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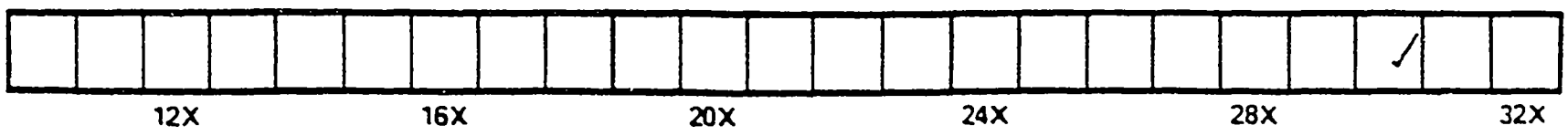

The Canadian Engineer

VOL. V.—No. 6. TORONTO AND MONTREAL, OCTOBER, 1897. PRICE, 10 CENTS $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY MARINE AND SANITARY ENGINEER, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada and the United States, $1.00 per year, Great Britain and foreign, 6s. Advertising rates on application.

OFFICES—62 Church Street, Toronto; and Fraser Building, Montreal.

BIGGAR, SAMUEL & CO., Publishers,

E. B. BIGGAR
R. R. SAMUEL

Address—Fraser Building, MONTREAL, QUE

Toronto Telephone, 1892. Montreal Telephone, 2589.

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 1st of each month to ensur insertion.

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For THE CANADIAN ENGINEER.

RAILWAY ENGINEERING.*

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

CHAP. III.—(*Continued.*)

ARTICLE 10.- EASEMENT ON TRANSITION CURVES.

In article 6, under "Curve Resistances," is given formula (8), which indicates the amount that the outer rail on a curve should be elevated above the inner one, but, as the two rails on the adjoining tangents are of the same height at any given point, the question arises as to the best manner of effecting this change of conditions so as to lessen any shock to passengers or rolling stock, or indeed to entirely abolish it. Practice has determined that, where there is distance enough to permit, the curve super-elevation ought not to be lowered more than ½ inch per rail length (30 feet), or (*e.g.*) on a 10° curve of ½ inch super-elevation per degree, this would require a distance of 300 feet. The most common practice in America has been to bring the full elevation to the ends of the curve, and then lower it on the tangents. This, evidently, will act so that as a train approaches a curve the play of the wheels (½ inch to 1 inch) will all be at the outside, *i.e.*, the wheels will press against the inner rail, and then, at the instant the curve is reached, there will be a lurch to the outside in assuming the natural position, in passing round a curve, of the front wheel of each truck against the outer rail.

Some have tried to remedy this by lowering the elevation partially on the curve, and partially on the tangents, which merely divides one shock into two smaller ones. The true remedy lies in not making an abrupt change in horizontal alignment from a curve to a tangent or *vice versa;* but in so arranging the track at each end of a curve, that commencing with a curve of infinite radius, this radius is gradually decreased, *i.e.*, the curve is sharpened, and at the same time, the elevation of the outer rail is increased, keeping this elevation at each point just sufficient for the curvature until a junction is made with the main circular curve, with a curvature equal to it, and with a full elevation, and having kept an equipoise between curve and elevation at each instant, all lurches and shocks will be avoided. That this is the only true and rational solution, is proven by the fact that practical trackmen, unguided and even hindered, often, by engineers' rigid centre stakes, but recognizing the evil and its remedy, have introduced crude easement curves wherever they could do so, and improved the situation as much as possible; but as the tangent and main circular curve were both fixed in position by construction, all that could be done was to flatten the ends of the curve at the expense of the adjoining portions, which were thus made sharper than the main curve itself, and formed more or less of elbows in the track, often 2° or 3° sharper than the main curve.

Now this can be avoided by moving the curve inward bodily, or by changing the position or direction of the tangents, or by sharpening the whole curve slightly, any of which will permit of the introduction of proper easement curves at the two ends of the circular curve. Many methods have been advocated for putting in these easements, the endeavor being to simplify the process, in point of time and mental effort, and still preserve the essentials. Some of these are: (*a*) A succession of short pieces of curves of decreasing radii. (*b*) A modification of (*a*) in the form of a spiral. (*c*) A modified quadratic parabola (Holbrook spiral). (*d*) A modified cubic parabola. As any one of these can, when once understood, be easily laid out in the field, it is only necessary to decide on the most adaptable and suitable one for all cases to be met with, and study its theory and actually use it, after which its seeming difficult nature and laborious methods of application, so long dreaded by many railway engineers, will be found quite simple, and capable of rapid manipulation.

Almost all engineers are agreed that transitions are intrinsically necessary, and on European and the best American tracks their use has become established; the chief objections to their general adoption here have been the deeply rooted ideas that they were difficult to apply and too refined for ordinary use, but as speeds are being increased and competition is keener, they are beginning to be used by all roads of any importance because the consequent easier riding caters to the travelling public and also because the wear and tear on the rolling stock, and the difficulty of keeping the ends of curves in proper line, are thereby much decreased.

(*a*) This first class of transitions does not require any

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

demonstration. Some engineers put 100 feet or 200 feet of a curve of larger radius at each end of the main curve, and trust to the trackman for the rest, others introduce a series of short arcs of decreasing radii, say 30 feet of 1° curve, 30 feet of 2° curve, etc., leading up to the main curve at the rate of 30 feet per degree; this necessitates placing the transit every 30 feet, is a tedious and clumsy method, and the result is that the trackmen fuse one portion into another until it is, to all intents and purposes, the same as a spiral. It does not admit of ordinary calculation or manipulation unless modified as in the next paragraph.

(*b*) In "The Railway Spiral," by Searles, is given a complete analysis of the transit work necessary to lay down a succesion of short circular arcs, beginning at zero, and having equal lengths of arcs of equal increments of sharpness, *e.g.*, 20 feet of 1° curve, 20 feet of 2° curve, etc., up to any required sharpness. Tables of deflections are worked out, so that any point of change of curvature can be used as a transit site, and any point of change can be established from any other point of change by transit deflections. Methods of conversion are also given, so that from one foundation series other deflection tables may be determined suitable for spirals of more or less rapid sharpening. The subject is well discussed and thoroughly worked out for all probable conditions, but as it does not present that same flexibility and simplicity of use which the cubic parabola possesses, its continued use is doubtful. It has served its day, and, where used, furnished the trackmen with a succession of hubs, really the ends of arcs of increasing sharpness, but practically points on a spiral very suitable for an easement curve.

(*c*) The Holbrook spiral (quadratic parabola). The idea involved in this easement curve is that the *vertical* acceleration of the train, as it passes around it, should be uniform. If we let t represent horizontal distances (with train moving at a uniform speed) in the general formula $s = \frac{1}{2} f t^2$, then, in order to keep f (acceleration) constant, the distance, s, (*i.e.*) the amount which the train rises above the normal tangent level, must vary as the (distance)^2, and as the elevation should always bear a constant ratio to the degree of curve at each point, therefore the degree of curve on this required spiral must vary as the square of the distance from the zero of such a curve, (*i.e.*) the radius of curvature, at each instant, must vary *inversely* as the distance from the zero of the curve

A curve of such a nature has the equation $y = (f)x^4$ to represent it, and is a curve very flat at the beginning, but increasing very rapidly in curvature. This easement curve sacrifices the correct horizontal alignment, as will be seen in the next paragraph, for a supposed refinement in the vertical one; it is quite difficult to apply except in most ordinary cases, as the formulæ used involve expansions of sine and cosine, does not prevent any advantage over the cubic parabola, and is not so adaptable or easy to manipulate in the case of any problems having special conditions (*d*).

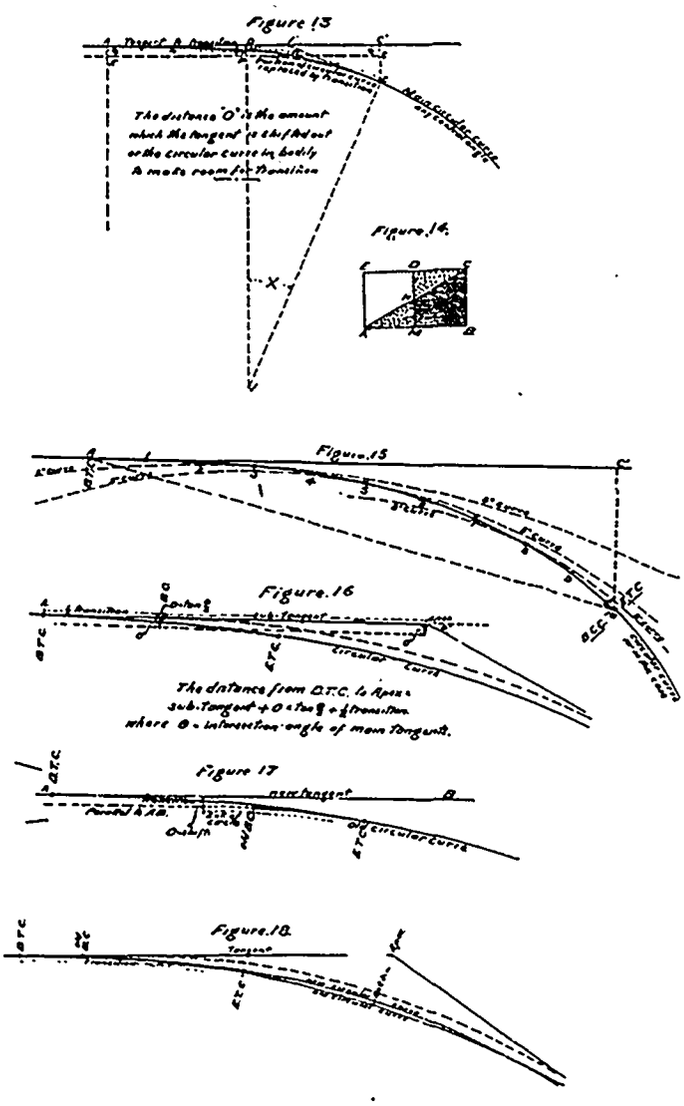
The Cubic Parabola.

This curve as adapted to transitions to railway circular curves has been studied pretty thoroughly. Howard, Armstrong, and others have written pamphlets on it; the transactions C.S.C.E. for 1891, 1892 and 1893 have several papers and discussions on it, and its probable originator, the late A. M. Wellington, determined very simple equations for it which were published in the *Engineering News*, January and February, 1890.

It is this last demonstration that will be now given to which will be added necessary developments. The curve required for a suitable transition is one which starting with an infinite radius or D (degree of curve) = 0. at the $B\ T\ C$ (A Figs. 13 and 14) has a degree of curve at each point in direct proportion to its distance from the $B\ T\ C$ until it joins and becomes tangent to the main curve at C, and is, at that point, of the same degree of curvature as the main curve.

The cubic parabola $y = (f)x^3$ approximates to these conditions.

Let $A\ M\ C$ (Fig. 13) be the cubic parabola, $A\ C^1$ tangent to it at A, and $I\ C$ the radius of the D degree curve with which it connects at C, having there a common tangent $I^1\ C$.



Let X be the central angle of the circular arc $P\ C$, which is changed into the transition curve $A\ M\ C$.

Let $E\ P\ G$ be tangent to $P\ C$ at P and therefore parallel to $A\ C^1$, and make $C\ C^1$ perpendicular to $A\ C^1$.

Also in Fig. 14, let vertical heights represent degrees of curvature at any point and horizontal distances, measurements along the cubic parabola.

Then the rectangle D B will represent graphically the circular arc $P\ C$, and the triangle $A\ B\ C$ represent graphically the cubic parabola $A\ M\ C$, and from this diagram and Fig. 13 we may readily conclude:

(1) Because the total angles of the arc $P\ C$ and the transition $A\ M\ C$ are equal, therefore the area of the triangle $A\ B\ C$ must equal the area of the rectangle $D\ B$, and therefore a transition curve is always twice as long as that portion of the circular curve which it replaces.

(2) Because the triangles $A\ M\ N$ and $C\ D\ N$ are equal and similar, therefore the angular deflections or offsets from the tangent to every point in $A\ M$ (Fig. 13), and

from the circular curve outward to every corresponding point in the equal distance $C\ M$, are equal in magnitude and distribution, and $\therefore$ $D\ M$ is equal to $M\ P$ and half of $D\ P$ (Fig. 13). Hence the offset or shift $D\ P$ ($= O$), and the transition curve $A\ M\ C$ bisect each other at M.

(3) The offsets from a tangent to a circular curve vary as the square of the distance from the tangent point (nearly), or to formulate it O varies as $n^2\ D$.

Where O = offset from tangent,
n = distance of the offset from the tangent point,
D = degree of curve,

but by our definition of a transition curve the degree of curve at any instant also varies as n. Therefore in a transition curve of this nature O varies as $n^2 \times n = n^3$.....(12), and also by paragraph (2). If we have a given offset from tangent to circular curve at $D = D\ P\ (= O)$, then the offset to the transition curve at a distance m from A is equal to $\left(\frac{m}{n}\right)^3 \frac{O}{2}$ where $n = \frac{1}{2}$ length of transition $= A\ M = M\ C$. And, in the same way, measuring back from C along the curve toward P at any distance, m the offset outward from the circular curve to the transition curve $= \left(\frac{m}{n}\right)^3 \frac{O}{2}$ ..... (13)

The equation to the cubic parabola can now be established in terms of the offset O and $\frac{1}{2}$ length n. let $y = C\ x^3$, but when $y = \frac{O}{2}, x = n$, therefore $C = \frac{O}{2} \times \frac{1}{n_3}$

and $\therefore y = \frac{O}{2n^3}\ x^3$ ..... (14)

(4) because by equation (12) offsets to a transition curve vary as cube of distance from origin, therefore in Fig. (13) $C\ C^1 = 8 \times D\ M = 4\ O$, and therefore $G\ C = 3\ O$.....(15)

Now, for very small angles, $G\ C = P\ C \times \text{Sin}\ \frac{X}{2}$ (nearly), and $P\ C = 2 \times I\ C \times \text{Sin}\ \frac{X}{2}$ (nearly), therefore by substitution we get

$G\ C = 3\ O = 2\ I\ C \times \text{Sin}^2\ \frac{X}{2}$ (nearly), but $I\ C = \frac{5730}{D}$ (D = degree of curve), and $\therefore$ $O = \frac{3820}{D} \times \text{Sin}^2\ \frac{X}{2}$, and

$\text{Sin}\ \frac{X}{2} = \sqrt{\frac{O \times D}{3820}} = .01618\ \sqrt{O \times D}$ .....(16)

from which we can get X, having O and D; or otherwise, since $n = \frac{X}{D}$ (evidently), and for small angles $\text{Sin}\frac{X}{2} = .0087\ X$ (in degrees).

$\therefore$ substituting in (16), we get

$X = \frac{.01618}{.0087}\ \sqrt{O \times D} = 1.86\ \sqrt{O \times D}$ ..... (17)

and $n = \frac{1}{2}$ length of transition $= 1.86\ \frac{\sqrt{O \times D}}{D} = 1.86 \sqrt{\frac{O}{D}}$ .....(18)

This can also be put in the approximate form,

$O = \frac{n^2}{6R}$ .....(19)

Where R = radius of the curve.

Equations (12) to (19) give such relations between X, n, O and D as will enable any length of transition curve to be put in for any degree of curve.

(*e.g.*) Let D = 10° curve, and O = 10 feet.

Substituting in (18) we get, n = 186 feet, or the transition is $2n$ = 372 feet, which is somewhat longer than is needed.

(*e.g.*) Let X = 15°, and D = 10° curve.

Then, $O = \frac{15 \times 15}{(1.86)^2 \times 10} = 6.5$ feet, and $n = 100 \times 1.86 \sqrt{\frac{6.5}{10}} =$ 150 feet, which latter could have been determined directly.

Also $\frac{O}{2} = \frac{6.5}{2} = 3.25$ feet, and any other offset will vary as cube of distance from A; that at the quarter points being, for instance, $(\frac{1}{4})^3 \times 3.25 = .41$ feet.

A most usual length of transition is 30 feet per degree of curve, which permits of the super elevation being lowered at $\frac{1}{2}$ inch per 30 feet = 1 rail length, which is a most usual amount.

Now, although these equations enable us to put in transitions by offsets, if we have for instance, the tangents already in place, and can move the main curves inward bodily so as to permit the requisite "shift" O, which is very useful if, on construction, the rigid curves and tangents are found already in place, and offsetting is the quickest method to use—still, we also wish to be able to put in transitions as a regular part of location, and not as an afterthought, and to do so it is necessary to determine methods of locating such curves by transit deflections from the beginning, end, or intermediate points.

Any small angular deflection from a meridian to any point varies as $\frac{\text{offset}}{\text{distance}}$, or in other words the natural tangent of any small angle is its circular measure.

Now referring to equation (12) and Fig. (13) any offset from the tangent $A\ C$ to the transition curve varies as the cube of the distance from A.

$\therefore$ angular deflections to the transition curve from tangent $A\ C$, using A as origin, vary as $\frac{\text{offset}}{\text{distance}} = \frac{(\text{distance})^3}{\text{distance}} = (\text{distance})^2$... ..... (20)

Also in Fig. (13) $\frac{G\ C}{A\ C} = \frac{1}{2} \frac{G\ C}{P\ C} = \frac{1}{2} \times \frac{X}{2} = \frac{3 \times O}{2 \times n}$ (evidently)

$\therefore$ $X = \frac{6 \times O}{n}$ but the angle $C^1AC = \frac{C^1\ C}{C\ A} = \frac{4 \times O}{2 \times n} = \frac{2 \times O}{n}$

$\therefore$ the angle $C^1\ A\ C = \frac{1}{3} \times \frac{6 \times O}{n} = \frac{1}{3}\ X$ ..... (21)

Equations (20) and (21) enable us to determine any deflections to the transition curve from the point A; (*e.g.*) let a 10° curve have a transition curve 300 feet long then $X = \frac{n}{D} = \frac{300}{2} \times \frac{1}{10} = 15°$.

$\therefore$ by (21) the angle $C^1\ A\ C = 5° = 300' =$ deflection from tangent at A to the end of the transition, and by equation (20) the deflections to each 30′ intermediate point are:

1st 30 ft. point $\left(\frac{30}{300}\right)^2 \times 300' = 03'$
2nd " $\left(\frac{60}{300}\right)^2 \times 300' = 12'$
3rd " $\left(\frac{90}{300}\right)^2 \times 300' = 27'$
4th " $\left(\frac{120}{300}\right)^2 \times 300' = 48'$
etc., etc., etc., etc.

This series of deflections from the origin A, continued as far as necessary, may be called *a foundation series*, and is the basis of all deflections forward or backward from any point. We must now, in order to fix on intermediate deflections, with the transit also at some intermediate point, look on a transition curve, thus: (See Fig. 15). Suppose it to be stopped at 1, then it is a transition curve to a 1°

curve; if stopped at 2, it is a transition curve to a 2° curve, etc.; therefore if the transition *does* continue past the points 1, 2, 3, etc., we may consider it to be composed of two parts: 1st, a 1°, or 2°, or 3°, etc., curve, according to circumstances. 2nd. Plus the *foundation series* of 3′, 12′, 27′, 48′, etc., beginning at the point considered, and continuing forward to any desired extent, and the transition curve deflections are the sum of these two. Also, in the same way, the transition curve deflections looking backward, with transit at any point, are those of a certain degree of curve corresponding to this point, minus the same *foundation series;* (e.g.) suppose the transit to be at the point 3, with the vernier at zero, and line of sight tangent to the curve, then the vernier readings to each intermediate point would be—

$$(A) -\left(\frac{90}{100}\times\frac{180'}{2}-27'\right)= -0^\circ\ 54'.$$

$$(1) -\left(\frac{60}{100}\times\frac{180'}{2}-12'\right)= -0^\circ\ 42'.$$

$$(2) -\left(\frac{30}{100}\times\frac{180'}{2}-3'\right)= -0^\circ\ 24'.$$

(3) $0^\circ\ 0' = 0^\circ$ o position of transit.

$$(4) +\left(\frac{30'}{100}\times\frac{180'}{2}+3'\right)= +0^\circ\ 30'.$$

$$(5) +\left(\frac{60}{100}\times\frac{180'}{2}+12'\right)= +1^\circ\ 06'.$$

$$(6) +\left(\frac{90}{100}\times\frac{180'}{2}+27'\right)= +1^\circ\ 48'.$$

$$(7) +\left(\frac{120}{100}\times\frac{180'}{2}+48'\right)= +2^\circ\ 36'.\ \text{etc.}$$

In this way a table can be prepared giving deflections to be made to any point (every 30 feet), with transit located at any point. These tables are conveniently made out by Mr. Armstrong, for 30-foot chords = 1 rail length; but different foundation series and different tables may be made out, or special calculations made by equations (12) to (20) for a transition curve of any rapidity of sharpening, but of the same nature and handled in the same way. This is often necessary where there is not room between the *BC* of one curve and *EC* of the previous one to permit of the introduction of transitions which sharpen so slowly as 30 feet per degree.

