.g.*, a heavy cutting composed of a mass of small boulders closely cemented together would only classify as hard pan, but often must be excavated entirely by drilling and blasting, and in such a case percentages, at least of rock, would be quite justifiable.

This idea of *helping out* a contractor, however, is a very pernicious one, and should only be done for good cause, where the recipient is worthy of it by his economical handling of the work, and with full knowledge and consent of the railway company. The vigilant watch and full knowledge of the various classes of material met with in excavation and the most economical methods of handling them, form one of the most important duties that a railway engineer has to perform, needing, moreover, a knowledge of men as well as ways and means. The calculation of quantities in structures should be made very minutely and in detail, as the prices are so much higher per unit than those of excavation; but the method to be used will depend on the terms of the contract and the individuality of the engineer. In some cases payment is made on bills of timber furnished, and on general plans of masonry, while in others the actual timber used and the masonry as built are the basis of payment. In the case of timber this latter method should include payment, as timber delivered, for all pieces cut off either from piles or timber, so long as the material used was as per bill given.

Quantities of earthwork should always be measured in excavation, for no one can determine accurately the shrinkage of fills, especially as only a portion of it takes place while construction is in progress, and continues for a year or two depending on the method of forming the bank. The total shrinkage is fairly well known, being about 5 per cent. for sand, 10 per cent. for clay, and 15 or 20 per cent. for loam; while rock expands 50 to 75 per cent., depending on the size of the pieces, and such figures modified according to the age of the bank will be sufficiently accurate for monthly estimates, but not for final ones. It is more laborious, often, to measure irregular borrow pits, but by insisting on these pits being shaped up before being left, the extra labor is not so very great and is the only really reliable way, the chief value of embankment quantities being to aid in a proper distribution of material from cuts, to enable overhaul calculations being made, and for approximate estimates where errors of 5 per cent. or even more are not objectionable, as the company, in its monthly payments to contractors, reserves 10 or 15 per cent. for just such exigencies. In taking monthly estimates, the only certain method is to make each one a total estimate in fact as well as in name, and derive the current estimate by deducting the total one for the month previous from it, that is, never take notes only of what is thought to have been done during the month, for nothing is more difficult or more apt to lead to error—whereas if the total work done or material delivered at each point is noted, the errors of each month are eliminated in the next one—the extra labor involved in this is usually insignificant.

Specification for Excavation.—Materials excavated will be classified as earth, quicksand or dry hard-pan, loose rock and solid rock. Earth includes everything except the other classes mentioned. Hard-pan includes all cemented clay or gravel, or any combination of these that it is not practicable to plow with a four-horse team. Loose rock includes all stone containing not less than one cubic foot, and masses of detached rock containing not over one cubic yard; also all slate, shale or other soft rock which can be removed without blasting, although blasting may be resorted to. Solid rock includes all loose rocks containing over one cubic yard, and all rock in place which requires drilling and blasting.

(N.B—.The earth and hard-pan are sometimes placed in one class as earth, at a higher rate, thus saving much contention.)

ARTICLE 30.—SURFACE DRAINAGE.

In addition to the provision for flow of water under or through the track, there is yet the question of track and slope protection which is of almost equal importance. Where, on side-hills, the surface flow toward the top of the cut slopes and toe of the embankment slopes is considerable, ample provision should be made to intercept it. In general, catch water ditches three or four feet wide, and one to one and one-half feet deep, should be dug so as to run in a continuous line along the upper side of the cuttings and embankments from each lateral watershed to the nearest culvert or stream--which should set back five or six feet, generally, from the edge of the slopes leaving a solid berm; the material from these ditches, cast on the lower side will form an additional protection. In very porous soils, these ditches may need to be lined with pitch or planked; but in any case will prevent that heavy washing down of cut slopes which, otherwise, fills up the track ditches and floats the track, making the roadbed soft.

The track (cut) ditches themselves should be turned into these catchwater ditches at the upper grade points, so as not to empty down along the toe of the embankment, eating it away; and in very wet cuttings, it may be necessary to run a farm tile about three feet under the track ditches and parallel to them to aid the drainage. In case of quicksand, which will soon fill up tiles, the tile must be covered with straw and laid with collars, or longitudinal round pole drains may be substituted for the tiles.

The slopes of cuttings themselves also need protection to prevent erosion; in ordinary cases the sowing of grass seed on the slopes of cuts and fills will answer the purpose, but where the cut slopes are wet and springy it may be necessary, in addition, to cut a series of diagonal ditches on the slopes to bring the water to the cut ditches by easy grades; in extreme cases the construction of a network of tiles on the slopes may be necessary to effect complete protection. Perhaps the most imperative matter of all is to have the ordinary cut ditches always cleaned out—free from boulders, ties, ballast, etc., which tend to accumulate during maintenance. The form which such ditches assume is of a wedge shape, with a slope from the track of about 3 to 1 and an outer slope the continuation of the cut slope. This form will tend to maintain itself better than one with a flat bottom and steeper slopes.

(*Conclusion Vol. I.*)

For THE CANADIAN ENGINEER.

SEWAGE DISPOSAL THROUGH THE ACTION OF BACTERIA.

BY W. M. WATSON, TORONTO.

Toronto and several other cities and towns, as well as private places, are contemplating putting in sewage works. Perhaps a little information, gathered from the leading bacteriologists, chemists and engineers, who have with the assistance of the best appliances been studying and experimenting on sewage for the past fifteen years, with the object of solving the knotty problem, viz., how to purify foul fluids, may be useful. My own experience in this connection will also be of interest.

Up to the present time precipitants of lime, powdered clay, alumina, ferrozone, sulphurous powder, sulphate of iron, and other chemicals, have been used to clarify or clean sewage by settling in tanks, generally extracting about a twentieth part of a pound of sludge per gallon of sewage treated, at a cost per head of population ranging from 25 to 75 cents, and often having considerable difficulty in disposing of the solids, even when expensive pumps, presses, and other machinery are used. The average composition of domestic sewage is: organic matter, 27.72 grains per gallon; nitrogen, 6.21; phosphoric acid, 1.17, and potash about 2.03 grains per gallon, which is principally in solution, and can only be removed by filters that contain numerous colonies of a very small rod-shaped bacteria that can be seen only by the assistance of a very powerful microscope. These organisms feed and thrive on the foul contents of sewage matter. Trade sewage may contain any chemical, and in some cases may need special treatment, which ought to be given it before it is allowed to enter the public sewers. Sewage heavily charged with grease may require a precipitant of bisulphide of carbon. Sewage from sugar factories which contains vegetable organisms, oscillaria alba, or beggiatoa, which act like ferments, rapidly decomposing, may require a magnesium chloride, quicklime and coal tar preparation, to extract its foul contents, and sewage from slaughter houses should have the blood and fat extracted before entering the public sewers.

To discharge clarified sewage that has only passed through settling tanks into fresh water is simply undoing the work done, because the dissolved putrefactive matter is held in solution after the solids are thrown down by the precipitants, and after being delivered into fresh water the dangerous microbes increase rapidly, and putrefaction is set up. Almost the same end is reached by allowing the sewage to enter fresh water after it has been carefully screened through a fine sieve, and it is probably more to the advantage of the public to allow sieved sewage to go in raw, than after it has been settled by the use of precipitants, because precipitants add somewhat to the chemicals held in solution, and make the sewage harder to purify.

Sewage placed under a microscope shows various decaying matters, multitudes of dangerous microbes, amoebiform bodies, infusoria, fungi, etc., including all the classes discharged from the skin and intestines of man and the animals. When water carriage is used to remove excrements, it is usual to calculate upon a basis of about 156 lbs. of solids and 200 gallons of liquids from each one thousand of population to remove daily. The sewage from clothes washing is very dangerous.

Disposal of sewage by broad irrigation over the top of land is neither efficient nor profitable in cold climates, because it takes a large space, and only about two gallons per yard per day can be put on, even when vegetation is active, because of the tenacity of the soil in holding moisture. Vegetation only takes up the manurial deposits, and the bacteria in the land must extract the foul gases or poisons, which they cannot do when the air cells of the earth get choked with fat and dirt. Then the bacteria cannot secure aeration, and so becomes useless. During heavy rains and hard frosts, the land is totally worthless as a filter or absorber of foul matter. When either irrigation land or artificial filters become water-logged too long they become asphyxiated, the organisms cease to act and oxidation is suspended until air can again be introduced to the filtrate to give vitality to the bacteria. On that ground irrigation through land can only be a success when the position is high and dry, and the water can freely escape at a depth of over four feet, and when it is composed of sand and gravelly soil. Under these circumstances, it will act as a bacteria filter, and can be made to purify sewage all the year round, by laying perforated pipes about every two feet, so that the fluid will be evenly distributed over the land. The pipes may be laid about fifteen inches below the face of the land, out of the reach of the frost in winter, and out of sight in summer, to prevent any nuisance, and to allow the land to be cultivated. By so doing, the moist air rising from the sewage will aid the vegetation growing on the surface. When this system is adopted proper arrangements must be made to discharge the sewage through the pipes at stated periods and equal quantities, giving the land periods of rest and sufficient time to secure aeration, and to supply the air to the underground pipes, flues and air circulating shafts must be constructed so that every part of the irrigating land, gravel and sand, also the microbes lodging in it, may be sufficiently supplied with oxygen. A firm in Ireland mix a solution of soda with the sewage, which it is claimed gives the bacteria all the oxygen they require without wasting time aerating. This is described elsewhere.

The marked success lately of the scientists has shown that all purification of foul fluids, whether accomplished by fresh water, by farm land, or artificial filters, is done by bacteria, and every method used to purify sewage must have proper provision made to supply these microbes with oxygen. By scientific management these friendly bacteria, which are humanity's scavengers, can be coaxed to eat up all the dirt and impurities in the sewage and discharge it into the atmosphere in the form of non-injurious gases, and by so doing saving the expense of handling the sludge.

This narrows down the art of cleaning foul fluids into being able to cultivate, to breed and use friendly microbes to advantage. When this is accomplished and the ditritus screens, the preparative storage tanks and the bacteria filters stocked with the friendly microbes and set in motion, it afterwards costs little to manage the treatment plant, for it can be made fully self-acting, only requiring the ditritus removed from the screens, and the grit removed from the syptic preparing tank about once a year.

There are several sewage purifying works constructed on the system just described working at present, and it will no doubt be generally adopted when properly understood. What is named the syptic tank, is placed underground and arched over, made air-tight and kept dark. The town's sewage goes in at one end and is almost motionless for a day, and during that time the coarser particles in suspension become deposited, and the putrefactive bacteria contained in the sewage are disintegrated, and a large portion of the inferior microbes disappear along with the sediment, after which it overflows over the opposite end, and is passed on to the bacteria filters.

Where convenient, towns should have separate drains for the collection of sewage, and they ought to be divided into small districts, each having its own sewage works. By adopting this plan only small main sewers would be needed, a better grade could be given, the sewage would arrive at the works in a fresher state, and on that account would be easier to treat, it would not have time to putrefy in the pipes, and the sewers would not need so much flushing, and the large trunk sewers might be dispensed with. By the new method of sewage purification the district plan can be easily carried out, because the whole sewage plant can be placed underground in public squares or other convenient places, out of sight and totally free from smell or nuisance, there being no machinery required or sediments to remove, and the first expense of plant will be less than by the old systems, and the cost of management after the system is put in full working order will be very small.

When proposing to lay down a sewage disposal plant there need be no stereotyped rule, nearly every place will require a little different method of arrangements in detail. The difference in the composition of the sewage, the geographical position and surroundings, and the amount of depth applicable, will each need to be considered in the style of construction. The general points to be secured are, first, that when a filter is started it must be stocked with sufficient colonies of the friendly bacteria; second, see that they are supplied at short periods with plenty of oxygen by a thorough aeration of the filter; third, never allow the filter to empty with a rush, because in that case some of the bacteria would be washed out of the filter. Rush the sewage on as quick as you please, but draw off the effluent slowly. Never allow the filter to be water-logged longer than the microbes can exist under water on the store of oxygen that is in the air cells of the filtrate and the little there may be in the fluid. Where possible to secure carbon made by carbonizing towns' garbage, use it for a filtrate. When these instructions are adopted the plant may be made to any design and placed in any position, either open or buried underground, and the results will depend on the amount of scientific management and good workmanship introduced into the construction, as to whether 200 or up to 500 gallons of sewage per superficial yard of filter space can be run through each day.

I have already described the preparatory settling tank into which the sewage first enters for treatment after being freed of all ditritus. The bacteria filter that purifies the fluid is simply a separator, that divides the sewage into small particles, and also constitutes a residence for the millions of bacteria which are brought into contact with each particle of sewage, on which they feed and from which they extract the foul gases. Any handy material that is easily wetted and easily dried and cannot be dissolved by chemicals, will answer for the filter, because it is not so much the nature of the filtrate, as it is the size, the thickness and the arrangement of the material in the filter, that is of the first importance. The best material is that which contains the largest amount of air cells to the cubic inch, in which the oxygen can be stored when the filter is getting aerated. Carbon is preferable because it is a better non-conductor than gravel, it also possesses the most air cells and is a natural deodorizer. Thus, either charcoal, carbon made from garbage, coal, spar, marble or gravel chips, clinkers, slag, sandstone, gravel, coarse sand, hard burnt clay or cinders will answer to charge the filter with.

If there is about 20 feet of depth between the bottom of the outfall sewer and the high-water mark of the fresh water channel into which the clear effluent is intended to be discharged, a free hand can be used in the construction of the works to the advantage of the paymasters; but if there be only five feet between the two points, a plant may still be made to work without the aid of pumps or other water lifting machinery. In places where there are combined storm-water and sewage sewers, it is unnecessary to treat sewage when a violent rainstorm is on, except that portion which is forced forward at the first rush, and which is really the scourings of the drains, because when 25 per cent. of sewage is well mixed with 75 per cent. of fresh water it becomes harmless, because the bacteria that are always in fresh water are in the ascendant, and will devour the small amount of foul matter the sewage contains. But when sewage is emptied into fresh water without being properly mixed and shaken up, it holds itself apart, and the *bacillus coli communis* and fecal microbes rapidly breed and thrive with the help of the adjoining fresh water, and resist the attacks of the scavenger bacteria by keeping in a compact body.

Filters can be constructed so that a constant current of air will flow through the body of the filtrate, simultaneously with a flow of sewage continually passing on and downward through the filtrate; and where the space is limited and room for a syptic tank cannot be secured, then in place of the dark syptic tank an upward flow roughing filter composed of crushed clinkers will answer for the preparatory process.

I have recently received the plans of a very simple and inexpensive mode of purifying sewage that is continuous in action, and requires no sieves, or screens, or any attention. If the sewage is weak because storm water gets a little mixed in, it goes through a little quicker to make up for it. It is well understood that it is the top twelve inches of a filter that does the work, and that there the bacteria slime rests because it is there where the air can be got the easiest, so the inventor forces the sewage in at one end of the filter and it moves along under the surface to the other end and passes out, thus the bacteria can secure air from the dry surface at any time.

There are a great many expensive sewage-disposal works now in use that discharge their finished effluents in a state that cannot be purged of the putrefactive matters that are held in solution, and that contain many colonies of active and dangerous microbes These impure effluents are either discharged unfiltered, or are passed through filters which are rendered useless by the fact that they are never aerated.

For THE CANADIAN ENGINEER.

THE OXYGEN SYSTEM OF SEWAGE PURIFICATION.

BY W. M. WATSON.

The Sewage Purification Company, of Dublin, Ireland, has been good enough to send us a small pamphlet explaining their patented system of purifying town's sewage. There are several new features in the process worth noting. The company tells us that they use extra deep settling tanks, with sumps to collect the sludge, that they use baffle plates to throw down the solids, and that they supply the micro organisms with the necessary oxygen they require by the use of nitrate of soda in place of and as a substitute for atmospheric air. They say that the oxidation of sewage is brought about by the operations of micro-organisms, and that the organisms which live on dead organic matters will quickly multiply in sewage, and will rapidly set up an oxidation of the organic matter it contains, making the sewage harmless if there is a regular and continuous supply of oxygen to all parts of the liquid under operation sufficient to sustain vitality during their life processes; and the sewage is preserved until acted upon in a neutral or slightly alkaline condition, and continued so during the activity of the organisms. When these conditions are maintained, several chemical changes take place. When the sewage passes through the first or roughing tank, the heavy solids are extracted; when passing through the second settling tank, the sewage, by the help of a precipitant, is converted into ammonia carbonic acid and water; and by the third and last process the ammonia is turned to nitric acid by microbes or bacteria. They say that they have succeeded in estimating the amount of air the microbes require to perform their work well. Thus, for very foul sewage, it takes 1,400 volumes of air to 1,000 volumes of fluid to remove the suspended matter, and even three times the bulk of air to one of fluid to finally and perfectly purify trade sewage. They point out that oxygen must be regularly supplied to the micro-organisms; if not, they will at once set up putrefaction, emitting offensive and dangerous odors. This would appear to mean that they hold that the intermittent method of aeration is a failure.

It will explain the remarks more fully by stating that the process of filtering is at present as far as sewage is concerned an artificial means of supplying the micro-organisms with oxygen. Therefore it is necessary to arrange appliances so that they will continually aerate every particle and item of the filtrate where the microbes that clean the sewage lodge. On this ground every description of filtrate must be open and porous, whether it be sand, crushed stone, clinkers, coke, fine pea coal or charcoal, and packed together in a way that will divide the sewage into small thin films that will move from one item to another on its downward passage through the filter, allowing the bacteria the filtrate contains to devour all the dead matter, also to allow a free passage of air to every particle of filtrate, so that the micro-organism it contains can be amply supplied with oxygen.

This so-called oxygen system consists of three processes, the roughing tank, then clarifying by a precipitant called manganese, often called Condy fluid, and the final process by the microbes, which are supplied with air or oxygen by the use of nitrate of soda without the help of filter beds, such as is described in the preceding paragraph, and that as thus far being in general use as a lodgment for the microbes and a medium for the circulation of air to supply them with oxygen.

The advantages of their system appear to be that by using nitrate of soda as a substitute for atmospheric air to supply the bacteria with the oxygen, they are able to sustain activity in a gradual and regular form, thus preventing any danger of the sewage setting up putrefaction during the process of purification. This, of course, assumes that oxygen can be properly supplied from nitrate of soda. The second advantage is that by using deeper tanks, baffle plates and nitrate of soda, they can keep up a rapid continuous flow through each of the three processes required, thereby purifying about 60 per cent. more sewage than can be done by other appliances used to mechanically purify foul fluids; taking only about one-third of space that other systems do for plant, having no expensive machinery pumps or fans, no tanks standing idle, aerating, etc. I approve of the idea of the deep tank and baffle plates; the soda business, also, if it is a genuine substitute for air, and can be efficiently applied at a small cost. I cannot approve the use of any precipitant, though manganese is one of the best precipitants that can be used, because the latest scientific experiments have proved that microbes and bacteria can totally destroy every impurity contained in sewage when properly aerated and housed in filters composed of powdered charcoal made from town refuse or small pea coal, and in a lesser degree by sand, small clinkers, stone and coke.

SOME MODERN FORMS OF MILLING MACHINERY.*

FREDERICK T. SNYDER, KEEWATIN, ONT.

The time has happily gone by when directors of mining companies order a mill "ready made" like a suit of clothes, and it is not unusual to have a mill designed to fit the ore it is to treat, as carefully as the development aims to explore the lead. The machinery, whose description follows, is a case where designing to meet specific conditions has been carried somewhat further than is customary. The problem was to plan a custom plant to handle the gold ores of the Lake of the Woods, many of which are low in grade, but contain streaks of high values. The absence of copper or lead in addition to the low tenor, put smelting out of the question. A site was selected at Keewatin, having ample water power with the lake for a mill pond. The ore is brought in from the mines to the plant in barges carrying thirty tons. It was decided to build the mill, to unload this ore, crush it, and sample into storage, then run over amalgamated plates and vanners; all the ore handling to be automatic. It will be seen in the following description that nothing radical was introduced, and that the principal features worth noting were improvements in the detail of existing methods.

The ore is unloaded from the barges by means of a Locke-Miller cableway of four hundred and fifty feet span. This hoists the ore in skips to an elevation of seventy feet and carries it across the main line of the Canadian Pacific Railway into the sampler building. The skip is automatically dumped into a two hundred ton bin, by means of a spring hook. The bottom of this bin is shaped like the letter W, having a gate at each point, so that each side may be used as an independent bin. Both discharge into a crusher feed hopper in the form of an iron cone, thirty inches in diameter at the bottom, placed with the open end thirty inches from the crusher feed floor. The gates being open the ore forms a cone on the floor around the bottom of the hopper, and automatically works down as it is fed into the crusher.

This crusher is of the "Invincible" type. Tension strains are carried by wrought iron, and all compression strains by cast metal. The movement of the jaw is parallel, the top and bottom moving equal distances; and not, as in the Blake, where the bottom moves more than the top; or, as in the Dodge type of crusher, where the top has the greater throw. The usual arrangement is reversed and the outside jaw made movable, with the result that the common massive frame is done away with. This brings the weight of a ten-inch by eighteen-inch machine, which is the size used in this plant, down to nine thousand pounds, while the customary weight of the cast-iron framd machine of the Dodge or Blake type is from twelve thouse and pounds to eighteen thousand pounds. Each portion of the jaw moves over an elliptical path, the long axis of which is so inclined that during the moment of crushing the hanging jaw plate moves directly towards the stationary plate, and only at the end of the stroke moves down and back to feed the material through. The result is a minimum amount of cut ng of the plates by the ore, there being no sliding movement at the time of greatest pressure. The tension strains are taken by four wrought rods, which run through the frame of the machine to the rear and end in nuts. By tightening independently the rods holding the top and bottom of the hanging jaw, the inclination of the moving plate with reference to the fixed one can be altered. It is profitable to have the opening of the crusher as large as possible, that sledging may be avoided, while the angle between the jaws must be so sharp that the rock will not jump up when the jaws come together. These independent adjustments allow the angle between the jaws to be the largest practicable for any particular ore, and once placed, does not change during the operation of the crusher. In the design of this machine the parts which require attention have been concentrated at the back, so that the jaw end can be built into the feed floor, placing the jaw opening where most accessible, and at the same time bringing together within easy reach and out of the dirt and dust from the ore all oil cups and adjustments requiring attention. The inertia effects in this machine were planned to make it as free as possible from longitudinal shake, and in this plant, where it is set twenty feet or more from the ground, produce little or no vibration of the building.

The ore from this crusher is carried by bucket elevator to a screen, which deserves especial notice, its use removing the list of troubles attendant on handling crushed quartz dry through a revolving trommel. It is an ordinary gravel screen, set up at an angle of forty-five degrees, and furnished with a cover. But it is this cover that makes the difference, as it prevents the ore from taking long jumps, and thus permits the use of a screen of almost double the mesh of the product desired. That is, to get half inch mesh ore use a one inch screen, the ore particle striking the screen at so small an angl as not to fall through if more than two-thirds the size of the opening. Particles of ore which get wedged in an ordinary screen do not get into the openings of this screen at all, but jump down over it to be further crushed. The screen surface used in this plant is five feet long and ten inches wide, and readily handles six tons of ore per hour.