In street railway work, for instance, transitions sharpening from 0° to 20°, or even 40°, etc., are needed, and must not occupy more than 20 or 30 feet in length. Special corrections must be applied in such a case, and even for steam railways Mr. Armstrong has worked out corrections in lengths to apply to the very approximate equations here given, but as the correction is zero until an 8° curve is reached, and only 1 foot in 300 for a 10° curve, it is hardly worth taking account of here. Any one desiring extreme accuracy for curves from 8° upward, are referred to J. S. Armstrong's pamphlet.

The three problems most frequently met with in practice are briefly as follows:

1. (See Fig. 16.) To keep tangents fixed and to move the circular curve inward, retaining the same degree of curvature. In this case, take an arbitrary offset or length of transition, and determine the other unknowns by foregoing equations. The distance from the apex of tangents to the *B T C* consists of three parts:

(*a*) Sub-tangent of circular curve = $R \times \tan\frac{\theta}{2}$ (R = radius).

(*b*) Correction of shift = $O \times \tan\frac{\theta}{2}$. (See Fig. 16).

(*c*) ½ length of transition = n.

The amount in (*b*) is usually very small, unless θ is large.

2. (See Fig. 17.) To keep the circular curve fixed, and move out the tangents either in direction or position, or both: If the tangents are moved outward and kept parallel to their original positions, proceed as in (1), except that the correction of shift (*b*) does not exist. If the tangents are not moved outward parallel to their original positions, but pivoted about some distant point, then calculate the angle pivoted, and continue the circular curve through an equal central angle. So that a tangent to the curve at the new *B C* or *E C* would be parallel to the pivoted tangent; then measure the amount of shift *O*, and by the ordinary equations calculate the unknowns; the amount of shift *O* could be calculated without any field work. No correction of shift is here necessary; this second case is most usually met with in revising location, and is very convenient often in the final slight movement of tangents or curves, by avoiding the running over again of the whole circular curves, often situated on a rough hillside or heavy bush, and yet enabling a tangent to be moved on to better ground.

3. (See Fig. 18). To sharpen a curve and introduce transitions, so that the track will not be altered in length; this problem is the one met with in re-running old track centres where transition curves have not been previously used.

The method of solution is to assume an external secant slightly less than the original one, by an amount = expected shift, *O*, + an arbitrary amount of five inches to ten inches, depending on the sharpness and total central angle of the circular curve; then calculate the transitions and complete position of a curve of assumed external secant and given total central angle, and, either by plotting or calculations, determine whether this new curve will cross the original one about at the ¼ points and give the same length of track, thereby minimizing the movement of the track. If in error, a second trial will give usually satisfactory results. This method will often be found to give transitions, which, unless the central angle is large, will occupy the whole central angle, leaving no circular curve at the centre. As this is not desirable, it is preferable in a case of this kind to use shorter and sharper transitions, so as to retain a considerable portion of circular curve at the centre.

While these are the three usual problems to solve, others may arise such as introducing a transition at a point of compound curvature which needs special solutions. For further details, the reader is referred to the literature already mentioned, and the engineer, young or old, who has not used transitions in the field, is advised to become familiar with some one of the forms given, and actually put it into practice, when its seeming tediousness and difficult nature will disappear.

He should recognize that, as he would be quite ready to spend a few hours extra now and then, during railway construction or maintenance, on trivial matters such as affect the general appearance of the road only, and are not really important, he should be far more willing to give much additional labor and attention to such a question as this, when the returns will be increased comfort to travellers, decreased wear on rolling stock, and greater ease in retaining good alignment at the ends of curves. Whenever transitions have been used, their beneficial effects have at once been recognized, and once established trackmen maintain them easily and instinctively. Some of the oldest and most conservative of the American roads are now engaged in introducing them on their permanent tracks.

STEAM TURBINES.

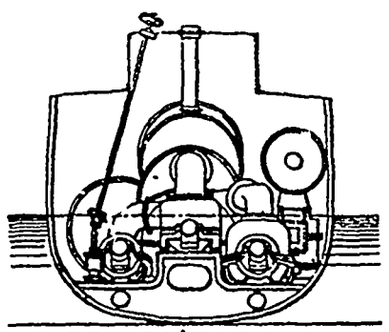
In the July issue of THE CANADIAN ENGINEER there appeared a description of the "Turbinia," the English torpedo-boat destroyer, whose great speed has attracted world-wide attention to the novel motor (the invention of the Hon. C. H. Parsons) which moves her propellers. We are now able to give drawings of the "Turbinia" and a fuller description of the turbine engines.

The Parsons' turbine consists essentially of a cylindrical case. Attached to the inner surface of the case are a number of rows of inwardly-projecting blades, which extend radially towards the axis of the engine. The function of these is to guide the steam. Through the axis of the engine there passes a shaft which is directly coupled to the screw-shaft. On the axial shaft is mounted a light drum, the external diameter of which is some inches less than the internal diameter of the case. When, therefore, the drum is placed inside the case and co-axial with it, there is left an annular space. This space is occupied by the blades, projecting inwards from the case before referred to, and by other rows of outwardly projecting blades attached to the outer surface of the light drum. The blades on the outer cylinder are called "guide blades," and the similar blades are known as "moving blades." When steam at pressure is admitted to the annular space it first comes in contact with a ring of the fixed guide blades, which are so formed as to direct the flow of steam on to the adjacent ring of moving blades at an angle to the surface of the latter, such as will cause the moving blades to rotate round the axis of the engine. As they are firmly attached to the drum, and as the latter is fixed to the shaft, motive power for a screw propeller or a dynamo is thus obtained. There are, of course, numerous alternate rings of guide blades and moving blades, there being perhaps eighty rows of both in an ordinary Parsons turbine. When the steam has been directed on one course by a ring of moving blades, it requires to have its line of motion altered so that it will strike the next ring of moving blades at the required angle. The guide blades are so shaped as to effect this purpose. In order to use steam economically it must be worked expansively, and this problem Hon. C. H. Parsons has solved in this way. As the steam does work, it necessarily increases in volume, and loses proportionately in pressure; to accommodate the increased volume additional blade area is given by gradually increasing the annular space and the size of the blades. Though its action in each individual turbine is approximately as if the fluid was inelastic, yet a small increment of volume takes place at each passage through the blades, and the expansion going on at something like geometric ratio at each of the numerous successive turbines, soon assumes large proportions. Ratios of expansion of fifty up to one hundred or even two hundred-fold are common in one single compound turbine of the condensing type—a notable feature in turbine practice being the high expansion ratios, and very large volumes can be economically dealt with without necessarily increasing the size and weight of the engine to any large extent.

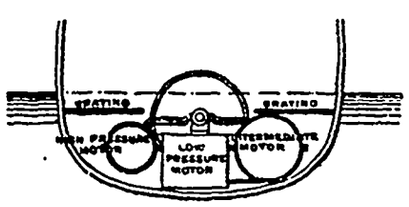
The high speed of revolutions diminished not only the weight of the engine in proportion to a given h.-p.; but also of shafting propellers and supports, as well as of the hull.

The inventor makes the following claims for the new motor: Greatly increased speed, owing to diminution of weight and smaller steam consumption; increased carrying power of vessel; increased economy in coal consumption; increased facilities for navigating shallow waters; increased stability of vessel; reduced weight of machinery; reduced cost of attendance on machinery; reduced size and weight of screw-propellers and shafting; absence of vibration; lowered centre of gravity of machinery, and reduced risk in time of war.

The "Turbinia" is 100 feet in length, 9 feet beam, 3 feet draught amidships, and 44½ tons displacement. She has three screw shafts, each directly driven by a compound steam turbine of the parallel flow type. The three turbines are in series, and the steam is expanded (at full power) from a pressure of 170 lbs. absolute, at which it reaches the motor to a pressure of 1 lb. absolute, at which it is condensed. The shafts are slightly inclined, and each carries three screws, making nine in all. The screws have a diameter of 18 inches, and when running at full speed they make 2,200 revolutions per minute. Steam is supplied from a water-tube boiler, and the draught is forced by a fan, mounted on a prolongation of the low-pressure motor shaft, the advantage of this arrangement being that the draught is increased as the demand for steam increases, and also that the power to drive the fan is obtained directly from the main engines. Up to the present the maximum mean speed attained has been 32¾ knots, as the mean of two consecutive runs on the measured mile. These runs



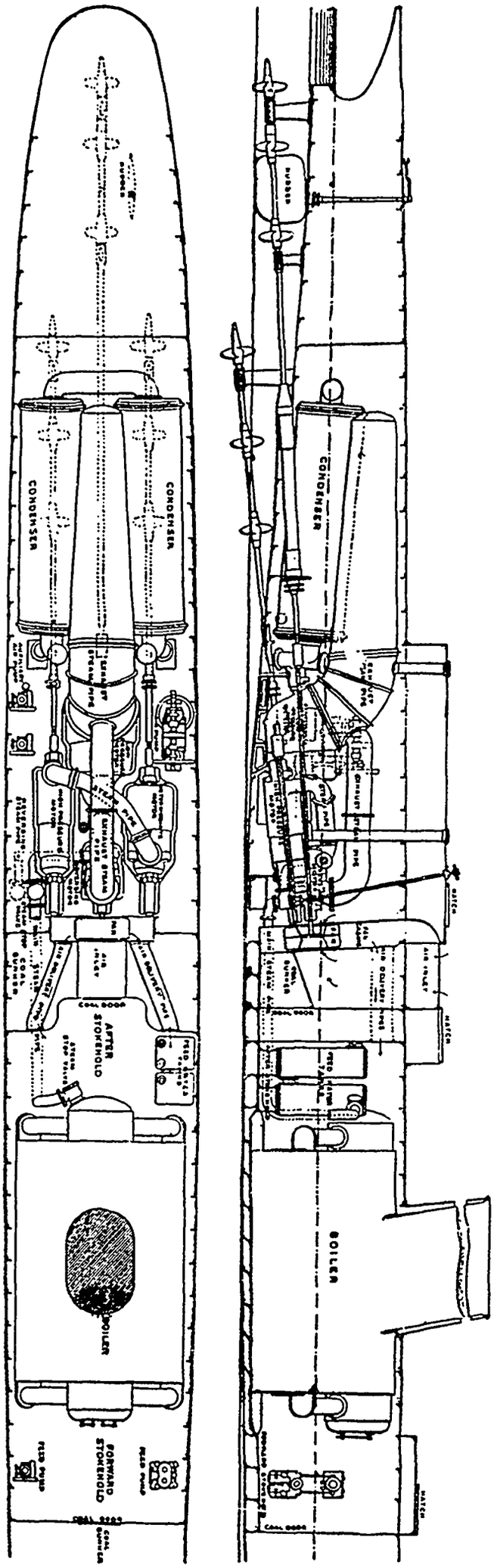
SECTION THRO' ENGINE ROOM LOOKING AFT.



SECTION THRO' MOTORS

were made after about four hours' steaming at other speeds, and the boat on the day of the trials had been fifteen days in the water. It is anticipated that on subsequent trials, after some alterations to the steam-pipe, still higher mean speeds will be obtained. As it stands, however, the I.H.P. realized is 2,100, and the consumption of feed-water per I.H.P. hour 14½ lbs, and the speed the fastest of any vessel irrespective of size. The weight of the main engines is 3 tons 13 cwt. Total weight of machinery, including turbines and auxiliary engines, condenser and boiler, the propellers and shafts, the tanks and the water in boiler and hot well, 22 tons. Thus nearly 100 h.p. is developed per ton of machinery, and nearly 50 h.p. per ton of displacement of boat. The total weight of the "Turbinia's" engines is 3 tons 13 cwt., and they develop 2,100 indicated horse-power, as determined by Professor J. A. Ewing, F.R.S. Ordinary navy engines of the torpedo vessel class would weigh probably 15 to 20 tons.

"The advantages of a rotary-motor for the purpose of marine propulsion are manifest as regards a direct application of the force of the steam to the shaft to be driven, and a consequent saving of bulk, weight, friction and wear," says the *Marine Engineer*, London, in a recent article. 'When such a motor is shown to be economical in steam



construction, and that the power delivered by the motor at a high speed of rotation can be economically transformed into thrusting power by the screw propeller, and that the whole of the machinery is simple and easy to work, the position of the rotary-motor becomes well established as a rival of the reciprocating engine, provided there are no drawbacks to detract from the advantages which it manifestly possesses. Up to the present no such drawbacks have shown themselves, or seem likely to."

"The 'Turbinia,'" says *Engineering*, of London, "which, at the special request of the admiral in command of the fleet, made a run at full speed through the lines at the great naval review, is so novel a vessel that in spite of the remarkably successful results achieved by her, it would be difficult to say to what she will lead. Certainly it is a very long step forward to imagine steam turbines taking the place of the ordinary reciprocating engine in heavy vessels. But if the difficulty at present attendant on going astern can be overcome, it can hardly be doubted that for very high-speed craft the new system will find a conspicuous place in warship design, in spite of the multiple screws and the high rate of turning."

New principles, whose application seems likely to have such great influence in the future development of naval architecture, have not escaped the notice of the leading shipbuilders and owners of Canada. The Richelieu and Ontario Navigation Co., as noted in THE CANADIAN ENGINEER recently, has during the past couple of months examined the Turbinia model, with a view to its possible adoption for their new steamers.

INSTRUCTION IN PRACTICAL SCIENCE.

Discoveries made in the past ten years have materially changed the problems which civil engineers are required to solve and changed problems demand enlarged equipment for their solution. The department of the waterworks engineer has been most materially affected by recent discoveries. Formerly water supplies and sewage works were matters of construction and hydraulics. The water supply was obtained as pure as possible, and pains were taken to maintain that purity. The sewage was filthy and its condition was a hopeless matter—it was "disposed of" in "disposal" works or poured out to contaminate the water supplies of other places.

It is now established as a fact by scientific research that the dangerous elements of impure water and sewage are largely the same, are caused in fact by the presence of certain bacteria. These bacteria cannot continue to exist in the presence of certain other classes of bacteria, and the problem of water purification to-day is solved by the most advantageous bringing together of these various classes of bacteria.

It does not ordinarily lie within the sphere of the duties of a civil engineer to make cultures of bacilli, but if his practice is to include public water supplies and sewage works, he should possess sufficient knowledge of the general principles of biology and enough of bacteriology to know what should be done to determine the sanitary condition of the water he is dealing with and the effluent from his sewage disposal works. In order that a civil engineer shall be professionally qualified either to design some modern water supply and sewage-disposal works, or to maintain and operate them, it is absolutely essential that he should have suitable biological training in the school of civil engineering. How many of the civil engineers who have been instructed in our expensively equipped schools of science have ever heard of the bacteria of putrefaction, or who would know a microbe if they saw it with the aid of

the most powerful microscope. For example, do the students of the School of Practical Science, Toronto, an institution maintained by the Ontario Government, ever avail themselves of the lectures given during the college term by the faculty of the Biological Department of Toronto University, which is also maintained by the Ontario Government? We are unable to find any record their having done so.

While discussing this general subject we must refer to a paper by George C. Whipple, in the *Proceedings* for 1896 of the Society for the Promotion of Engineering Education, on "Biology for Civil Engineers." He points out the fact that the science of biology has intimately touched the profession of civil engineering in water supply and sewage practice, so that the educational training of a civil engineer can no longer be considered complete without a suitable grounding in bacteriology. In this he is undoubtedly correct. He pointedly observes that filters, which civil engineers must now design and operate as prominent features of both water and sewage treatment, are not mere strainers but immense colonies "of organisms whose one object in life is to convert the decomposable matter * * * into harmless nitrates." The bacteriological laboratories connected with the waterworks of Boston and of Brooklyn, to say nothing of others, show clearly what must of necessity be the trend of civil engineering education in relation to this matter, and the excellent work already done by civil engineers in the same line at Boston and other places demonstrates the correctness of the views we have expressed.

ANALYSIS OF NOVA SCOTIA COALS AND OTHER MINERALS.

BY E. GILPIN, JR., LL.D., F.R.S.C., INSPECTOR OF MINES, HALIFAX, N.S.

A set of analyses of coals from the three seams worked at Springhill by the Cumberland Railway and Coal Company were given me some months ago. They are made by J. T. Donald, Montreal, and were taken from the workings at a depth of from 800 to 1,000 feet. These analyses are interesting when compared with a set of analyses of the same seams made by me in the year 1881, and I believe not hitherto published, and with an analysis of the Black seam made by me in the year 1880, and published in the "Transactions of the North of England Institute of Mining Engineers," in a paper on "Canadian Coals," giving a full set of analyses of Nova Scotia coals, their ashes, etc.

East or No. 1 Slope—Black or Main Seam:

	Analyses made in 1897.	Analyses made in 1881.
Moisture	2.02	3.86
Volatile combustible matter	18.94	{35.65 26.46
Fixed carbon	75.29	{59.90 65.23
Ash	3.75	4.45
	100.00	
Sulphur	1.14	

West or No. 2 Slope—South Seam:

Moisture	1.41	1.399
Volatile combustible matter	27.93	{34.808 31.225
Fixed carbon	67.47	{58.003 61.586
Ash	3.19	5.790
	100.00	
Sulphur	.58	.808

North or No. 3 Slope—North Seam:

	Analyses made in 1897.	Analyses made in 1881.
Moisture	2.71	1.625
Volatile combustible matter	28.41	{33.401 28.672
Fixed carbon	64.69	{60.701 65.431
Ash	4.19	4.272
	100.00	
Sulphur	.79	.783

Analyst—J. T. DONALD, *Montreal.*

These analyses show the coals to be of excellent quality. The amounts of ash and sulphur are small, and that of the fixed carbon is large.

From a comparison of the later with the older analyses it will be seen that those of coal from the deeper portions of the seams show lessened amounts of volatile combustible matter, increased percentages of fixed carbon, and diminished amounts of sulphur and ash. Speaking in general terms, the coal would appear to have developed more into a steam fuel, the evaporative power being in a general way proportionate to the percentage of fixed carbon. This would give the coals as at present mined a high calorific power. From analyses by Mason and Matheson in a paper read before the Nova Scotia Mining Society, it would appear that the calorific powers of coals from the Sydney coal fields vary from 7238 to 7623; of Pictou coal (sample from Intercolonial mine), 6963, and of Springhill coal, 7898. As compared with United States coal, they should stand nearly in the rank of the best free burning coals of Pennsylvania, Virginia and Maryland. Those coals hold from 12 to 21 per cent. of volatile matter, and from 69 to 76 per cent. of fixed carbon. The average contents of the United States coals are from 29 to 35 per cent. of volatile matter, and from 53 to 67 per cent. of fixed carbon. These coals therefore from Springhill should rank for steam purposes next to the class which may be described as the best selected for use on the large ocean passenger vessels.

I have not at hand any proximate analyses of English coals to compare with these under consideration. However, taking the results obtained in the English Admiralty trials of steam coals, and comparing the percentage of fixed carbon found in the trials with the fixed carbon given in these analyses, it will be found that the English and Scotch coals run from 49 to 88 per cent., as compared with 68.2 per cent. in the Springhill coals. This would give the Springhill coal about the same relative position to the best Welsh coals as has already been assigned to it in comparison with the best American coals. The evaporative power of the Springhill coals would, from the analyses, stand higher than that of the English and Scotch coals, and rank next to that of the best Welsh steam coals. It may be remarked that the best American and Welsh coals would be classified as free burning, semi-anthracite, while the Springhill coals are bituminous and coking.