What fails to pass the screen goes to a pair of rolls, in which the best results of the experience of a number of mining machinery designers have been utilized. These rolls having shells thirty-six inches in diameter and ten inch face, weigh twenty-six thousand pounds, and when taking rock from a three inch screen and crushing to half inch mesh, run smoothly without jar. The frame is cast in one piece, extended below to form a hopper. The moving roll is of the sliding yoke type. The bearings are nine inches in diameter by twenty inches long, and are patterned after the journals of a railroad axle, which seems to be the best type for heavy service under repeated strain. They have a solid shell and are babbited on the side supporting the strain. The other half is chambered out to form a recess to hold waste, soaked with oil. In addition, back of the babbit is cored out a water jacket, which, in the event of heating, can be connected by hose with the water supply, and the operation of the rolls continued. The shell on the outside is but partially formed in the shape of a ball and socket box. It allows the box to adjust itself to any horizontal angularity of the shaft, such as is produced when one side of the roll is fed an the other side is empty, but prevents the

*A paper read before the Federated Mining Institute, Montreal shell from tipping out of a horizontal plane so that the babbit in one end of the bearing cannot wear out without wearing out the other end at the same time. These bearing shells are supported in yokes, which, in the case of the movable roll, form the sliding part, and in the fixed roll are cast in the frame. By removing the caps of the yokes a roll, together with its bearings, can be lifted out at any time for repairs without disturbing the tension of the springs. One bearing of each shaft is furnished with collars on both ends, each of which, in the case of the ten-inch by thirty-six inch roll used in this plant, has a bearing surface of two hundred and sixteen square inches. Between these collars and the ends of the box are loose brass rings, making the total thrust bearing surface in each direction, on each shaft, four hundred and thirty-two square inches. These collars are threaded upon the shaft, and by screwing them in or out the shaft is adjusted endways to keep the rolls in alignment. The housing above is a prolongation of the frame furnished with openings covered with canvas curtains, making all dust tight. The shaft of the moving roll passes through sliding plates, which are held against the housing by springs. All the principal nuts on the machine are split and provided with clamp nuts, so that they can be securely held in adjustment, yet readily be loosened for movement. In operation, the rolls are set apart by means of cast-iron plates, against which the sliding box is screwed up solid. When running it does not jump. Each yoke of the sliding boxes has a bearing surface under it twenty inches wide by thirty-eight inches long, in the form of a steel plate two inches thick, removable when worn. To provide against the accidental introduction of a piece of steel too large to go through the rolls, safety springs are provided, which, however, do not yield until the pressure per lineal face of roll exceeds four thousand pounds, giving a spring pressure for this size of roll of forty thousand pounds, which will flatten out a wrought iron nut, but will allow a cold chisel to go through. The feeder for these rolls has no moving parts, but consists of a series of four inclined steps facing in opposite directions, from one to the other of which the ore slides, and is so spread evenly over the width of the roll shells. One of these steps is hinged, and by means of a short lever can be thrown up against the step above it to shut off the ore supply in case of trouble with the rolls or with the spouting above.

That portion of the ore passing through the screen goes to an automatic time sampler, which was designed for this plant. It consists of a casting about the size and shape of a miner's gold pan which is mounted to revolve on the end of a horizontal shaft. The ore to be sampled is allowed to fall on the inside of the sloping flange, and slides off into a receiving bin. At one point of the sloping flange is a narrow slot, which, as the sampler revolves, passes under the spout and allows a portion of the ore stream to pass through to the back of the sampler into a second bin, where it forms a sample of the lot. This sampler was designed to avoid the mechanical complication of the Bridgeman sampler, which was recognized as doing theoretically correct work. An attempt was also made to reduce the head room necessarily occupied by a sampler, with the result that the seven feet required for a Bridgeman sampler of the same capacity, has been reduced in this machine to twelve inches. It is probable that this machine, while making but one cut on the material, does theoretically the same work as the Bridgeman, which makes three.

From this sampler the ore drops into one of two three-ton hopper scales, where it is weighed and delivered by flat belt conveyor to one of the two hundred ton storage bins. When required for reduction it is drawn off from the bottom and carried by another belt conveyor two hundred feet into the stamp mill. These are flat belts, twenty inches wide, eight ply rubber, running at a speed of three hundred feet per minute, and have proved entirely satisfactory. The surface wears but little, the ore being given the same forward velocity as the belt, before it is allowed to drop upon it. This belt has carried over sixty tons of ore per hour on a space not over eight inches wide in its centre. The belt goes uphill and delivers the ore into the ore bins above the stamps.

From these it is fed by automatic feeders of the suspended "Challenge" type, which are without the usual frame and hopper, the disc with its rotating mechanism being hung on two iron bars at the back of the mortar. A light iron spout connects it with the ore bin gate, and the ore bin proper forms the hopper, thus giving free access both to the back of the mortars and to the mechanism of the feeder.

These deliver ore into the mortars, which were designed solely as crushing machines intended to give a maximum output when fed with ore which has passed a half-inch screen. They are double discharge, provided back and front with splash boards. The discharge from the back screen is carried through a channel cored out in the base of the mortar so as to issue, together with the discharge from the front screen, through a short spout on the front of the mortar. These mortars weigh six thousand pounds apiece, the base being ten inches thick. They are furnished with steel liners on the sides and ends, and the wear of the shoes compensated for by false bottoms of steel. The screens stand at an angle of seventeen degrees from the vertical, and are twelve inches by fifty-two inches, giving a total discharge area of twelve hundred square inches. The stamps dropping in these mortars weigh nine hundred and fifty pounds each, and drop eight inches one hundred times per minute.

The pulp passes from the mortar to the distributing box of a gyrating copper plate, four feet long and six feet wide. These are silver-plated, coated with amalgam, and by a simple mechanical arrangement each point in the surface of the plate is caused to gyrate around a circle about three-quarters of an inch in diameter. This causes each particle of ore, in place of running over a straight path of amalgamated copper six feet long, to go over a spiral path about thirty-four feet long, before it reaches the bottom of the plate. The gyrating shake enabling the table to be operated at about one half the incline necessary without it.

From these plates the tailings pass to vanners with four feet plain belts. These vanners, in place of the customary side shake of the "Frue," are given the same gyrating shake as the plates, that is, each point in the belt moves over a circular path about three-quarters of an inch in diameter. The reason for this circular shake in place of the customary side shake of the Frue vanner will be apparent to anyone who has attempted to settle the contents of a gold pan; or in a hand screen, has tried to get the coarse material on top. The advantage of this shake is so apparent, that the question arises, why it has not been used before, especially as it was patented some seventeen years ago in the United States. The difficulty has been to build a practical machine that would not shake itself to pieces under the varying strains brought about in producing this gyrating motion. Success was obtained in the vanners of this plant by stripping them of the customary heavy frame, supporting them on six round steel rods, one end of which was screwed to the floor, the vanner resting on the upper end free to float around in any direction. The belt is stretched over rollers in the usual arrangement and below it is supported, on a short vertical shaft, an unbalanced weight. When this weight is caused to revolve by a two-inch belt the amount that it is out of balance causes the vanner to swing around in a circle, whose radius multiplied by the weight of the table equals the radius of gyration of the unbalanced weight multiplied by the amount that it is out of balance. In practice it has been found desirable to use a gyration about three-quarters of an inch in diameter, and to run the table at a speed of about two hundred and twenty-five shakes per minute. Owing to the fact that the table is just balanced by the amount the gyrator is out of balance, no jar or shake is transmitted to the floor, and no racking strain is set up in the vanner itself. The feed of the belt is obtained from a Challenge feed clutch on the head roll. The tail of this clutch is attached by a flexible link to a point on the floor, the gyration of the table furnishing the necessary movement. By changing the point of attachment of the link to the floor, the feed of the belt can be altered from nothing up to twenty-five feet per minute. The heavy frame of the Frue vanner, the side shaft with its three eccentrics, and the complicated "G" spring feed is avoided. From the vanners the tailings are divided over two more sets of gyrating copper plates, each four feet wide by six feet long supported in a similar manner on flexible steel rods, and gyrated by the revolution of an unbalanced weight supported below each.

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THE PUBLISHERS.

THE D'ESTE AND SEELEY COMPANY'S STEAM TRAPS.

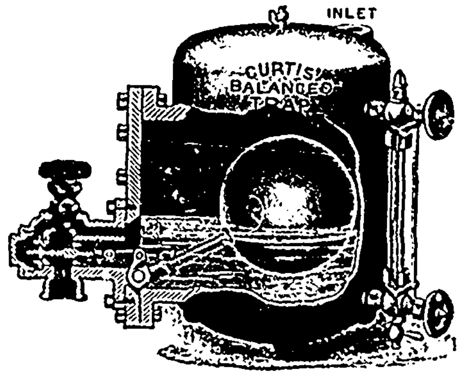
Every high pressure heating plant or any heating pipe not returning to the boiler should not be allowed to run a moment without a steam trap. No sane man would think for a moment of opening a pipe direct from his boiler to the atmosphere and try to get steam, and yet that is just what is done when a pipe is not drained by a trap. The amount of money wasted in this way on an ordinary steam plant in one season would pay for traps enough to last for years, and thus be one of the very best instruments which the owner or engineer could possibly make. While any trap is far better than no trap, it is always well to remember that a good trap costs little, if any, more than a poor one, and a purchaser with a little care in making a selection can assure himself that he is getting the best the market affords.

Four things should be required: First, efficiency; second, simplicity of parts; third, durability; and fourth, ease of making repairs when necessary. In all four of these points the Curtis balanced trap stands high, as may be seen by the following description:

The full prospective view shows a cylindrical pot with rounded ends, of the strongest form to resist pressure. On the side is a neck or nozzle of sufficient diameter to admit the float. This nozzle is covered with a strong plate, to which is bolted the composition valve. It will be seen that when the plate is removed it brings away the float and valve with it, which can be taken, altogether, to any suitable place to be examined or repaired, or can be shipped to the manufacturers, leaving the pot in place and connected.

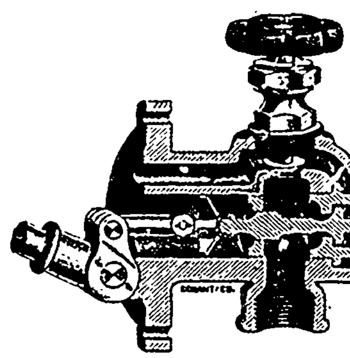
The composition valve can be removed without removing the cover, by taking out the four tap bolts by which it is fastened; then the float steam can be pulled out far enough to unscrew it from the knuckle, leaving the float inside and cover joint intact.

The sectional view shows a valve body cast with strong ears to bolt it on to the cover of the trap. The valve consists of two discs of equal area on a single stem, one with



a short sliding fit, and the other with a ground seat taper fit, which guides it onto its seat, while the valve stem is guided by a spider with three arms, and is loosely connected by a knuckle joint and stem to the float. The valve stem is in two parts, the outer one carrying the discs screwed into the inner one; and when unscrewed the valve can be taken out for repairs or grinding.

By removing the cap from the end of the valve body, the valve can be taken out without starting a joint, pipe, bolt or gasket. This is claimed by the makers as an entirely new, as it certainly is a valuable, form of construction. It is also provided with an independent passage or passby, and is the only trap, so far as known, with the valve so easily accessible from the outside. It is also provided with an independent passage or passby controlled by a stop valve, and work can be continued and the water drained off, even if the discharge valve should remain closed for any reason. The float is very large, perfectly rounded, so hard that it cannot be dented, nor can it be collapsed at 200 lbs. pressure. It is made by a special process of an alloy with aluminium, and is practically indestructible. It is hermetically sealed as a glass globe, and is so located in the trap that the outlet is always sealed by several inches of water.



These steam traps have acquired their reputation in the last eight years simply on their merits. This is presented as a strong, plain, serviceable machine, and is warranted to work correctly under any disadvantage to which a steam trap can be subjected. They will work against any head or back pressure less than the direct pressure in the trap. Some of them are now working with 75 pounds in the trap, against 30 pounds pressure on the outlet, and deliver hot water into the second and third story or into a closed tank.

The Curtis balanced trap is also often used as a water-line trap on large plants, when there is need to balance any particular circulation, to prevent snapping and cracking in the pipes and radiators. This is accomplished by connecting the direct steam-pipe to the top of the trap, and bringing in the return below the water line of the trap.

MONTREAL ISLAND BELT LINE RAILWAY.

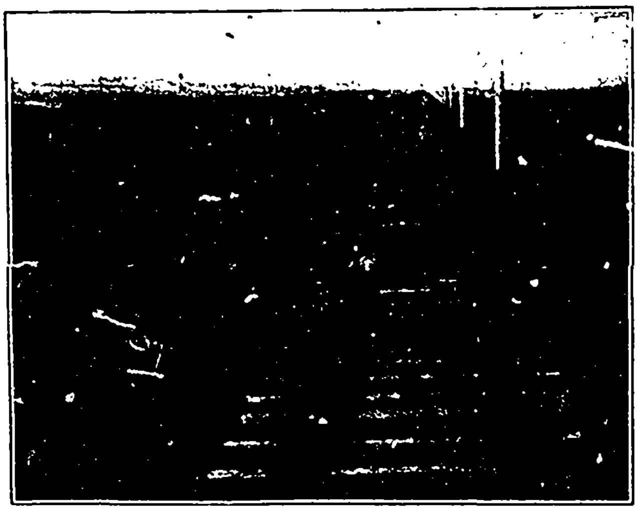
The Montreal Island Belt Line Railway, about thirteen miles of which was opened for operation during the past year, constitutes perhaps one of the most significant facts of recent years in connection with the development of the commercial capital of Canada. At the time the North Shore Railway was being constructed between Montreal and Quebec, great pressure was brought to bear upon the Government to bring it across the Riviere des Prairies at Bout de l'Ile, and thus traverse the Montreal Island to the city of Montreal. For reasons, apparently political, this influence was disregarded, and the North Shore Railway was brought into the city via St. Martin's Junction, thus adding fifteen unnecessary miles to the length of the line. The lower part of the Island, which comprises its best half, covering a distance of about thirteen miles, consequently remained in a large measure inert, until a year ago, when operations were begun by the Belt Line. This seems to be the beginning of the much-talked-of scheme to girdle the Island, a charter for which is held by the Belt Line Company.

In 1897 the old Belt Line Company was reorganized, new blood and large capital brought into it, and operations begun on a vigorous scale. Although the charter is for the construction and operation of either a steam or electric railway, the directors judged it in the interests of the company to make use the latest developments of electricity as a motive power. The construction of the line was pushed rapidly forward in the face of great difficulties in the way of land expropriations, and the line was opened for traffic a little more than a year ago.

The line is thoroughly constructed, on the standard gauge, and specifications of the Dominion Government railways. It has its own private right-of-way, constituting a strip of land eighty feet in width, the whole distance. It is almost a straight line from one end to the other, and with the single exception of the Canadian Pacific Railway at Hochelaga, its gradients are practically level. The line leaves the Canadian Pacific Railway at Hochelaga, and passing near the proposed Inland Basin, traverses the municipality of Maisonneuve, Longue Pointe and Pointe aux Trembles. Where the line crosses La Salle street in Maisonneuve, an extension is built along La Salle street (one of the principal streets in the town) to Notre Dame street, crossing on its way the tracks of the Montreal Street Railway at Ontario street, St. Catharine street and Notre Dame street. The Town Council of Maisonneuve, alive to its own interests, secured this concession from the Belt Line Company by granting them a perpetual franchise of the street in question and exemption from taxation for a long term of years. In its course through the municipality, the line passes close to several large manufactories, to which sidings have been laid by the company. Passing through the municipality of Longue Pointe it runs within a few hundred feet of the immense Asylum for the Insane, which is now in course of construction.*

It may not be known by everyone that the extensive Longue Pointe Asylum, which has existed for many years near the banks of the St. Lawrence in Longue Pointe for the care of an unfortunate class of the community, about to be removed to a more suitable location, about a mile and a half further back on the same property, where the buildings will be reconstructed on an immensely larger scale than ever existed before, and that *to this end the Quebec Government guaranteed a loan of* $500,000 at a low rate of interest. The buildings of the new asylum are in the course of construction, and when completed will constitute almost a town of themselves.

From Longue Pointe the line of railway pursues a perfectly straight course to Pointe aux Trembles, a most flourishing and attractive suburban village, situated about six miles from Montreal. Since the advent of the railway building, operations in the village have been very active, and there is every prospect of a most prosperous time for the village. From Pointe aux Trembles the line turns slightly to the left, and following the course of the St. Lawrence River, and in full view of it, it reaches Bout de l'Ile, a distance of another six miles, passing on its way the Catholic convent at Pointe aux Trembles, and the French Protestant Training School.



A STRAIGHT BIT OF TRACK.

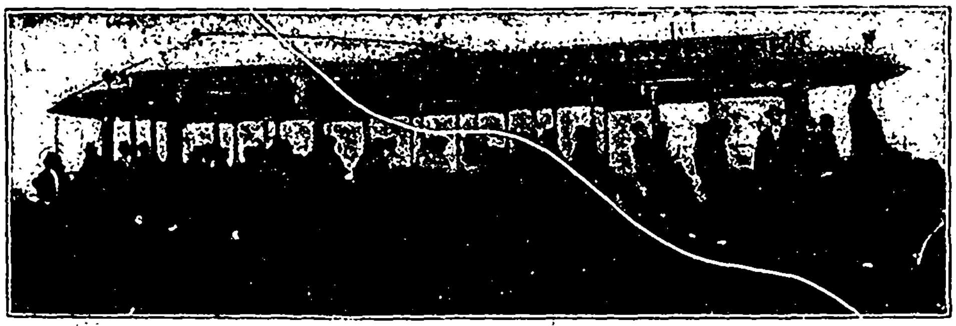
At Bout de l'Ile, where the cars are connected by a steam ferry with the town of Charlemagne and other points, a large park has been established by the company, covering more than twenty-five acres. Bout de l'Ile ("the end of the Island") is an ancient hamlet, beautifully situated at the "meeting of the waters," where the Ottawa (Riviere des Prairies), merges into the blue St. Lawrence. The company has transformed this dreamy hamlet into an ideal summer resort. Its charming grove of maples and elms has been turned into a picnic ground, and ample pavilions, band stand, boat-houses and bath-house put up. A bicycle track has also been laid out around the park, to form at no distant date an important feature in the plans of devotees of the wheel in Montreal. The large hotel overlooking the two rivers has just been purchased by the company, and plans have been made for a big extension, which is to be ready for occupation by the Queen's birthday. The idea is to provide first-class accommodation and harmless and amusing diversions for the citizens. The hotel grounds will comprise 330,000 sq. ft. of land, and the new building will have a dining-room 36x60 ft., and a billiard-room 20x50 ft. The grounds will have fountains, tennis lawns and croquet courts That the susceptibilities of temperance people may not be offended, the bar will be kept away from the hotel building altogether.

The company, in equipping their line, made a new departure from what has seemed to be the established custom in Montreal. The cars placed upon the road are of the best description, finished inside and out of imported mahogany, oiled and polished. The cars, instead of being the orthodox one-truck, were equipped each with double Taylor electric trucks of the latest construction. Inside they are luxuriously upholstered and polished, while the unsightly stoves of some electric railways have vanished, and each car is heated with six electric heaters of the latest description. They are handsomely vestibuled at both ends, and brilliantly lighted. These cars can only be compared to Pullman coaches on a smaller scale. The open cars, so much appreciated by summer travelers, are likewise built and finished in the handsomest possible manner. They are forty five feet long, also double trucked with the Taylor Electric trucks. One of the open 45 ft. cars is shown in the accompanying engraving.

The company has also placed upon its line an electric locomotive, built to handle ten loaded cars. This latter move was *made in order to meet the demands of the trade in the lower* part of the city, connections having been made with the tracks of the Canadian Pacific Railway. A satisfactory arrangement was made with the latter company and the Belt Line for switching the East End freight coming over the Canadian Pacific Railway and destined for points in Maisonneuve, Longue Pointe and Pointe aux Trembles, and the end of the Island, in car lots.

An electric rotary plow has been in operation all the winter, and has performed most efficient work. The snowfall of the past winter is well known to have been one of the most severe in the memory of man, and on the occasion of the most severe of these storms, when all the steam railways in the country were tied up for three, four and five days at a time, the rotary plow of the Belt Line opened the line up from one end to the other inside of five hours. At places the drifts of snow were so deep that the upper part of the drift had to be removed to permit of the egress of snow from the machine as it was discharged in a continuous and rapid stream from the vents.

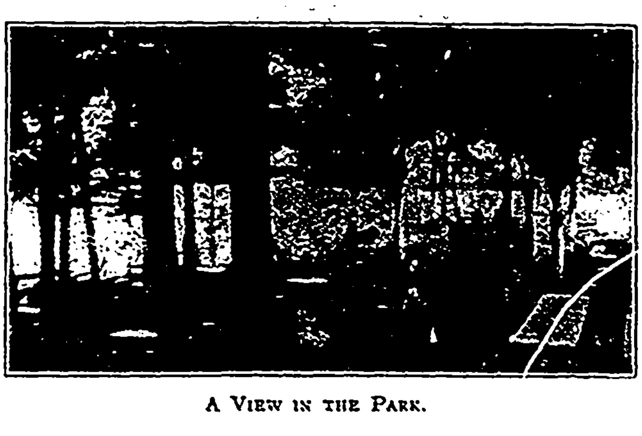
tion that a copper cent can be set upright on its edge on the curved surface of the cylinders and remain there indefinitely without being overturned. The engines are divided into three units, two of 150 h.p., and one of 435 h.p. By thus dividing the units, the power for every varying condition of traffic upon the company's line is made to correspond with the consumption of fuel. So economically are these engines built and graduated that during last year's operations the consumption of fuel, repairs to motors, engines, boilers and generators, all included, amounted to less than 2 1-3 cents per car mile. The makers appear to have surpassed their usual excellence of work. The contract for the large electric dynamos was given to the Canadian General Electric Company, of Peterboro, and has been filled in an equally satisfactory manner. These machines will develop as high as 900 h.p. between them, and their regular rated capacity is nearly 700 h.p. At times during the past summer work upon the line was very heavy indeed, notwithstanding which no defect of any kind discovered itself in these magnificent machines. The motors for running the cars were also obtained from the Canadian General Electric Company, and were placed two to a car. They average about 35 h.p. each, and are geared to run the cars at a speed of about 25 miles an hour. The motors have done excellent service. Twice since the opening of the line for operation, the company have been obliged to increase the number of cars and motors.



Double Truck Car

The power-house of the company is built about half way between the two ends of the line, near the village of Pointe aux Trembles. It is situated on the edge of the St. Lawrence, and a wharf has been built at this point out into the stream. Two large car barns have also been erected, besides other minor buildings, and as this point is connected with the main line by a short branch of a few hundred feet, there appear to be excellent facilities for ultimately bringing car-lot freight from Montreal, destined for shipment, and here transferring to the vessels. The company before deciding upon its equipment investigated all the latest improvements in electricity, and canvassed the various electric manufacturers in Canada and the United States. The decision arrived at, and what has been carried into effect, was to install three compound condensing Wheelock engines, aggregating over seven hundred horse power, belt connection, and two electric dynamos, one of 200 kilowat, and the other of 325 kilowat. The contract for the engines was given to the well-known makers, Goldie & McCulloch, of Galt, Ont., and was carried out in a highly satisfactory manner to the railway company. The engines are models of perfection, grace and easy working. They are placed on massive masonry foundations, and when revolving at a high rate of speed, so slight is the vibra-

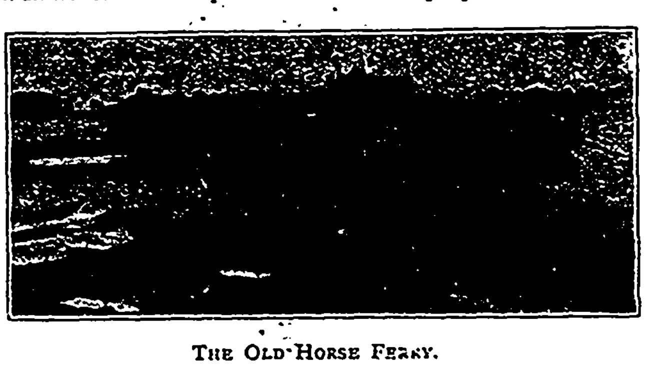
Rotary Snow Plow.



A View in the Park.

The car bodies were built principally by the Ottawa Car Company, of Ottawa, and the managers believe that in construction and finish they are unsurpassed by any electric cars in Canada. The number of cars now consists of four large open cars, 45 or 50 feet in length, and with a capacity of 150 to 200 people to the car, five shorter cars, and four closed cars, in addition to the locomotive. Several of these cars have been added quite recently, as the traffic during last season was so great as to frequently compel passengers to satisfy themselves wih standing room only. It is with a view of doing away with this inconvenience to their patrons that the company has lately increased its rolling stock. During the year past, which was the first year of opening, the company handled over 300,000 people, and it is anticipated that during the present year this number will be doubled.

The operating expenses of the road were only 62 per cent. of the gross receipts, notwithstanding the fact that much experience had to be learned, and that last season was unprecedently wet and cold. During the summer months the cars ran every ten minutes, and throughout the winter an hourly service was maintained. The operations of the company so far have given such satisfaction to the public, as to support the belief among some railroad officials, at least, that it is best to conciliate and please the patrons of the road. Incredible as it may seem to outsiders, before this railway was opened, the lower part of the Island was in a worse position as regards postal facilities and



The Old-Horse Ferry.

traveling accommodations for the public than many country districts a hundred miles away. The only means of communication was the old-fashioned stage coach, which ran daily between Montreal and Bout de l'Ile, plodding its weary way through mud or snow drifts, as the case might be, exposing its patrons to a drenching rain or a burning sun, and consuming from three to six hours in making the trip. The evening newspapers' issues to-day did not reach their subscribers until to-morrow night, notwithstanding that these seekers after knowledge were within twelve miles of the metropolis of the country. The communication with Charlemagne and the towns along the line, some of them of very considerable importance, including the large town of l'Assomption, at which there is one of the most noted educational institutions in the country, was restricted until lately to a peculiar construction called the "horse-boat." This craft was composed of two hulls placed side by side, and planked over, a stern wheel is slowly revolved by means of a pair of unhappy-looking horses working a tread-mill. The approach of the boat to either side was irregular, and usually depended upon the impulse of the officials in charge. There was not, however, usually any chance of the waiting traveler losing his boat, as its approach was heralded from afar by the clanging and rumbling of the iron cogs of the wheel connecting the tread-mill with the unhappy horses at the back. In stormy or windy weather the boat usually declined to make any trip at all. One of those quaint craft is still to be seen at Bout de l'Ile. It is probably the most primitive form of ferry-boat to be found on this continent. J. H. Bernard, of Montreal, informed a representative of The Canadian Engineer that his grandfather used to cross the St. Lawrence by this ferry over 100 years ago, and it was doubtless in use long before his day.

Some time, no doubt, the railway will be extended across the river. Sixty years ago an enterprising farmer on the other side of the river constructed a bridge at this point over both channels of the Riviere des Prairies, aggregating about half a mile or more in length. The model of this old structure is still to be seen in the old dwelling-house of the time. It is an ingenious construction, and bespeaks a great degree of industry and no little ability in the maker. This useful structure, however (for during its life it was used by a great many people), was not long for this world. Some three years after its construction the high water of the spring and the ice carried it mercilessly away, and nothing remains to tell the tale beyond the approach on each side, and here and there the ruins of a sunken pier.

Since the opening of the railway the aspect of everything has been changed. The beautiful farm sites along the banks of the river have been laid out in building lots, and many cottages have been erected. Four rivers, known as the l'Assomption River, Back River, and Riviere des Prairies, the two latter being branches of the Ottawa, and the mighty St. Lawrence, all come together at Bout de l'Ile, hence this point has been fittingly named "Where the Waters Meet."

Robert Welsford, Engineer.

The Belt Line cars are always on time at the intersection of La Salle street and Notre Dame street, in Maisonneuve. One of the strict rules of the company is that the cars run absolutely on time. The point of starting is reached by the Notre Dame street line of the Montreal Street Railway. During the winter the Ontario street line of the latter company has been extended to the intersection of the Belt Line, and during the coming season Montrealers will doubtless find it both pleasanter and easier to reach the Belt Line cars without the trouble of making any transfer on the way. By this means a passenger can take the Montreal street car at Wellington street, and for four cents enjoy a trip of nearly seven miles in length, where he again proceeds another twelve miles to a charming park at the end of the island, and which is so large that even when four or five thousand people are scattered over it, there can be found a quiet retired corner for himself and his picnic surroundings.

The officials of the company are W. Dale Harris, late managing director of the Ottawa and Gatineau Railway Company; John P. Mullarkey, managing director, a railway man of considerable experience; John Rowley, superintendent; Robert Welsford, engineer in charge of engines and plant, and C. H. Wright, electrician.

Robert Welsford, engineer of the Montreal Island Belt Line

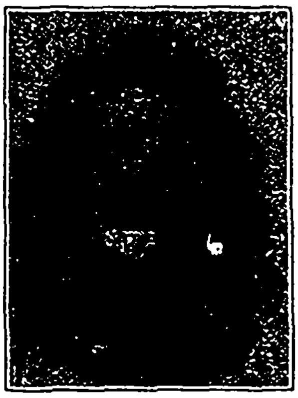
W. Dale Harris, President.

Railway, was born in Paisley, Ont., 35 years ago. As a boy he obtained his education under great difficulties, having been able to go to school only two years, but while serving his apprenticeship as a miller, he studied at night, and made good headway in his studies. He filled good situations as miller with such firms as A. W. Ogilvie & Co., Montreal; James Goldie, Guelph, and Robert Noble, of Norval. Owing to fail-

J. P. Mullarkey, Gen. Manager.

ing health, he quitted the milling business, and afterwards, having a taste for engineering, he took instructions in mechanical and electrical work for one week, and with this short apprenticeship he installed the first arc light plant in Mount Forest, ten years ago. Since then he has been steadily employed as an engineer. Mr. Welsford's aim is to produce horse-power with as little fuel and friction as possible, and in aiming at this he has never been in want of a situation, while at the same time he has been able to help more than one fellow engineer in time of need. Mr. Welsford is the inventor of a new oil filter and waste sewer, which has been in use for five months at the Montreal Island Belt Line power house, with the most satisfactory results. We hope to give a description of this device in an early issue.

W. D. Harris, president, and J. P. Mullarkey, managing director of the Montreal Island Belt Line Railway, were associated on the directorate of Pontiac and Pacific Junction and the Ottawa and Gatineau Railways. Mr. Mullarkey was first connected with the Belt Line Railway as managing director, which position he held for about a year, when he purchased the capital stock, reorganized the company, and induced Mr. Harris to become president.



JOHN ROWLEY, SUPERINTENDENT.

John Rowley, superintendent of the Montreal Island Belt Line Railway, is an old steam railroader, having been connected with the Midland Railway, Quebec Central, Quebec & Lake St. John Railway, Ottawa & Gatineau Valley, Pontiac & Pacific Junction Railway. He also put in the large new main water pipe from Lorette to Quebec city, eight miles, for the supply of water to the city, bridging the St. Charles with a tubular bridge. The stop gates and all connections to that system were done under his supervision. He took charge of construction on June 1st, 1896, of the Montreal Island Belt Line, and charge of the operating department Nov. 1st, same year. Born in the city of Quebec, 1861, went through the common school and took commercial course through the High school, Quebec, under the noted principal, Daniel Wilkie.

C. H. WRIGHT, ELECTRICIAN.

C. H. Wright, the Montreal Belt Line Company's electrician, started with the Renfrew Electric Company as trimmer and cleaner. He then engaged with the old Royal Electric Co., of Montreal, as dynamo tender in the alternating and power station, and later as wireman. He subsequently joined the Edison General on installation work. Returning to Renfrew, he installed and operated a three-wire alternating plant, it being the first of the kind in Canada. Leaving there, he worked at Peterborough for the Canadian General Co., then for the Kingston Street Railway, and finally constructed the Belleville Street Railway line. In 1892 Mr. Wright entered McGill University, from which he was graduated as B.A. Sc. in 1896, taking honors and leading in all electrical subjects of the third year. In the fourth year he led the electrical engineering graduating class, taking honors in four subjects, and making all the marks obtainable in electrical laboratory work under Prof. Callendar. Mr. Wright was vice-president of his class. He entered the employ of the Belt Line when the first rail was laid, and when operation started he was taken into the permanent staff as electrician.

ACETYLENE GAS ON A CANADIAN RAILWAY.

The Pontiac Pacific Junction Railway Co. claim the credit of having the first express train in America, if not in the world, illuminated with acetylene gas. In conversation with Andrew Holland, of Ottawa, Wm. Ressman, superintendent of the road, suggested that acetylene gas would be a splendid illuminant for railway trains, if it could be safely handled. Mr. Holland expressed his firm conviction that it could be done with a Niagara Falls generator, if space in the baggage car were devoted to the purpose. Mr. Ressman at once placed two cars at Mr. Holland's disposal for the experiment. A twenty-light generator was installed in the baggage car. The cars were regularly piped for gas, with ordinary goose-neck drop fixtures. At each end of the cars the main pipe, ⅜, terminated with a hose cock, by which means the gas was piped between cars by rubber tubing. It was a hard time of the year for such a test, coming on the severe frost and storms of January. It was, however, a splendid success, so far as illumination was concerned. The light was as steady as starlight, bright and soft, so that passengers on the train could read the evening papers from any seat in the car with ease. The frost had no effect on the gas, and no amount of shunting could put out the lights. The disadvantages were: 1st, space occupied by the generator; 2nd, slopping over of the gas tank; 3rd, danger of causing slop and smell, should an explosion take place, where such a quantity of gas had to be generated, and trainmen with lanterns, pipes and matches always present; 4th, the putting out of the lights in the other cars when the baggage car had to be disconnected.

Mr. Ressman said if these difficulties could be overcome, acetylene gas, as an illuminant, had come to stay. It was cheap and effective. An idea suggested itself to Mr. Holland, that if small generators were coupled up in series to a main feed pipe, individual car lightning could be effected without any of the drawbacks complained of. The piping of the first-class car was slightly changed, five small generators, each 18 inches high, and 10 wide, were installed on shelves in a locker in the water closet. Mr. Holland felt confident that he had solved the problem. The first trip was a disheartening failure. When the train got up speed and the car began to rise and fall on its springs, out go the lights, and it took a box of matches to keep them re-lit. By the next trip, Mr. Holland had thought out a simple plan to remedy this defect, and the cars are now running with the lights in perfect order. Mr. Ressman has, in consequence, decided to equip both systems of railway, over which he has the management, with acetylene gas fixtures.

Mr. Holland's next experiment was with a locomotive headlight. The management of the Canada Atlantic Railway, ever alive to the improvement of their line, and the comfort, convenience, and safety of their patrons, placed a shunter engine at his disposal. The experiment proved the possibilities of acetylene gas as a headlight illuminant. Locomotive No. 26, of the Montreal express, was then temporarily piped; for the headlight and gauge lamp, the postal baggage and express car were fitted up, and on Monday evening the express pulled out with the new light. Mr. Holland rode with the engineer, feeling anxious about the result, as the installation had to be put in so rapidly. The headlight was splendid, lighting up the entire right-of-way and far away ahead of the train. The terrific vibration of the locomotive did not affect it, but coming round a curve, a sharp rush of wind down the lantern ventilator extinguished the headlight, while the gauge lamp light, unprotected, was also blown out. The train was slowed down while the fireman went forward, re-lighted the jet, stopped the hole in the lantern with cotton waste, and the train proceeded without any further trouble. The postal car was so brilliantly illuminated that the clerks told Mr. Holland he would have to come with a revolver in both hands to take out his plant again. It is claimed that the system adopted by Mr. Holland is at present the only safe way known to utilize acetylene gas where the generator is subject to vibration and is liable to come in contact with fire by accident or design. He deliberately explodes a generator without doing any more damage than causing a report like that of a toy pistol. The safety lies in the fact that only a very small quantity of gas is generated at one time. Railway men are taking a deep interest in the new light. Mr. Bailey, of the Railroad *Gazette*, of New York, came to Ottawa specially to investigate the system, and after seeing the generator charged and the train lighted, declared it to be the most simple and effective light for railways that he had ever investigated. The Government car "Cumberland" has been piped for gas and a plant installed. Mr. Schreiber is anxious to have the gas system thoroughly tested as to safety, as well as efficiency. It will be of interest to railway engineers to know that the locomotive headlight generator makes the run from Ottawa to Montreal on two pounds of carbide, costing three cents per lb. wholesale.

THE YORK STREET BRIDGE, TORONTO.*

This bridge is at the foot of York street, Toronto, and gives access to the water front from the city for vehicles and pedestrians over the numerous railway tracks at that point As the bridge was built jointly by the city and the Canadian Pacific Railway, the plans were prepared by P. A. Peterson, chief engineer of the C.P.R. and approved by the City Engineer of Toronto.

The general design of the bridge is a steel trestle, composed of about 32 spans deck plate girder, ranging from 30 feet to 70 feet span, with wooden stringers and decks. There are also in addition two spans of less than 20 feet, rolled steel I beams. These girders and I beams rest on iron columns, standing on stone pedestals, except at the three ends of the bridge, where there are stone abutments. The width of the roadway, except on the southerly ramps, is 37 feet 6 inches, with sidewalks on each side 7 ft. 6 in. wide. On the southerly ramps the width of roadway is 32 feet 6 inches, with one 7 ft. 6 in. sidewalk. The ground plan of the bridge is "T-shaped," with the base resting on the south side of Front street, and it extends southerly therefrom, across the deviation of York street and the railway tracks to Lake street, a distance of about 905 feet. Here the ramps of the bridge turn, one to the right, and the other to the left, and descend to the level of the street. The length of these ramps is each about 316 feet, making a total length of bridge of 1,538 feet. From Front street the roadway of the bridge rises with a grade of one foot in twenty, for about 298 feet, and at the Lake street ends, there are similar falling grades of one in twenty, about 500 feet in length. Heavy loads to the railway freight sheds are taken over these grades every day, and no special difficulty seems to be experienced. There are in all three abutments and sixty-eight pedestal blocks. The foundations of the two Lake street abutments and all the pedestal blocks, except fourteen north of the south line of the old Esplanade, are on piles driven to the ledge rock. This was necessary, as this land was formerly part of Toronto harbor, and had only been filled in the year previously with miscellaneous rubbish, earth, brickbats, tin cans, as well as more objectionable refuse. When piles were to be driven, an excavation was carried down to one foot below zero level of the water of Toronto harbor, and soundings were then taken down to the rock. The piles were then cut off the correct length and driven home, with a "follower." Under the specifications, the piles were to be cut off one foot below zero level, and the above method was found less expensive than actually cutting them under water, and it was very seldom that a pile had to be cut when once driven home. Only a very blunt point was made on the pile, before driving. Four piles were driven for the small pedestals, eight for the medium and nine for the large pedestals. Under the abutments the piles were 4 ft. centres longitudinally, and 2 ft. 6 in. transversely. The excavation was then carried down six inches below the top of the pile and two feet in depth of concrete put in. In some cases where the underlying material was very soft, short lengths of two-inch plank were laid flat under the concrete, between the piles, in order to keep the concrete from settling on the soft material before it was set. The concrete foundation is 7 feet square under ten of the pedestals carrying the longer spans, 6 feet square under nine of the pedestals, 5 ft. 6 in. square under five pedestals, and 4 ft. 6 in. square under the remaining 44, and is generally two feet deep. The concrete was composed as follows, except when laid under water: Cement, 1 part, clean sharp sand, 3 parts, broken stone, 5 parts—all by measure. Under water the concrete was composed: Cement, 1 part, sand, 2 parts, broken stone, 5 parts. The cement used was the "Star" brand, made by the Rathbun Company, of Deseronto. Below ground the stonework is what is known as "rubble masonry:" above ground it is "rock-faced ashlar," and was built under the Canadian Pacific standard masonry specifications. The stone was brought partly from the contractor's quarries at Owen Sound, and partly from the Orangeville quarry. The contractor for concrete and masonry work was David Chalmers, of Owen Sound. The piling was done by the railway company's own men, and their track pile driver. The two top courses of the pedestals had to be drilled before being placed in position to receive the 1¼-inch iron rods which secured the iron columns to the masonry, and some little difficulty was experienced drilling completely through these stones without breaking them. This drilling was done with a steam drill, half from each side of the stone. The iron work was erected during the winter of 1896-7. It was supplied and erected by the Central Bridge and Engineering Co., of Peterboro', Ontario, and was paid for at so much per lb. in the finished work. The bridge was designed to carry in addition to its own weight the following live loads, either singly or in any combination: (a) 100 lbs. per sq. feet of roadway and sidewalk, (b) one 32,000 lb. road roller having a wheel base of 11 ft. 2 in. in length and 7 ft. 4 in. transversely, (c) a string of electric cars 26 ft. long, each weighing 30,000 lbs., fully loaded, on each track.

All parts of the structure were proportioned so that maximum loads should produce no greater tensile strain upon the net section than 12,000 lbs. per sq. inch. A wind strain of 400 lbs. for each longitudinal lineal foot, and 150 lbs. for each vertical lineal foot of the trestle bents was allowed for.

All steel had to come up to the following requirements:

Ultimate strength	58,000 to 65,000 lbs.
Elastic limit	33,000 lbs.
Elongation in 8 inches	20 p.c.
Reduction of area	40 p.c.

and was made by the open hearth process. Before leaving the shop it was thoroughly cleaned of all loose scales and rust with steel scrapers and brushes, and was then given a good coating of red lead mixed with linseed oil, well worked into all joints and surfaces, and after erection the ironwork was given two more coats of paint. All the timber in the deck of the bridge, with the exception of the sidewalk planks and paving blocks, is southern yellow pine, creosoted with 10 lbs. of dead oil of coal tar per cubic foot.

On top of the joists and 4-inch plank, were laid two thicknesses of best tarred paper, thoroughly sealed with roofing pitch to the planking, and each other. On top of this was laid the paving blocks, consisting of square-cut white pine blocks, 8 in. x 4 in. x 4½ in. deep, grain upwards. These blocks were held apart at the cross-joints by three specially-made nails driven into each block up to the collar, leaving the blocks 3-16 in. apart. All joints and vacancies were then filled in with best paving pitch, and the roadway covered ½ inch deep with gravel. A double track girder rail for electric cars was laid across the bridge by the Street Railway Company before the paving was done, for possible use in the future. The sidewalk planks are of tamarack, 7 ft. 6 in. long, 2 in. thick, laid with 1½-in. felt towards the kerb. The cost of the structure was approximately:

Foundation and earthwork (including piling).	$ 4,200 00
Stone and concrete work	15,900 00
Ironwork	43,000 00
Damages St. James' hotel property	4,900 00
Deck and roadways	28,000 00
Engineering	2,000 00
	$98,000 00

* Extracted from a paper read before the Ontario Land Surveyors, by A. P. Walker, of the City Engineers Staff, Toronto.

ONTARIO LAND SURVEYORS.

The adjourned annual meeting of the Ontario Land Surveyors was held March the 8th in the repository of the association, in the Parliament Buildings, Toronto, the president, T. H. Jones, of Brantford, being in the chair. On this, and the two succeeding days, the meeting was occupied in hearing the reports of the various committees, and in listening to the reading of a number of very valuable papers by different members.

Extracts from some of these papers will be given our readers next month, as lack of space prevents us giving a full report of the meeting in this issue. The annual dinner took place on the evening of the 9th, and was a most enjoyable affair, being more largely attended than any previous dinner. The nominations of officers resulted as follows: President, P. S. Gibson, elected by acclamation; Vice-President, H. J. Bowman, elected by acclamation; Secretary-Treasurer, A. J. Van Nostrand, elected by acclamation. For Council of Management, in place of F. L. Foster and J. L. Morris, whose terms expired 1st of April, four candidates, F. L. Foster, J. L. Morris, Geo. Ross and Capt. W. F. Van Buskirk, were nominated. For auditors, A. W. Campbell and H. L. Esten, by acclamation. The president appointed as scrutineers of ballots Capt. K. Gamble and J. F. Whitson, who will, on the 7th of April attend the opening of the ballots by the secretary.

STEEL CYLINDER PIERS.

Editor CANADIAN ENGINEER:

In the item in last issue of THE CANADIAN ENGINEER *re* bridge recently completed at Dundas, Ont., you say it is supported by steel "rail" piers. This should be steel "cylinder" piers. This is a small error, but I would not like anyone to think I would construct a pier of steel rails.

Yours very truly,

JNO. S. FIELDING, C.E.

Hamilton, March 12, 1898.

MINING IN QUEBEC.*

BY J. OBALSKI, G.M.E

The state of the mining industry in the Province of Quebec during 1897, is shown by the following notes, and is quite satisfactory, although there is no booming, for the present, on any of our minerals. I would mention copper and asbestos mining, charcoal iron-making as very important industries, with mica and chrome coming after, besides a few others which may become prominent later on.

IRON.

The Radnor forges had its furnace in operation for the whole year, and the Drummondville, one since July. They have produced 8,386 gross tons of pig iron, 680 men being employed by this industry. The consumption of raw material has been 19,766 gross tons of bog ore, 2,545 gross tons of limestone, 1,031,800 bushels of charcoal. The quality of the product need not be mentioned. It is a credit to our country: in fact, it is highly praised, not only in Canada, but in the United States and Europe, competing with the best brands on either of the continents.

CHROME.

This year, shipment has been 2,340 gross tons, mainly to the United States, and we have still in hand over 2,000 tons, about 60 men being employed. Our ore is mostly high grade, but I consider that with concentrating plants, we could use our low grade ore and the refuse of the mines, and considerably increase our shipments. This industry is in its infancy, but nevertheless, with only hand-working, we have taken out, since 1894, over 10,000 tons, representing an approximate value of $140,000, of which 8,183 have been shipped. I refer to a pamphlet I am just publishing on the subject.

TITANIC IRON.

I would make mention of the discovery of important deposits in the Lake St. John district. People have also an eye on our magnetic sand, on the north shore, which may eventually become profitable to handle.

OCHRE

Is prepared as in the past by two companies, in the vicinity of Three Rivers, with a production of 1,239 short tons of burnt ochre, which have been used in Canada, or shipped to the United States, 50 men being employed.

COPPER.

Our low grade ores have been worked as usual, at Capelton, the product being 36,815 gross tons, of which 29,512 tons were shipped to the United States, a small cargo to England, and the balance used on the spot for sulphuric acid manufacturing, 270 men being employed. At Harvey Hill, some work has been done, but only 20 tons of high grade ore shipped. Several prospects have been made at a few points of the Eastern Townships, and the time may come when this industry will be one of the most important of this province, if we take into consideration the numerous good mines actually idle.

LEAD, ZINC AND SILVER.

On the Calumet Island several good prospects have been made, showing the existence of an important mineral belt, containing zinc blend, and rich galena, carrying sometimes 200 ounces of silver to the ton. The Lake Temiscaming mine has also been worked to some extent, but no shipments made, and we may say that last year's output has been 430 tons of zinc blend, and 5,000 tons of galena, 45 men being employed.

GOLD.

Prospecting was going on in the Beauce district, on the Gilbert, on the du Loup, and in Dudswell district, with also some finds reported in the vicinity of Sherbrooke. Besides those we know of, every summer, small parties find their living by washing in the rivers of our gold district. Some preparatory work has been done last fall on the old diggings of the Gilbert River, and according to recent informations, gold, in paying quantity, has been struck. I estimate approximately, that not more than $900 of gold have been taken out during the year. The question of the Beauce district has been discussed at length at previous meetings, and although not yet satisfactorily settled, I personally am fully confident in the final success of that region.

GRAPHITE.

The graphite industry is one of the most difficult to operate advantageously in Canada, as we have to compete with old establishments in the United States, taking easily their supply from Ceylon. In the Buckingham district we have three companies with well equipped mills, two using the wet, and one the dry process, and it appears to me that their product is as good as any other one, and all that we require is a regular market for it. But little work was done last year, and we have not the account of the production.

ASBESTOS.

The market for asbestos has been fair: three companies at Thetford, and one at Danville, employing altogether 800 men, have been in operation for the whole year, having shipped 12,565 tons of 2,000 lbs., of fiber, about 42,000 gross tons of the new product, called asbestic, have also been prepared, of which a very large quantity has been shipped, and the contracts made for the coming year will, it is expected by the company, take the entire output. Shipments have been made to England, Germany, Australia, South Africa, besides the United States and Canada. The Black Lake mines have not been in operation this year, and the production of two companies, having their mill in the Laurentian district, near Ottawa, was small, little work being done.

PHOSPHATE.

No work done on this material, except a few hundred tons extracted from the mica mines.

MICA.

Several prospects were made in the Gatineau district, but of small importance. In the vicinity of Perkins mill, in Templeton, three important companies have worked regularly, and taken out a large quantity of mica, well adapted for electrical purposes, of which a good part has been sold in Canada, and in the United States. It is very difficult to give exact figures regarding this mineral, on account of the numerous qualities and sizes, representing as many different prices, but according to the best informations, I estimate that about 200 short tons of thumb-trimmed mica have been taken out, 90 men being employed. I understand that the demand is less than previously, on account of the high duty in the United States, and that only the best grade of electrical mica is wanted. No mine of white mica has been worked last summer.

PETROLEUM.

Prospecting and boring are going on as usual in the vicinity of Gaspe. Last season, some excitement prevailed on account of a larger quantity of oil being struck in one of the wells, which, in fact, has been flowing for some time. Nevertheless, nothing very definite has yet been ascertained. About 30 wells have been bored, some of them having struck oil in greater or less quantity. I am confident in the future of this district as an oil-bearing one, but the country is large, and its stratigraphi-

*A Paper read before the Federated Canadian Mining Institute.

cal structure not very well known. We don't know that any shipment of oil has been made, so far, except some barrels as specimens, and, in fact, there is not yet regular pumping done.