In the upper part of Georges River in Cape Breton county there is a large deposit of iron pyrites in rocks, which are, I think laid down as Laurentian by the Geological survey. The deposit has as yet been examined only superficially, but so far appears somewhat low in sulphur. The following analysis from the most promising exposure gives:—

Sulphur	25.00
Copper	1.10
Gold	Trace.
Silver	Trace.
Silica	52.00
Iron, etc.	25.00

For a number of years the presence of iron ore at Whycogomah in Cape Breton has been well known. The ores, which are magnetites and red hematites, are so very favorably situated, being close to the waters of the Bras d'Or Lake, that a good deal of work was done on them a number of years ago. A number of beds were opened and traced. They varied up to nine feet in thickness, and occurred in the limestone division of the Laurentian, as described by Mr. Fletcher in his numerous reports on the geology of Cape Breton, issued by the Survey. The analyses of the ores were contradictory in character, some being high in phosphorus, while others were very pure and ran high in iron. Last fall fresh discoveries were made in this district some distance from the old openings, of beds of magnetite, some upwards of 100 feet in width. Indications are not wanting that these ores extend over a large tract of country.

The following analysis will serve to show the quality of the ores :—

Silica	14.41
Alumina	7.33
Manganese oxide	.61
Lime	3.00
Sulphur	.22
Metallic iron	54.50
Phosphorus	Trace.
Magnesia	Trace.

Iron.	Phosphorus.	Sulphur.
55.70	None.	.68
59.60	.16	.23
63.20	.004	.31
54.30	.005	.38
53.20	.38	.25
50.74	.31	.024
53.12	.28	.026
52.85	.0058	.138

Silica	21.05
Ferric Oxide	53.54
Ferrous Oxide	21.24
Alumina	2.26
Manganese Oxide	.50
Lime	1.17
Magnesia	.36
Sulphur	.023
Phosphorus	Trace.
Metallic Iron	54.00

Metallic Iron	54.36
Phosphorus	.38

Silica	13.00
Metallic Iron	55.70
Sulphur	.68
Phosphorus	Trace.

These analyses show that there are ores in this vicinity valuable enough for shipment as regards quality, and the present owners consider that new explorations now being carried on will show that the ore is present in quantities sufficient to warrant working on a large scale. In this connection reference may be made to this division of the Cape Breton Laurentian in which these deposits occur. It may be distinguished as the limestone division, as it is distinguished mineralogically from the other, or felsite division, by the presence of numerous beds of limestone, in addition to the felsites, gneisses, granites, etc., common to both. These limestones furnish marble, as at West Bay and other localities, lime of excellent quality, and dolomites, suitable, as at New Campbellton, for furnace linings. Iron ores occur in them at numerous points both hematite and magnetite. Graphite is also found. In all probability, phosphates similar to those found in Quebec will be proved on search being made. Where these measures are cut by dykes, copper and lead ores carrying gold and silver occur, and may in some cases prove valuable. As yet, so far as my information goes, free gold has not been found in quartz in the limestone division. The gold of Middle River and Cheticamp appears to be associated with soft talcose and felsitic schists of the other division. This gold occurs at Middle River free in quartz and in the river gravel derived presumably both from the quartz and augmented by gold flakes from the schists. At the Cheticamp River, so far as can be judged from the work done, it would appear to have a similar source, and to be connected only with the felsite series. In the latter case part of the gold may be derived from mineralized zones adjoining the dykes cutting the various rocks. However, the explorations of the coming season will probably give us more exact information. It is interesting to note in connection with the occurrence of gold at Cheticamp that native silver occurs in the Mackenzie River a short distance north, and it is possible that explorations in that section may result in the discovery of important amounts of this metal and associated gold.

THE GREAT LAKES AS A SENSITIVE BAROMETER.*

BY F. NAPIER DENISON, METEOROLOGICAL SERVICE OF CANADA.

For many years fishermen and sailors upon our great lakes have noticed with interest and curiosity the rapid rise and fall of the water, most marked at the head of shallow lagoons or bays, and have considered it to be an inexplicable phenomenon. While in the vicinity of Lake Huron last summer the writer's attention was attracted by what appeared to be a regular ebb and flow at the mouths of rivers. At Kincardine, by means of a special float, a set of readings was taken, and a variation of level of over three inches observed, averaging nine minutes, that is eighteen minutes for a complete undulation. The weather at the time of observation was fine and excessively hot, but during the night the town was visited by a severe thunderstorm. During the same day at Goderich, a few miles distant, regular undulations of six inches amplitude were reported. From these and other observations, it appeared as if these undulations might be caused in some yet unknow nmanner by differences of atmospheric pressure upon the surface of the lake.

Upon returning to Toronto and discussing the matter with the Director of the Meteorological Service, he authorized me to proceed with the investigation as part of the regular work of the service, supplying the funds for the construction of such instruments as appeared necessary in a preliminary examination of lake undulations and atmospheric waves. An instrument was set up at the mouth of the Humber River, near Toronto, where ever since most interesting results have been obtained.

The following is a brief description of this instrument: It consists of a recording cylinder placed horizontally, which by means of clockwork completes one revolution every 24 hours. Resting upon this is a self-inking pen attached to an arm which slides freely upon a horizontal guide. This arm is connected by a line to the float, which is enclosed in a special shaft, so constructed as to admit the water only through several small holes; this prevents any sudden movement of the float being caused by local wave motion. As the float rises and falls, the pen correspondingly moves up and down upon the paper, which is revolving at the rate of one inch per hour. The ratio of movement between pen and float is as 1 to 4, so that a rise of one inch of water level corresponds to a movement of one-

*A paper read before the meeting of the British Association for the Advancement of Science, held in Toronto.

quarter of an inch upon the paper. One-quarter inch squared paper is used, the vertical lines marking fifteen minute intervals and the horizontal one-inch change in water level. To prevent the water freezing in the shaft during the winter months, oil was used, which had the effect of depressing the water level below the frost line.

In order to increase the value of these records, a similar instrument was set up at the Burlington Canal last September. Before bringing before you some interesting tracings taken from these instruments, permit me to summarize previous investigations in other countries.

This phenomenon had been noted by Duillier as early as 1730, upon the Swiss lakes, where it obtained the name of seiche, owing to the apparent "drying up" or recession of the water upon one side of the lake, when rising at the other. In 1779, De Saussure remarks that he believes local variations in the air pressure may be the cause. Vaucher supposed that the atmospheric pressure diminished over one part of the lake, while over another it remained constant or increased. If this change in pressure occurred suddenly, the water which had thereby been set in motion would not come to rest again until after a number of oscillations. Professor Forel agrees with this theory, which has also been accepted by Studer, Meyer and Favre. From 1854 to 1856 an important series of observations were made by six observers placed at different points upon the shore of Lake Geneva, who, using a system of signals to warn each other of the approach of an oscillation, noted the variations of the barometer and of the lake level. As Professsor Forel, in his article, entirely disregards these barometric observations, they do not appear to have been published

In 1876 Forel set up an automatic instrument to register these movements, and from records extending over four months he deduced the existence of three varieties of seiche, viz., transverse, duration 10 minutes; longitudinal, duration 70 minutes; intermediate, duration 25 minutes. Upon this instrument he also observed movements of what he terms "vibration" caused (1) by steamers. The interval between these is from 9 to 60 times greater than that between ordinary waves, and they preceded the approach of a vessel by about 25 minutes, or when it was 9½ kilometres distant, continuing for two or three hours afterwards. (2) By wind, having no regular time or rhythm, and varying in amplitude from nothing to 10 millimetres, and in duration from 45 seconds to three or four minutes. He remarks that "sometimes there are little or none with a strong wind."

Lord Kelvin gives a theoretic law for the duration of these seiches in any lake, viz.: the semi-period of an oscillation is equal to the time that a body, travelling at the rate which it would acquire in falling from a height equal to half the mean depth of the lake would take to traverse the length of the lake. Thus, the duration of a seiche is proportional to the square root of its mean depth. (Archives des Sciences Naturelles, Geneva, 1876). Applying this to Lake Ontario, and assuming the mean depth to be 300 feet, we obtain a theoretical duration for a longitudinal seiche, of over five hours. As will be shown later, the mean interval between the longest undulations, as taken from the Humber traces, is about 4 hours and 49 minutes. In 1880 Professor Forel, in a letter, states that the smaller and more rapid oscillations may be accounted for by dividing the lake surface into more than one nodal point. (Archives des Sciences Naturelles, Geneva, 1880). Mr. Crosman in his valuable charts of the great lakes refers to the existence of a "seiche" movement similar to that observed upon the Swiss lakes. He also states that when the lakes are undisturbed by the action of the wind, a regular series of small waves can be detected, which have a marked time interval of ten minutes. These pulsations appear on Lake Superior almost without cessation. Lastly, H. C. Russell, of Sydney, New South Wales, has studied these oscillations at the south end of Lake George by means of a self-recording gauge, and has obtained longitudinal seiche movements whose amplitude is about four inches, and time interval two hours and eleven minutes.

As the chief object of this paper is to demonstrate the direct action of the atmospheric waves upon the water, permit me to dwell for a moment upon the movements of the upper strata of our ocean of air, "at the bottom or on the shoals of which we live," as Humboldt so poetically says.

The late Professor Helmholtz, of Berlin, who has made a special study of atmospheric waves from theory and analogy with ocean waves, has clearly demonstrated the existence of huge waves or billows in the atmosphere like the waves in the ocean, which are due to friction between atmospheric strata of different densities, moving in different directions and with varying velocities. He also states these waves may be of all sizes from the minutest ripple to the gigantic billows which affect the barometer at the bottom of this ocean.* This theory is sustained by Professor Langley, of Washington,† and by Mr. Clayton, of the Blue Hill Observatory. The latter has also shown that the larger waves, as marked upon the barograph traces, have a maximum frequency with north-easterly winds, and a minimum frequency when the wind is from the south-west.‡ The chief point of origin of these waves appears to be at the lower boundary surface of the upper or poleward current which travels approximately from the south-west to the north-east in its spiral course around the globe. Its average summer velocity at this latitude is 60 miles per hour, which increases to 112 miles per hour during the winter months. When the lower stratum of air is travelling in an opposite direction to the superincumbent upper current, huge waves or billows are set up between these rapidly moving opposing currents, which are of different densities. Such conditions would exist during the approach of a cyclonic storm from the south-west. The influence of these huge waves extends to the earth's surface, where they have been recorded upon barograph traces. Other forms of wave movement in the lower air stratum (say cumuli level) may be caused by two subsidiary strata travelling at velocities and in directions differing from one another, as may often be observed during the approach of an important storm centre. These waves also extend to the earth's surface, and are recorded upon the barograph traces as short and rapid undulations.

Under certain conditions the existence of these atmospheric waves may also be observed in the cloud formations; for instance, during fine anti-cyclonic weather, one has frequently noticed great parallel bands of cirri clouds appear in the west, and rapidly extend eastward in advance of a severe storm. These represent the crests of the larger or primary billows mentioned by Helmholtz, and are caused by the lower denser stratum of air being forced up into a lighter and cooler level, where condensation takes place.

In order to pursue the study of the still smaller atmospheric undulations, which cannot be discerned upon the ordinary barograph, a simple form of self-recording air barometer was constructed and set up at the Observatory,

* From the Sitzungs-berichte of the Royal Prussian Academy of Sciences at Berlin, July 25th, 1889.

† Internal Work of the Wind, Smithsonian Contributions, 1893.

‡ Blue Hill Meteorological Observations, Vol. XL., Part III, Appendix E, 1893.

the scale value being 17 inches to 1 of mercury. To obtain a definite knowledge as to the manner in which the waters respond to the atmospheric pressure changes, the lake records and corresponding sensitive barograph traces have been tabulated in conjunction with the bi-daily synoptic weather charts, under the following headings:—

LAKE RECORD.

Date.	Time 8 a.m. 8 p.m.	Amplitude In Inches.	Time Interval 7-8 | 8-9	Condition during last 12 hours. Amplitude. | Mean Time Interval.

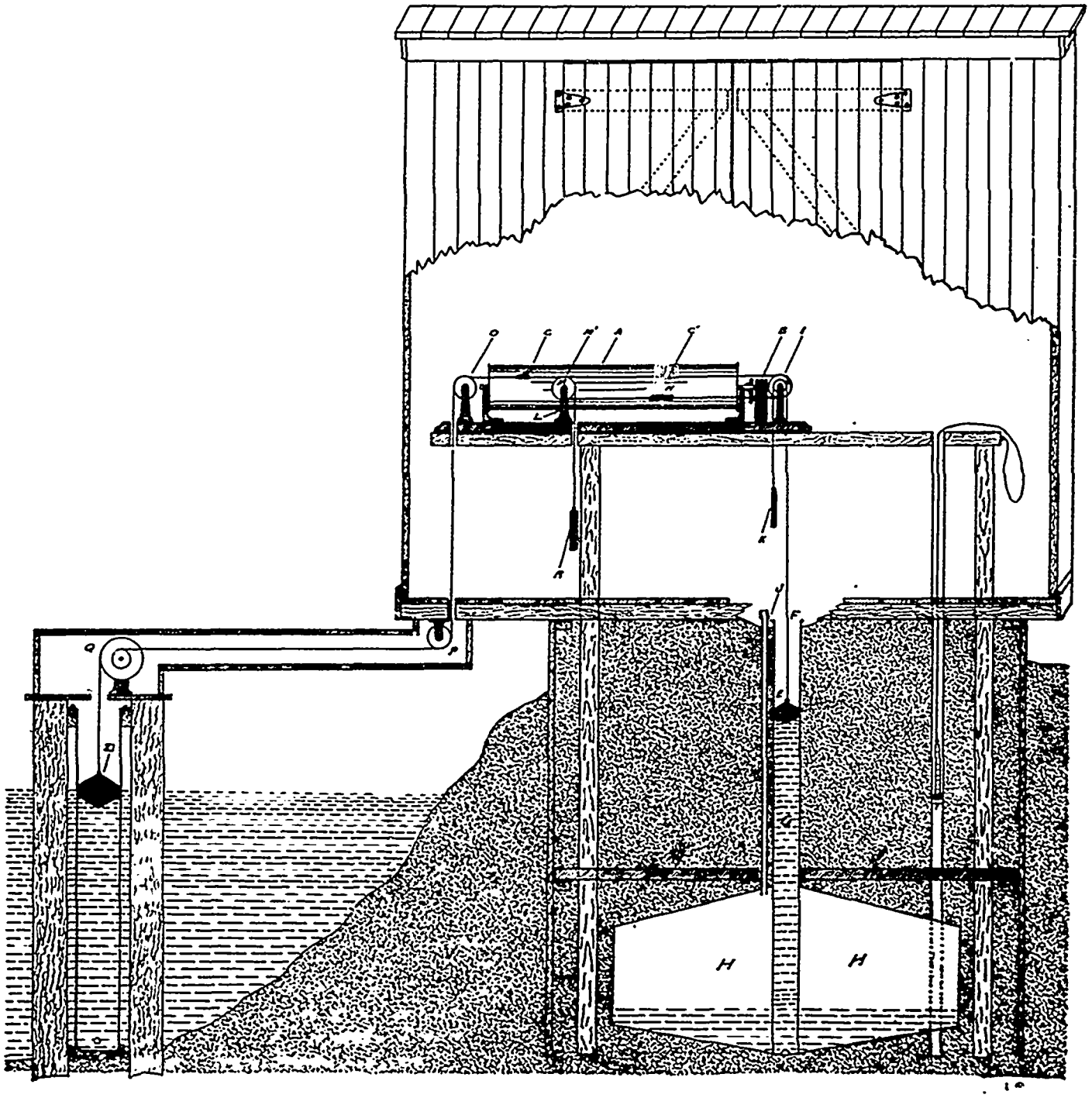
AIR BAROMETER.

		Amplitude In Inches.	Time Interval 7-8 | 8-9	Condition during last 12 hours. Amplitude. | Mean Time Interval.

Position of Lows and Highs, with barometer readings at their respective centres; barometer reading, weather wind and precipitation at Toronto, and remarks column

As the information obtained from these tabulations has clearly shown a marked correspondence between the air and lake movements, the writer has recently devised a simple instrument to record both undulations upon the same time sheet. This now supersedes the former instrument at the Humber.

The following is a brief description of this instrument as shown above, which is placed in a specially constructed house close to the water's edge: *A* is a cylinder, three feet long by twenty-four inches in circumference, which, by means of the clock *B*, completes one revolution every twenty four hours. Upon this cylinder rest two self inking pens *C* and *C'*, whose movements (though impossible to show in the above section) are quite independent of each other. *C* is actuated by the lake level float *D*, and *C'* by the float *E* in the air barometer *F*. This barometer consists of a vertical pipe *G*, four inches in diameter which passes down through, and is attached to the bottom of a cylindrical air chamber *H*, four feet in diameter, constructed of a heavy gauge of steel. This chamber is hermetically sealed with the exception of two small holes at the bottom of the central pipe *G*. To complete this instrument, water is poured into the central pipe *G*, until the confined air in *H*, is compressed sufficiently to sustain a column of water,



HYDRO-AEROGRAPH.

upon which the float is placed. When the external atmospheric pressure increases upon the surface of the column of water in *G*, more water is forced into *H*, thereby reducing the height of the central column and increasing the compression of the confined air. When the external atmospheric pressure becomes less, the reverse action takes place. In order to prevent variations due to sudden temperature changes, the chamber *H* is buried five feet below the ground level, which in this case is also below the level of the water. The daily reading of the soil thermometer *T* gives a constant record of the temperature at this depth. To facilitate the sinking of the chamber *H* below the surface of the water the confined air was expelled by removing the cap from the small pipe *J*, and pouring water into the central pipe until *H* was filled. After filling in the sand to the top of the chamber *H*, double planking *S* was laid across from shoulder to shoulder of the curbing to prevent any variable strain on the top of H, due to changes of atmospheric pressure upon the earth's surface directly above. To put the barometer in working order the water was all pumped out, then after screwing the cap on the pipe *J*, sufficient water was again poured into the central pipe *G* until it had risen as shown by the dotted lines. To prevent evaporation the top of the column may be sealed by a suitable form of oil. Referring again to the recording portion of the instrumet *I* is a double grooved pulley placed between centres. Upon its smaller grooved circumference rests a line which has one end attached to the barometer float *E* and the other to a counterbalance weight at *K*. *L* is a standard supporting two grooved pulleys *M* and M^1 of similar diameter. Pulley M^1 which is obscured by *M* in the section is connected to the pulley *I* by a fine line kept taut by means of an adjustable spiral spring at *N*. To overcome friction the barograph pen C^1 is attached to a slender aluminum arm, which in turn is connected to a fine aluminum sleeve fitting tightly upon the line in such a manner as to permit a free vertical, but not horizontal, movement on the sleeve. The lake level recording pen *C* is attached in a similar manner to the line which starts from the smaller grooved circumference of the pulley *Q*, and passes over pulleys *P*, *O* and *M*, terminating in the counterbalance weight *R*. To prevent errors due to changes in the length of the line between float and pen, a fine plated steel wire was used from *Q* to *P*, and a special flexible material from this to the instrument. The recording sheet is ruled into one-quarter inch squares. Two feet upon the cylinder is allowed for the barometric range, and one foot for the lake level changes, and as the ratio of movement between pen and float remains the same as previously described (viz., 1 to 4), a range of twelve inches on the cylinder would correspond to a change of water level of forty-eight inches. Both pens are set in line in order that their times will exactly agree, also the barometric pen under increasing pressure is arranged to move up the paper in the same direction as the lake level would assume during a rise of the water. The object of this instrument is not so much to furnish a very accurate measurement of the atmospheric pressure changes, as are now obtained from the more expensive mercurial and aneroid barographs, as to magnify these movements to enable one to study the characteristic forms and extent of the ripples, waves or billows, which have lately been found to exist in our atmosphere during almost all conditions of weather; also as a means of proving conclusively to what extent, and in what manner these atmospheric disturbances affect the waters of the lake. As this appears to be the first instrument of its kind the writer ventures to term it a hydro-aerograph.

(To be Continued)

THE GREAT NORTH.