FELDSPAR.

In the vicinity of East Templeton Station, a quarry of feldspar has been worked with 15 men, for the whole season, the quantity shipped being 1,260 short tons. The material appears to be of a good quality, and is sent to the United States for ceramic purposes. A few other deposits of them, connected with white mica mines, exist, but are not worked.

KAOLIN.

I want to make a special mention of the discovery of this material in our province. In 1894 I visited the township of Amherst, Labelle county, and my attention was called to a white material, which, after testing, I was able to pronounce to be a genuine kaolin. The indication was a small one, but may lead to the discovery of an extensive field of said material. Subsequently R. Lanigan, from Calumet, secured some property there, made some prospects, and came to the conclusion that workable deposits existed. He also sent specimens to porcelain works, and received high testimony regarding the quality. The Imperial Porcelain works, of Trenton, U.S., have pronounced it of a superior quality. The district above-mentioned is five miles from the Montfort Railroad, which connects with the C.P.R.

MOLYBDENITE.

We have enquiries from a party in England about this mineral, which I understand has some new use in a form of alloys, but the price offered (14 cents per lb.), does not give much chance for the opening of our small deposits, which, besides not being developed, are rather far from ordinary communication, we know of only three deposits giving indications of some importance, one on the north shore of the St. Lawrence, and the other in the Gatineau valley. The latter was discovered in Egan township, about 110 miles from Ottawa; the surface indications would justify further development.

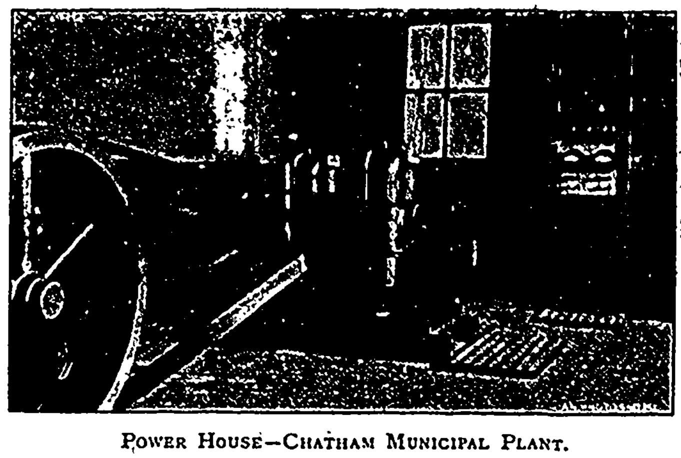
BUILDING MATERIAL.

There is nothing special to mention in this line. We have shipped 3,208 tons of 2,000 lbs. of slate, 90 men being employed, and also 1,072 tons of flag-stones. I am not prepared to give any figure on the building stones, notwithstanding its importance. Re granite, the Stanstead, Whitton and Lake St. John quarries have been in operation, as usual, the latter only for local supply. The limestone quarries, on the Trenton belt, between Quebec and Ottawa, have been extensively worked. We record, for 1897, a production of 14,000 barrels of cement, but new companies are in process of formation, and preparations are made to considerably increase it for the coming year. If we consider the large consumption of such material, in our country, which is partly supplied by an importation of over 200,000 barrels, we may look for a good future for this industry. The established lime kilns and brick-yards are going on as usual. It is not easy to give exact figures regarding the same, as they are scattered all through the province, but by careful researches, I am able to give the following: Approximately, we have, in round numbers, 300 lime kilns, producing one million of bushels of lime, of a value of $140,000, with 250 men employed all the year round. In round numbers also, we count 150 brick-yards, employing 1,200 men for the summer season, and producing 120 millions of bricks, of a value of $600,000.

As a conclusion, I may say that the raw value at the mine of the minerals taken out from this province, represents about *$1,800,000, including the building material, the number of men* employed the most part of the year being about 4,000.

CHATHAM MUNICIPAL PLANT.

The electrical equipment of the municipal arc lighting plant installed by the city of Chatham, Ont., last fall, consists of two automatic arc dynamos of nominally 50 lamps capacity each. These are supplying current to 104 arc lamps and 10 series incandescents, through circuits which aggregate some 24 miles in length. The 10 incandescent lamps and two arc lamps are used for illuminating the power-house and adjoining waterworks plant, while 102 lamps are for street illumination exclusively. These latter are provided with substantial telescoping storm protectors, and are suspended from a suitable steel mast arm. Sleet-proof lamp supporting pulleys and thoroughly insulated lamp hangers are used throughout. The outside circuit is of No. 6 B. & S. hard drawn copper wire, triple braided, strung over double petticoat insulators, and at intervals of two



POWER HOUSE—CHATHAM MUNICIPAL PLANT.

miles is protected by an effective magnetic blow-out lightning arrester. Wherever possible, the circuit is divided into loops, comprising some five to ten lamps, each loop being controlled from a substantial absolute cut-off switch.

The interior wiring is of No. 6 B. & S. rubber-covered wire. A plug switch-board, arranged so that machines and circuits may be interconnected, is provided. This is furnished with ammeters and magnetic blow-out lightning arresters of a new pattern, the whole being neatly arranged on a white marble base. The whole plant was subjected to the most vigorous tests which would ever meet the demands of service. The machines were short circuited at full load for one minute, and also while at full load the circuits were suddenly opened. These tests thoroughly demonstrated their ability to withstand any exigencies of service. This was manufactured and installed by the Thompson Electric Company, then of Hamilton, but now amalgamated with the Toronto Electric Motor Co., and doing business in Toronto.

REPAIRS IN DOCK.

Editor THE CANADIAN ENGINEER.

SIR,—I recently ran across what I considered a rather smart piece of work. I was down at the wharf of the American Line in New York city, and noticed lying on the wharf a propeller blade, the tip of which had about two feet knocked off. I made inquiry, and discovered that it had been taken from the starboard propeller of the steamer "New York," which vessel was then alongside the wharf, being in the course of preparation for sea. It transpired that the job of removing this blade commenced just about 24 hours previous to the time at which I saw the men removing the gear and tackle used in dry-docking the propeller, as she was in wet dock. The work was commenced one morning at 10 a.m., the nuts slacked back, of which there were eight, perhaps 3½-inch diameter, the old blade removed, new one substituted, inside the period of about 24 hours. One can readily see what a saving is effected by being able to so make it possible to work in this way at a damaged propeller, and at the same time allow the cargo to be worked. I judge the weight of the propeller blade to have been about four tons. I have spent a night even in a dry dock slacking back nuts on jobs of this kind, and I consider this piece of work on the "New York" quite an example of ingenuity.

Yours sincerely,

JAMES J. SALMOND,
Box 388, Port Richmond, N. Y.

THE VENTILATION OF PLUMBING APPLIANCES.

We have received a letter from a writer signing himself "Plumber," in which he requests us to ask our sanitary correspondent to give our readers his views on the advantages and disadvantages of the present method of ventilating plumbing appliances and waste pipes, traps, etc. We have submitted the letter to our regular correspondent, W. M. Watson, Toronto, and have received the following reply, to illustrate which the accompanying drawings have been made:

In answering this query, let me first say that if "Plumber" had studied the articles on sanitary matters published in almost every issue of this paper for the past one and-one-half years, he would have been already pretty well informed, especially by studying the one in the issue of April, 1897. The first and most important rule in fixing sewer and house waste pipes, is to arrange every part, if possible, equally graded, with a constant rise upwards, so that a continuous supply of air will regularly pass through every portion except the traps, avoiding any air pockets, where air may lodge motionless and putrefy. See illustration I. in page 351 of the April, 1897, number of THE CANADIAN ENGINEER, except the sink pipes, which by mistake were shown wrong. The method of fixing vent pipes at the highest point of the bend, or knee, of traps, is wrong (see Fig. 1) and in a short time frustrates the intention in so placing it, because each time that soapy water is forced round the sharp bends in the trap a froth is formed which flies up into the vent pipes and dries on like a coat of paint, gradually closing the opening until the pipe becomes useless. Moreover, wherever there is a separate stack for the use of ventilation alone (see Fig. 1), there is often a strong down-draught, varying momentarily, according to the pressure changes of the atmosphere at the terminating points, which causes an oscillation of the water seal in the most sensitive traps fixed on the line. That causes the seal to overflow, and break the key. This might partly be prevented by connecting vent pipe C to soil pipe B, at junction, Fig. 2. Therefore, it is always safer to join the main ventilation pipe into the side of the soil pipe stack (see junction Y, Fig. 2), at a point before it passes outside, when in that case the down-draughts will act directly and squarely down the soil pipe to the main drain, or through the floor line breather pipe. The illustration in the April number will also explain this point still more. Then, vent pipes that are open to the outside air convey a drying atmosphere to the water seal, which quickly absorbs the moisture, drying out a 1½-inch trap very quickly, especially if the pipe is attached to a separate ventilation stack, or the vent is coupled in a way that the body of air presses squarely on the water seal contained in the trap (see Fig. 6 and Fig. 1), or there is hard, dry frost, or hot, drying air outside. They also often act as an overflow tank when the waste pipe is choked, because of the sewage forcing upwards into them when it can not freely flow downward by the proper pipe, gradually dribbling away down the waste pipe afterwards. They form obstructions, and often cause stoppages by small points of solder dropping in when wiping the joints; and also the roughness of the end of the vent pipe, peeping through at an intricate point where smoothness of turn is absolutely necessary. Therefore, if vent pipes are needed, they ought to be inserted a few inches backward from the crown of the bend (see Figs. 3, 4, and 5), so that it would be impossible for the pressure of the atmosphere to rest directly on the off-side of the water seal of any trap.

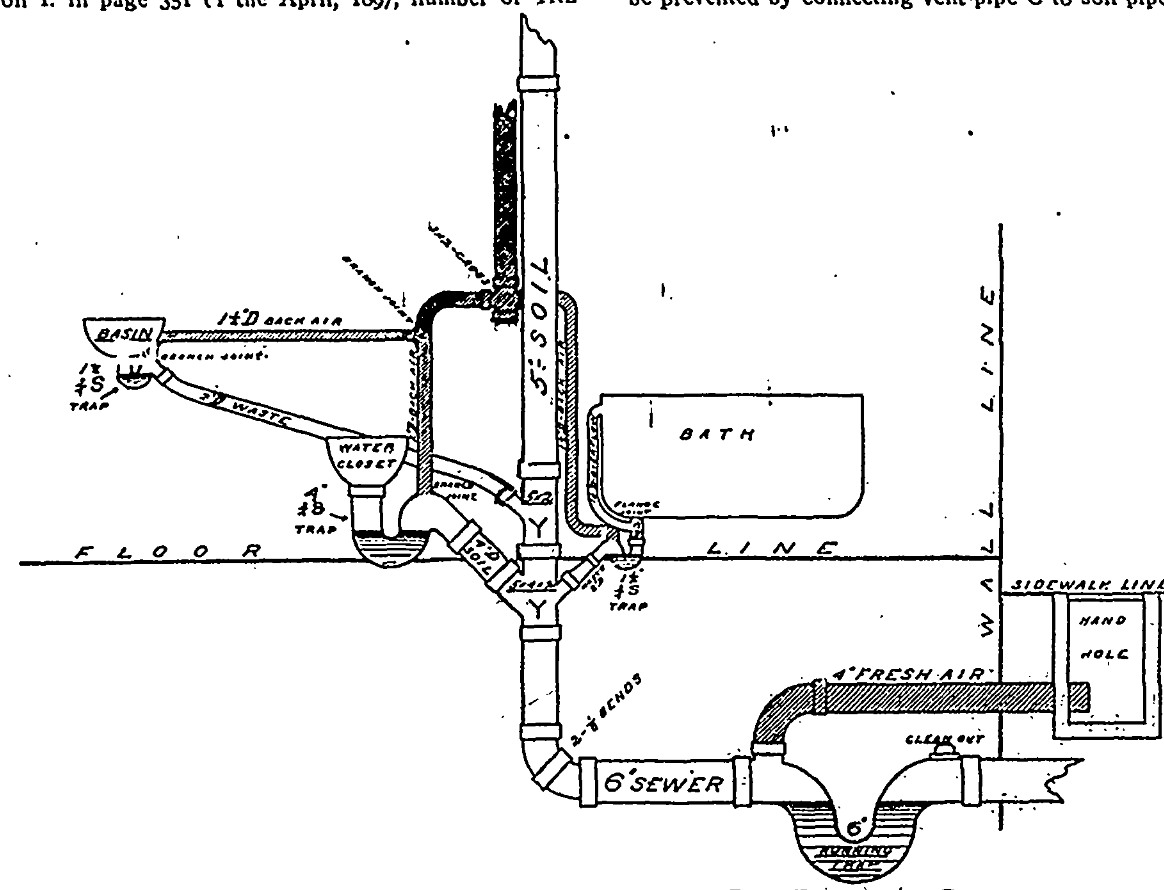


FIG. 1—PRESENT METHOD OF FITTING WITH BOTH PIPES THROUGH THE ROOF.

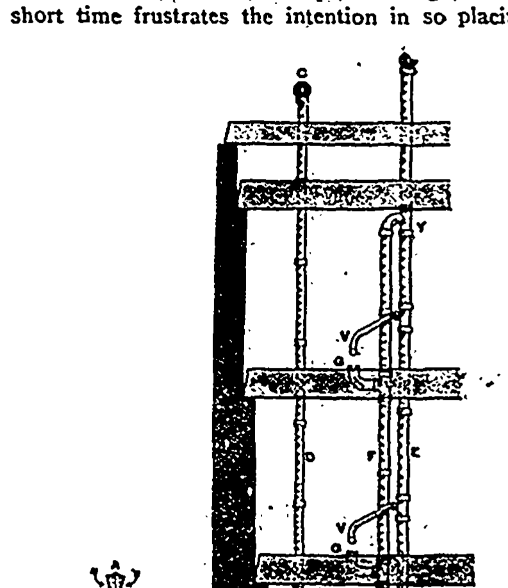
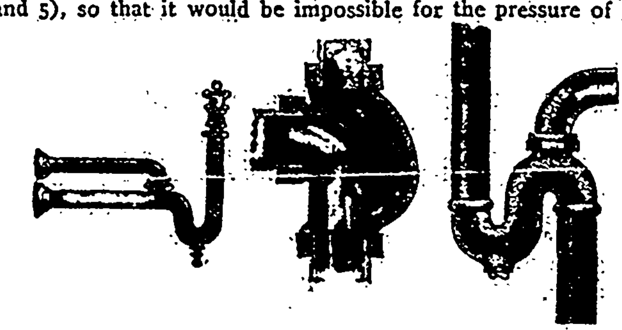


FIG. 2—SEWER VENT.



FIGS. 4, 3 AND 6.

Plumbers may have noticed that the vents of English-made w.c.'s are never on the crown point, but act almost as a right angle branch. They make it hard to remove a choke in a waste pipe that is vented, because a force pump is useless, the fluid passing up the vent when it ought to be making pressure in the waste pipe to force the obstruction.

The fad of the so-called trap syphoning is almost a canard. It can easily be done, but it does not occur naturally once in 100,000 times. There is a danger of the traps being drawn in places where soil pipes stop at the closets, and there is no vent of any kind through the roof, and the w.c. used is of the George Jinnings or Demarest kind, that drops about three gallons of

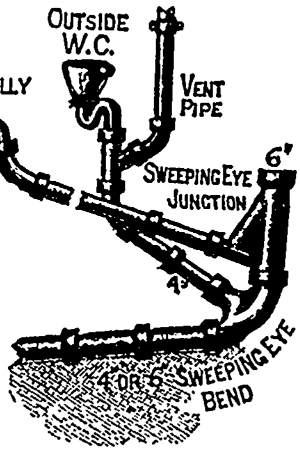


FIG. 6.

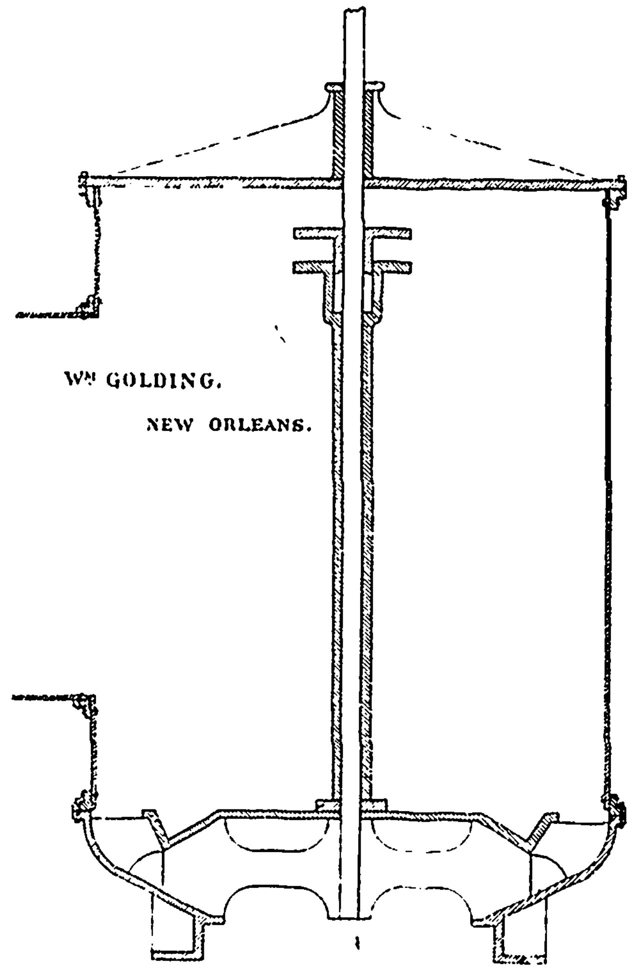
water and the excrements, etc., down the soil pipe suddenly, like a piston passing down a smooth cylinder, causing a considerable vacuum behind, because there is no vent pipe to bring in the atmosphere and fill the space, so it must needs draw it through the w.c. trap, and should it not have reached a larger pipe or sewer before the valve is dropped down again (of course backing the air from going that way), then the vacuum will draw any or all of the small traps in the house. But a water closet flushed by cistern and 1½-in. lead pipes can never syphon any traps, because the water and solids do not go down in bulk sufficiently large to fill a space of a 4-inch pipe, and the air will pass off in the opposite direction. Nor can syphoning ever occur where the soil pipe end is open above (see G. Fig. 2), and also sketch in last April number. The intricate fittings and methods of arranging pipes have caused more premature deaths than the well-appointed and carefully-constructed plumbing put in over thirty years ago, which was totally void of ventilation, but which also never had any dried-out water seals, which in Toronto are answerable for many deaths.

Three years since, I was privately engaged to go to a house having the best and latest designs and workmanship in plumbing throughout the place. I arrived in time to see some members of the family taken away by diphtheria, leaving only the nurse and another ill in the house. I proved enough to believe that it was the overdone plumbing and dried-out trap seals that hurt them, and if the eyes of those who understand air currents and sanitary matters were properly used, more such proofs of the danger of going to extremes in sanitary matters would be forthcoming.

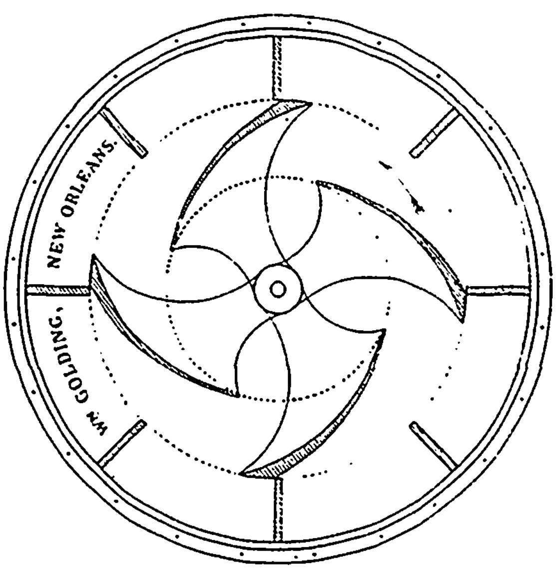
I have so far dealt with the evils of the present method of connecting ventilation pipes to waste pipes, and fixing them often where they are not needed, and where they do a real and positive harm, but the law requires them so to be placed, and though it was made probably by men void of practical knowledge and very ignorantly stupid in such matters, it must be carried out, if the whole town is injured thereby. In another article I will try to show the advantages the present method possesses.

CENTRIFUGAL PUMP.

The annexed sketches illustrate a type of centrifugal pump, the invention and design of Wm. Golding, C.E., New Orleans, La. The feature of this pump is the wheel cover, which rests in taper fit upon chucks, that are cast on the lower portion of the wheel box. There is no fastening to this cover, none being required, as the weight of the water will hold it down. Should the wheel break, or should any obstruction prevent its free movement, the cover and wheel may be removed from the case by simply taking away the upper spider. The lower part of



the discharge branch should be placed on a level with the minimum height of outfall receptacle, while the upper portion of discharge branch will be on a level with maximum height of outfall receptacle. The driving power will be attached to end of the wheel shaft above the spider. To ascertain the discharge



capacity of this pump, ascertain the cubic contents of wheel box (between dotted lines), and multiply by 4, for 4-bladed wheel, and by 5 for 5-bladed wheel, etc., etc., for each revolution of shaft, for the reason, as will be seen, that the wheel box is emptied four times per revolution. To ascertain the power required, ascertain the foot pounds in the quantity to be lifted, and add 50 per cent. The efficiency of this pump when properly installed is claimed to be 85 per cent of the power applied to the shaft.

EXTRACTS FROM ADDRESS OF GEO. E. DRUMMOND, PRESIDENT FEDERATED CANADIAN MINING TRUST.

Within the next few months Great Britain will pour into this, the first of her colonies, thousands of her sons and a vast amount of capital. The United States and other countries will contribute their quota in men and money, and Canada stands upon the threshold of a great national advance that means not only an early increase in material wealth, but what is equally important, that her natural resources shall at least be better understood and better valued both at home and abroad.

We who are directly interested in mining know that the Klondyke represents but a very small part of the great natural wealth of this country, and we are, therefore, confident that, properly directed, the workers and capitalists now coming to our shores, if by chance unsuccessful on their first adventures on the gold mines of Canada, can be absorbed to their own benefit and to that of the Dominion in many other fields of lucrative labor and investment which this country affords. The wealth of our coal fields and iron mines is undoubted. We are rich in silver, copper, asbestos, mica, plumbago, phosphate, chromic iron, galena, corundum, talc, and almost every mineral known to science.

Without presuming to dictate to our English and European friends, the members of this association may be permitted to express the opinion that the Canadian mining engineer, acquainted with this particular field of operation, experienced in the ores of this country, and fully understanding the climatic conditions under which the work has to be carried on, is better fitted to cope with and overcome natural difficulties than, for instance, an engineer who may have gained his experience on the free milling reefs of South Africa.

The official returns of the Geological Survey of Canada, just published, calculates the total production of minerals in Canada during the year 1897 at $28,789,173, an increase of $617,934 over the production of 1896. In 1886 the total production of minerals in Canada only reached a value of $10,000,000. What can better attest the importance of developing the mining industries of the Dominion than this advance of nearly 188 per cent in the short space of eleven years. . . .

In reviewing the different sections of mining, the address continued: The coal areas of the Dominion are estimated at 97,200 sq. miles, not including areas known, but as yet undeveloped in the far north. First the coal fields of Nova Scotia and New Brunswick; second, those of Manitoba and the North-West Teritories, and third, those of British Columbia.

The operations for 1897, so far as reported by the Bureau of Mines and the various companies interested show as follows:—

In Nova Scotia, coal raised	2,345,138 tons.
" New Brunswick, coal raised	6,000 "
" Manitoba and North-West Territories, coal raised	297,000 "
" British Columbia, Vancouver Island collieries, coal raised	798,458 "
	3,446,596 tons.

The production of coal for 1897 may be put down at a value of at least $7,000,000.

Coke—Nova Scotia reports the production in 1897 of 58,000 tons of coke.

We are without actual figures for the production in other sections, but it is gratifying to note that the coal companies of the Dominion are gradually extending their trade, export as well as native, through the medium of their coking plants.

Quoting from the Canadian Mining Manual of 1897: In 1884, 49 steamers, 18 sailing vessels, and two large barges were employed in the St. Lawrence-Maritime trade, when $360,680 were distributed for labor in transportation, trimming cargo, handling, etc., and $55,556 for wharfage, and $55,333 for pilotage. In all a total for these three items of $480,577.