A railway to the shores of James Bay or Hudson Bay is not only quite feasible, but it is urgently needed to develop the resources of our great North Land. For the past century and a half furs have been the great staple of trade in this region of Canada, but there are many sources of wealth about Hudson and James Bays, and some of these can only be drawn upon by means of a railway. Take the marine products alone. "The salmon," says an official report, "abound in the streams running into Hudson Strait so plentifully that a ship can be loaded with them in a few days. They are pronounced the finest in the world—much better in quality than those in the Pacific or those in the more southern waters of the Dominion." The same is said of the trout. The bay teems with other fish, such as cod, hake, pollock, whiting, etc. For many years American whalers have resorted here, and returns to the United States Fisheries Department show that the value of the "takes" of fifty whaling voyages there have aggregated $1,371,000, or $27,420 per voyage—a statement which ought to attract the attention of some of our Canadian sea fishing men who complain of bad seasons on the Atlantic. United States fishermen in the last ten years have taken out of Hudson Bay in fish oil and whale oil alone an average value of $150,000 a year; while the Hudson Bay Company get over $50,000 a year from the blubber of the whale and porpoise. The narwhal, the walrus and the hair seal form very valuable sources of trade here. Of the porpoise alone, C. R. Tuttle, who accompanied the Dominion Government expedition in 1884, says: "I do not overstate the truth when I say that with proper facilities 4,000 or 5,000 of these oil-bearing animals could be taken at one place in a single season, which means blubber to the value of over $300,000." A railway to James Bay would pay, looking to the development of the fisheries alone, but these are only an element in the case. Countless millions of feathered game can be obtained here, such as wild geese, ptarmigan, curlew, and ducks. There are three or four varieties of wild geese and over a dozen species of duck, among which may be noted the eider duck, which produces the eider down so valuable in commerce. Leaving out of question the fur trade, which is still of immense value, it is to be noted that the country from Michipicoten north to James Bay is rich in minerals, though the real value of the minerals can scarcely be said to have been investigated. From the cursory trips of geologists and travellers we know there are deposits of gold, silver, molybdenum, galena, iron, mica, coal, graphite, asbestos, zinc, fire clay, salt, gypsum, copper and ornamental stones. Dr. Bell was struck with the fine specimens of pure copper pyrites, and of manganese iron ore. It would only be repeating the history of other regions, if the building of a railway would of itself lead to the opening up of new mineral beds not yet known to exist. Vast tracts of the country between the Ontario lakes and Hudson Bay are heavily timbered, and the spruce is of magnificent growth and excellent quality for pulp making. The pulp industry by itself would afford traffic in a few years for such a railway. Lastly, as to agriculture, it may not be generally known that the climate of the region in question is in the main as temperate as that of Manitoba, as the meteorological records at Moose Factory show, and "the gardens of Rupert's House, East Main and Fort George show that potatoes and all the ordinary vegetables thrive well." The Hudson Bay Co. maintain a stock farm at East Main, where cattle and sheep thrive well.

The subject of a railway to James Bay is just now engaging the attention of people both in Ontario and Quebec. The scheme for a road there from Toronto was outlined in our August number. In Quebec, Charles Baillairge has proposed a route starting at the present terminus of the Lake St. John Railway, and running up the valley of the Chamouchouan, thence across the height of land and down the Waswanipi and Nottaway rivers, reaching the Bay at Rupert's House. This route is endorsed by Henry O'Sullivan, Inspector of Surveys of the Province, who has been over the ground, and who more than confirms the statements we have made regarding the natural resources of the Hudson Bay region. Mr. O'Sullivan gives an interesting account of his explorations in the "Bulletin of Geographical Events of Quebec," just published. A committee of this society have drawn up a memorial to the Provincial Government of Quebec, urging the extension of the railway from Lake St. John to James Bay, without committing themselves to any route. They mention as an alternative route that *via* the Chamouchouan and Hannah rivers, the latter being west of the Nottaway. Information in the possession of the society goes to show that wide stretches of country along these routes possess a wonderfully rich soil, with a climate as favorable as that of the Lake St. John valley, which is now being steadily and successfully colonized. The distance from Roberval to Rupert House is only about 360 miles, and the highest point of land is only 900 feet above the altitude of Roberval. The mean grade from the height of land down to the Bay is only five feet in a mile, which makes the problem of construction very easy. The building of a railway to James Bay from Ontario or Quebec, or both, is well worthy the attention of capitalists, and the encouragement of Government.

The promoters of a railway from Toronto to Hudson Bay have surely made a blunder in tacking to it a suppositious navigation—beginning at the north end and proceeding, with an intervening railway stretch, from the west end of the Chesterfield Inlet, so called, but which is really the lower end of a long water course—to the Thlew-ee-cloh or Great Fish River. The assumption is of course that this river is or can be made navigable, at a cost which it would be possible to meet. The promoters must also assume that the waters beyond the Thlew-ee-cloh are so far navigable as to serve as a means of getting towards the Klondike. These assumptions are absolutely contrary to the fact. Some parts of the waters along this immense distance do provide the means of navigation for almost any kind of craft. Of the whole length of these water stretches the Mackenzie River is the best.

But what is the character of the Thlew-ee-cloh? Capt. Back, who, acting under instructions from the British Government, went along the whole course of the river from its source to the Arctic Ocean, in 1834, is the best, if not the only authority. His account of the river is very different from the imaginings of the gentlemen who, with a light heart and triumphant mien, talk of making it a link in the road between Toronto and the Klondike. "The Thlew-ee-cloh," Capt. Back, as the result of this special inspection, made under almost insurmountable difficulties, informs us, "after a violent and tortuous course of 530 geographical miles, running through an iron ribbed country, without a single tree on the whole of its banks, expanding into fine large lakes, with clear horizons most embarrassing to the navigator, and broken into falls, cascades and rapids to the number of no less than 83, pours its waters into the Polar Sea in lat. 67° 11′ 00″ N., longitude 94° 11′ 00″ W. Some of these obstructions occur below the point at which a railway from what, until the nomenclature is reformed, in accordance with recent discoveries, we must continue to call Chesterfield Inlet, would strike the Thlew-ee-cloh, but there are enough of them above to make the river unnavigable, by any expense which it would be rational to conceive possible or any delay of time which could reasonably be expected to be made by travellers on this route. This water route would take the pilgrim on his way to the Klondike some 200 miles too far south, at Great Slave Lake, and as he would have to go north again an equal stretch, the whole deviation would be 400 miles.

Between the Thlew-ee-cloh and Great Slave Lake the character of the navigation does not improve. Before Great Slave Lake could be entered, on the upward voyage, Parry's Falls, nearly twice the height of Niagara, would have to be overcome. Captain Back states this fall to be "between four and five hundred feet."

And how long would the waters on this route be open in each year? Captain Back started at the source of the Thlew-ee-cloh, on his downward voyage on the 28th June, and arrived, on his return, at the same place, Sept. 17th, having met much hindrance from ice most of the time. At what date in the summer does the ice in Chesterfield Inlet break up? What would be the length of the season of navigation on this route, if it were possible to establish any navigation that would serve as a suitable adjunct to railway travel?

Some one connected with the promotion of this amphibious railway project ought to give his days and nights to the study of the geognosy of the region to be traversed.

AN IMPROVEMENT IN GOLD MILLING PROCESSES.

The richest gold mines are not always the most profitably worked, as there is often more made from a mine in which the gold in the ore can only be economically recovered by the most exact processes. In Canada, so far, development has been largely confined to ores which are rich enough to yield profits without too expensive plants or too complicated processes. We must, however, seek on every side for improvements which will enable us to take profits from more of our low-grade ores and from our less advantageously situated leads.

Great economy in the water supply for gold milling is made possible by an improvement in milling processes described in a recent issue of the South African *Mining Journal*. Much difficulty has recently been experienced on the Rand through the scarcity and muddiness of mill water. Careful practice under working conditions and on several mines has finally established beyond dispute that one of the details of a slimes process—the admixture of a small percentage of slaked lime with the slimes-pulp—is a complete preventative of muddiness in mill water; and it may be taken for the future as one of the fundamental axioms in mill practice that no gold mill need suffer loss or inconvenience from scarcity of water if it has a supply sufficient to circulate through the battery, tailings plant, and slimes plant, and can make good a diminution of about 5 per cent. in that supply during the month's working.

In employing this process, about 5½ lbs. of finely-divided slaked lime are added to the slimes pulp for every ton of solid slimes contained, and within 2½ hours a large proportion of the water contained in the slimes-pulp is delivered back to the mortar-boxes clarified from all sediment, and having an appreciable alkaline reaction. As a rule the mill-pulp is separated, the sands being collected for cyaniding, and the slimes running away to the slimes-

dam, where it is sometimes weeks before the water becomes clarified, and where there is a loss by evaporation, leakage, etc., of never less than 25 or 30 per cent., and often more. Moreover, heavy pumping charges have to be incurred for the purpose of returning the still somewhat turbid water from the slimes-dam to the mill, as well as for the purpose of making good the serious loss by evaporation, etc.

For THE CANADIAN ENGINEER.

FIRE FIGHTING.

BY EXTINGUISHER.

Having some experience in the business of extinguishing fires, handling, drilling, and leading fire brigades in one of the British towns, and having for about a dozen years resided opposite one of the Toronto fire halls, I feel that I am in a position to make comparisons between the two systems. I have noticed that in nearly every large fire there is an unnecessary destruction of property, and damage to the extinguishing apparatus, and either through carelessness, recklessness, or questionable management, there is a large number of accidents and considerable loss of life, which offsets the good done by the brigade in staying the flames.

The system adopted in Toronto of compelling men to loaf their time away in a lazy fashion reduces their energy and efficiency, causing them to do their work, when it comes along, in a jerky, impulsive way, and when the brain is most needed it is often dull and inactive, on account of being underworked or undisciplined. Some five years since I was at a convention in London, Ont., when the mayor gave a show by calling the brigade to the square opposite the Boswell House. The roads are wide, but too narrow for one of the reels, which struck the curbstone and pitched off the men, one striking his head against a sharp corner of the hotel wall. This was called an accident, but I am sure it was one that could have been easily avoided by proper drill.

There appears to be small chance in Toronto of proving that a fire has been started purposely to defraud, because of the custom of our firemen of breaking open doors and windows and letting in the air in large volumes, which at once turns a smoky, smoldering mass of burning material into a fierce and destructive flame; and where a few gallons of water intelligently sprayed on the smouldering mass would have destroyed the fire without injuring other goods, the fact of letting in more air than is necessary to do the work, often causes the gutting of the building.

When a fire is started by illuminating gas a small quantity of air let into the building will cause a fierce flame throughout the whole premises. Many valuable buildings have been destroyed by allowing unlighted gas burners to be turned on at full near the bottom of air hoist or staircase well, and a small light burning near the top. If the building be a large one, it may take a few hours to get the well or hoist shaft sufficiently charged with gas to ignite, when a sheet of flame will start on every flat, and if a good volume of air be introduced to feed the flame, the whole building is sure to be destroyed, together with the evidence of the way the fire started.

Steam is the best extinguisher of fires when soda, salt water, or other chemicals cannot be used. A volume of water is of little value until split up into small particles and made into steam by the fire on to which it is discharged. In all cases the water should be sprayed on under strong pressure, and wherever practicable, forced under or into the centre of the burning materials, because by so doing, the water will more quickly be turned into the steam needed to extinguish the fire, and no useless water will be discharged to run off and damage the surrounding goods and premises.

The men selected for the best brigades in the old country are mechanics, who thoroughly understand the details and construction of buildings; who are used to work and climb to giddy heights; men with nerve sufficient to walk across a fifty foot beam suspended high up in the air with safety. They are trained to attack a fire at points where the water will have a telling effect, and to avoid discharging useless water, or damaging property or goods unnecessarily.

Factories where they use steam boilers can put out the most dangerous fire by steam in about two minutes without damaging any machinery or goods.

Extinguishing fires is a fine mechanical science, and a good team of practical men can put out fires without hurry, fuss, or losing their wits. They have no preventible accidents or loss of life, nor do they damage any of the surrounding goods by flooding. In Canada a good team cannot be got. We require a good show in the street, and we are prepared to let a small blaze spread and destroy a whole block if our stations are carpeted and surrounded with costly appliances. The *men* engaged are the last consideration. We want to see spirited horses tearing through the street. It is of little importance whether good judgment and care is used by the men when in action. We are sympathetic when a fireman is lamed or killed, and never blame the men who placed him in danger, though his manifest unfitness for such a calling was a sure guarantee that his life and limbs were in constant jeopardy.

The old story can with reference to firemen be re-told, that a good workman or mechanic is very valuable, and of service to his fellow man, but a person who is wrongly placed and ignorant of the points and details of his work, is worse than useless, for he not only destroys the valuable appliances that are entrusted to him to use, but he endangers the lives of others as well as his own.

ACETYLENE.

The formation of a company in Montreal for the manufacture of calcium carbide and the extension of the works of the Willson Carbide Co., of St. Catharines and Merritton, are among the evidences that acetylene gas—at present the chief product of the carbide—is steadily making its way as an illuminant in Canada. Of course prejudice remains to be overcome and it is evident that the board of underwriters who have framed the code of regulations for the use of acetylene in insured buildings have much to learn about the nature of this gas. These regulations, which are quoted elsewhere, are vexatious without any apparent reason, unless they are designed to prevent the use of acetylene altogether. It is carefully provided that there shall be no chance to heat a building, and as all generators have some form of water seal, how is a building to be kept from frost in a Canadian winter?

One of the most comprehensive and instructive articles on acetylene we have seen in a long time is that in the *Engineering Magazine*, of New York, for August. After tracing the first discoveries of acetylene the writer, Henry Harrison Suplee, gives an account of some of the experiments made in liquefying the gas for commercial use. This method of using acetylene for lighting would seem to be unsafe in ordinary hands, but when the gas is made direct from the carbide with water it is as safe as any other gas. "It is probably no more poisonous,"

says Mr. Suplee, "than ordinary illuminating gas, while its characteristic odor causes leaks to be readily detected. A number of experiments by Vicille and Berthelot have demonstrated that at atmospheric pressures, a decomposition originated at any point is not propagated through the mass of the gas. Neither a spark, an explosion of fulminate, or direct contact with flame causes any action beyond the immediate vicinity of the heat. When, however, the gas is subjected to a greater pressure than two atmospheres, it exhibits all the properties of an explosive mixture; hence, the danger is clearly marked, mixtures of acetylene are,or are not explosive, according to the proportions of the two components, the limits being between three of gas to one of air, up to twenty of gas to one of air, this being a somewhat wider range than is found with ordinary illuminating gas." When the gas is better understood, the liquefied form may be safely used, as it would have great advantages, considering that the liquid is only one four-hundredth of the volume of the gas—that is, a foot of the liquid would make 400 feet of the gas. One remarkable thing about liquid acetylene is its expansibility. A given volume at a temperature of 32° F. becomes 1.07 volumes at 62°, and 1.24 volumes at 96° which shows it to be the most expansible liquid known. Cylinders should not be filled full, as when brought from a low to a high temperature it would rupture a very strong vessel. "In no case, however, should explosions of the liquefied gas be confounded with supposed dangers of the gas at ordinary pressure, as the two are absolutely distinct." In concluding his interesting article, Mr. Suplee says: "While it may be too soon to draw definite conclusions upon all the points at issue, we may infer that acetylene as an illuminant has a positive value, which for many purposes is immediately available; that it can be produced and used without greater risk or danger than is involved in the use of ordinary illuminating gas; that in the compressed or liquefied form it should be handled by experts under well ascertained conditions; but that notable advances must be made in its economical production if it is to compete broadly with coal and water gas as an illuminating agent." The writer here refers to the cost of manufacturing the carbide, which he puts at 2.02 horse-power per pound of carbide.

BREAD VS. BOUQUETS.

Among the many attributes of perfection which are ascribed to the Ontario Government, that of Defender of the Beautiful has not hitherto been one. Culture its members have been known to possess, and a commendable interest has been shown in various cultures and cultivations from pigs to preachers, but their absolute devotion to the Beautiful has escaped public attention. The Parliament Buildings may be supposed to have had something to do with this; people who spent much time there could not but have their perceptions of the True and the Beautiful dulled, while it was generally conceded that any one who had anything to do with authorizing their erection must be entirely ignorant of the existence of these words, when spelled with capitals. But the public, as is generally the case, was wrong. The Ontario Government is prepared to sacrifice much to Beauty, and keeps the Niagara Peninsula a garden, a place of green grass and flower beds, and falling streams and trees; the resort of newly-married couples, and the people of Toronto on Saturday afternoons. The Government accepts $25,000 per year to keep in idleness a water-power whose development would be worth more to the Province than the timber limits about whose possible destruction we are at present so much agitated. We are well advised to look to our timber supply, of course; but if every stick of merchantable timber in Ontario were cut down, it could be replaced in time, though not without vast expenditure. But once permit the turning aside of natural and industrial forces, and who dare assume their return even with the most enormous expenditure? If the power of Niagara is once handed over to the citizens of the United States, it is lost to Canada forever.

In industry as in all living things there is no standing still; growth and death go on side by side and when growth is outrun by death the end comes. In the same way the industries of Ontario, and chiefly of Toronto and Hamilton, cannot go on in the next five years as they have in the past. Quebec has cheap labor to-day and to-morrow will have unlimited electrical power. We have only to name the great development companies over to remind ourselves of that: Chicoutimi, Montmorency, Shawenegan, Chambly, and Lachine. How can Ontario meet this competition except by power as cheap or cheaper than that in the neighboring province? If there were a tariff wall between the provinces, or if communication were slow and expensive, there might be some chance that the mill wheels of Ontario might still be turned by steam-power, but with the two best railways of the continent and the world's greatest waterway competing to reduce transportation charges there is no such chance. The only possible relief would be cheap coal, and Ontario has no coal, and southern Ontario has no power except what is derived from Niagara, and natural gas in a limited area of the West. Both of these are handed over to enrich aliens.

Some months ago in an article on this subject THE CANADIAN ENGINEER ventured the prediction that Niagara Falls would in future be more of an industrial force than an objective point for sightseers. We are pleased to notice that Lord Kelvin, during his recent visit to Niagara, at the time of the meeting of the British Association for the Advancement of Science, stated in an interview that he believed that all the waters of Lake Erie would ultimately find their way to Lake Ontario through electrical machinery. His Lordship said:

"I think we already see the beginning of what is destined to grow into a great industrial district around Niagara Falls, within ten or twenty miles of Niagara, both on the United States side and on the Canadian side. I do not prophesy anything, but I anticipate industry will advance on both sides of the border, and that the power of Niagara will be taken advantage of to any extent we may imagine. . . The originators of the work so far carried out and now in progress, hold concessions for the development of 450,000 horse-power from the Niagara River. I do not myself believe any such limit will bind the use of this great natural gift, and I look forward to the time when the whole water from Lake Erie will find its way to the lower level of Lake Ontario, through machinery doing more good for the world than that great benefit which we now possess in the contemplation of the splendid scene which we have presented before us at the present time by the waterfall of Niagara. I wish I could think it possible that I could live to see this grand development."

We hope the silence which the Ontario Government preserves with regard to this subject is only a cover for the discretion which they are about to display in the development of the natural resources of the country. It is remarkable that a body of men, who display such admirable judgment in the management of their private affairs, and whose administration of the public domain should be in most cases so excellent as to defy criticism,

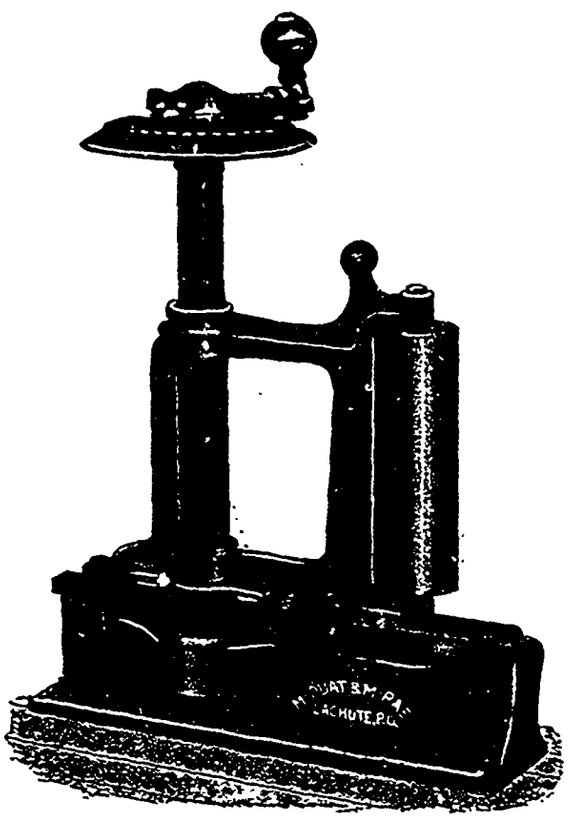
are unable apparently to make more out of one of our greatest assets than a few acres of flower garden.

Those who should be in a position to know state that the United States company has found means to arrest the proposed power development by a canal at Chippawa, and that nothing will come of the occasional activity of power company promoters on the Canadian side, at least nothing tending to the enrichment of Canadians generally.

What would be the verdict of the people upon a government which enacted a law forbidding the use of the steam engine and compelling manufacturers to resort to manual labor? What is the difference between forbidding the free use of steam in the past and forbidding the free use of electricity in southern Ontario for the next hundred years?

TIMBER GAUGE.

The Climax timber gauge, invented and placed on the market by McOuat & McRae, Lachute, Que., has been a pronounced success and has made its way steadily among Canadian lumber manufacturers. The makers prove a number of advantages for this device, which is illustrated herewith:—



The roller arm swings over the bed, and is so arranged that if the log strikes it, through accident or carelessness, it is merely knocked out of place and can be replaced instantly, without injury. This alone is of great importance to the purchaser. The standard is not stationary, but moves back with the roller bracket. It is never nearer than 11 inches to the saw, and will move back 22 inches clear of the saw. It can be moved out still further without loosening a bolt. It can be changed in half a minute from a right hand machine to a left, by changing a small stopper from one side of the standard to the other. The dial plate is divided accurately into inches and quarter inches, with distinct figures cast on, and notches cut deeply to hold index hand, so that there is no possibility of slipping or shaking out of position. The roller can be changed for different sizes of lumber, by simply pressing down on the crank, and turning the required notch and letting it go, no pin being required. To cut lumber heavier or lighter than the exact size, it is not necessary to move the machine on the saw frame, as the index hand is provided with an adjustment for that purpose. In designing it the makers took care that no place was left where sawdust could lodge and clog the machine, and they guarantee it cannot clog. If after ten days trial it is not found satisfactory, the purchaser may return it at the expense of the manufacturers.

FILTERED VS. UNFILTERED WATER.*

Through the researches of scientists it is to-day practicable to make hard water soft on a commercial scale; it is practicable to remove the matters giving rise to discoloration and disagreeable odors, and it is possible to remove almost to complete exclusion those minute forms of life which are supposed to be the source of many diseases, and which are carried and disseminated by water. In some cases natural influences effect a purification of water in certain directions; for instance, certain forms of low vegetable life in waters are destroyed by darkness; † certain other forms of microscopic life are destroyed by sunlight; ‡ certain impurities, like iron, can be removed by allowing the water to flow over a steep bed, or rapids, where it will become aerated. And a knowledge of these facts and many others, enables us to take any water that may be considered fit for a water supply to a city, and bring it to a very high standard of purity.

That pure water has been the means of saving many cities from dreadful consequences has had frequent proof. A recent very interesting case is that of the cities of Hamburg and Altona in Germany. The epidemic of cholera which broke out in Hamburg in 1892 will be remembered for its extremely "explosive" character. The history of this case is so very interesting that it will bear narration. On the river Elbe, some miles from the sea, there are two cities, adjoining and forming in appearance one city. These are Altona, a Prussian city,

Boundary line indicated by a line of dashes.
Cases of cholera by solid circles.
Cases of cholera imported from Hamburg by open circles.
Water mains in Hamburg streets by black lines.

and Hamburg, a free German city. A stranger walking through these cities would not know, unless informed, whether he was in Hamburg or in Altona. They are each supplied with water from the River Elbe, but their waterworks are independent of each other. In 1892 Altona took its water from the Elbe several miles below where the Hamburg sewers emptied into it. Hamburg took its water from above the city. At this point of the river the tidal influence is still felt, and at times the sewage from Hamburg is carried on a flood tide up the river occasionally as far as

*Abstracted from Some of the Important Water Supplies of Europe Considered Mainly from a Sanitary Standpoint, a paper by James H. Fuertes, Mem. Am. Soc. C.E., reprinted from the *Journal* of the Association of Civil Engineers of Cornell University.

†"Some Observations on the Relation of Light to the Growth of Diatoms." Geo. C. Whipple in a paper at the Ann. Conv. of the N. England W. Wks. Association, June 10, 1896.

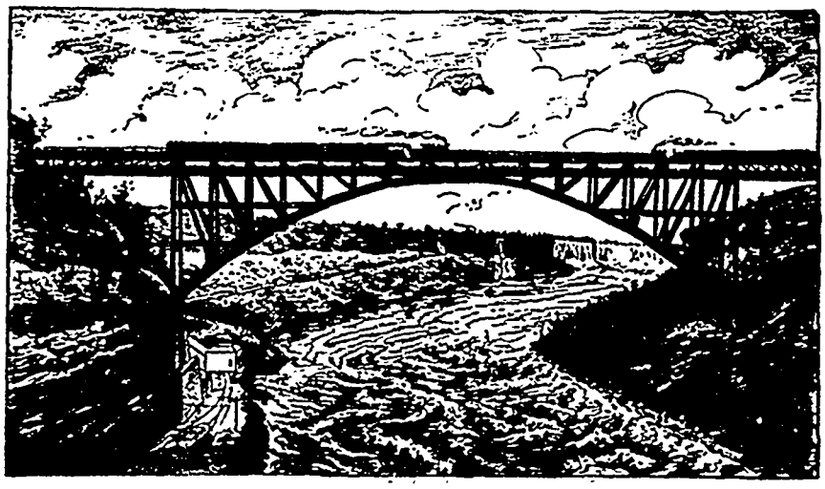
‡"Water Supply," Professor Mason, 1896, p. 66.

the water-works. The Altona water was all filtered through large sand filters, carefully operated, while the Hamburg water was supplied to the people just as it was taken from the river On August 16th, the epidemic of cholera in Hamburg began to spread alarm. In 12 days the epidemic had reached its height, and during the week of its extreme severity there were more than 6,000 cases of cholera in Hamburg. In about 12 days more the worst was over. By an inspection of the map of that part of the two cities near the boundary line between them, it will be seen how comparatively few cases appeared in Altona, and that it is possible, with an approach to accuracy, to define this municipal line by the location of the deaths from cholera. Many of the cases in Altona were caused by drinking the Hamburg water; many were developed there from other modes of infection, and many cases were of doubtful origin; but the fact shows graphically enough that the Altona filters saved that city from the fate that made Hamburg lose 8,000 lives in about a month, and spread terror and apprehension over the whole world.

The improvements at once undertaken and carried out in the water supply of Hamburg, have placed the city on an equality with its neighbor in the matter of pure water. The tests which are made almost continuously show the water to be comparatively constant in its composition and of a very high degree of purity.

THE NEW NIAGARA BRIDGE.

In our August number, we gave a description of the new great single-arch bridge of the G.T.R. over the Niagara, which replaces the well-known old suspension bridge. It only remains to say that the formal opening of the new structure took place last month beginning on the 23rd and lasting three days. Enormous crowds were present each day and night, and the fireworks display exceeded anything of the kind ever seen in Canada. A very elaborate programme of entertainment was provided for each afternoon on both sides of the river, and—what formed a very agreeable novelty in entertainments—all was free The Grand Trunk Railway are to be congratulated on the handsome way in which they provided for the pleasure of the people, and upon their ability to provide for the transportation of such vast crowds of excursionists.



NEW NIAGARA BRIDGE

BAILLAIRGE'S MARINE REVOLVING STEAM EXPRESS.

Editor THE CANADIAN ENGINEER.

SIR,—Marine Revolving Steam Express is the name of a vessel conceived by the undersigned, now some forty or more years ago. How the idea struck him or was originated in his mind, was from observing the rotation of a wheel under the impetus given to it by the feet of a squirrel. He imagined that such a wheel, if inclosed all around, and partly up the outer periphery of the ends or sides towards the centre or axis, and if then laid to run on any smooth surface or ice, would thus move with great velocity by the constant displacement of its centre of gravity by the motor inside of it. The same effect would, of course, obtain on any liquid surface as that of water, in which case it might be advantageous to put paddles around the vessel or cylinder to guard against any tendency to its slipping, and consequent backward or less speedy forward motion, though upon trial such paddles might prove to be of no necessity.

The diagrams on the accompanying plate are merely intended to be suggestive of the mode of steering such a vessel, by a rudder attached to it in a way to allow the vessel to revolve without carrying the steering apparatus with it in its revolution; as for instance, by tying it by a chain or belt around the vessel in a groove in the keel, said groove set with a series of friction wheels to ease the motion, and the rudder itself made heavy enough, without any tendency to sink, or while buoyant enough to float, too heavy for the vessel to lift out of the water; the steering gear being as shown, fixed to an outrigger extending each side through the open ends of the vessel, and supported by the engine, or as well as the passengers and freight on, or from a platform attached to the engine, or forming portion of the construction thereof. The smokestack of the engine, if driven by steam; or of the generator, if by electricity or compressed air, would of course have to be also taken out at the ends or at one of them, unless by dividing the outlet it were found, while balancing weight on each side, to accommodate itself better to the direction of the wind, shutting off one side while opening the other, or by both sides simultaneously if found advisable.

Now this idea or mere element could be multiplied or extended as required, so that the vessel which as per design might be suited to a mere lake or river with no wind blowing of sufficient force to overturn it, or as a mere water bicycle, could be adapted to rough water, to hold more passengers and freight by extending the vessel of cylindrical hull in length, while the diameter remained the same, or extending both in any required ratio. The hull or cylinder, for instance, might be of length to accommodate two or more motors climbing up its side together, when the two or three or more might be joined by one passenger and freight-carrying platform pivoted in a manner to remain in a horizontal position, as has been proposed for the dining room or saloon of an ocean vessel, in a way not to rock or pitch with the vessel. Again, the outriggers protruding from the ends of the vessel might be so braced from the non-revolving platform as to give them strength enough to suspend therefrom, as a car from a balloon, a circular or other water-tight receptacle, boat or vessel for outside passengers wherefrom to enjoy the view and air and such that, with any rolling of the hull or cylinder, the buoyancy of the outrigged boats, hanging as if from davits, would on striking the water help to right it and return it to its normal position. The diagrams show no other light penetrating openings than the open ends of the vessel, which in rough weather it might be necessary to curtail or partly enclose; but it is of course evident that any number of windows or lights might be introduced all around the hull or cylindrical surface, precisely as in an ocean steamer, and of course it could also be easily lighted up at night, as the want of sufficient daylight could be supplemented by gas or electricity with equal facility.

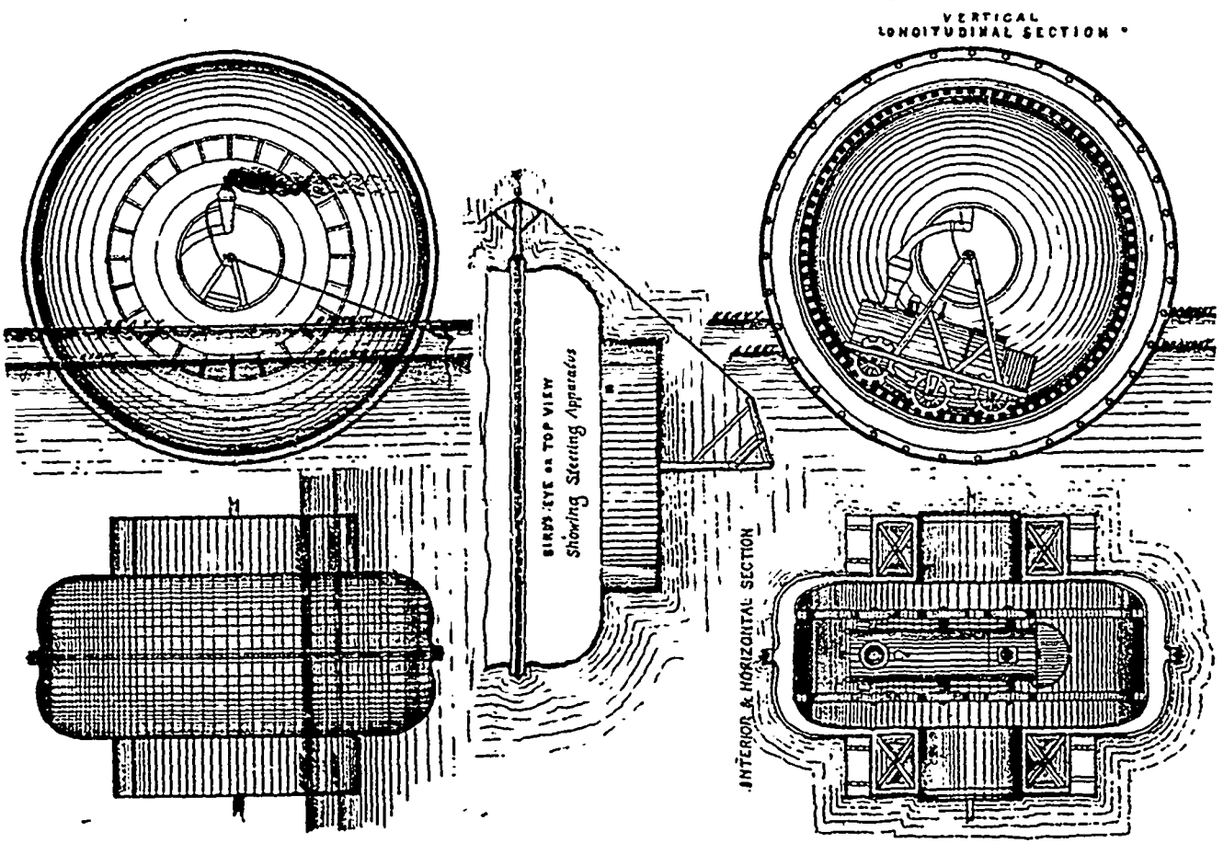
This plan has remained rolled up, out of sight and out of mind since it was made so many years ago, and at the time considered in advance of the age, though at the New York "World's Fair," held at the same epoch—sometime, I believe, before the war of secession (1853, I believe)—and at which it was on exhibition, though it, of course, attracted the less attention on account of its coming from such an end-of-the-world sort of place as Quebec, another invention purporting, as the papers then said, to be of the same description, had been exhibited by some minister of the gospel of a mechanical turn of mind, showing how two persons, who have never met may be similarly impressed, as with Adams' and Leveries "After Neptune." And now I see, by a paragraph in a recent issue of the Quebec *Daily Telegraph*, that some other individual, one F. A. Knapp, of Prescott, Ont., has also been similarly taken hold of. This fact it is which has awakened me to the possibility of there being something in it after all, and that the time has come when the invention can be carried out, which I heartily leave to Mr. Knapp to do, without even hinting at the possibility or probability of his having ever heard of my priority of conception. Again, I say, two or more persons may at the same time or at intervals of years be imbued with the same ideas, as in the case of the first artesian well at Grenelle, in France, while many such had existed in China from time almost immemorial, and in the same manner as suspension bridges had been conceived as new in Europe, while centuries ago to be found in Asia.

Finally, if my idea of so many years ago was then before its time, as was also the "Great Eastern" when built by Brunel, and as the latter is now, or vessels almost as big as it, beginning to be utilized, so may my apparently impossible-of-realization conception of 1850 become a reality, and I wish Mr. Knapp all success in making it so.

In this age of rapid transit the world is ready for something sensational of the kind, an advance on Martin's boat on wheels, while in this instance the wheel itself is the boat, and the boat revolves. Every one knows the piece of mechanism called a horse-power, where a horse

without any forward motion of his own causes an endless chain or wheel to revolve under his feet. Now, let the horse be placed within this endless wheel or chain, and made to tread its under inner surface instead of its outer upper periphery, and a correct idea will be formed of this rotating vessel; since the horse-impelled wheel would evidently advance, if not debarred from doing so by being made a fixture.

The idea is also illustrative of how such a wheel may be looked upon in the light of a revolving tramway, or railway track, or track for any other vehicle, or for any man or animal on foot, and by which said man, or animal, or vehicle or engine might be said to lay its or his own track as he or it advances, or to carry his or its track with it, thus smoothing or levelling the way itself in a manner to avoid rough or bad roads, or to avoid sinking into deep snow, or mud, or mire, or as a man on a bicycle might be supposed to do by running forward on or up the inner periphery of a wheel of larger diameter encircling him and his bicycle, and rotating and moving forward with him, and in a manner so to say, to lay his own track as he went along over soft or boggy ground or snow, into which his bicycle might otherwise have a tendency to sink and retard his motion, while also increasing his labor of pushing through. The lights necessary in such a vessel to satisfy the rules of navigation and prevent collisions and accidents by night, would of course be established at the extremities of the non-rotating outriggers. To these salient extremities of the non-rotating axis or



shaft of the vessel, might also be attached circular signboards with the vessel's name painted thereon as on a medal, and arrangements could also easily be made by which a flagstaff might be erected at each end, and with halliards for working the colors as required.

Truly yours,

C. BAILLAIRGE.

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

In the following paragraphs we attempt to give our readers an outline of some of the papers read before the British Association for the Advancement of Science at its Toronto meeting, which are of greatest technical interest.

EARTHQUAKES.

Prof. John Milne, F.R.S., F.G.S., of Slode, Isle of Wight, delivered a lecture in the Massey Music Hall, Toronto, Aug. 23rd, on "Earthquakes," which was largely attended and very warmly received. Prof. Milne opened his address by referring to the fact that, because each student of engineering in Japan had to attend a course of twenty lectures on that particular branch of seismology, which has to deal with the subject of construction to resist the effects of earthquakes, it was evident that to satisfactorily epitomize all the knowledge we possess relating to seismology and volcanology within a period of 60 minutes, was a task of so much difficulty that, rather than speak of these subjects as a whole, he would practically confine himself to the answers of two very ordinary questions: First, what were the causes leading to displays of seismic and volcanic activity? And, secondly, what were the benefits we could expect to derive by studying the same?

In Japan, he told his audience that there was a belief, or, more correctly, a poetical conceit, that beneath the empire there lived a gigantic catfish, which, when it wagged its tail or moved its eyelids, shook the earth. Other subterranean monsters were the elephant of the Mussulman, the mole of India and the hog of the Celebes and Mongolia. After the shock, which, at the end of last year, rudely awakened the inhabitants of the Severn Valley, amongst other curious communications he received, there was one which at great length endeavored to prove that all the commotion was to be attributed to an earthquake-producing serpent which until recently had been buried beneath London, but which had escaped to the atmosphere and could from time to time be seen hovering above Trafalgar-square. Beneath Kamschatka the existence of a god called Tuil has been pictured, who drives with sleigh and dogs over subterranean snows, whilst beneath Scandinavia we have the imprisoned Loki, each of whom by his endeavors to escape or restlessness shakes our world. From subterranean mythology the lecturer passed on to the quasi-scientific theories of the middle ages, amongst which we find the unruly wind within the earth, which Shakespeare tells us "topples down steeples and moss-grown towers," the subterraneum tonitruum of Italy, the explosive gases and fatty vapors derived from a materia pinguis, chemical, electrical and other hypotheses.

The nineteenth century belief respecting earthquakes is that they are the result of rocky strata being bent—as in the process of mountain formation—beyond the limits of their elasticity. They are accelerations and announcements of orogenic and bradyseismical processes, which tell us that adjustments have taken place in the elastic or gravitational isostasy of the earth's crust. Wherever rocky masses are being folded, there we get earthquakes. If these foldings are near an ocean by capillary action water soaks inwards, a steam pressure is created, and the magma of molten rock and water from time to time finds an exit, and we get displays of volcanic activity. The reason that rock-folding exists is that the crust of our earth is not sufficiently strong to support itself above a nucleus which is gradually growing smaller by loss of heat. That which is happening on the surface of our earth is similar to that which would happen to an arch of brickwork of enormous span when the supporting centreing was withdrawn. Imagine such an arch supported on a centreing carried on piers across Lake Ontario, and then let the supports be gradually removed. The arch

would sink, crack, and buckle into ridges as it accommodated itself to the span between the piers. Each crack would represent a geological fault; when it was created the sudden snap would be an earthquake; whilst the hummucks and ridges would correspond to continental elevations and mountain ranges.

Turning to the useful aspect of seismology, Mr. Milne stated that, as the result of observation and experiment, many rules and formulæ had been arrived at respecting construction in earthquake countries, and it had been found that where these had been put into practice, the effect of seismic disturbances had been greatly mitigated. In Japan it was now clearly recognized that ordinary engineering practice as applied to embankments, piers for bridges, tall chimneys, the framing of ordinary dwellings, and other structures was to be avoided, and whenever, as, for example, after a disastrous earthquake, or a fire, reconstruction was required, new methods were adopted, the result of which is that the loss of life and property is being steadily reduced.