Iron—During the earlier months of the year the Nova Scotian furnaces, as well as the one situated at Hamilton, Ont., were practically closed down, awaiting the decision of the Government regarding the tariff. That happily settled, the furnaces went to work (the Hamilton furnace as late as 29th June), with the result that at the close of the year the returns show an output of coke iron pretty well up to that of 1896 and an increased output of charcoal iron. Advices received from New Glasgow, N.S.; Londonderry, N.S.; Radnor Forges, Que., and Hamilton, Ont., report a combined gross production of about 57,904 net tons of pig iron, 18,562 net tons of steel, 1,403 net tons of forgings, 4,646 net tons of bar iron, puddled bar and other finished products, the three last mentioned items reported by the Londonderry Iron Co.

The capital invested, the number of men employed and the quantity of materials used remain practically about the same as in 1896. The output of charcoal iron at the Radnor Forges furnace, included in the above returns, shows an increase of 50 per cent. over the operations of 1896. The whole outlook in the Canadian blast furnace business is promising.

Our charcoal iron has taken front rank in point of quality, and so far as coke iron is concerned, Canadian founders now acknowledge the product for home furnaces to be equal in every way to the imported American article.

Ferro-Manganese—During the year the plant of the Pictou Charcoal Iron Company at Bridgeville, N.S., has been leased to the Mineral Products Company, who are undertaking the manufacture of ferro-manganese. The company has secured important concessions in manganese mines in Albert county, N.B. These operations will be watched with considerable interest by members of this Institute, who wish the new venture every success.

Chromic Iron—The returns for 1897 are not yet completed, but we are glad to be able to report shipments by the Quebec Central Railway to the extent of 2,593 tons. The quantity shipped in 1896 from the mines of the Province of Quebec, with points of destination, was as follows:

To Philadelphia	750 tons.
" Pittsburg	1,232 "
" Other points	55½ "

Mr. J. Obalski, Inspector of Mines, Que., estimated in his report for 1896 that during the preceding four years 10,500 tons of chromic iron had been raised, of which quantity 9,000 tons was shipped from the Province of Quebec. A concentrating plant is badly wanted to raise the values of a very large quantity of this mineral in the Eastern Townships, at present too low to market at a profit.

Mica—Quebec Province reports the total production to a valuation of $125,000, and we are also glad to report English capital recently invested in Ottawa County mines.

Phosphate—Some phosphate has been taken out during the past year in working for mica, and enquiries for this mineral are more numerous, although the prices offered are as yet too low to admit of actual business.

Gold.—Of all our mineral wealth, gold has excited far the greatest interest . . . . The total production in Canada in 1897 is reported by the Geological Survey of Canada as $6,190,000.

The President then reviewed the conditions in the Yukon, British Columbia, Nova Scotia, Quebec, Ontario, and concluded: A matter of note is that important indications of gold-bearing quartz are found in the Sudbury district at Lakes Wahnapitae and Temogaming. This district, already famed for its deposits of nickel ore, is said to be very promising in gold.

Silver.—The total output for 1897 was 5,558,446 ozs., valued at $3,322 905.

These minerals continue to be the principal source of dividends in British Columbia, substantial profits having been realized by the Slocan Companies, among others the Payne, Whitewater, Peco, and the Hall Mines, Ltd. The figures for the past year are not yet reported, but they show an increase upon those of 1896.

In Ontario, a number of mines in the neighborhood of Port Arthur have been re-opened.

In Quebec important operations were begun, and shipments made from Calumet Island, Ottawa County. A valuable deposit of argentiferous galena has also been discovered in Brome County, on the shores of Lake Memphremagog, which is now being investigated.

Lead.—The total production in 1897 amounted to 39,018,219 ozs., a value of $1,396,853.

Asbestos.—The Geological Survey report gives the output of asbestos and asbestic as 25,262 tons, valued at $324,700. The shipments reported by the Quebec Central Railway for 1897 show:

Black Lake	1,020,425 lbs.
Thetford Mines	16,110,135 "
	17,130,560 "

It is pleasing to note the considerable trade that has sprung up for the refuse sand and short fibered asbestos for use as fireproof plaster, for which purpose it is admirably suited.

Copper—The copper ore mined in the Province of Quebec during 1897—39,928 net tons. Of this quantity 31,080 net tons went to the United States, the remaining 8,848 tons being treated in Canada. These figures show an increase over those of 1896 of 7,448 tons exported to the United States, and a decrease of ore treated at home of some 1,344 tons. The market in the United States has been in a healthy condition, with an active demand and well-sustained prices throughout the year.

In Canada the reduction of the import duty on sulphuric acid has resulted, as feared, in opening our market to the American manufacturer, in consequence of which there is a decrease in home production and also lower prices.

The Bureau of Mines of Ontario reports the production of metallic copper to the extent of 2,750 net tons, of a value at the works of $200,067.

Shipments of blister copper to Great Britain are reported by the Hall Mines smelter at Nelson, B.C.

Nickel.—The Geological Survey Report for 1897 places the total production in Canada as 3,997,647 lbs., valued at $1,399,176.

Mr. Archibald Blue, Director of Mines of Ontario, reports.—

Nickel ore smelted in 1897	96,094 tons.
Metallic nickel contents	1,969 "
Value at works	$359,651

In certain quarters efforts are being made to induce the Government to impose an export duty upon Canadian nickel.

Gypsum.—The total production for Canada reached 239 691 tons. The output for Nova Scotia and New Brunswick combined reached 150,000 tons.

The other industries such as oil, natural gas, salt, graphite and building materials, show no specially new features, and returns of same are not yet to hand.

COMMERCIAL PROGRESS AS INFLUENCED BY THE DEVELOPMENT OF THE IRON INDUSTRY.*

Commercial prosperity is proportionate to the capacity of a country to produce what is required by its citizens, to its financial ability to sustain these products, and to the facilities for distributing what it is able to supply. Disclaiming any desire to minimize the important bearing upon national advancement which should be credited to the other specialties, the iron industry may be given the leading position. Few articles which we manufacture have been so liberally discussed by political economists as pig iron, and in legislation concerning customs' duties, this product has assumed such a prominent position that we may infer that this particular industry is recognized as exerting a marked influence upon the country and especially certain sections thereof. Facts sustain the inference that probably no one industrial pursuit, except possibly coal mining, has done more to advance the United States than the production of pig iron, and by this product and its subsequent manufacture much assistance has been given to the development of the coal mining industry which now contributes about 71,000,000 tons annually or 30 per cent. of the world's coal output. Having a general knowledge of what has been done towards the establishment of a Canadian iron industry and the efforts to encourage this by Government assistance, some application of the foregoing conclusions to the future of the Dominion may be expected at this time. The suggestions offered are not based upon detailed knowledge of local conditions, for I realize how much better equipped others are to discuss this subject locally. But it may be possible for one whose personal work has included numerous investigations of the adaptability of various locations for the establishment of iron and steel works, and whose examinations have embraced some of the deposits of the Dominion, to present new phases of pig iron production as exemplified in the records of progress of the United States, which may be applied to Canadian development. Canada is well supplied with iron ores, many of them of excellent quality; some have withstood any cost of transportation and paid duty for consumption in the blast furnaces of the United States, several hundred miles from where they were mined. The problem which seems to retard the Canadian industry is the bringing together of satisfactory fuels for smelting and ores of desirable character close to points of distribution or consumption. In determining the advisability of a district or individual location for the production or manufacture of iron or steel, the requirements are: (*a*) The facilities of obtaining raw material of satisfactory character, viz., iron ores, fuel and flux, their cost, and the character of metal which they will produce advantageously; (*b*) the market which can be conveniently reached, or which can be developed, and the character of product most in demand; (*c*) the transportation facilities, both existing and prospective, and rates obtainable on raw material and finished products; (*d*) the supply and cost of labor, and the conditions which may cheapen or enhance the wage rate; (*e*) the relation which the local bears to other established concerns which may make similar products, and the competition which must be met from these; (*f*) the character of works which can be constructed, and cost; (*g*) the cost to produce pig iron, and to manufacture iron and steel of the forms most in demand; (*h*) the probability of other locations where no iron is made, but possessing equal, or in some cases superior, advantages, engaging in iron production; (*i*) In countries like the United States and Canada the trend of increasing population demands consideration. The problem is, therefore, by no means a simple one; and in the light of recent concentration of numerous plants under one general management or control this question of ample capital to build up, equip and operate works adds another factor.

In 1897 almost 12,500,000 tons of ore were shipped from Lake Superior mines to furnaces, some of which are 1,500 miles distant, the average distance between mines and furnaces using the ore being probably 800 miles. These ores have gone partly to meet the fuel, but the predominating attraction has been the market afforded for distribution of the metal produced and the articles manufactured from it. A brief summary of the development of the iron industry of the United States may be given in a statement of the rapidly increasing output of pig iron, this being the basis of the entire industry.

Year.	Gross tons of pig iron made.
18[illegible]0	93,908
1830	165,000
1840	286,903
1850	563,755
1860	821,223
1864	1,014,282
1870	1,665,179
1872	2,548,713
1880	3,835,191
1881	4,144,254
1886	5,683,329
1887	6,417,148
1889	7,603,642
1890	9,203,703
1897	9,652,680

In the past three months the production has been at the rate of 12,000,000 tons per year. Taking the census reports for the half century, the data indicates that the pig iron output of 1890 was over 32 times that of 1840. Improved machinery and technical knowledge applied to iron smelting has done more than anything else to secure the advancement indicated. While pig iron is a most important factor in the development of a district, province or nation, its manufacture cannot be made successful without the use of good business management and technical knowledge. Even with this, failure may follow the location of plants without giving the matter thorough investigation.

Mr. Harvey Graham, who was called upon by the president, agreed with the remarks of Mr. Birkinbine, and drew attention to the immense amount of coal required to make 1,000,000 tons of pig iron per month—say, 2,000,000 tons of coal.

*Extracted from a paper read by Jno. Birkinbine, Philadelphia, before the Federated Canadian Institute, Montreal.

THE CHEMISTRY OF FOUNDRY PRACTICE.

BY ERNST A. SJOSTEDT

(Concluded from last issue).

The powerful influence of sulphur in changing the character and fracture of the pig iron has more than once been forcibly brought to the personal experience of the writer, and an extreme case was met with several years ago at Kathadin Iron Works, Maine, with iron made from a bog ore that contained from 1 to 3 per cent. of sulphur, and which at the time was only imperfectly roasted. Analyses of several samples of all grades of this pig iron—from open gray to white and spongy—revealed the presence of sufficient silicon, which under ordinary circumstances would have made them all gray and soft, but the varying amounts of high sulphur present was here the determining agent, as we see from the following table.

	No. 1	2	2	3	3	4	4	5	5	6	6	6	6
Silicon ..	3 09	3.10	2.35	3 55	2 00	2.74	2.70	2.22	1 30	3 89	3.05	2.73	1.00
Sulphur...	.03	:13	.18	.39	.19	20	.34	.12	.18	.60	.46	.65	.43

Here, thus, we have a white iron with nearly 4 per cent. silicon, which but for the .6 per cent. sulphur present would have shown an open soft gray fracture.

An element we often hear about, and which when present even in the smallest quantity in steel is much dreaded, is *Phosphorous*. In foundry pig, however, a certain small amount is not only permissible, but highly desirable, as it lowers the melting point of the iron and makes it fluid, thus causing it to retain its heat longer and making it suitable for producing small castings of a delicate pattern. Pig iron with less than 2 per cent. P is apt to shrink. But when it is present to over .75 per cent the iron becomes brittle—this in proportion to an increased percentage of carbon present—and strong castings should not contain over 5 per cent. phosphorous. It unites readily with iron to about 26 per cent., but the pig iron in the market contains from a trace to 1.5 per cent. Phosphorus is not eliminated in the cupola smelting, and its presence should therefore be kept run of.

Manganese is also an element to be taken in consideration in foundry practice, for so many iron ores contain this metal, and a certain amount enters the iron during the blast furnace process, while part combines with the lime and the sulphur, and is removed with the slag. Its most striking property is to make the iron "chill," *i.e.*, prevents formation of graphitic carbon. But this chill does not make a durable wearing surface, as it is more crystalline than hard, and readily crumbles under the impact of rapid shocks (to which, *e.g.*, a car wheel is subjected). Its presence up to one per cent., however, is not considered detrimental, but a high percentage of manganese makes the casting brittle and white—provided the silicon is not exceptionally high, in which case (as in some Scotch foundry pig of good repute, which carry two to three per cent. of manganese), the graphite is separated, and a gray iron obtained. Iron alloys with manganese in all proportions, and when the amount of manganese runs between 20 and 30 per cent. the product is called ferro-manganese, and when containing from 5 to 20 per cent. it is termed "spiegel" iron. Manganese raises the point of saturation for carbon, *i.e.*, permits of a high total carbon. So while iron without any manganese rarely contains over 4.5 per cent. carbon, ferro-manganese often runs from 5 to 7 per cent. (nearly all of which is in the combined state). Owing to its affinity to sulphur, it acts as a "purifier" (even more so than lime), in the cupola, removing oxides of iron and silicon from the molten iron, and thus helps to prevent blow holes.

A metal which during the last decade has come in great favor as an admixture to iron and steel is *Aluminum*. [The credit of first calling attention to the influence of aluminum on iron castings belongs to a Swedish inventor who introduced the so called "Mitis" castings, a mixture of wrought iron and aluminum]. The principal effect this metal has upon cast iron is that it lowers the melting point of the alloy, consequently increases its fluidity and makes it run quick and sharp, besides giving the gases an opportunity of escaping from the molten iron, hence its reputed property of preventing blow holes. Like silicon, aluminum tends to make a gray iron, and lessens the tendency to chill (*i.e.* favors the formation of graphite), and if allowed to take the place of silicon it will make a stronger and softer casting than if silicon were the agent; but added to an iron already high in silicon it makes it weaker. An addition of aluminum, therefore, is beneficial only to a low silicon pig. If added in sufficient quantities (2 per cent. and more) aluminum, for the same reason as silicon, prevents shrinkage.

Other elements, such as titanium, arsenic, copper, nickel, chromium, etc, also exert their influence on the character of the iron, but they rarely occur in sufficient quantities to require looking for.

From what already has been said, it follows that carbon is a necessary, but passive component in the pig iron, made to change in amount and in form by the presence of other elements. Thus sulphur and aluminum tend to change the carbon into graphite, while sulphur, manganese and phosphorous do not cause carbon to leave its combined state. Sulphur, manganese and combined carbon increase the tendency to shrinkage, while silicon and phosphorous help to counteract this evil, and the more of the effective element the iron contains the more is its action facilitated or retarded, as the case may be.

According to the state in which the carbon is present in the pig iron its grading is determined, but as we have also seen how largely the proportional amounts of graphite and combined carbon are dependent on the many foreign elements present, and to a great extent also on the conditions under which the metal has been allowed to cool, it will at once be evident how uncertain and unsatisfactory it must be to try to judge the quality of the iron simply from the fracture it presents. On the other hand, it is not claimed that the physical properties of an iron are wholly dependent on a certain chemical composition, for there are several possible and proper compositions for an iron intended for any certain purpose, "each of which depends for its physical success on the manner of working the iron, as the full blast, temperature, etc., and on the relative proportions of one element to another, as well as on the actual amount of each present." But before we institute chemical investigations we do not gain a true knowledge of what *causes* these different physical qualities in the iron, nor is it otherwise possible to ascertain the true composition of the pig iron or the cupola charge. In trying to remedy any evil, the first step to be taken, after all, is in the direction of discovering the *cause*, after which a restorative generally can be found. And, as said at the Foundrymen's Association in Philadelphia some time since, "in forming his deductions the chemist's mode of procedure is singularly simple, reasonable and practical. As a result of years of scientific experience, theory and actual practice, it is known that certain impurities in the material produce certain characteristic effects on its physical behavior; and these impurities may be eliminated, retained, or forced into combinations with others, according to fixed laws and conditions to which they are subject. There are founders who can get along without chemical services, but there are very few who could not obtain practical benefit from a use of the knowledge now obtainable upon this subject."

Montreal, February 10th, 1898.

THE STEAM ENGINE.

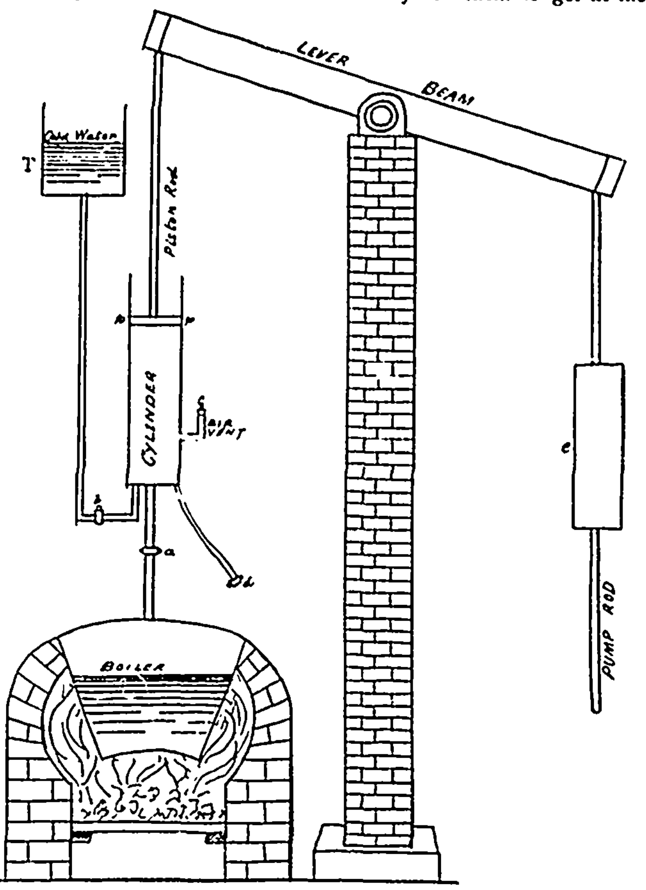
Editor CANADIAN ENGINEER:

My last letter to you was on the setting of boilers. In this paper I propose to speak to the young engineers and readers of your valuable journal, THE CANADIAN ENGINEER, and address them as my sons. I will now draw your attention to the horse-power, or the power of a horse, and the duty which may be expected from a horse day after day; the power and duty of a steam engine or any and every machine has been and is now measured and compared with the power and duty of a horse as a unit.

Sixty years ago I was fifteen years of age and had served the first year of my seven years' apprenticeship in the boiler shop of one of the largest foundries in the west of England. My second year was designed to be spent in the erecting shop, so I had to spend much of my time among the mines taking down old and putting up new engines and machinery. My curiosity was aroused in looking through the storerooms of the mines. I saw many old tools and parts of machines. I made enquiry about their use. There in a corner lay an old leather bag or bucket, likely it had not been moved for many years. Being inquisitive, I asked the old storekeeper its use, and how long it had been there? He said, "many years ago, when I was a young man, about the close of the last century, 1790, instead of having an engine to pump the water from this mine, as you are now taking out, and the large new one you are about to put in, we had to draw it out with this leather bucket. A rope over a large pulley drawn by a horse, a heavy framework of timbers stood over this shaft with a large pulley on the top, and over that road the horse used to travel drawing the rope over it. A slow motion, but it had to be kept going. When one horse's eight hours were up another took its place, which would not keep the mine clear of water, being much deeper now and more men employed in bringing up the copper." Now a good reason was given for using leather bags. It would not knock down anything which happened to be loose on the side of the shaft, for the miners went up and down the same shaft. If the ore was brought up the same shaft it was made large enough to bare in a part for the iron bucket or cibble to pass up and down. Another pulley was provided and placed in the framework over the shaft for a chain to pass over in a groove.

The miners did not then go up and down in elevators as now, but had ladders placed perpendicularly fastened to the side of the shaft with iron rungs, and about every 100 feet a resting floor was made for them. I well recollect, after coming up six hundred feet over such a ladder, I was tired enough. The miners wore hard felt hats with wide brims to protect their heads and shoulders, with a piece of clay stuck on the brim and with a candle in it to give them light. There were no matches and Davey lamps as there have been since; it was a very unfortunate thing for them to lose their light. I one time went into a place like a large room, there was not sufficient air to feed it. My light was gone, all was dark, I had to grope my way to the nearest wise man, whose light still burned (you young men be sure you do not get into such a position with your excited mining speculations). It is very nice to hear the voices of the miners coming up the shaft, singing some well known tune in their lively meeting houses and keeping time with their feet on the thaves of the ladders as they go up and down, and sometimes at their work, to go through a well regulated mine and ramble through long tunnels, observe the way they work to get out the ore: sometimes it is not all pleasure nor profit to the worker, nor investor—but I have wandered off, I must return to my text.

The horse power, and his duty drawing up water for eight hours per day, was an important subject in the year 1698. Some 300 years ago Captain Savery obtained a patent for a steam engine, to draw up or force up with a pump the water from the mine instead of the horse arrangement, he called it the miners' friend, and after he had it going he found his engine would force up as much water as twelve horses in a day, then he called it so many horse-power. Their cost also had to be compared, to calculate the advantage of using steam (that great natural force they had learned to bridle and harness); it soon became noised through the mines and country that the horse had been superseded by the steam engine, for it could run night and day for less cost than the three horses. The excitement caused a number of the thinking men to turn their attention to making steam turn the mills, factories and other machinery. Companies were formed and a great deal of money spent. Newcomen, Cowley and Savery formed one company in England, others in Scotland built foundries. Steam was the great topic of the day. This Newcomen Company got seven teams of horses in a field, in a ploughing match. It was found the average weight a horse could draw through the day was 163 pounds, and travel $2\frac{1}{2}$ miles per hour. Another trial was made by them some time after with 14 horses drawing a weight with a rope over a pulley eight hours per day, to be on the average 150 pounds, and traveling $2\frac{1}{2}$ miles per hour; but the most direct way for them to get at the



NEWCOMEN ENGINE.

(a) Stopcock between boiler and cylinder, (b) Stopcock between cold wate tank and cylinder, (c) Valve closing air-vent, (d) Valve closing the outlet for condensed steam; (e) Weight which drags down the beam, (pp) Piston which is pressed down by the atmosphere when the cylinder is empty.

power of their engine was to find how many gallons of water a horse could draw up in eight hours out of a mine so many feet deep, which they did, and found their engine would force up as many as 100 horses in the time, the horse power to them then became their unit or standard for making their engines.

In 1705 this Newcomen Company was formed. Newcomen, being a very active man in business, made a model engine for the University of Glasgow of brass about the year 1710, the cylinder was two inches diameter, six inches stroke (this engine had *some improvements* over Savery's), the boiler was made of copper, nine inches diameter, without a safety valve. At times the steam rose too high, 75 to 100 lbs. per square inch, but had to be governed by the regulation of the fire. The cylinder of this engine stood directly over the boiler, and was connected by the steam-pipe. This cylinder had a bottom, but no cover for the top, so that the piston could be seen and the air-press on the top of it. This pressure of about $114\frac{1}{2}$ lbs. per square inch is the power of the engine. The cylinder being 2 inches by 2 inches by 7.854 = to 3.1416 square inches on the piston, by $14\frac{1}{2}$ lbs. atmospheric pressure, gives about $45\frac{1}{2}$ lbs. on the piston, so that whatever size engine was required the size of the piston was given and number of pounds expected of it, providing the piston was airtight in the cylinder, and a good vacuum was formed under it by the steam raising the piston up again. The steam was then condensed and the cylinder cooled by a spray of cold water let in, and was let off from the cylinder. A part of this warm water was used to feed the boiler. The tap or valves had to be opened and shut by hand every stroke. One day the boy, Humphrey Potter, wanted to be relieved of his duties, he saw he could tie a lever and a string to the working main beam to do his work. The piston rod was fastened by a chain to a wood beam one end and the other end to the water pump. To such ingenious boys we are greatly indebted for our many improvements we have to-day. This engine remained in the museum of the University for many years. A number of professors and students looked at it and passed by. Sixteen years after it was made, a little boy was born in Greenock; his father rejoiced and said he had a man from the Lord, and called his name James Watt, 1736. Being a mechanical ship-builder, he trained his boy to be mechanical, too, by giving him tools to use when out of school. Being rather weakly, his mother kept him home and taught him good, scientific knowledge and honest principles. At the age of 12 years he was found by his aunt in her kitchen, watching the steam coming out of the spout of the kettle, he stopped it from coming through the spout and put a weight on the cover to see what it would do. The steam rose and blew off the cover, and some of the water into the fire. This caused his aunt to come and see what had happened. She scolded him for wasting his time and the water she wanted and told him to go home to his mother. Her displeasure did not stop his thinking about the much talked of steam among boys and men; of what it was doing in the mines taking the place of the horses. *At the age of 16 years, Watt was sent to* London to learn the art of a mathematical instrument maker, that was then one who made clocks, fishing tackle, sailors' compasses, quadrants, doctors' tools, university and school instruments, and a variety of things to be repaired. At the age of 21—1757—he left London and went to Glasgow, opened a little repair shop for anything he could get any money by, for he had to depend on his own income, as his friends were much reduced by heavy losses. The professors and students of the university visited his shop for repairs; that same year he was appointed instrument maker, and had rooms provided for him in the University of Glasgow. Among many other tools he had to repair was Newcomen's engine, and to see further what it could be made to do, as for 47 years little had been done with it. He soon discovered its great defects and what was wanted, he found it took six *pounds of cold water to condense one pound of steam (one pound of* water will make one pound of steam) and cool the cylinder so as to form the vacuum required; the great idea struck him if he could keep the cylinder hot and get clear of the steam, he could put a cover on the top and cause the piston to descend by the steam with much greater pressure than by the air $14\frac{1}{2}$ lbs. His mind seemed to be fully occupied, that he could not think about anything else. One Sunday morning as he was going to church his hands were not engaged, but his mind was fully absorbed about the engine; a voice seemed to sound in his ears from someone beside him, "get another cylinder and carry the steam from the top and the bottom of the piston and condense it there with a spray or jet of cold water; your engine will go faster and be of much greater power, as the steam can be raised much higher by having a larger and stronger boiler;" everything seemed to be clearly marked out before him; for a real steam engine to be used in factories, steamboats and land carriages. He became much excited over the vision in his mind, he could not follow the preacher in his sermon. A very great obstacle stood in his way, that was, the money it would cost to try his plans, he drew his plans and talked it over with Dr. Black, Dr. Roebuck, Dr. Ure and other friends, who agreed to assist him He then withdrew from the University and devoted his time getting out his patterns and castings to get his engine to work. Here we had better let him carry out his plans, and we will observe him going from pattern to molding shops, machine to erecting shops, directing his workmen until his engine is finished and working. Dr. Roebuck and other friends provided the money and gave him room in the Carron Iron Works.

In summing up our standard of measure or unit we now call the horse power. We must borrow an idea from Mr. Watt, and make our figures and calculations as simple as possible. I will now suppose the water in the mine to be about $206\frac{1}{4}$ feet to be drawn up, the bucket and rope to weigh about 125 lbs., and the water $287\frac{1}{2}$ lbs., $28\frac{3}{4}$ gallons, or the whole $412\frac{1}{2}$ lbs. The rope and bucket will descend by gravitation. The travel of the horse for the first draw will be $206\frac{1}{4} \times 2 = 412\frac{1}{2}$ feet, and if this be continued ten times per hour will give $4,127\frac{1}{2}$ feet for the horse to travel and $4,127\frac{1}{2}$ lbs. to draw, and if continued for eight hours a day, which is considered a day's work or the duty of a good horse, will give 33,000 lbs. drawn up over a pulley 33,000 feet or $6\frac{1}{4}$ miles per day. This gives 1 lb. to the foot, or as it is now called, a foot pound. If a horse could raise 33,000 lbs. one foot in a minute it would be considered a day's work, or the duty expected from him for a day's pay, as much as if he had taken eight hours. This is called the nominal horse power, and if a machine, steam or moved by any other force, can be made to do or exert that amount of force or work in one minute, or eight hours, it is called one nominal horse power, or if it can exert 100 horse-power in a minute it is called 100 nominal horse-power.

In bringing this subject to a close I think it wise to lay before you the cost of raising 33,000 lbs. or 2,300 gallons out of the mine $206\frac{1}{4}$ feet deep, and the horse has traveled 33,000 feet in eight hours The horse should be well stabled and fed with an allowance of 25 lbs chopped hay and a half a bushel of oats, beans and bran ground, about 40c. per day, a man's wages \$1 for attending to it, and other expenses \$1.50 per day. The first outlay equals about \$300, interest \$18.

In this paper we have seen a little into the workings of the steam and the atmospheric engine; in my next paper, if you, Mr. Editor, can find room for the little light I can bring before the readers of your valuable journal, I propose to follow our dear old friend, Jas. Watt, with his improvements, and trace down a little of what has been done since his death in 1819 Yours truly,

P. T. TROWERN,

Feb. 15th, 1898. Chief Engineer Asylum for Insane, Toronto

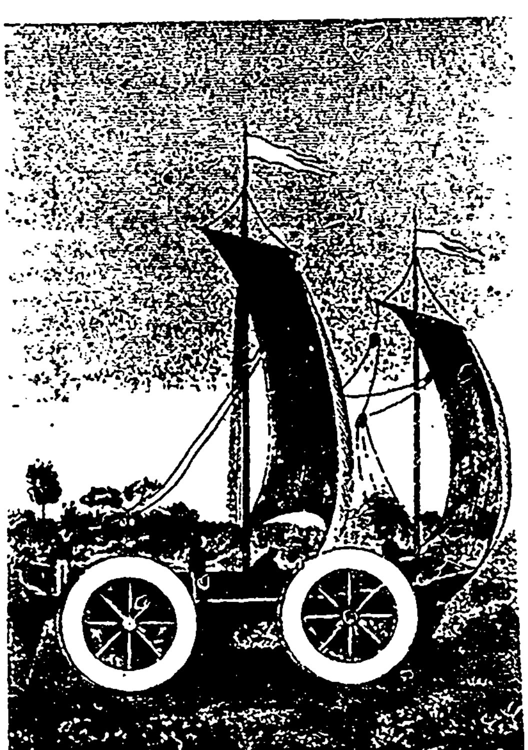
THE MOTOR CARRIAGE.

PAST AND PRESENT.

"With the exception of lands and ruins, there are few material things of value to man which do not derive that value, in part at least, from transport from their original position Cheap means of transport is one of the most important of all the subjects occupying engineers to-day, and one which offers, as it has always done, one of the most profitable sources of investment."—Worby Beaumont, M. Inst. C.E., M. Inst. M.E., M. Inst. E.E., President of the Society of Engineers, England.

THE EARLIEST MOTOR CARRIAGE—1796.

The earliest motor carriage—a hundred years ago. The carriage shown was not strictly an autocar or automobile, but rather a manomotor, and the man who "moted" was in a double sense a footman. The pedals are crude bicycle pedals, therefore this curious old engraving represents the ancestor not only of the modern motor-carriage, but of the bicycle. As for the sailing chariot* or airmotor, the present-day prairie schooners would stand no chance in a cyclone-race with this Flying Dutchman. It was, too, picturesque, and had no massive storage batteries to be charged; no ponderous fly-wheels—though



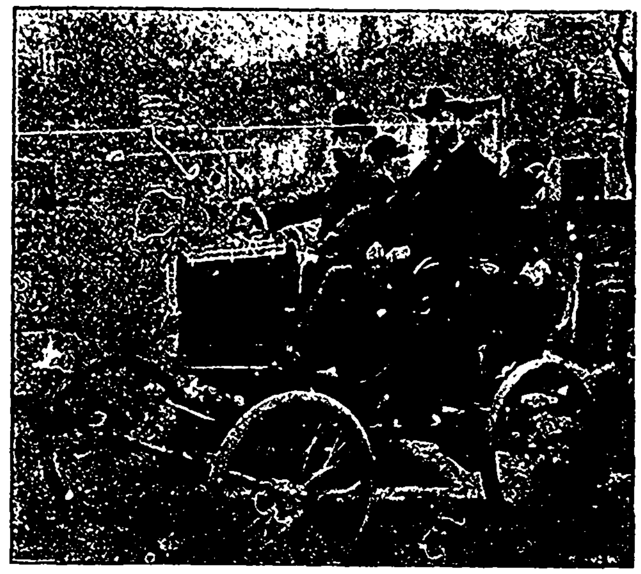
THE SAILING CHARIOT.

This chariot was constructed in the last century by Stephinus, at Scheveling, in Holland, and would carry 8 or 10 persons from Scheveling to Putten, 42 English miles, in 2 hours. The wheels require to be farther asunder, and the axletrees longer than in ordinary carriages, to prevent overturning. Carriages of this kind are said to be frequent in China. In any wide level country their use must be sometimes both pleasant and profitable, when the wind is right.

all four wheels fly; no water-jacket; no missing of explosions; no odors to offend the passers-by, or noise of escaping steam or exhausting gases to frighten horses. Of course if the wind happened to be in the wrong quarter, the ship simply lay-to and "waited the turn of the tide." So much for the past: these old engravings certainly mark the first definite attempts at the solution of the motor-carriage problem, and it is with pardonable pride THE CANADIAN ENGINEER presents them for the first time.

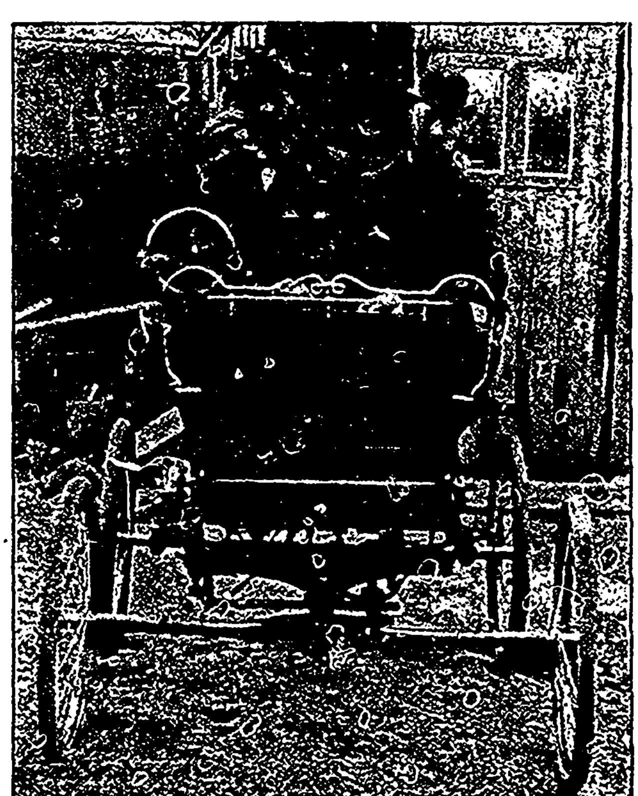
*For the engravings of the "Earliest Motor Carriage, 1798," and the "Sailing Chariot," we are indebted to Thomas Bengough, of Toronto, who, having the motor-mania, and being a book collector, recently captured the precious old volume containing the original engravings on steel.

What about the present? It is a time of unwonted activity among the inventors, engineers and mechanics. Thousands of the brightest brains in the world are struggling with the complicated problem of mechanical traction. Engineers who have made a special study of this question are aware of the peculiar difficulties it presents. That mechanical skill will finally triumph we firmly believe; and as seven cities claimed the honor of Homer's nativity, so will all civilized countries do homage to the genius who with seven-league boots shall stride in this mechanical Klondyke and show the world the way.



THE LATEST MOTOR CARRIAGE.—1898.

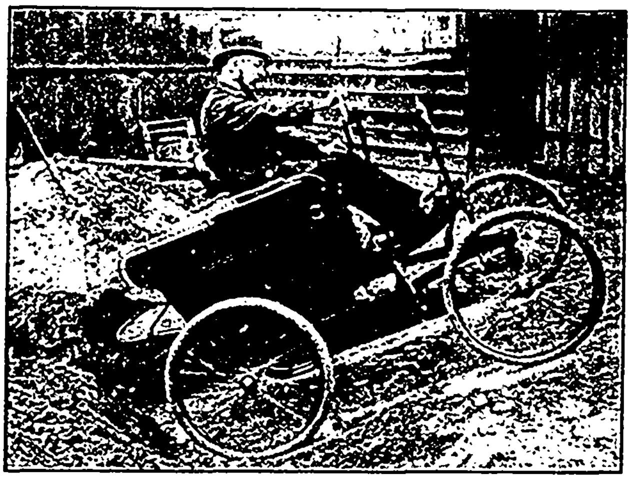
One of the most hard-working students of the motor problem is W. J. Still, who for nearly seven years has been experimenting in Toronto with the various types. The history of his failures would make interesting and profitable reading, but it is only of his success we have room to tell. Mr. Still's first experiments were with electricity, but although his work in this



CANADIAN MOTOR CARRIAGE.

Front view, showing steering gear and controller. Hand wheel used for steering. Mr. Bengough at wheel, Mr. Still to his left. Weight of motor, 3:0 lbs. Entire weight of carriage (unloaded), 750 lbs. Power of motor, 5 h.p.

connection encouraged the young inventor, he fully recognized that electricity has severe limitations, the most serious of which is the absolute necessity for recharging. This consideration alone puts the storage battery out of the race for running through districts where charging stations do not exist. Mr. Still's attention was therefore turned to gasolene engine construction, and following his radical bent, he determined to avoid altogether the weak points of all gasolene engines, viz., rapid piston movement, complicated cycles, and differential gearing: fo these features involve practically all the troubles that beset the motor carriages to-day. The sequence is made up thus:

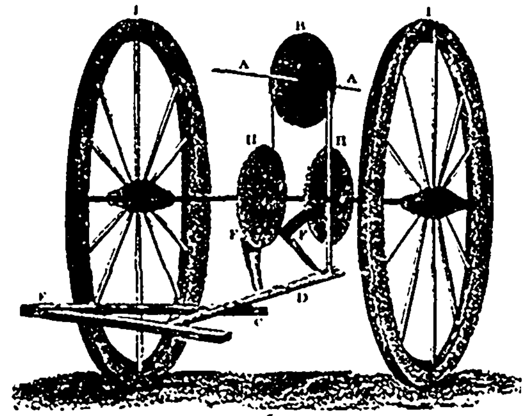


CANADIAN MOTOR CARRIAGE.

On grade specially constructed to scale of 1 in 3. As soil was soft, boards were laid for wheels so as to reduce tractive force and make test as severe as possible Brakes had not been fitted to rig when photo. was taken, and carriage is held in position by its own motive power.

(1) Rapid piston movement—600 to 1,000 revolutions per minute—causing immense heat, often up to 1,500 deg. or 2,000 deg. Fah.; this high temperature in turn necessitates the use of heavy oils, which at great heat give off bad odors. It also requires a water jacket and cooling water tank, with pipe system for circulation of water and radiation of heat. All these points involve great size, weight, and cumbrousness in proportion to load. (2) The complicated cycles, in which frequent misfires occur, involve very bad odor by the unused gas being emitted through the exhaust. The piston thus receiving no impetus, a heavy fly wheel is essential, and this adds further weight and clumsiness. (3) The elaborate series of differential gearing add immensely to size, with no advantage except varying the speed of transmission. Sir David Salomons considers all differential gearing such a nuisance that he frankly says were he a manufacturer he would willingly give £20,000 to be entirely rid of it. Following on the heels of the heavy and complicated mechanical construction above noted, come noise and vibration. There also comes a loss of power in proportion to size and weight of mechanism. The highest record of power exerted by a motor carriage up to date was 187 pounds draw bar strain, while the carriage (unloaded) weighed over 1,200 pounds. A good horse—such as Watt used to obtain his standard "horse-power"—will pull 400 pounds; therefore, 187 pounds is less than one-half horse-power.

To remove at one stroke all this complication, with consequent losses and disadvantages, was the herculean task to which the young inventor set himself. The essential point was to discover or invent a new cycle. There must be no "false motions" causing friction but resulting in no power. There



MECHANISM OF 1796 MOTOR CARRIAGE.

This carriage was exhibited in Paris, France, last century, by Dr. Richard, of Rochelle. When the footman presses down one of the treadles, suppose C, with his foot, he brings down one of the pieces of iron, F, and consequently turns the wheel H, that is next to it. At the same time, by means of the rope that runs over the pulley B, he raises the other treadle D, together with its piece F, which, being thrust down, will turn the other wheel H, and so alternately; and as the great wheels are fixed on the same axis they must necessarily move at the same time.

must be no mechanical absurdity, such as is involved in the process of creating intense heat and then taking it away by a cumbrous round-about process of cooling. There must be a further feature superadded, which does not exist in any gas or gasolene engine; which exists in a limited area in the storage battery, which is found in perfect form in the steam engine: that feature being the ability to give off for short periods much more than normal power. In the case, for example, of the carriage referred to, 187 pounds would be easily sufficient to propel 1,200 lbs. on a level, but what would happen when a hill is reached? Sir David Salomons, one of the greatest, because most disinterested authorities on the autocar question, lays down this rule as to power of motors for carriages. "If twelve miles per hour be fixed as the speed of a vehicle weighing, when laden, say one ton, then the power of the carriage should be sufficient to run at this in all weathers and over all highways, and to climb every hill with a maximum ascent of, say, one in ten, at the proposed rate. The vehicle should also be able to mount a hill of one in five, but at less speed.....I have come to the conclusion that, for every ton, not less than ten horse-power should be carried." This, it will be noticed, is the exact proportion of power developed in the Canadian motor carriage. Sir David continues: "This does not necessarily imply that a ten horse-power engine is required. It means that the engine shall, for considerable periods, and without injury to itself, be able to give off 10 h.p. It must be remembered that when the carriage is started, a far larger amount of power is necessary than when it is running. It is therefore very important to have a good reserve." Sir David then quotes valuable figures to show the varying power needed according to the grade, taking

PASSENGER AND PARCELS AUTOCAR

Now under construction by Canadian Motor Syndicate for the St Germain Autocar Line. Scale of drawing, ¼ in. = 1 foot. Van to seat 25 passengers, equipped with motors producing 20 h p., capable of ascending all grades up to 1 foot in 3; lighted by electric light; furnished with special indicator, for motorman; strong, effective brakes of two separate designs, seats to be handsomely upholstered, windows to have automatic spring roller blinds, roof railed for parcels.

a stage coach weighing 1,800 pounds, exclusive of passengers, thus:

Grade of 1 in 40, 6 miles per hour, required ....160 lbs.
" 1 in 30 " " ......165 lbs.
" 1 in 26 " " ......213 lbs.
" 1 in 20 " " ......268 lbs.
" 1 in 40, 10 miles per hour, requires....172 lbs.
" 1 in 30 " " ......200 lbs.
" 1 in 20 " " ......318 lbs.

On this point it may be interesting to quote from Mr. Worby Beaumont, whose quotation heads this article: "The increase in the power required to haul a load up a hill is directly proportional to the angle of inclination from the horizontal, and hence on a hill of one in twenty, a very common gradient, the hauling power jumps from the average, on a good macadam road, of say 45 lbs. per ton to 54 + 125 lbs., or a total of 157 lbs. instead of 45 lbs. Bad as this is, it is insignificant as compared with the pull required on a gradient of one in ten to one in eight, not at all unfrequently met with. On one in ten the hauling power required becomes 269 lbs. instead of 45 lbs., or no less than six times the power required on the average nearly level road. It is to meet this heavy demand for power that two or three horses have often to be sent with a load which, but for the one or two short lengths of steep hill, could be taken by one horse, and it makes it necessary to put on a motor vehicle boiler and engine power of from 12 to 16 horse-power, where from three to four horse-power would be sufficient."

Mr. Still set himself to solve this difficult problem, the peculiarity of which not even engineers understand who have not studied it in detail; for it must be remembered that the addition to a motor carriage of the boiler and engine power spoken of by Mr. Beaumont would in itself be fatal to the actual work of the motor carriage. Mr. Still's aim was to secure a draw-bar strain equal at least to one-half the total weight of the vehicle. His system is practically in itself a differential gearing of unlimited scope. It allows of a speed gear from the motor, beginning at the ratio of 1 to 1, and running to an almost unlimited scope, certainly over 120 to 1—the latter range having been actually reached in shop tests; this being entirely automatic according to the draw-bar strain required, and without any dividing line on either ascending or descending scale, and without belt, friction or gear-drive.

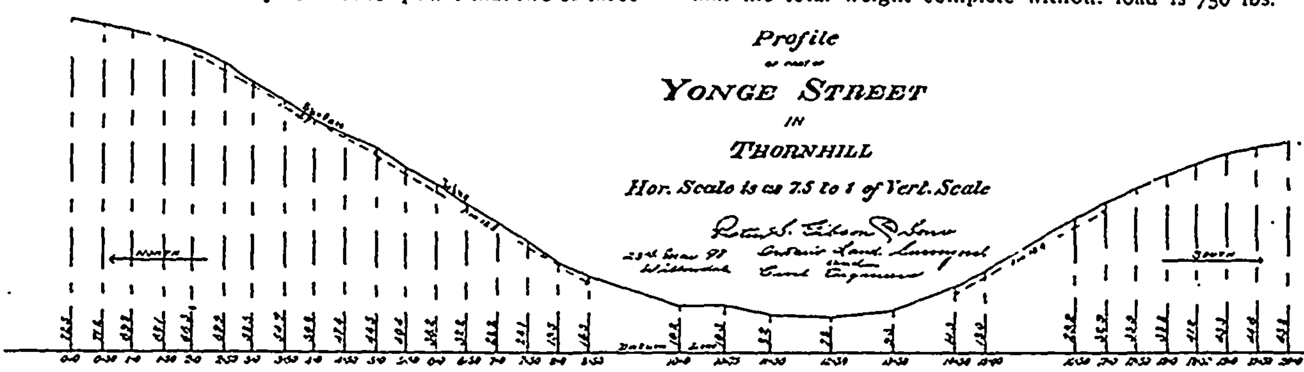
The Still system of motor power as it stands to-day, is unique in the fact of being able to place and maintain a rig in any desired position on any grade. This feature is admirably shown in the photograph representing the carriage standing on a grade of 1 in 3, the draw-bar strain being exactly proportioned to gravity and friction. No brake is involved in the operation: it is simply a question of a balance of the motive force; and about 20 lbs. in either direction would have overcome the balance and moved this rig, although at the time in question the outside draw-bar strain necessary would amount to about 270 lbs. This same force can also be used for sudden stopping in descending grades in case of emergency, and would not only stop a carriage, but rapidly propel it backwards the moment sufficient tractive force were obtained to stop the wheels from skidding. The control is simple. You simply push the controller forward if you wish to go forward; if you wish to go faster, you push it further forward; if you wish to stop, you pull the controller back, if you wish to reverse, a small lever, movable to the left hand, if pulled towards the rear, reverses the mechanism. This can, if necessary, be done at full speed without injury to the machinery. Steering is controlled by a hand-wheel on the controlling lever. Two separate powerful brakes are also provided, one operated by the foot and one by the left hand. Mr. Still's motor is a new departure. There is no sound of an exhaust; there is no odor of combustion, there is no heat; there is no necessity for the cooling water-jacket. In the rig as now standing, there is no water used or required. High speeds can be maintained, or the governor can be so adjusted that no speed above a certain maximum can be obtained, so that in case of delivery vehicles driven by careless Jehus, reckless driving will be impossible.

The motors used in this vehicle may be extended along the whole line, from a small bicycle unit to the unit necessary to drive ocean liners, including invalid chairs, all kinds of road vehicles, launches, street cars, railway engines and stationary engines.

It will be noted that the machinery in connection with the Canadian motor carriage is almost invisible, and not a line of the construction of the body has been changed. This carriage body is one of the regular make of the Canada Carriage Company, Brockville. Nothing has been done with it excepting that part of the flooring has been removed to allow room for the motor. The total weight of the engine is 300 lbs.; engine and truck together (including wheels), weigh 600 lbs.; the body of the carriage, controller and springs, add about 150 lbs., so that the total weight complete without load is 750 lbs. The load shown in the engraving (4 persons) is somewhat over 600 lbs. The carriage would easily accommodate its equal weight of load. Thus the proportion of weight to load is reduced to pound for pound, which is a reduction of about three-quarters of the ordinary weight of motor carriages. The power of this 300 lb. engine is equivalent to five horse-power. Thus the Canadian motor carriage combines the maximum power with minimum weight, and marks an epoch in motor carriage construction. A sudden development of the motor carriage industry in Canada has come within the past month. A. H. St. Germain, of North Toronto, has for over a year past been investigating the question of autocars, with a view of putting a service on the line between the city of Toronto and Richmond Hill, the service of the Metropolitan Street Railway up Yonge street—the main thoroughfare of the County of York—being very unsatisfactory. Mr. St. Germain is a wealthy gentleman, who lives at Bedford Park, about four miles north of the city, and he has personally suffered with others the inconvenience of the irregular service given by the Metropolitan Line. He had been corresponding with English autocar makers in reference to a number of storage battery omnibuses, but after having a private view of the Still engine as running upon the truck before the Gladstone carriage shown in the engraving was completed, Mr. St. Germain was convinced that his was the power he needed, and at once closed a contract with the Canadian Motor Syndicate, who control the Canadian business in connection with Mr. Still's inventions. This contract provides for the immediate construction of an autocar such as shown in the large engraving published herewith. This autocar is being constructed with all possible speed, and will take the road in the early summer. The following are the main features of the construction contract for the St. Germain autocar:

"Van to seat 25 passengers; equipped with motors producing 20 horse-power; capable of ascending all grades up to 30 per cent., lighted by electric light; furnished with buttons and special indicator by which motorman may be ordered to move to right or left boulevard, or stop suddenly; strong, effective brakes of two separate designs; seats on either side of middle aisle to be handsomely upholstered; windows to have automatic spring roller blinds; roof railed for parcels; everything to be of the best style and workmanship."