The application of seismometry to measure the irregular movements of locomotives has resulted in new forms of balancing the same.

The increased steadiness thus obtained is, among other things, accompanied by a marked saving in fuel. By the use of seismographs along the coast of Japan, submerged areas of seismic activity have been mapped through which it would be dangerous to lay a cable. Instruments which record the unfelt movements of the earth's crust sometimes tell us that cable interruption is due to earthquake action so far from land that it cannot be felt by those on shore. For want of information of this description in 1888, when three cables connecting Australia with Java were fractured simultaneously, in the former country naval and military reserves were called out, the supposition being that their sudden isolation indicated an operation of war. When it is remembered that this is by no means the only time a British colony has been suddenly cut off from communication with the rest of the world by the breaking of cables, such interruptions have shown the importance of being able to say whether this was brought about by natural or by artificial means cannot be overestimated. These same instruments, wherever they are established, give information of great seismic disturbances, even should they take place at the antipodes of the place of observation. Hence they enable us to correct, confirm, and even to disprove telegraphic information. From the enormous rate at which these earth messages pass through our earth, we see that our ideas respecting the effective rigidity of our planet must be modified. The daily tilting of horizontal pendulums has led to many experiments relating to the transpiration of plants and the subsurface condensation of moisture, which is of practical importance to the agriculturist. Possibly the long-continued tilting in one direction of these instruments may indicate that the ground or rock around that on which they are installed is gradually moving, seismic strain is increasing, and an earthquake may be expected. The seismograph has been employed to plot the roadbed of a railway, and in this way the condition of the whole line can be recorded and examined by the management at headquarters at any time.

Quite recently another line of investigation has been indicated which may possibly also lead to earthquake prediction. The effects of torsion and other stresses upon magnetized iron or nickel are well known, and it seems likely that the bending of rocks prior to the relief of stress may be accompanied by similar phenomena. In connection with this, Mr. Milne mentioned that prior to the two great earthquakes which last year devastated North Japan, at three magnetic observatories in that country the instruments showed unusual movements, commencing in both cases several days before the final collapse. The greatest magnetic perturbations took place some hours before the shocks, whilst afterwards, when seismic strain had been relieved, the magnetographs behaved in a normal manner.

The study of seismic sounds which are only heard on rocky strata, which do not travel far from their origin, which are not accompanied by perceptible movements, and which only occur from time to time, have been the means of laying many ghosts and re-establishing the reputation of country mansions. Severe shocks and volcanic outbursts have throughout the history of nations exerted an influence upon the nervous organization and the imagination, the effects of which may be seen in the character of a community, in literature, and its art. The study of earthquakes and volcanoes is of the greatest importance to the geologist, whilst it affords problems and facts of interest or value to the astronomer, the physicist, the mathematician, and to the student of all natural sciences, and in this way as an instrument increasing knowledge it becomes, directly or indirectly, a benefit to mankind.

Since his return to England, Prof. Milne has furnished a wonderful proof of the exactness of the records of the siesmograph. He writes: "While at the British Association meeting in Toronto I exhibited a seismogram which had been forwarded from my station on the Isle of Wight. This was the record of a large earthquake, the duration of which had been three hours. From the general character of the diagram, and because the preliminary tremors had a duration of 30 minutes, I suggested that the centre of the disturbance was in or near Japan, and, if so, originated there on Aug. 5, about 9.06 a.m. On Aug. 26, when I left Toronto, no news of such an earthquake had been received. I now find by mail advices, dated New York, Aug. 30, that in Japan there was an earthquake and tidal wave, accompanied by much loss of life, on Aug. 5 and 6. Capt Snow, of Yokohama, in a letter dated Aug. 5, says: 'While I am writing, a heavy, slow earthquake is going on. It is now 9 14 a.m.' The character of the motion felt by Snow indicates that Yokohama was a considerable distance, possibly 600 miles, from the place of origin of the disturbance. Therefore the time the earthquake took place was at least five minutes earlier than noted by Capt. Snow."

CANADA'S METALS.

Prof W C. Roberts-Austen, C.B., F.R.S., director of the Royal Mint, London, delivered a lecture in the Massey Music Hall, Toronto, August 20th, which was of the greatest interest to Canadians, as well as to the visitors from the old world. Prof. Roberts-Austen began by remarking upon the distinct relation borne to the welfare of the Empire by the metals of Canada. The point of a great part of his remarks was in the evolution of this idea. The strength of every country depended largely upon its metals. He hoped the Mother Country would soon learn to turn towards her eldest daughter for a supply of those metals necessary to the defence of the Empire. Since the British Association met in Montreal in 1844 interest in Canadian metals had been renewed The lecturer accredited this result largely to the efforts of the Canadian Geological Survey. The principal mineral products of Canada were in gold, silver, copper, nickel, lead and iron, as well as certain of the rarer metals. He told of the wealth in gold of the British Columbia, Ontario and Nova Scotia districts. The attention of the whole world had been attracted in a sudden and startling manner lately to the new region—the Klondike. People were dazzled by stories of a country where wealth was to be obtained at the expense of privation, and ofttimes of death Since 1884 the annual mineral output of the Dominion had doubled "There was now a very creditable and comprehensive collection of ore and metals at Ottawa, as well as at London I hope before long," he added, amid appreciative applause, "to take home to my countrymen some facts that will make Canada better known to them."

The slow development of these resources, he went on, was due to many causes. The first was the conservative attitude of the Hudson Bay Company, who controlled the mineral regions, and who for many years had devoted themselves to other pursuits than mining. But Sir Donald Smith of that company had been the first to bring down specimens of Lake of the Woods and Rainy Lake ore, and there was no doubt as to its value. As an instance how the order of things had changed, he told how, when he visited Rat Portage in 1884, it was a town with 870 souls, it had now grown to have a population of 4,000. Another reason for slow development was the former lack of railway communication, and a third of the false idea as to climate.

"We Englishmen," said he, "are not so assured as to the real facts regarding your beautiful climate as we might be." Sir Wilfred Laurier had aptly described it as hot summers, cold winters, and dry always. As to the Ontario deposits, enough was known of the territory north of Lake Superior to satisfy one that it was possessed of mineral wealth which made it the most valuable part of the province. Apart from Ontario was the great gold country of the west, British Columbia, where, since 1881, there had been an output of $12,000,000 of gold. Of the Yukon, where millions would be extricated in a few years, he urged that a route from the south was greatly desirable. It was said that there was scarcely a creek in the region that did not contain gold.

Diverting, he warned those who read of the riches of the Klondike, that they should not forget the qualities of iron and steel. Iron was a necessity to the Empire, for the best guarantee of peace was a readiness at all times to defend the Empire. The Canadians at the Jubilee must have been impressed with the display of 400,000 tons of steel afloat at Spithead. It was a fact that the navy required one-half of the iron output of the Mother Land. "Need I longer plead for the production in Canada of iron and steel for the protection of the Empire?" This point was followed by a reproduction on canvas of a map of the Dominion and illustrations of the mining operations going on in its various parts. The lecturer followed out his plea for the navy by experimental evidence as to the exceptional qualities for armament purposes of an alloy composed of Canadian steel and nickel. This was an argument in favor of the idea of utilizing the Canadian base metals for purposes of Imperial defence.

Then came the sensational display of the evening. Branching out from the topic of Canadian metals into that of the properties of metals in general, the lecturer, with the aid of an electric furnace, operated

by his assistant, Mr. Stansfield, threw upon the canvas a representation of the melting of various metals.

The experiments, which were then made for the first time on the continent, he explained as he concluded, were intended to teach that metals were not inert, but were vibrating masses of sensitive matter, strangely life-like. The forces of evolution in the inorganic were not less majestic than those now universally accepted as pertaining to the organic world. Many might shrink from advanced ideas of this sort, but if any present feared the process, he assured them, with Sir Thomas Brown, that we could not but have a conciousness of Divinity within.

MAKING FLUORINE GAS.

Fluorine gas was made for the first time in America, before the members of the chemistry section, by Prof. Meslans, assistant to Prof. Moissan, Paris, whose researches with fluorine have been one of the features of the recent chemical progress of the world. Prof. Meslans came to Canada to make the demonstration, and succeeded admirably. His running talk which accompanied the experiment was in French, and was merely a description of the apparatus and method employed. Prof. Meslans' apparatus consisted of a bucket filled with snow and salt, in which was immersed a "U" shaped tube containing hydrofluoric acid. Two electric wires dipped down into the liquid, and small copper tubes carried away the liberated gases. These tubes first ran into a curious little copper vessel which was filled with solidified carbonic acid and alcohol to keep the temperature sufficiently low to prevent the destruction of the apparatus. When Prof. Meslans had arranged everything to his satisfaction the current was turned on and the gas began to form. Then a number of experiments were carried on, showing that the curious element attacked practically everything presented to it, bursting into flame the moment it touched charcoal, silicon, alcohol, benzine, sulphur, potassium, iodide, and many other substances. The demonstrations were greeted with many bursts of applause.

THE CONDENSATION OF STEAM ON METAL SURFACES.

Before the Mechanical Science Section a paper was read by H. L. Callendar, M A , F.R.S., and by J. T. Nicholson, B.Sc., on new apparatus for studying the rate of condensation of steam on a metal surface at different temperatures and pressures. As the result of some experiments by electrical methods on the measurement of the temperature changes of the walls and steam in the cylinder of a working steam engine, which were made at the McDonald Engineering Building of McGill University in the summer of 1895, the authors arrived at the conclusion that the well-known phenomena of cylinder condensation could be explained, and the amount of condensation in many cases predicted, from a knowledge of the indicator card, on the hypothesis that the rate of condensation of steam, though very great, was not infinite, but finite and measurable An account of these experiments was communicated to the Institute of Civil Engineers in September, 1896, and will, it is hoped, be published in the course of the ensuing year. In the meantime the authors have endeavored to measure the rate of condensation of steam under different conditions by a new and entirely different method, with a view to verify the results of their previous work, and also to estimate the probable effect of wetness or superheating of the steam, and the influence, if any, of the film of water adhering to the walls of the cylinder.

THE PRESENT TENDENCIES OF ELECTRIC TRAMWAY TRACTION.

The Mechanical Science Section heard a paper on "The Present Tendencies of Electric Tramway Traction," by J. G. Waldridge. Among other points the author said, tramway work is, at the present time, and has been for some years past, characterized by an increasing use of mechanical traction systems The reasons for this are obvious and self-evident. It is, however, worth while to look into the considerations that, so far as electric traction is concerned, have caused one system or another to grow into favor, noting also the inherent qualities or attributes of each, which must have an effect on future developments. The United Kingdom has practically 130 miles of electric tramway at work or under construction; of this length 103½ miles are operated on the trolley or overhead wire system, 15¼ miles by means of a third rail conductor, 6 miles by means of storage batteries, and only four miles on the underground conduit system. Objections to the overhead trolley wire system are almost entirely aesthetic, but at the same time have such great weight and force that every incentive is offered to the genius of invention to make improvements in other directions. The ordinary underground conduit with open slot is most expensive to instal and troublesome to maintain efficiently, it cannot be built for less than £10,000 or £12,000 per mile. Closed conduits with surface contacts usually operated by means of electro-magnetic switching devices in boxes under the street level are complicated, and it is to be feared are unreliable. The great weight of lead required on each car for accumulator traction means practically that the live paying load can never reach 25 per cent. of the gross weight of loaded car; whilst the combinations of trolley wire and battery, attempted on systems like those of Hanover and Dresden, are obviously ill-designed. The trolley seems to be the most desirable method.

NICOLA TESLA'S OSCILLATOR.

In the department of mathematical and physical science great interest was aroused by the reading of a paper prepared by Nicola Tesla on a new electrical oscillator, and the exhibition of the apparatus invented by him. The invention shown was a new machine for making Roentgen rays of extreme penetrating power. It is designed to take the place of an ordinary induction coil, for the purpose of exciting a Crookes' tube, and was said by Prof. Barker, of Philadelphia, who had seen it work in Tesla's laboratory, to furnish such a strong excitation, that with a fluoroscope he was enabled to look through Tesla himself, with the greatest ease The device consisted of two large coils of wire mounted on a neat wooden base, which contained inside of it a new type of condenser made by Tesla himself. One of these coils acted as a magnet to make and break the current, and at the same time helped to charge the condenser. This latter in turn threw its electric power into the second coil, which acted like an ordinary induction coil but with extraordinary efficiency. According to the scientists present, this scheme was an entirely new mode of using condensers. After the reading of the paper by Prof. McClennan, the room was darkened and the current turned on. With a current from an ordinary incandescent lamp, sparks were produced six inches long. Then two fine wires tied to glass rods were stretched out parallel from the terminals Immediately a band of glowing phosphorescent light was formed between the two, diversified with frequent brilliant sparks. During the discussion which followed several diverse theories were advanced to account for the operation of the new invention.

THE BARREN LANDS OF CANADA.

In the Geography Section, a paper read by J. B. Tyrrell, M.A., B.Sc., Ottawa, on The Barren Lands of Canada, was of especial moment. He stated that the barren lands, or more properly the northern plains and prairies of Canada, cover an area of about 350,000 square miles between the Mackenzie River and Hudson Bay, extending from the coast line of the Arctic Ocean down to the general northern limit of the forest. On the west coast of Hudson Bay they reach southward to north latitude 59 degrees, and thence their southern boundary extends in a northwesterly direction, roughly at right angles to the magnetic meridian, to within a short distance of the mouth of the Mackenzie River, crossing the Kazan at Ennadai Lake, the Telzoa River at Boyd Lake, and keeping some distance back from the shore of Great Slave Lake. In general character the country is a vast undulating, stony plain, thinly covered with short grass, while rounded rocky hills rise here and there through the stony clay. It can be divided into two fairly distinct portions, viz., the Coastal Plain, which rose from beneath the ocean in post-glacial times, and the Interior Upland, with a somewhat more pronounced topography, just as it was left at the close of the Glacial epoch. The whole country slopes gently towards the north-east, and the three main streams which drain it have a more or less parallel course in that direction. These streams are the Back or Great Fish River, with a total length of 650 miles; the Telzoa, or Doobaunt River, with a length of 750 miles, and the Kazan River, with a length of about 490 miles. The author showed illustrations, drawn from photographs, exemplifying the general character of the country, its herds of reindeer, and its native inhabitants.

THE FUEL AND AIR SUPPLY OF THE EARTH.

Lord Kelvin read a paper before the Mathematical and Physical Section, on the "Fuel Supply and Air supply of the Earth." "All known fuel on the earth," began his lordship, "is the residue of ancient vegetation. One ton average fuel takes three tons oxygen to burn it; and therefore its vegetable origin, decomposing carbonic acid gas and water, by power of sunlight, give three tons oxygen to one atmosphere. Every square metre of earth's surface bears ten tons of air, of which two tons is oxygen. The whole surface is 124 thousand millions of acres, or 510,000,000,000,000 of square metres. Hence there is not more than 340,000,000,000,000 tons of fuel on the earth, and this is probably the exact amount; because probably all the oxygen in our atmosphere came from primeval vegetation. The surely available coal supply of England and Scotland was estimated by the Coal Supply Commission of 1831, which included Sir Roderick Murchison and Sir Andrew Ramsay among its members, as being 146 thousand million tons. This is approximately six-tenths of a ton per square metre of area of Great Britain. To burn it all would take one and eight-tenths of a ton of oxygen per square metre, or within two-tenths of a ton of the whole oxygen of the atmosphere : ing on Great Britain. The commission estimated 56 thousand million tons more of coal, as probably existing at present in lower and less easily accessible strata.

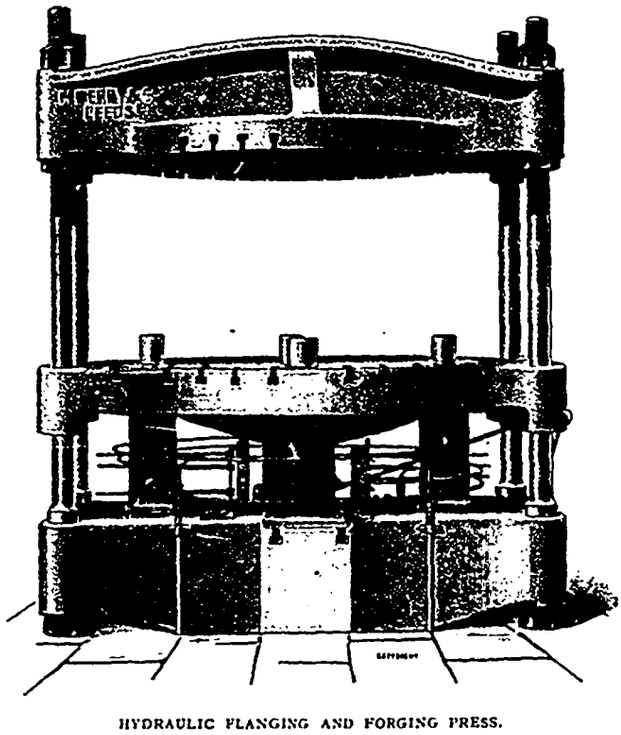
It may, therefore, be considered as almost quite certain that Great Britain could not burn all its own fuel with its own air, and, therefore, that the coal of Britain is considerably in excess of the fuel supply of the rest of the world, reckoned in equal areas, whether of land or sea."

In an Imperial Hydrographic Survey, read before the Mathematical and Physical section by Alexander Johnson, M A., LL.D., professor of mathematics, McGill University, the author explained that in 1884, at the Montreal meeting of the Association, a paper was submitted to Section A by the present writer, in consequence of which a committee was appointed for the "promotion of tidal observations in Canada." The writer was made secretary, and subsequently chairman This committee, supported by the Royal Society of Canada, and by those specially interested in navigation, succeeded, after many delays, in getting the Canadian Government, in 1890, to make a grant for tidal observations, which were to include not only the rise and fall of tide, but also the tidal currents. The grant was continued from that time until the present year, when it was reduced so that the survey of the currents could not be continued this summer, although an investigation of the utmost importance for the navigation of the St. Lawrence, more especially when the fast Atlantic line is going to be established. Possibly the entire grant is imperilled. It is believed that this reduction would probably not have taken place had there been in existence a fully organized hydrographic survey for Canada to advise the Government. The Royal Society of Canada had some time ago recommended the creation of such a department, and at its recent meeting in Halifax, appointed a deputation to present its views to the Government. The work of such a department can probably be most effectively carried out with the co-operation of the Admiralty.

The object of the communication was to seek the advice and aid of the British Association in inducing the Imperial and Canadian Governments to act together in making the necessary arrangements, which if found satisfactory, might possibly be extended to other colonies, and thus the basis of the Imperial Hydrographic Survey might be laid.

HYDRAULIC FLANGING AND FORGING PRESS.

The accompanying engraving illustrates a special type of hydraulic flanging press manufactured by the firm of Henry Berry & Co., makers of special hydraulic machinery, Croyden Works, Hunslet, Leeds, England. This machine is invaluable in large locomotive works where the plates to be flanged are of irregular form The press is fitted with four auxiliary rams for holding the plate to be flanged against the top die, and these can be adjusted radially. In addition to this the central main



HYDRAULIC FLANGING AND FORGING PRESS.

flanging ram is so arranged as to form a cylinder to receive a further vice ram which will hold the plates in position when too small to be dealt with by the outside vice rams. The regular standard types of these presses are made to admit plates from 7 feet to 9 feet, the diameter of the ram of the smallest size being 14 inches and the largest 17 inches, with a stroke in the former case of 28 inches and in the latter of 30 inches. This firm are extensive makers of almost every kind of hydraulic machinery for every purpose, and their catalogue is quite a cyclopedia of special machinery, some of which is made by no other firm.

VIEW OF KING'S MOUNTAIN.

A very important work is being done by the Department of the Interior in mapping out the country which forms the boundary between Alaska and the Canadian Yukon. This work has been carried out

KING'S MOUNTAIN.

under W. F. King, chief astronomer, in honor of whom the mountain here shown has been called. It is a fine sample of Yukon scenery. The view is taken from near Pyramid Harbor, Chilcoot Inlet, looking south-westerly. The height of the peak is 6,500 feet.

GAS FROM GARBAGE.