The route of the St. Germain autocar is a particularly difficult one, as can be seen by an examination of the profile prepared by the Township Engineer, Peter S. Gibson. It was



impossible to give in our limited space a profile of the whole line, covering ten miles, but a selection was made of one of the steepest grades, that near Thornhill. It will be seen by the figures upon the profile that this grade amounts to 8 and 10 per cent. These grades would require (as shown by the above extract from Mr. Worby Beaumont) a hauling power "six times that required on an average nearly level road." It must be remembered, too, that the conveyance which is to run over these immense grades is not an ordinary road carriage carrying from one to four people, but is a passenger and parcels van, seated for 25 persons, in addition to baggage on the roof. No such van is now running in any part of the world; and it speaks volumes for the courage of the promoters of the Canadian Motor Syndicate that they should be prepared to undertake such a task. Mr. Still, however, with an autocar equipped with his engines, capable of 20 horse-power, and being built also to exert this power much beyond the normal rates in times of emergency, is satisfied that the car will be able to surmount them without the slightest difficulty. The two motors, although small, will be placed immediately over or next the axles; every wheel will be a driving wheel, and the aggregate power which will be at the command of the motorman will be equivalent to 2,000 lbs. draw-bar strain—each of the motors being capable of 500 pounds draw-bar strain. This latter is the figure already reached in various tests of the motor with which the small Gladstone carriage is equipped.

It is interesting to note in connection with the name of Mr. St. Germain, the promoter of the Pioneer line of Autocars, that the town of St. Germain in France, about 17 miles from Paris, had the honor of possessing the first railway in France; and true to its traditions, it was also the first to carry out trials of mechanical vehicles for public transport. A company has been formed in that ancient town to start a line of autocars between St. Germain and Ecquevilly, with a prolongation eventually to Nantes. Mr. St. Germain, although past the allotted threescore and ten, has shown great enterprise and enthusiasm in this matter, and is keeping the Canadian public posted constantly as to his proposed autocar service. He has purchased an interest in the Canadian Motor Syndicate, and to show his confidence and good faith in the enterprise, has on deposit the sum of $100,000 to invest in the autocar business.

The president of the Canadian Motor Syndicate is Thomas Bengough, court stenographer, Toronto; the mechanical engineer is W. J. Still, and the secretary is L. W. Dorling. At present writing, the business is being rapidly developed, patents having been applied for in all countries of the world covering the inventions of Mr. Still, and negotiations are in progress for increased factory accommodation.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

On March 8th, Inspector St. John, of the Boiler Inspection and Insurance Company, delivered an interesting and instructive lecture before the Toronto No. 1 C.A.S.E., on the strength of materials in boilers.

The regular meeting of Toronto No. 1, Wednesday, March 16th, was one of the best held this winter. The question box was full, and Bros. Fox, Barman, Mosely and Wickens took part in answering in a very full and instructive manner.

The Hamilton branch of the C.A.S.E. held an open meeting recently in their hall. Quite a large number of the members attended and although through some misconception no regular paper was read some very interesting questions dealing with boilers, engines, machinery, etc., were discussed. In answer to one question as to whether more fuel is used in running two small engines instead of one large one, it has been proved that a large engine of, say, 150 horse-power uses considerably less fuel than two of 75 horse-power. This is owing principally to the fact that more heat is carried off in radiation in using the two than in the one. In cases of electric light plants, power houses, etc., it is often desirable to have two small engines instead of a large one, so that if anything happens to one the power need not be stopped as they will have the other to fall back on. The annual banquet of the Hamilton branch will be held in April.

At a meeting of the London branch C.A.S.E., held in Sherwood Hall recently, a lengthy discussion took place on Electric Motors and Steam Boilers, in which all members took part. Some time ago a pamphlet was issued by the examining board, Messrs. Risler, Bright, Geldart and McLean, with a number of engineering questions to be solved. Two prizes were offered for the best answered paper. D. J. Campbell was awarded first prize, $8, and D. McKinley second, $5.

Industrial Notes.

YARMOUTH, N.S., is to have a $12,000 school building.

THE village of Hintonburg, a suburb of Ottawa, is to have water-works.

M. MOORE, Chatham, Ont., purposes to start a canning factory in Berlin, Ont.

A LARGE saw mill is to be erected at Tusket Wedge, N.S., by J. H. Pothier & Co.

TENDERS are being asked for the building of a waterworks system in Port Colborne.

ST. PATRICK'S CHURCH, Ottawa, Ont., is to be improved this year at a cost of $50,000.

PLANS are being prepared for a new Y.M.C.A. building at Winnipeg to cost $50,000.

THE Guelph, Ont., Foundry Co. has been organized to manufacture hot air furnaces.

WM. MCKENZIE, Toronto, has become a director of the Calcium Carbide Co., St. Catharines.

A MONTREALER interested in the iron trade is negotiating to buy the Kingston Locomotive Works.

A BUILDING permit has been taken out for a brick addition to the Greening Wire Works, Hamilton.

M. BEATTY & SONS shipped two hoisting engines to Ryan & MacDonald, Dominique, Que., recently.

CITY ENGINEER BARROW, Hamilton, Ont., has planned an $18,000 trunk sewer, to be built this summer.

THE Canadian Typograph Co., Windsor, Ont., has shipped 400 bicycles to South Africa this season.

G. BROWN, Westmeath, Ont., is building the bridge across Coulonge River, near Coulonge, Que., at $6,000.

AT the annual meeting of the Belleville, Ont., Gas Co., on the 12th ult., J. W. Johnson was elected president.

I. USHER & SONS are putting in a new one hundred horse-power engine in their cement mills, at Queenston, Ont.

THE filters installed in the Renfrew, Ont., water-works by J. McDougall, Montreal, have been successfully tested.

THE Wm. English Canoe Company, Peterborough, Ont., shipped twenty-four canoes to the Yukon in one week recently.

T. L. WILLSON, of the Calcium Carbide Co., Merritton, Ont., will, it is said, build large works near Montmorency, Que.

BLONDE BROS., Chatham, Ont., will build the Kent County House of Refuge at their tender of $14,421 for the building complete.

THE Columbia Handle Company, Thamesville, Ont., has moved its plant to London, Ont., and is located in the old London East G.T.R. freight sheds.

THE Massey-Harris Co., Limited, Brantford, Ont., will spend $25,000 on enlargement of their works, and will also greatly enlarge the Toronto factories.

THE Hamilton, Ont., Blast Furnace Company during the past winter took three thousand tons of iron ore from the township of Darling, Lanark county, Ont.

FREE instruction will in future be given in sheet metal pattern cutting in the rooms of the Sheet Metal Workers' Union, Toronto. All sheet metal workers of the city are invited to attend.

J. L. GOODHUE & Co., belt manufacturers, Danville, Que., are completing a number of large belts for a new mill on the Pacific coast, consisting of one 48 feet double, two 20 feet double, two 18 feet double, and the smaller belts required.

ARTHUR DENISON, architect, Toronto, has taken out a permit, on behalf of the Cawthra estate, for the erection of a $50,000 store building, to be erected according to his plans on the old John Eaton Co.'s site, corner of Yonge and Temperance streets, Toronto.

E. GOFF PENNY, R. Prefontaine, J. A. C. Madore, Montreal, N. A. Belcourt and F. McDougall, Ottawa, are applying for a Dominion charter as the Canadian Agricultural Utilization of Sewage Water Company, Ltd., having its chief place of business in Montreal, with a capital stock of fifty thousand dollars.

AN important students' organization came into existence at a recent meeting of the students of engineering at McGill University. It is the Applied Science Technical Society of McGill University. The special importance of the organization is that it will unite together not only the students at college but the graduates of the faculty.

D. McGillivray, Fort Steele, B.C., has received the contract for the bridge work on the Crow's Nest Pass Railway from Crow's Nest Lake to Moyie Lake, 200 miles.

Goldie & McCulloch, Galt, Ont., shipped recently six carloads of sawmill machinery, including six boilers, for the Crow's Nest Pass Railway Construction companies.

A company will build a charcoal iron smelter in Deseronto, Ont., on condition that the Rathbun Co. take 25 per cent. of the output, and that the town gives a bonus of $25,000.

An acetylene gas generator exploded in a house in Oshawa recently, doing damage. The machine was blown to pieces, the top being blown upward, making a hole through the ceiling.

The molders at the Waterloo Manufacturing Co.'s foundry have gone out on strike, there being a difference between the manager and the molders regarding what the latter considered a fair day's pay.

The Tisdale property, Brantford, Ont., which has been vacant for several years, will be occupied by the Chalcroft Screw Company, which will be engaged in the manufacture of screws, nuts and bolts.

J. Stuart, foundryman, St. Catharines, Ont., recently cast what is said to be the largest bevel gear ever cast in one piece in Canada. It will weigh four tons; the gear will be used in the Riordon Paper Mills.

At the annual meeting of the Hamilton Iron Mining Company, John Milne was re-elected president, and the old board of directors was also re-elected. The company declared a dividend of 6 per cent. on the year's business.

The New Glasgow Steel Works may go to South Bar, C.B. It is stated that the Dominion Coal Co. are favorable to the erection of the works there, and that they are offering the Victoria pier at a very small sum, and free coal for a certain time.

The Goold, Shapley & Muir Company, Brantford, Ont., who recently had their factory destroyed by fire, have decided to stay in Brantford. The city council has given them the old Verity building for twenty years at a nominal rental of one dollar per year.

Robert Brick, who has been in charge of the tool-making department of the Canada Screw Works, Hamilton, for about a year and a-half, has gone to Vancouver, where he has secured a good position with the Automatic Can Company.

The Portland Rolling Mills Company, Limited, at the annual meeting elected the following board of directors, viz.: J. C. Robertson, president; S. Hayward, vice-president; James Mowat, sec.-treas.; Joseph A. Likely, W. H. Murray, and George F. Baird.

The Bushnell Oil Company are bringing in the machinery of their Petrolia, Ont., refinery to Sarnia. The Petrolia premises will hereafter be used only as a receiving station. The Bushnell Company is having a large number of underground tanks put down on its property in Sarnia.

J. Allison, W. H. Murray, T. McAvity, G. F. Baird, G. S. Cushing, G. McKean and James Fleming, Saint John, N.B., are applying for a New Brunswick charter as the Cushing Sulphite Fibre Company, Limited, chief place of business, Fairville, N.B; capital, $50,000.

St Thomas is to have a brass foundry, which will be established by the Messrs. Jewett, foundrymen, of Buffalo, N.Y., who have made arrangements to supply the Michigan Central, the Wabash and the Grand Trunk Railways with all the brass fittings they require, and will also do a general business.

At a recent meeting of the Quebec Bridge Company, Mayor Parent reported that the statutory capital of the company, $200,000, was now more than fully subscribed, that the borings in the bed of the river were progressing satisfactorily and the bridge plans had been approved by the chief departmental engineer at Ottawa.

Vincent & Dufresne, civil engineers, St. James Street, Montreal, have a contract for a light portable dredging plant, to be equipped with engines to be run by acetylene gas. Builders of generators for this gas, and makers of suitable engines, should communicate with above firm at once. The experiment will be an interesting one, and the results will be carefully watched for.

The seekers after the treasure buried at Oak Island, N.S., are making progress. They are now sinking a shaft to be used as a pumping shaft, and when a depth of 180 feet is reached they will set up pumps and drive a tunnel toward the drain that leads into the "money pit" from the shore and takes the water out by way of the new pit. While sinking this pit they were doing some prospecting with a drill, and struck iron at 125 ft., 126 ft., 152 ft., 165 ft. and 170 ft. At the 153 feet depth they went through an oak box full of metal of some kind and brought up from it a small piece of parchment. This box is bedded in a cement analyzed and found to be composed of lime and sand.

J. R. Booth, Ottawa, will build a 300 barrel flour mill in Ottawa.

A. Gagnon, Victoriaville, Que., is adding one of the Jenckes Machine Co.'s standard boilers to his equipment.

The Dominion Paper Co., Kingsey Falls, Que., is setting up a new wet machine, one of the Jenckes Machine Co.'s standard 72-inch wet presses, shipped them a week or two ago.

A F Bury Austin, Montreal, has secured the contract to supply all the dimension timber, white pine and hemlock, for both the understructure and bridge flooring of the new interprovincial bridge at Ottawa.

Joseph Guilbert, of Windsor Mills, Que., is making extensive additions to his saw mill, and has placed an order with the Jenckes Machine Co., Sherbrooke, for a large quantity of shafting, log-handling apparatus, etc.

W. W. Lee Chance, architect, Hamilton, Ont., has prepared plans for a steel frame canning and evaporating building for J. W. Van Dyke, Grimsby, Ont. The building will be 45 x 160 ft., without columns, and two stories high.

Incorporation has been granted to W. C. Fox, T. H. Graham, E. Buffum, F. G. Bowers, D. G. Lorsch, H. B. Latimer and J. R. Shaw, Toronto, as the Frontenac Lead Mining and Smelting Company, Limited; capital, $55,000.

The correspondence system of education in technical subjects, as carried on by the International Correspondence Schools, of Scranton, Pa., is one of the most successful plans ever devised for giving thorough, practical education to wage earners.

The Jenckes Machine Co., Sherbrooke, Que., is furnishing the Canadian Rand Drill Co. with a handsome compound Corliss air compressor weighing some 33 tons, together with accompanying apparatus, bringing the total weight nearly up to 40 tons.

Steps are being taken by T. L. Willson, president of the Calcium Carbide Company, to enter an appeal against the judgment of Magistrate Hall, convicting his men of a breach of the Lord's Day Act in the recent trial for working on Sunday, as mentioned in our last issue.

City Engineer Barrow, of Hamilton, has recently made some interesting experiments in sewage filtration on the lines laid down in different numbers of The Canadian Engineer. One of his experiments which was very successful was made with slack coal as a filtrate.

William McVicar, McVicar, Ont., is putting in a Dake Steam Feed, built by the Jenckes Machine Co., Sherbrooke, Que., with whom the Phelps Machine Co., of Eastman, Que., formerly Canadian manufacturers of the Dake engine, has amalgamated.

The Dominion Radiator Co. is being incorporated to take over the business of the Toronto Radiator Manufacturing Co.; capital, $300,000; directors are as follows:—Jos. Wright, D Carlyle, J Stark, J. M. Taylor and C. T. Stark, Toronto.

Incorporation has been granted to the Tree Rotary Engine Company, of Woodstock, Limited, to manufacture and sell Tree's Rotary Engine, and, for the said purpose, to acquire Dominion of Canada letters patent number 55,616 and number 56,806; capital, $24,000.

The waterworks system of Barrie, Ont., has been valued for arbitration purposes by E. Vanier, C.E., Montreal, at about $110,000, and by Willis Chipman, C.E., at $53,770; and E. H. Keating, C.E., Toronto, at $52,369. These figures are the estimated cost, less the speculative depreciation in seven years.

Galt, Ont., manufacturers are enlarging their establishments this year. The Goldie-McCulloch Co. is erecting new offices and intends to add to its present molding shop. The R. McDougall Co. Limited, is also contemplating extensive improvements to its foundry, and the C. Turnbull Co. will put up a mill on the site of the W. S. McKay factory.

The Royal Paper Mills Co. has recently added a complete rope drive to the transmission machinery at the East Angus, Que., mill. This was furnished by the Jenckes Machine Co., Sherbrooke, which is furnishing the entire tank work, together with the accompanying machinery. East Angus presents a scene of great activity, carload after carload of material arriving and being placed in position. When completed, this mill will take a prominent place among the producers in the pulp and paper trade.

PLEASE EXAMINE LABEL.

The date printed on address label of this paper signifies when the Subscription is paid to. If you are in arrear, kindly favor us with remittance. Subscriptions are payable in advance.

THE PUBLISHERS.

Willis Chipman, C.E., has made a report to the London, Ont., city council, favoring the establishment of a sewage farm instead of running the sewage into the river as at present.

City Engineer Mitchell, of Niagara Falls, Ont., has made a survey of the Niagara River bank both at the top of the cliff and the water's edge between the cantilever bridge and the whirlpool, for the park commissioners, who are preparing preliminary surveys of the water power facilities at the rapids.

Railway Matters.

F. B. Wade, Bridgewater, N.S., is applying for a charter to build a railway from Shelburne to Halifax.

The Pennsylvania Steel Co., Harrisburg, Pa., will build sixteen bridges for the Grand Trunk this summer.

The plans have been prepared for the new C.P.R. shops at Revelstoke, to which place the shops at Donald will be removed.

The C.P.R. will build a new depot at Vancouver, B.C. This with wharves and other buildings, entail $300,000 expenditure.

Alexander McGregor has been sent out by the Dominion Atlantic Railway Company of London, Eng., to act as superintendent at Yarmouth, N.S.

F. R. F. Brown, mechanical superintendent of the Intercolonial Railway, has been removed from his position and will, it is understood, open an office in Montreal as a consulting engineer.

The Canadian Pacific Railway has done such a large grain business from St. John, N.B., this season that it has been decided to build another elevator there, and the plans are being got ready for a new one, which will be of 800,000 bushels capacity.

Dr. King, vice-president, and Superintendent Woollat, of the Lake Erie and Detroit River Railway, have made a trip over the proposed extension of the L. E. & D. R. R. from Ridgetown to St. Thomas, Ont. The latter town will probably give a bonus of $20,000 to the extension.

The Canada Atlantic Railway Company is applying for power to construct an extension from some point on the line of the company on or near the River Richelieu, in the county of Missisquoi, in an easterly direction to a point on the international boundary line in the county of Missisquoi, or in the counties of Brome, Stanstead or Compton, so as to form a connection with the railway systems of the United States, and also from some point on present line near the St. Lawrence River or north-westerly therefrom, through the counties of Soulanges and Vaudreuil, crossing the Ottawa River near the Village of St. Anne, and to some point in the City of Montreal, by the most feasible route to the St. Lawrence River, at some point in or below the said city.

The report of the Grand Trunk shows the net revenue surplus for the half year ending December to be £275,263, being an increase of £236,117 over the corresponding period last year. Passenger earnings decreased £151,728, compared with 1896. The tons of freight and live stock have increased 410,960. The earnings per train mile have increased fourteen cents, and the working expenses have decreased nearly seven per cent. The Chicago and Grand Trunk shows a deficit of £49,467, being £17,900 better than in 1896. The Detroit and Grand Haven shows an increase in net revenue of £21,373, leaving a net deficit of £2,174 on revenue charges. The directors report the agreement granting the Wabash Company joint use for 21 years of that portion of the Grand Trunk between Windsor and Black Rock station.

The Governor of Newfoundland, Sir Herbert Murray, has signed a railway contract with R. G. Reid of Montreal. The Government claims that the arrangement will effect a saving of $80,000 a year in addition to promoting the development of the country. Mr. Reid has contracted to build a railway across the island and to work the entire railway system of 650 miles for 50 years, receiving a subsidy of 2,500 acres of land per mile. He pays $1,000,000 now, which will become $7,000,000 at the end of the period, when the colony takes the money and the contractors will take the railway. If he should make default in carrying out the contract during the period, both the money and the railway are forfeited to the colony. Mr. Reid purchases St. John's dock for $350,000, and the Government telegraph lines for $125,000. He also undertakes to build seven mail steamers to ply in the Great Bays, receiving a subsidy of $100,000 for thirty years. The contractor secures also certain coal areas which he agrees to work, as also pulp and lumber mills and copper and other minerals, being protected by a dollar duty to be imposed on imported coal. Furthermore he contracts to build an electric railway in St. John's, and to pave the main streets of the city for $140,000.

The management of the Grand Trunk Railway system has contracted with the Pullman Company, Chicago, for the construction of twenty first-class passenger coaches. They will be turned out with every modern improvement. The Grand Trunk is just finishing the construction of two hundred freight cars, and have decided to build three hundred coal cars in their Canadian shops. In addition, ten new locomotives have been received from the Baldwin Works, and ten more are coming from the Schenectady Works. The C.P.R. is also making the addition of some fifty-five cars to the already large supply used by the great Canadian trans-continental line. Ten of them will be sleeping cars, twenty of them first-class passenger coaches, ten tourist cars and five baggage cars. All, except the tourist cars, are being built at the company's shops, Niagara Falls, Ont., the Crossen Works at Cobourg having the contract for the tourist cars.

MOVING TIME!! Subscribers are reminded to notify us of any change in address necessary. Give both old and new addresses.

THE PUBLISHERS.

Electric Flashes.

W. Moore & Sons have renewed their lighting contract with Meaford, Ont.

The Perth, Ont., Waterworks Co. is installing two phase "S.K.C." motors.

The Montreal Street Railway Co. has received an order for 20 motor cars from Kingston, Jamaica.

C Fraser has succeeded Electrician Brown in office at the H., G. & B. power-house, at Stoney Creek, Ont.

Arkona is said to be willing to give a $10,000 bonus to the proposed electric railway from London to Lake Huron.

Peterborough, Ont., is discussing a bonus of $1,000 a year for 20 years for a radial railway taking in the lake district.

Henry Morgan & Co., Montreal, have placed an order with the Royal Electric Co. for a 20 K.W. direct current generator.

The Brantford, Ont., Electric and Operating Co. is installing a 60 K.W. "S.K.C. and a 40-light T-H Arc machine received from the Royal Electric Co.

It is reported that the Quebec Electric Street Railway will extend its line from the city to Cap Rouge via the St. Louis road, and returning by the St. Foye road.

Arrangements have been completed by which the extension of the lines of the Montreal Street Railway into the village of Verdun, are assured for the coming summer.

Owing to ill-health, John McDermott, who has been in charge of the Almonte Electric Light Company since it was formed, has retired from active work.

Negotiations have been commenced with a view to construct an electric railway between L'Epiphanie and Joliette, Que., passing through the parish of St. Jacques de L'Achigan.

The projectors of the Hamilton, Chedoke & Ancaster Radial Electric Railway, propose to extend it to Brantford, and are vigorously pressing the matter with the municipalities most concerned.

W. J. Fletcher, Markham, Ont., proprietor of the electric light plant there which was recently destroyed by fire, has decided to reconstruct the plant, and has purchased from the Royal Electric Co. a 20 K.W. "S.K.C." generator.

Last year the Galt, Preston and Hespeler Railway carried 221,647 passengers, an increase of 2,027. The total freight carried was 12,973 tons, an increase of 4,663 tons. The increased earnings was $1,900. President Todd has been re-elected.

The C.P.R. management is experimenting with a system of electric light generated from the axles of moving cars, and the results are said to be very promising. Storage batteries are used. The "Winchester" is the first with the new electric system.

The long-standing litigation over the assessment of the poles, wires and tracks of the Toronto Railway Company has been settled by the Court of Appeal giving judgment in favor of the city of Toronto. By the decision, the assessment of $452,277 against the company in Wards two to six is confirmed for 1898, which will probably yield between $7,000 and $8,000 in taxes.

Toronto and Hamilton, Ont., are both agitating the question of municipal lighting plants. Tenders will, probably, be called for in each case: but only in order to determine prices for purposes of argument.

The Shipton Electric Light and Power Co., Danville, Que., has received a Crocker Turbine from the Jenckes Machine Co., Sherbrooke, which is proceeding with the installation of the same with penstock and draft tube.

The report of the U.S. commissioner of patents for the year 1897 shows that to residents of foreign countries the number of patents issued were: England, 706; Canada, 286; Germany, 551, and France, 222. The most noted are those connected with the development of electrical inventions.

T. E. McLelan, the courteous and obliging manager of the Berlin and Waterloo, Ont., Street Railway, has resigned his position to go to the Klondyke. He will be succeeded by H. H. Hilborn, E.E., of Montreal, who, since his graduation from Cornell, has been in the service of the Montreal Street Railway Co.

The Halifax Electric Tramway Company, Limited, has just installed two large generators, each having a capacity of 6,000 sixteen-candle power lamps, which, together with generators previously operating, make the capacity of the company 18,000 sixteen-candle power lamps. There is no ground, the company states, for the rumor of the amalgamation of the company with the People's Heat and Light Company.

The transfer of the Quebec District Railway from the present company to the new one formed by H. J. Beemer, will take place before July 1st. New open cars for summer use have been already ordered. Meanwhile the changing of the steam system to electricity on the line of the Quebec, Montmorency and Charlevoix Railway will be proceeded with. Most of the cars now in use upon the road will be run as electric cars with one, two or three trailers, as necessity may arise. It is the intention to run electric trains to Ste. Anne about every hour About the whole amount of the capital stock of the new Quebec Electric Railway Company has been underwritten.

Personal.

Morgan Baldwin, harbor master, Toronto, died last month at his residence in that city.

Theo. Zwicker, machinist, has now charge of the machine shop at the Halifax dry dock.

S. S Foley, Chapleau, Ont., has been appointed despatcher on the Crow's Nest Pass Railway.

Ed. S. Fraser, C.E., New Glasgow, N.S., has taken a position on the staff of the South Shore Railway.

Jas. W. Milne, formerly of the Waterous Engine Works Co., Brantford, Ont., has gone to Vancouver, where he will represent a Montreal firm.

Engineer Hutchinson of the G.T.R., who was badly burned in the railway accident at Burlington, Ont., died at the Hamilton Hospital, March 4th.

Architect Adams, of the Kingston Penitentiary, has been suspended from duty on a charge of insubordination preferred by Deputy Warden O'Leary.

H. Gardner Smith, the new engineer of the D.A.R. steamer "Prince Edward," has arrived at Yarmouth, N.S., from England and entered upon his duties.

R. G. McConnell, of the Dominion Geological Survey, has accepted the position of mineralogist of the Province of British Columbia, to succeed W. A. Carlyle, who resigned.

The death occurred at Truro, N.S., last month, of Wm. Yould, sr., assistant trackmaster of the I.C.R., aged 78 years. He was the first foreman of tracklaying on the Nova Scotia Railway, now a part of the I.C.R.

Raoul Rinfret, C.E., of Montreal, who is going to the Yukon with the Slavin-Boyle party, has been commissioned by Minister Sifton to organize a meteorological service in the Yukon country, as well as to make certain surveys for the Interior Department.

The well-known contractor, John Ross, died very suddenly at Lancaster, Ont., March 12th. He was very successful as a railway contractor, and very wealthy. It is said of him that he built more miles of railway than any other contractor in America. He was 78 years of age.

Albert Robinson, formerly of Crowe's Iron Works, Guelph, Ont., and lately of Detroit, has been made foreman of the Cossitt Works, Brockville, Ont.

John Galbraith died recently in Brantford, Ont., from blood poisoning. Deceased had been employed for the past ten years as boiler-maker at the Waterous engine works. A few weeks ago he got his foot badly bruised with a heavy piece of iron, from the effects of which blood poisoning set in.

James M. Macoun, who has interested himself in the Behring Sea investigation for some years, has, in recognition of his services been appointed by the Government assistant naturalist of the Geological Survey. He has been on the temporary staff of the Geological Survey since 1883.

The death of W. M. Hamilton, recently, removes an old resident of Toronto. Mr. Hamilton had been for the last year manager of the St. Lawrence Foundry, but from 1885 to 1893 he was superintendent of the Parkdale Waterworks Department, but resigned when it was amalgamated with the city.

Sir Henry Bessemer, the celebrated inventor of Bessemer steel, died in London, March 15th. Deceased was an eminent engineer, born in Hertfordshire, England, in 1813, he early devoted himself to the improvement of machinery, and acquired celebrity by his invention of a new practical process for the manufacture of steel, which was extensively adopted in Europe and America, and the product of which is known in trade as Bessemer steel.

Cecil B. Smith, Ma.E., A.M., Mem. Can. S.C.E., who has just resigned his post at McGill, to take a position on the engineering staff of the C.P.R., was born at Winona, near Hamilton, March, 1865, and received his education at the Hamilton Collegiate Institute, and afterwards in civil engineering at McGill University, graduating in 1884 with first honors and the Governor-General's medal. Since that time he has been engaged chiefly on railroads, although working for a short time under Mr. Thomas Monro on the Welland Canal, and under Mr. John Kennedy on the Montreal Harbor Commission. He has had charge of many heavy pieces of construction; on the Northern and Pacific Junction Railway under Mr. J. C. Bailey, on the St. Catharines and Niagara Central Railway under Mr. E. N. Molesworth, on the C.P.R. at London, Ont., under Mr. W. T. Jennings; surveyed for the Toronto, Hamilton and Buffalo Railway during the summer of 1889, under Mr. A. L. Hogg. He was then appointed successively: resident engineer, chief draughtsman and division engineer on the C.C. and C.R.R. in Tennessee and S.C. under Mr. A. N. Molesworth, constructing 70 miles in all. He was then appointed division engineer on the Roanoke and Southern Railway, under Mr. Andrew Onderdonk, in charge of 65 miles of heavy work, including track-laying and maintenance. On this being completed, after short reconaissances for the Concord Southern Railway, he was appointed resident engineer on the Baltimore and Ohio Railway, under Mr. W. T. Manning, in charge of 14 miles of very heavy work. On completion, he was appointed Lecturer in Civil Engineering and Descriptive Geometry at McGill University, the duties of the former being to lecture in railway engineering and on testing of materials of construction. In 1888 he was made associate M.C.S.C.E., and in 1894 obtained the degree of Master of Engineering from McGill University. On the occasion of his resignation from the faculty of applied science, McGill University, Professor Smith was the recipient of a beautifully engraved walnut case containing two very valuable aneroid barometers, with kindest expressions of regard and regrets at his withdrawal from the university, on behalf of the undergraduates of 1898 and 1899 of the faculty of applied science. The interesting series of papers from Mr. Smith's pen which have appeared in the Canadian Engineer during the past year will be continued in next year's volume. The articles which have already appeared are now ready to be issued in book form as "Railway Engineering," Vol. I.

Marine News.

Edwardsburg Starch Co., Cardinal, Ont.: Steamer—Rosedale, Capt. Jas. Ewart, Engineer E. O'Dell.

Myles' Sons, Thomas, Hamilton, Ont.: Steamer—Myles. Capt. John S. Moore, Engineer Jas. Smeaton.

Sylvester Bros., Toronto, Ont.: Steamer—Eurydice, Capt. J. Jackson, Engineer Alex. Munro. Schooner—St. Louis, Capt. Geo. Williamson.

Merchants' Line, G. E. Jacques & Co., Montreal: Propellers—Cuba, Capt. Robert Chestnut, Engineer Wm. Kennedy; Melbourne, Capt. Hy. Chestnut, Engineer, Thos. Milne.

J. B. Miller, Toronto, Ont.; Steamer—Seguin; Capt. J. B. Symes; Engineer, Samuel Gillespie.

Fairgrieve & Co., J. B., Hamilton, Ont.: Steamer—Arabian, Capt. Oliver Patenaude, Engineer Alex. H. Bertram.

Conlon, J. & T., Thorold, Ont.: Steamer—Erin, Capt. P. Sullivan, Engineer J. Dawson. Schooners—F. L. Danforth, Capt. John Cornwall; Maggie, Capt. John Rosie.

North-West Transportation Co., Sarnia, Ont.: Steamers—Monarch, Capt. E. Robertson, Engineer E. W. McKean; United Empire, Capt. John McNab, Engineer S. Brisbin.

Lake Ontario & Bay of Quinte Steamboat Co., Kingston, Ont.: Steamers—North King, Capt. John Jarrell, Engineer O. J. Hickey; Hero, Capt. Wm. Bloomfield, Engineer John McEwan.

Canadian Pacific Steamship Co., Owen Sound, Ont.: Steamers—Manitoba, Capt. E. B. Anderson, Engineer R. Chalmers; Alberta, Capt. J. McAllister, Engineer A. Cameron: Athabasca, Capt. G. McDougall, Engineer W. Lockerbie.

McKay, R. O. & A. B., Hamilton, Ont.: Steamers—Sir S. L. Tilley, Capt. Geo. Mackey, Engineer Jas. H. Brown; Lake Michigan, Capt. Wm. O. Zealand, Engineer Jos. Boulanger. Schooner—T. R. Merritt, Capt. Wm. A. Corson.

Niagara Navigation Co., Jno. Foy, Manager, Toronto, Ont.: Steamers—Chippewa, Capt. J. McGiffin; Engineer, R. McCaul; Corona, Capt. W. H. Solmes, Engineer I. Walsh; Chicora. Capt. R. Clapp, Engineer H. Parker; Ongiara, Capt. R. McIntyre.

Matthews Line, Toronto, Ont.: Steamers—Niagara, Master, James Morgan; Engineer Thomas Mills. Clinton, Master, John Joyce; Engineer, Jno. Gray. Barges—Lisgar, Master, John Fahey. Grimsby, Master, S. Atkinson. Schooner—Clara Youell, Master, N. J. Colwill.

North Shore Nav. Co., Collingwood, Ont.: Steamers—City of Collingwood, Capt. W. J. Bassett, Engineer, Chas. Robertson: City of Midland, Capt. F. X. Lafrance, Engineer Wm. Whipps; City of Parry Sound, Capt. Ernest Walton, Engineer J. L. Smith; City of Toronto, Capt. A. C. Cameron, Engineer David McQuade; City of London, Capt. Geo. Dunn, Engineer C. Wilber.

The Toronto Ferry Co., Toronto, Ont.: Steamers—Primrose, Master, Chas. Tufford; Engineer Harry Brownley; Mayflower, Master, George Moulton; Engineer, Edward Abbey; Shamrock, Master, Thomas Jennings; Engineer D. Foley; Thistle, Master, Alex. Martin; Engineer, M. Murphy; Kathleen, Master, John Fertile; Soland Queen, Master, Joe Tymon; Engineer Thos. Good; Luella, Master, M. Corcoran; Engineer John Smiley.

Playfair Barge & Tug Line, Midland, Ont.: Steamer—St. Andrew, Capt. W. H. Featherstonehaugh, Engineer John McRae. Tugs—Magnolia, Capt. R. H. Gilberston, Engineer E. A. House; Metamora, Capt. Jas. Tyndall, Engineer George Smith, Minitaga, Capt. Ed. Burke, Engineer, Jno. Sinnott.

St. Lawrence & Chicago Steam Navigation Co., J. H. G. Hagarty, Mgr., Toronto, Ont.: Steamer—Algonquin, Capt. Jas McMauger, Engineer, Jas. H. Ellis.

The Ottawa River Navigation Co.: Steamer—Sovereign, Capt. H. W. Shepherd, Commodore; Purser, D. M. Robertson; Pilot, Joseph Dufour; Mate, Joseph Bertrand; Steward, Alex. Sleeth; Engineer, Jos. F. Marchand. Steamer Empress—Capt., Alex. Bowie; Purser, W. A. Dorion; Pilot, John Galbraith; Mate, Alex. Arsen; Engineer, Geo. Menish. Steamer Duchess of York—Captain, John McGowan, jr.; Pilot, Pierre Sauve; Engineer, Alex. St. Laurent. Steamer Princess—Capt. [illegible]n, Peter McGowan; Purser, John Kelley; Pilot, Hormidas [illegible]eau; Engineer, Ferd. Piche. Steamer Maude—Captain, E. Gauthier; Purser, A. S. McIntyre; Pilot, D. Dupuis; Engineer, Narcisse Fugere.

Calvin & Co., Garden Island, Ont.: Steamers—D. D. Calvin, Capt. A. Malone, Engineer T. C. Smith; Bothnia, Capt. Geo. Brian, Engineer R. Veech; Armenia, Capt. Chas. Coons, Engineer Geo. Hazlett; Chieftain, Capt. John Sullivan, Engineer Thos. Gray; Parthia, Capt. David Lefavre, Engineer Geo. Sauve; Johnston, Capt. D. Lefavre, jr., Engineer, Ed. Phelix; Bluebell, Capt. John Dix, Engineer Fred. Lefavre; Reginald, Capt. John Doyle, Engineer John Kennedy. Schooners—Ceylon, Capt. H. Smith; Augustus, Capt. Jos. Achee; Valencia, Capt. John Ferguson; Norway, Capt. John Harris.

The following are the officers of the Richelieu & Ontario Navigation Co.'s fleet, so far as appointed to date of publication: Algerian—Capt. A. Dunlop; 1st Engineer, Thos. Wadsworth. Berthier—Capt. C. Gouin; 1st Engineer, D. Laviolette. Bohemian—Capt. J. McGrath. Canada—Capt. Thomas Dugal; 1st Engineer, G. Lefebvre. Carolina—Capt. Reverin; 1st Engineer, L. Latulippe. Columbian—Capt. G. Batten. Corsican—Capt. Esford; 1st Engineer, Jno. Parker. Cultivateur—Capt. Raymond. Hamilton—Capt. Baker; 1st Engineer Geo. Marshall; Hochelaga—Capt. Mandeville; 1st Engineer A. Chapullon. Hosannah—Capt. Mongeau; 1st Engineer, H. Gendron. La Prairie—Capt. Peter McLean. Longueuil—Capt. Jodiona; 1st Engineer Boncage. Montreal—Captain not appointed; 1st Engineer F. X. Hamelin. Mouche-a-Feu—Captain not appointed; 1st Engineer P. Bouchet. Passport—Capt. McDonald; 1st Engineer W. Taylor. Quebec—Capt. L. O. Boucher; 1st Engineer J. B. Gendron. Spartan—Capt. H. P. Granger. Terrebonne—Capt. E. Gouin; 1st Engineer M. Sheridan. Three Rivers—Capt. F. St. Louis; 1st Engineer, F. Gendron.

Montreal Transportation Co., Kingston, Ont.: Steamers—Glengarry, Capt. Gordon Kean; Engineer, John Evans; Bannockburn, Capt. John Irving, Engineer R. Taylor; Rosemount, Capt, J. W. Mawdesley, Engineer H. Thurston; Active, Capt. Edward Bennett, Engineer, John Hamilton; Bronson, Capt. Jos. Murray, Engineer R. Hepburn; Glide, Capt. Thomas Murphy, Engineer, Geo. Tuttle; Jessie Hall, Capt. C. Martin, Engineer Alex. Barton; J. A. Walker, Capt. John Boyd, Engineer Geo. Boyd; D. G. Thomson, Capt. Jas. Murray, Engineer G. Henderson. Lake barges—Kildonan, Capt. Maxime Lefebvre; Minnedosa, Capt. R. C. Irwin; Selkirk, Capt. H. Colvin; Winnipeg, Capt. James Kirkwood; Melrose, Capt. James Fleming; Dunmore, Capt. John Phillips. River barges—Alberta, Capt. Frank Poirier; Acadia, Capt. Louis Hebert; Bella, Capt. Peter Lalonde; Cleveland, Capt. J. D. Parron; Chicago, Capt. Arsene Charlebois, sr.; Colborne, Capt. Ben. Sauvie; Corn Crib, Capt. A. Charlebois, jr.; Cornwall, Capt. H. Boyer; Detroit, Capt. Treffle Davust; Dorchester, Capt. Jules Lalonde; Eagle, Capt. A. Monnette, Jr.; Hector, Capt. Tim Hebert; Glengarry, Capt. Albert Major; Harvest, Capt. John Bradley, Jr.; Iowa, Capt. Jos. Davust; Jennie, Capt. Moise Moreau; John Gaskin, Capt. Theo. Leduc; Lancaster, Capt. Jos. Page; . McCarthy, Capt. E. R. Roy; Montreal, Capt. M. Lefebvre; Maggie, Capt. A. Monnette; Nebraska, Capt. Celestia Leboeuf; Regina, Capt. Ovide Trudell; Senator, Capt. Alfred Lalonde; Star, Capt. E. Secotte; Toledo, Capt. Fred Leduc; Toronto, Capt. A. Levoie; Wheat Bin, Capt. A. St. Marcelles; Cobourg, Capt. Frank Lafrance; Brighton, Capt. N. Mallette; Kingston, Capt. Alex. Hebert.

MINERAL PRODUCTION OF CANADA.

The following summary of the mineral production of Canada in 1897 has been issued by the Geological Survey Department, and is subject to revision in a later bulletin:

Product.		Quantity. (a)	Value. (a)
METALLIC.			
Copper (fine, in ore, etc.) (b)	lbs.	13,300,802	1,501,660
Gold		....	6,190,000
Iron ore	tons.	71,451	178,716
Lead (fine, in ore, etc.) (c)	lbs.	39,018,219	1,396,853
Mercury	"	688	324
Nickel (fine, in ore, etc.) (d)	"	3,997,647	1,399,176
Platinum		....	6,600
Silver (fine, in ore, etc.) (e)	ozs.	5,558,446	3,322,905
Total metallic		....	13,996,234
NON-METALLIC.			
Asbestos and asbestic	tons.	25,262	324,700
Chromite	"	2,637	32,474
Coal	"	3,876,201	7,286,257
Coke (f)	"	78,811	209,920
Felspar	"	1,275	3,506
Fire clay	"	1,923	5,759
*Grindstones	"	....	40,000
Gypsum	"	239,691	244,531
*Limestone for flux	"	....	40,000
*Mica		....	75,000
Mineral pigments—			
Baryta	tons.	571	3,060
Ochres	"	3,905	23,560
*Mineral water	galls.	....	140,000
Molding sand	tons.	5,485	10,931
Natural gas (g)		....	325,873
Petroleum (h)	bbls.	709,857	1,011,546
Phosphate (apatite)	tons.	908	3,984
Pyrites	"	38,910	116,730
*Salt	"	....	190,000
Sundry minerals, partly estimated, including actinolite, graphite, manganese, soapstone and tripolite		....	10,000

(a) Quantity or value of product marketed. The ton used is that of 2,000 lbs.

(b) Copper contents of ore, matte, etc., at 11.29 cents per lb.

(c) Lead contents of ores, etc., at 3.58 cents per lb.

(d) Nickel contents of ore, matte, etc., at 35 cents per lb.

(e) Silver contents of ore at 59.79 cents per oz.

(f) Oven coke, all the production of Nova Scotia and British Columbia.

(g) Gross return from sale of gas.

(h) Calculated from inspection returns at 100 galls. crude to 42 refined oil, and computed at $1.42¼ per bbl. of 35 imp. galls. The barrel of refined oil is assumed to contain 42 imp. galls.

STRUCTURAL MATERIALS AND CLAY PRODUCTS.			
Cement, natural	bbls.	85,450	65,893
" Portland	"	119,763	209,380
Flagstones		....	7,190
*Granite		....	75,000
*Pottery		....	125,000
Sewer pipe		....	164,250
Slate		....	42,800
Terra-cotta		....	155,595
Building material, including bricks, building stone, lime, sands and gravels and tiles (estimated as for previous year)		....	3,600,000
Total structural materials and clay products		....	4,445,108
All other non-metallic		....	10,097,831
Total non-metallic		....	$14,542,939
Total metallic		....	13,996,234
Estimated value of mineral products not returned		....	250,000
1897, Total		....	$28,789,173
1896 "		....	22,609,825
1895 "		....	20,715,319
1894 "		....	19,933,857
1893 "		......	20,035,082
1892 "		....	16 628,417
1891 "		.. ..	18,976,616
1890 "		....	16,763,353
1889 "		.. ....	14,013,913
1888 "		....	12 479,550
1887 "		....	11,365,705
1886 "		....	10,221,255

*Partly estimated.
(a) Quantity or value of product marketed. The ton used is that of 2,000 lbs.

The following table shows the principal changes in production and values for the calendar year 1897, as compared with the figures given in the revised summary for 1896:

PRODUCT.	Quantity. Increase. p.c.	Quantity. Decrease. p.c.	Value. Increase. p.c.	Value. Decrease. p.c.
Metallic—				
Copper	41·6	......	46 9	......
Gold	......	......	122·6	......
Iron ore	......	22·3	......	6·7
Lead	61·2	......	93·7	......
Nickel	17·7	......	17·7	......
Silver	73·4	......	54·6	......
Non-Metallic—				
Asbestos and asbestic	106·2	......	......	24·5
Coal	3·5	......	0·8	......
Gypsum	15·8	......	37·3	......
Natural gas	......	......	17·9	......
Petroleum	......	2·3	......	12·5
Cement	37·6	......	36·5	......

The increase in the items silver and lead is practically all to be credited to British Columbia, to which province is also largely due the increase in the production of copper. The largest increase in this latter metal is, however, due to the increased shipments of nickel-copper mattes from the Sudbury mines in Ontario. The third copper producing province, Quebec, also contributed a fair amount to the increase shown. The silver, copper and lead increases as far as British Columbia is concerned, represent the largely extended activities in the South Kootenay districts of Slocan, Nelson and Trail Creek.

The most significant item, however, is to be found in the increase of nearly 123 per cent. in the gold. All the gold producing districts of the Dominion show gratifying increases, although by far the largest part is due to the discoveries of rich placer mines in the Yukon country, and to the increased output of Trail Creek and other districts in British Columbia. The former increase amounted to about 2¼ millions and the latter to nearly $1,000,000.

The remaining metal of importance is nickel, which is seen to have shown an increase of nearly 18 per cent. As in the past this is all from the Sudbury district.

Thus the aggregate result of the increases in the metallic productions is nearly $6,000,000, or a proportion of about 74 per cent.

An interesting result of the mining developments and discovery of 1897 is shown in the increase in the proportion of the value of the total mineral production to be credited to the metals. In 1896 these constituted about 36 per cent., whilst in 1897 this proportion was increased to nearly 49 per cent.

Turning to the non-metallic products, we find that as far as the data at present available permit of a conclusion being arrived at, the total value shows under 2 per cent. of an increase over that of the previous year. The only considerable change to be noted is that given under the heading asbestos, where the quantity has more than doubled, whilst the value has fallen off almost 25 per cent. This is due to the fact that the output of the new by-product, asbestic, is included. This constitutes over half the weight of the whole, but being a low-priced article brings down the price per unit very much. The returns, however, show also a falling off in the prices of the usual grades of the mineral apart from the above influence.

In the important mineral coal the variation is but little. The falling off in the production of the higher priced mineral of British Columbia and the increase in that of Nova Scotia at a lower price causing a fall in the total value. In gypsum the increase in the value is larger than that shown in the quantity. This is due to the larger proportion of the higher priced product, plaster of Paris, included in the returns for 1897. The lower average price ruling during that year for petroleum caused the decrease in the value of this article to be much greater than in the quantity.

The following table gives the proportional values of the different minerals in the grand total. It is interesting to note the changes in their relative position in 1897, as compared with 1896:

1896. Product.	Per cent. of Total Production.	1897. Product.	Per cent. of Total Production.
Coal	31·94	Coal	25·31
Building material	15·72	Gold	21·50
Gold	12·30	Building material	12·50
Silver	9·50	Silver	11·54
Nickel	5·25	Copper	5·21
Petroleum	5·11	Nickel	4·86
Copper	4·52	Lead	4·85
Lead	3·20	Petroleum	3·51
Asbestos	1·90	Natural Gas	1·13
Natural Gas	1·22	Asbestos	1·13
Cement	·89	Cement	·95
Iron	·85	Gypsum	·84
Gypsum	·79	Coke	·73
Salt	·75	Salt	·66

ONE-TIME INSERTIONS.

"One-time insertions seldom pay. The publisher knows this as well as does the advertiser who has learned it by sad experience. He should impress this fact on the advertisers from whom he solicits business. There are few periodicals, however, strong enough to resist the temptation to take everything offered them without regard to the advertiser's best interests. The advertiser who has tested it knows that it usually takes several insertions of an ad. to arouse the interest of the readers of a periodical. It is continuous advertising that pays." —*Advertising Experience, Chicago, March, 1898.*

We quite agree with *Advertising Experience* on this point, having knowledge of more than one case in which results have come from advertisements many months after their appearance. Had advertisers judged of the merits of the medium from immediate results, the chances were decidedly against the paper.