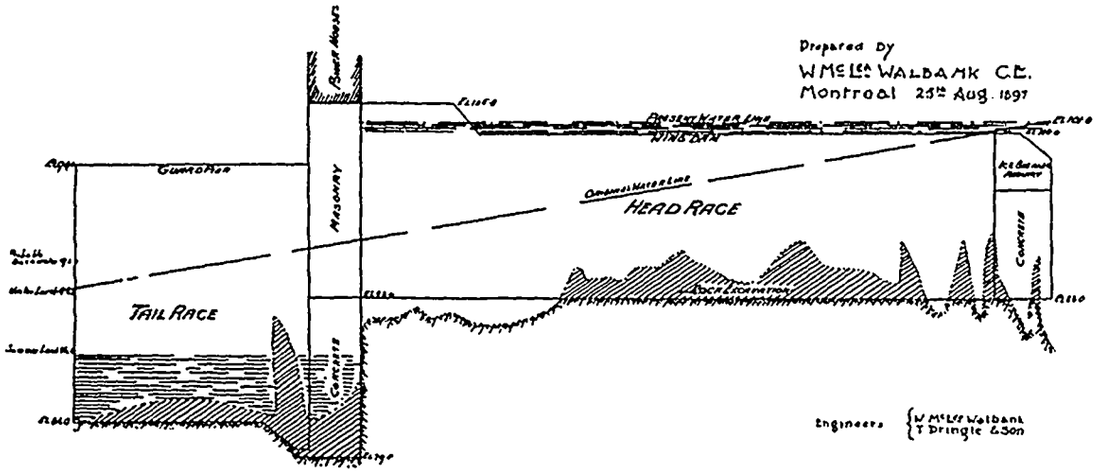
A representative of THE CANADIAN ENGINEER was called the other day to witness an interesting experiment in the production of illuminating gas from street garbage. For two or three years past, L. G. Harris, 55 Maitland street, Toronto, has been studying the problem of utilizing garbage and as a result he has been able to show an experimental plant, in which a quality of gas about equal to that of Toronto can be generated at a cost of a few cents per thousand. The generator is a simple form of retort placed over a common box stove. Into this retort 10 or 12 lbs. of vegetable refuse, such as potato peelings, melon skins, etc., are thrown, after being mixed with two or three cups of gas oil and some chemicals—the latter being Mr. Harris' secret. A coke fire is started in the stove, and in a short time the contents are heated and the gas begins to develop in the retort. As it is evolved, it is passed through a cylinder filled with broken brick for drying it, and thence to a chamber filled with lime, by which it is purified. This is the whole process, as the gas then passes into the gas holder, whence it is distributed to the burners. The cost of the oil and chemicals for mixing with garbage to the extent of a ton, is estimated at from 50 cents to 75 cents, and a ton will produce 14,000 feet of gas. There is a residue left in the retorts in the form of a kind of coke, and it is calculated that enough of this coke will be produced in one charge to make fuel for the succeeding charge. If this calculation is borne out in actual experience, the cost of fuel will be entirely eliminated from the expense of operation. There is also a liquid residue, the nature and value of which has not been determined. As to the quality of the gas no analysis has yet been made, but Mr. Johnstone, inspector of gas for Toronto, and an official of the Consumers' Gas Co. regard it as being about 18 candle power, or two candle power above the standard; while the inventor claims that it is better than the gas of Toronto or any other city for cooking and heating purposes.

The cost of cremating the garbage in the two incinerators in Toronto is over $12,000 a year, and the cost of collecting and cremation together, apart from snow cleaning, amounts to about $50,000 a year. In many American cities of like population the cost of garbage disposal is considerably higher, the expense in Minneapolis, for instance, being $100,000 for removal alone, besides $20,000 paid to a contractor. The question of garbage disposal is a serious one for all cities, and if Mr. Harris can turn it into gas and coke as cheaply as he believes he can, a great advance will have been made in civic economy. At all events the mayor and medical health officer of Buffalo, along with a Buffalo capitalist, have been over to see his process, and so impressed are they with its utility that they seem likely to adopt it there, and have invited the authorities of Chicago and other cities of the States to investigate it. Peter Ryan and K. R. Arnett have acquired

the rights for Canada, and have a plant in daily operation at the corner of Church and Lombard streets, Toronto.

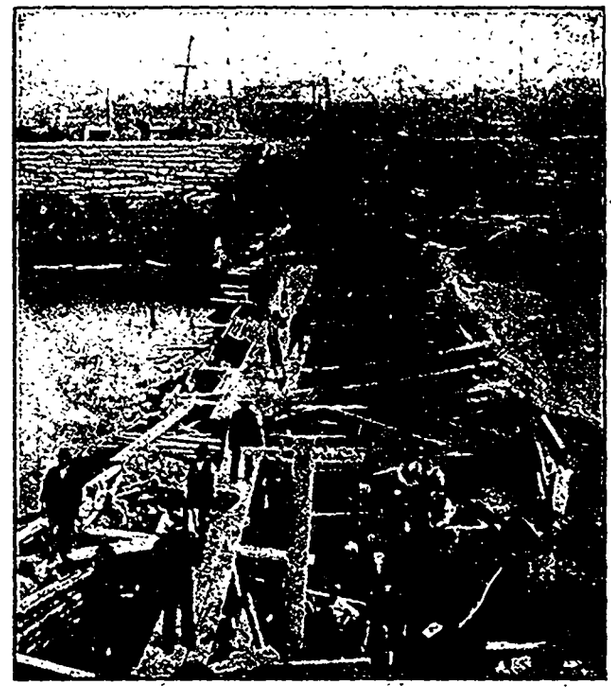
LACHINE RAPIDS POWER.

On the 2nd August water was let into the dam of the Lachine Rapids Hydraulic and Land Co., the second largest electric power works in the world; and on the 25th September the formal opening of the works took place in the presence of a large number of visitors. On previous occasions THE CANADIAN ENGINEER has given descriptions of the hydraulic features, the electrical features and the structural features



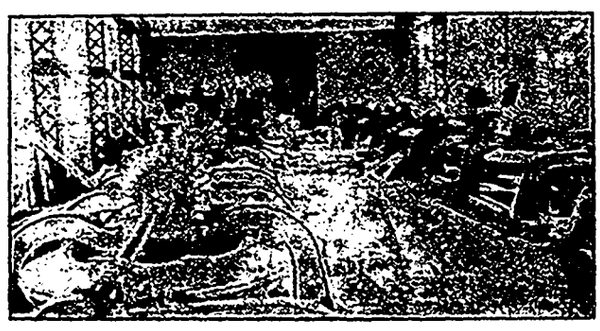
of these works. We give herewith a diagram indicating the physical features of the river bottom at the dam, and a reference to this in connection with our previous articles will show some of the problems that had to be solved in constructing the works. The observations of Messrs. Walbank and Pringle led them to believe that the difficulty of back water and ice in winter—which had been the *bete noir* of the engineers who had previously examined the Lachine Rapids—could be removed by blasting out the reef below the proposed site of the dam, and experience of last winter has shown that even the partial blasting away of this reef, which has already been accomplished, will do away with the trouble. There now only remains the question of the effect of frazil ice, but it is confidently believed that the large still-water basin above the works—walled off as it is by the boom and the natural dividing line of swift current at the head of the basin where the main body of water is deflected into the rapids at the rate of 10 to 20 feet per second—will avoid any serious trouble from this cause, as the still-water basin would be frozen over early, and frazil will not form under cover.

It may be of interest to recall the fact that the Lachine Rapids have been a source of power for over a century, one of the religious orders of Montreal owning a water power at the very site of the present works, where a grist mill, a flax mill, and a shop or foundry were running till the latter part of the present century. That this enormous power could be more extensively used evidently occurred to many, for in August, 1857, when the American Association for the Advancement of Science held its annual convention in Montreal a number of its members went down the rapids, and at the close of the meeting one of them congratulated the citizens on possessing such a city, and said there was "a power stored up here upon the shores, which within a hundred years will probably result in making this city the greatest city in America. This immense water-power being directed to the manufactures which might be established there, will make this one of the greatest cities of the globe." And yet this prediction was made before the possibilities of transforming water-power into electricity were realized. This prophecy probably moved local men to a consideration of the question, and in 1868 we find Thomas F. Miller writing a pamphlet on the subject, and recommending the very thing which the engineers of the present work have carried out, that is the formation of "a sort of lake or pond as the supplying source in which an unvarying head would be secured, over which ice would, of course, form rapidly as far as still water extended upwards, where all the frazil coming from beyond (none could form in this pond) would, with the current which brings it down—in consequence of the resistance here presented—be deflected and swept off into the rapids and main channel of the river south of Ile au Heron." It remained for the present company to carry out the theories then advanced, and the result is the largest power development in Canada. The company has spent $1,500,000, and has recently had its capital increased to $1,750,000, practically all being Canadian money. As before stated there are now 48 wheels installed, but room is provided for 72. There will then be 12 generators, each



SUBWAY UNDER THE LACHINE CANAL.

connected to a series of six wheels, and making 175 revolutions per minute and generating current at 4,400 volts. The current is carried to the city on cables supported on steel lattice poles, the first of the kind used in this country. In order not to interfere with canal navigation the cables are led under the canal near Wellington street by a subway [shown in course of construction in the accompanying cut], which was built in the short space of 14 days, while the water was let out of the canal for cleaning. The cables are thence carried to the sub-station at the intersection of McCord and Seminary streets, where it is distributed for the city. The company has a controlling interest in the Citizens Light and Power Company, which has a 50 years' franchise for supplying St. Henri and St. Cunegonde suburbs, and shorter contracts for street lighting in Westmount and St. Louis de Mile End. It has also a controlling interest in the Standard Light and Power Co., which by a decision of the Privy Council, given on the very day the water was



THE INTERIOR OF POWER HOUSE.

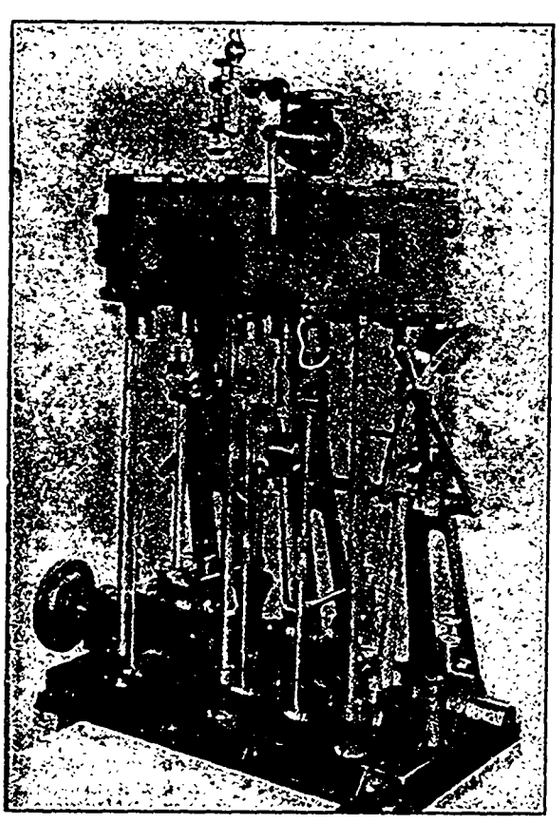
let into the dam, will have the power to construct electrical works in other cities, as well as in Montreal. The company owns a considerable amount of land near its Lachine works, and it is intended to lay out the foundations of a town and park, which will be connected by electric railway with Montreal. The officers of the company are: G. B. Burland, president; Alex. Fraser, vice-president; W. McLea Walbank, managing director, the other directors being R. Wilson Smith, S. Carsley, E. K. Greene, and Peter Lyall; Robert White, sec.-treas.; A. Cinq-Mars, auditor; T. Pringle & Son, mechanical engineers; R. S. Kelsch, operating superintendent; John Dodds, mech. superintendent; D. Barton, asst. electrical engineer; W. Kelsch, foreman of underground work, and E. Craig, superintendent of arc lighting.

A LAKE BUILT YACHT.

The cut shown herewith is from a photo of a cabin steam yacht built by Davis & Sons, of Kingston, Ont., for W. L. Standish, of Pittsburg, Pa., and now running on Lake Muskoka. She is 52 feet long, 10 feet beam, 4½ feet deep, and draws 40 inches of water. This handsome boat was contracted for on the 10th April last, to be completed

LAKE BOAT YACHT.

and loaded on cars by the 10th July. She made her trial run on the 8th July, with the owner and his wife, A. T. Lowe, engineer, and several gentlemen, and made a satisfactory record, and was shipped within the time called for in the contract. Her engines, which are shown in the cut herewith, are triple expansion, the size of cylinders being 5 inches, 8 inches and 13 inches, by 8-inch stroke, and capable of propelling the boat 13 miles an hour. These engines are fitted with the Bremme reversing gear, and turn a 38-inch brass wheel with 60-inch lead at a speed of 300 revolutions per minute when working under a pressure of 160 lbs. of steam. The boiler supplies 200 lbs. of steam



easily, and when the throttle is open the propeller will run up to 370 revolutions a minute. The engines and boiler were designed and made in Davis & Sons' own machine shops, and are considered a creditable piece of work.

WM. B. MACKENZIE,

MEM. CAN. SOC. C.E., MEM. AM. INST. C.E.

W B. Mackenzie, who has recently been promoted to the position of chief engineer of the Intercolonial Railway, is a native of Pictou county, N.S, and is the eldest son of the late James Mackenzie, a farmer, land surveyor and road-maker, who did a large part of the land surveying, and highway location and construction in Eastern Canada Mr. Mackenzie followed his father in these different occupations from the time he became old enough to hold the rear end of the chain and keep "tally" by cutting notches on a stick. After studying mathematics, including land surveying and navigation under Prof. Bayne in the Pictou Academy, he, in 1870, became leveler on the first preliminary survey of the Eastern Extension Railway, between New Glasgow and Cape Breton, and was in the same year appointed crown land surveyor for the county of Halifax. In 1872, when the Intercolonial was opened between Truro and Amherst, he was made office assistant in the chief engineer's office at Moncton, during which time he studied railroad engineering after office hours, including graphic statics, commenced under the tuition of Prof. Greene, of Michigan University. This, together with the bridge engineering course of the International Correspondence School, and other engineering subjects, has fully occupied his leisure hours to the present time. In 1879 he was appointed assistant engineer of the I.C.R. In this capacity he located and built the several branches of the Intercolonial, and designed the greater part of the bridge and bridge renewal work on the I.C.R. and P. E. Island railways, under the direction of the chief engineer, P. S. Archibald. He has travelled over and examined the tracks and bridges of the principal railroads in the United States, and has been quite successful in collecting information for the defence of several important I.C.R. law cases. In 1895 he spent several weeks at the principal U. S. creosoting works, and made a special study of the process at Norfolk, Va., where 1,900 piles were creosoted for the I.C.R. He has writen several essays on engineering subjects, such as: "Notes on Railway Location and Construction in Eastern Canada" (Trans. N.S. Institute of Science); "Cribwork Retaining Walls" (THE CANADIAN ENGINEER, Apr., '96), "Creosoting Timber" (pamphlet); "Painting Metal Bridges" (pamphlet); "The Tidal Marshes of the Bay of Fundy" (pamphlet). The third has been highly spoken of by competent judges, and the fourth is pronounced by the *Engineering Magazine* to be "one of the best essays on the subject that has recently appeared." He has been a member of the Nova Scotia Institute of Science and of the Canadian and American Societies of Civil Engineers for many years. His frequent inspections of I.C.R. connecting and other lines of railway has afforded him valuable experience, which, with an intimate knowledge of the Intercolonial Railway, seems to point him out as a person especially fitted for his present position.

The annual report of the Association of Ontario Land Surveyors for 1897 has just been issued, and makes a volume of 182 pages. The report contains the full text of the papers read at the last annual meeting in February, with reports of the discussions thereon, and the contents are, perhaps, more interesting than those of any previous issue. A portrait of Hon. S. P. Hurd, Surveyor General of Upper Canada in 1830, is given as a frontispiece, and a biographical sketch of him, with a picture of his birthplace in Bermuda, is given in the appendix. The obituary record contains the names of six members who have died during the past year, namely, W. R. Burke, Richard Coad, Michael Deane, J. R Peddar, Clifford E. Thomson and C. J. Wheelock. The secretary of the association is A. J. Van Nostrand, of Speight & Van Nostrand, Yonge street Arcade, Toronto, from whom all information can be obtained.

AN ENGLISH OPINION OF THE FAST ATLANTIC SERVICE.

The new contractors (says a correspondent of the *Marine Engineer*, London, England, when writing about the fast Atlantic service recently), Petersen, Tate & Company, have published their intentions in regard to the matter. It appears that the old terminal ports are not to be forsaken after all, in spite of the pleading of Sir Sandford Fleming in the pages of the *Queen's Quarterly*. The St. Lawrence and the Mersey are still to be the objectives. So far, good. But I am more than surprised to hear that the vessels which it is said are "to equal the 'Campania' in speed and comfort," are to be built of the turret type. This may be a most excellent type for cargo vessels—indeed it must be so, or such keen business men as those who direct the fortunes of Clan and Angier Lines would not be adopting it—but it does not look as though it were specially, or at all, adapted for passenger ships. It would be a thousand pities if a new departure were to be adopted in this regard which might imperil the popularity of the line with passengers, and so prejudice the link which we have so long desired to see forged to connect our little island with its great colonies in the west and south. But one cannot help having the greatest misgivings in regard to the whole business. Personally, I don't like the idea of the turret ships I should rather hesitate in putting forward that opinion, where my judgment is opposed to that of practical men whom the British and Canadian Government unite to honor and confide in. But I am somewhat emboldened to differ when I see that along with the turret idea is one which all men may well make bold to call ridiculous. The fleet is to consist of four vessels of 10,000 tons each. Of these, two are to be at work, giving a fortnightly service, within two years. The others will follow and make the service weekly, twelve months later. In passing, it may be remarked that it will be interesting to see if these ships really approach the great Cunarders in speed. But a fifth vessel is to be provided. It is she which excites my distrust of the whole scheme and that apart from any other consideration. Lest I should appear to be stating the case in an unfair way I will quote from the *Shipping Gazette*, which certainly does not appear hostile to the contractors or their device. "Apart from the details in regard to the design of the steamers, the contractors have had to face a very tangible difficulty in combatting the fogs of the St. Lawrence. . . . Mr. Petersen set himself to solve this hitherto almost unsolvable problem, and hit upon the happy and thoroughly feasible plan of employing a fast little craft of the torpedo boat type, to act as pilot and danger signal to the ocean steamers. The little vessel is designed to travel down the river and meet the incoming steamer, and is to be fitted with a sound signalling apparatus and a powerful electric searchlight. . . . . She will meet the approaching steamer on her passage up-river, sounding her signals at intervals, and giving an extra signal in case of danger. Taking charge of the steamer she precedes her, and, acting as a pilot, enables the navigation of the waterway to be conducted at a comparatively high speed, but nevertheless with comparative safety." The paragraph I have briefly quoted is printed by my contemporary in large type and is from the pen of their Newcastle correspondent. It concludes with a statement of the "great appreciation" with which the Canadian Government has accepted this "excellent device." But I imagine the Canadian Government is composed of neither sailors nor pilots, whilst I also feel sure that the Newcastle correspondent of the *Shipping Gazette* who went to see the firm which is at the moment in such prominence was a most experienced journalist, and one who did not allow the light of his own knowledge to obscure the 'happy idea' upon which Mr. Petersen had hit. What does it all mean? I am sure Mr. Petersen is welcome to all the credit his labors may bring him, and I hope his 'happy device' may prove as valuable as he expects If the torpedo boat can find the liner to guide her, she could also find her to put a pilot aboard of her. That is to say, the pioneer can have on board no guide, whom she might not be able to put aboard the guided. I suppose the big boats will draw 26 feet of water. A torpedo boat draws more like six feet. Her search light then will prove a mere will-o'-the-wisp, unless she maintains constant soundings based on the draught of the vessel she is piloting. Surely a liner with a big crew and lots of deck room is more suitable for all this sounding than a little craft. But let that pass. Let us even assume that the little vessel is instinct with knowledge that cannot be put aboard the big ship. What good will she be? Has Mr. Petersen ever heard of or seen a sea fog, either in the Gulf of St. Lawrence or in British waters? Does he not know from hearsay, at least, as some of us know from experience, that what sailors call a dense fog means an atmosphere so thick that the officer on the bridge cannot see the crow's nest, and that the most powerful light that ever was put into a lighthouse is obscured at a few yards' distance? The search light will be useless unless the torpedo boat runs the chance by her proximity to the liner's bows, either of being run down or of leading the liner into shallow water as she avoids a collision. I do not say that the St. Lawrence is so bad as Mr. Petersen makes out in the matter of fogs, but I do say that when fog is encountered, either in the St. Lawrence or elsewhere, so dense that a leading boat of light draught is required to pilot a mail steamer, it is quite time for the captain to stop his engines and drop his pick."

BOILER SETTING.

Editor CANADIAN ENGINEER.

SIR,—I was very much pleased with your article in your August number on the heating power and value of the coal we engineers have to handle daily. You have given the calorific value of coal and constant heating power of carbon 14.652, and the constant heating power of hydrogen 62.100; these two together you call volatile matter, or hydro-carbons = 14.652 + 62.100 — 5,400 neutralizing effect of oxygen less heat formed by the formation of nitric acid. In the real value of coal, say anthracite or hard coal, we have the fixed carbon, which is contained now in the ashes we throw away, equal to 28.648. This is too much to throw away or lose, more than a quarter of a ton on a ton, and if what you say about the measurements by instruments is correct, we may safely say a great many men using coal do not get out more than one-half its value, by inattention and bad construction of furnaces and boilers. I have chosen anthracite, because I use more of it than of bituminous.

The question may be very naturally asked, how shall we get more heat out of our coal and ashes? Our attention must be turned to the construction of our boilers, furnaces and chimneys, and leave the instrumental measurements to decide afterwards. About thirty years ago, I got this subject before some of our manufacturers in this city; I then got a boiler 14 feet long by 48 inches diameter, with two large flues 11 inches diameter each, and above were 19 tubes 4 inches in diameter, with a division plate behind and a smoke box in front, with four strong cast brackets to carry the boiler over the fire; the brick bed was laid down; the front was what was called half front. There was a dead plate nine inches wide, with a recess for the ends of four feet bars, and a bearer at the back of the ash-pit. The bars were raised behind four inches; the brick work behind the bars sloped up to the end of the boiler to eight inches, and six inches short of the boiler. There was no bridge, for I saw it was not wanted. At first, when the fire and bars were put into the long flue of the old Cornish boiler, with bars fitted across the flue below the centre to give room above the bars; they also dipped the bars behind to give more room for the fire, and built up the back of the ash-pit so as to keep the ashes from getting beyond the reach of the fireman and also to prevent the air from going in farther than the fire bars On the top of this wall they built the bridge to prevent the fire and coal from falling over the bars, so it is very apparent that a bridge was not to save coal or to sharpen the draught or to save the building of a proper or high chimney as is supposed by some of our engineers to-day. I have put together many furnaces within the past 60 years where the boiler was put on its bed, the front end was 20 inches from the dead-plate, and the back end was 8 inches from the brick or bridge, if you are pleased so to call it; the back end of boiler was one inch higher than the front end; the dome was straight up, and a centre line of the front end stood about the centre of the fire-door and ash-pit. I then divided the boiler end into three parts on each side of the centre line, two of these parts are enclosed in the fireplace with firebrick. At these points the firebricks were put on their edges, and the ends pushed against the sides of the boiler to stop the flame and smoke getting through. The wall here was set back 2½ inches, and was built up to the brackets on the boiler with pieces of boiler plate to move on when expanding. A thinner wall was built up above the top of the boiler to have bars put across, and on the top of those bars were plates of sheet iron, with bricks and mortar on top to keep in the heat, so that the boiler was enclosed as in an oven, with nothing touching it but the row on each side forming the fireplace. The reason why I divided the boiler end into six parts and took two into the fireplace was so that when the boiler expanded it would rise up and not push out on the brickwork, which can be renewed at any time from the inside, by taking out the bars and standing in the ash-pit. I built a large ash-pit, so that the air might be heated when entering the fire.

I have yet one of the boilers I set on this plan thirty years ago, and it is in good working order now, it has a good high chimney. I have others set on the same plan, but the chimneys are too low, so that I can only pass the heat through the boilers once.

I think if you could give us a good practical rule for building chimneys and setting boilers for every sort of coal, and then the instruments could be applied so that our ordinary engineers could see where their defects are, it would be of use to all enquirers.

I have a boiler set in on the same plan three years ago, 14 feet long, 48 inches in diameter, with 35 tubes 4 in. Since that time, or I

may say, within the last two years, I have had seven new tubes put into it, each one taken out showing all over pits eaten into it This boiler has to heat about 6,000 gallons of water per day for washing. What shall I put into it to prevent the tubes from being pitted and eaten away? I have another hot water boiler throwing off thousands of gallons every day which has done so for many years past and not a tube has been moved nor have any other repairs been made My impression is that the new inventions for smelting the iron and making the tubes and boiler sheets are not so good as the old Low Moor iron was They call it steel to-day. I fear they are squeezing and rolling up a lot of scraps and putting a gloss on it and calling it steel. The sooner we get back to good iron the better, as it will save great expense and many dangerous accidents, and remove the blame from many poor dead engineers, who did their best with very bad boiler material. Both the hot water boilers of which I speak are supplied with city water and from a tank above A large cylinder stands between the tank and boiler to receive the cold and hot water of each. After losing five tubes I was persuaded to feed this boiler from both ends, which I did, but do not find any advantage, for I have had to put in two tubes since

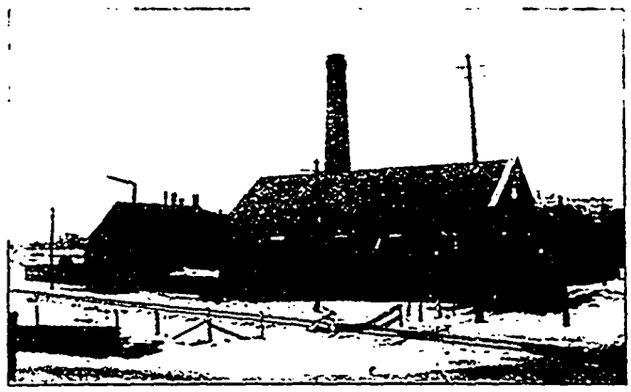
Yours truly,

P TROWERS,

Chief Engineer, Asylum for the Insane, Toronto

THE SARNIA GAS AND ELECTRIC LIGHT CO.

The electric light branch of the above company was established in 1894 and the plant was constructed during the summer of that year. The building, as will be seen by the accompanying illustration, is a handsome and substantial structure. It is built of red brick, with freestone trimmings and stone foundation, with basement under the engine and dynamo room, having truss roof, covered with iron, making the building practically fire-proof. Its dimensions are 34 x 72, with



POWER HOUSE.

octagon brick smoke-stack, 75 feet in height. The foundations for engine, dynamos and line shafting are of stone and brick set in cement, reaching through the main floor. The electric plant consists of one 75-light, Wood arc dynamo, with spare armature: one 30-kilowatt T.H. single-phase alternator, with 1½ K.W. exciter, and necessary switchboard apparatus. All of the electrical plant was installed by the Canadian General Electric Co., of Toronto and Peterboro The incandescent light business has developed to such an extent that it has been found necessary to increase the plant, consequently an order was recently placed with the Canadian General Electric Co for another of their standard alternators of 60-kilowatt capacity. About 750 lights are now wired up and the number is rapidly increasing, which speaks highly for the efficient service given. The arc line for street lighting required over 16 miles of No 6 B & S wire and 10 miles of poles There are seventy 1,200 c p lamps in use The steam plant consists of a Wheelock engine 13x30: two steel boilers, one 60 inches by 14 feet, and one 66 inches by 14 feet, both of the tubular type, with all necessary shafting and friction clutch pulleys manufactured by the Goldie & McCulloch Co., of Galt. In order to further increase the capacity and efficiency of the plant, a 300 h.p. Northey duplex condenser and duplex boiler feed pump were installed during the past summer, taking water supply from the river through an 8-inch pipe These improvements add easily 25 per cent. to the economy and efficiency of the plant. Besides the addition of another dynamo and boiler, new steam and smoke connections have been put in.

AN Ontario charter has been issued to William Lindsay, Brisbane, Australia, J. Joyce and R I Bradley, Petrolia; J. Marshall, J. Wallen, Oil Springs, as the Intercolonal Deep Well Boring and Manufacturing Company of Petrolia, Limited, to drill wells and manufacture and sell drills and drilling machinery.

ACETYLENE GAS REGULATIONS.

The following is a copy of the restrictions imposed by the Canadian Fire Underwriters' Association, on the use of acetylene gas for illumination.—

1st.—That no calcium carbide or gas generating machine be allowed in any building insured.

2nd—That generator must be placed in a separate building, constructed as follows, viz. —Walls solid brick or stone not less than nine inches thick; roof entirely of iron or other fire-proof material; floor of cement or concrete with slight upward slope from door; entrance to be an iron or standard fire-proof door, no windows or other openings except for ventilation, which shall be through an iron pipe not less than six inches in diameter protected sufficiently through the roof and turned down at the outlet. Generators must be provided with escape pipes of sufficient capacity to allow gas to escape freely at a pressure not exceeding five inches of water. Care must be taken to deposit residue from generator at a safe distance from any building.

3rd—That generator building must be located at least ten feet from a brick or stone building, or twenty feet from one of any other construction.

4th.—That the storage of calcium carbide be limited to three hundred pounds, to be kept in air-tight metallic cases not exceeding one hundred pounds capacity, and confined to the generator building.

5th - That if the above regulations are not fully observed, double rates must be charged

Industrial Notes.

SPOONER had his "Copperine" at the exhibition again.

CHRIST CHURCH, Listowel, Ont., is now lighted by acetylene gas.

A NEW bridge is to be built over the Mississippi River, at Glen Isle, Ont

A NEW provisional jail is to be built in Nelson, B.C., to cost $14,000.

A NEW r lroad bridge is to be erected by the C P R., at Kemptville, Ont

Two of the six miles of pipe are now laid in the Perth, Ont. waterworks.

THE village of Iroquois, Ont., is putting in an electric light plant and waterworks

THE Farmer's Elevator Co., of Lumsden, N.W.T., will build a 30,000 bushel elevator.

THE Peterborough Bridge Co is building a new iron swing bridge, at Rosedale, Victoria county, Ont

THE ratepayers of St. Thomas, Ont., will vote on a by-law to raise $40 000 for building a new city hall, on the 11th inst.

THE Smith's Falls, Ont., school trustees are to spend $1,000 on a system of ventilating and heating the central school.

THE rebuilding of the eastern abattoir, Montreal, on its former position is opposed by the municipality of Delorimier.

PEUCHEN & CO, Toronto, acetic acid manufacturers, are rebuilding their Tonawanda, N.Y., branch, recently destroyed by fire

THE cement works of the Rathbun Co at Napanee Mills, Ont, are very busy, and two new kilns are being erected at the works.

THE Heinze Pickling Co., Pittsburg, Pa., is negotiating for premises to open a branch in Canada, probably in Hamilton, Ont.

AT the recent exhibition at Sydney, New South Wales, the Canada Paint Company of Montreal was awarded first prize for paints and varnishes.

DAVID WHITE, Brantford, Ont., is superintending the erection of a sawmill at Bell City, Rainy Lake, Ont. It will be running by November 1st

J. H. Ross, formerly employed by the Goold Bicycle Works, Brantford, Ont., has been appointed a boiler inspector, with headquarters at Orillia.

THE Edwardsburg Starch Works, at Cardinal, Ont., are running day and night, and are to be enlarged so as to double the capacity of the works at once.

A BREAK in the Montreal water main, which passes under the Lachine Canal at Atwater avenue, recently gave the city water department considerable trouble to repair.

J. U Ross, Hamilton, Ont., has bought the Haggart works, Brampton, Ont., which have been idle for some years, and will manufacture threshing machines, engines, etc.

ARCHITECT GAUTHIER, of Montreal, has been instructed to prepare plans for building an $18,000 addition to the Catholic Church of St. Thomas, of Alfred, Prescott county, Ont.

THE ratepayers of Gravenhurst, Ont., will vote in January on a by-law authorizing the expenditure of $16,000 on waterworks, $9,000 on an electric light plant, and $4,000 on a town hall.

WORK on the St. Lambert, Que., water and sewage works is being pushed by the contractors, Drummond, McCall & Co, Montreal, the legal difficulties raised by the opposing ratepayers having been overcome.

THE machinery at Toronto exhibition was lubricated with the Standard Oil Co's "Capital Cylinder," "Renown Engine," and "Atlantic Red Oil" from the Queen City Oil Co., Limited, Toronto.

PAQUET & GODBOUT, St Hyacinthe, Que, have been awarded the contract to build the new headmaster's house and gymnasium at Bishop's College School, Lennoxville, Que., and the plans have been prepared.

THE Hamilton Powder Company of Montreal has placed an order with the James Cooper Mfg Co., Ltd., for an Ingersoll-Sergeant piston inlet compressor, to be used at its Beloeil works for pumping and agitating acids.

THE ratepayers of Springbank, N.W.T., are to vote on 14th inst. on a by-law to raise $40,000 on the security of their lands for the purpose of constructing a canal, laterals, flumes, reservoirs, etc., for the irrigation of the district.

THE Canada Paint Company has recently in one week booked orders for over one hundred tons of colors and varnishes. This is another example of the superiority of Canadian products when brought into direct competition with foreign goods.

THE Beacon Acetylene Generator Company, of Woodstock, Ont., lighted the Fair buildings at Woodstock, Ont., again this year with acetylene gas. Last year the results were very satisfactory, that being the first occasion when the new gas was used on a large scale in Ontario.

J. E. WHITTAKER & Co., St. John, are making rapid progress on their factory which is being built at Hampton, N.B. The main building, 100 by 40 feet, and the boiler house are nearing completion. Tinware will be manufactured, and an enamelling and graniteware department will be added shortly.

THE machine shop business of Jonathan Weir & Son, Moncton, N.B., which has recently been conducted under lease by the Record Foundry and Machine Co., will in future be managed by John P. Weir. The firm will undertake mill work, boiler making, forging and repairs of all kinds Engines will be built to order, and a specialty will be made of locomotive repairs.

NEW sewers have been recommended for the following streets in Montreal: St. Denis, from St. Ignace to the C.P.R. track; De Montigny, from Beaudry to Montcalm streets; St. Henry, from Notre Dame to St Paul streets; Desrivieres avenue, its whole length; St. Andre, from Marianna to Mount Royal avenue, and from Mount Royal avenue to Perrault street.

THE open season for most sorts of game is now on, but, of course, bonus hunting is always in The Kingston *News* says in a recent issue. "The Wortman & Ward Manufacturing Company, of London, want a bonus of $12,000 and exemption from taxes to locate in this city. The board of trade will recommend the council to give them a free site and exemption from taxation without bonus."

DARBLAY, PERE & FILS, of Paris and Rouen, one of the largest pulp and paper-making firms in France, have had agents in New Brunswick recently making arrangements for a supply of spruce for pulp making Export of pulp wood should not be encouraged, and if the large number of pulp mills now projected in New Brunswick are built, the supply for export will not be so great.

MANY of the St John saw mills are shut down on account of the American tariff changes, says the Fredericton, N.B., *Reporter*. Stetson, Cutler & Co.'s large mill at Indiantown is silent, and a large number of men are idle. Jordan's mill, at Pleasant Point, is shut down; Miller & Woodman's two mills, at Milford, are closed, and Chas. Miller's mill is shut down. Murray's, Cushing's and the Grand Bay mills are still running.

CHIEF JUSTICE ARMOUR dismissed the suit brought recently in the Civil Assizes by Launcelot B. Montgomery against the Toronto Mineral Wool Company for $1,000 damages. Montgomery was moving an engine for the company, when one of the jacks supporting it gave out, and the engine fell over against Montgomery, inflicting injuries to his knee and abdomen. Montgomery held that the company was responsible, having supplied him with defective appliances. The court held that he was an expert, and should not have used the defective jack.

OVER 300 men are now employed in the C P.R. car shops, at Perth, Ont.

F. LEMOINE, Montreal, has been awarded the contract for the piers and abutments of the bridge at Edmonton, N.W.T., at $36,000.

THE Jesuit Fathers will shortly build a very large college building in Westmount, Montreal.

T. SMITH has the contract for the Perth, Ont., pumping station; building, to be completed by the 20th inst.

ST. HENRI, Que., recently voted $20,000 as a bonus to the Moseley Shoe Leather Company to establish a tannery.

IN Berlin, Ont., I. E Shantz & Co.'s foundry, H. J. Hall's woodworking factory and the Berlin Brush Co. are working overtime.

THE Mooers Elevator Company, Kingston, Ont., has awarded the contract for the engine and boiler required for the elevator to the Goldie & McCulloch Co of Galt, their tender being the lowest of seven.

SOME time ago a dam was built on the St. Francis River at Drummondville, Que., which developed about 10,000 horse-power. So far very little use has been made of the power, and the townspeople are disappointed.

HARVEY & Co., have their Newfoundland pulp mill ready for operation. It is expected that a number of other mills will shortly be erected if the first one proves a success, as it no doubt will, as Newfoundland has unlimited water-power and spruce wood.

THE Robb Engineering Co. have received an order for three tandem compound engines, side crank type, for export to Spain. These engines are to be direct connected to electric dynamos, and were ordered by an English Engineering firm for electric tramways at Barcelona and Madrid.

A. L. CURRY, of Curry Bros. & Bent, Bridgetown, N.S., is in Labrador in the interests of his firm. He is investigating the possibility of lumbering operations there on a large scale, for the purpose of shipping to Europe, and if his report is favorable, the firm will build mills there.—*Annapolis Spectator*.

RECENTLY while J. J. Copp, a moulder at the works of Rhodes, Curry & Co., Amherst, N.S., was carrying a ladle of hot iron from the furnace, he spilled a quantity of molten metal inside his boot. Before the boot could be removed the foot was terribly burned, the flesh from the instep to the great toe being destroyed.

THE Gravel and Construction Company, of Toronto, Limited, has been incorporated to construct public and private works, and deal in building and paving material, with a capital of $40,000. It is composed of A. Campbell, M.P, J. Smith and R. L. McCormack, Toronto Junction; J. P. McIntosh, Toronto, and A. H. Royce.

WALKERTON, ONT., has captured one of Toronto's important industries, the business of the American Rattan Co. having been purchased by the Walkerton parties, who will remove it to that town. The price paid for controlling the stock is $75,000, and about 100 hands are employed, many of whom will remove to Walkerton. The company was established in Toronto ten years ago with ten year's exemption.

THE contracts in connection with the new sewage interception works at Hamilton, Ont., were awarded as follows: Carpenter work, R & J. Poag, $1,639; masonry excavation, etc., G. F. Webb, $5,699; machinery, A. J. Nie, $5,480; plumbing and steam heating, Fairley & Stewart, $633; roofing, J E. Riddell, $897; painting, D. Kemp, $198; boilers, R. Quinn, $1,050; elevator, Leitch & Turnbull, $475; electric wiring, $130.

AT Brantford, Ont., the Paterson Biscuit Company is working 24 hours a day, new machinery will be installed, the Verity Plough Works are working day and night, and contemplate making large additions to the works; the Massey-Harris Company which generally closes down altogether in September, is now running full time; the Cockshutt Plow Company recently built an addition larger than the original factory, and will shortly close down a few days to instal a new boiler plant.

R. A. LATIMER Montreal, carriage manufacturer's agent, has assigned at the demand of White, Chelloran & Buchanan; liabilities about $85,000. The principal creditors are: Canadian Carriage Co., Brockville, $13,073.13; Cossit Bros. Co., Brockville, $10,326.28; Brantford Carriage Co., $5,668.23; Wm. Gray & Co., Chatham, $4,287.79; G M. Cossit & Bros., $3,934.57; Deering Harvester Co., Chicago, $3,541.94; McLaughlin Carriage Co., Oshawa, $2,300 82; J. W. Morin Mfg. Co., $2,852.50; Wortman & Ward Mfg. Co., London, $2,402.79; Wilkinson Plow Co., Toronto, $2,194.06; Chatham Mfg. Co., $1,807.42; P. T. Leger, Quebec, $1,000; Molsons Bank (securities), $10,878; Molsons Bank (mortgage), $3,802.73; Bishop's College, Lennoxville (privileges), $3,000.

ONE thousand shares have been subscribed in Shawville, Que., to sink a public artesian well.

THE Rathbun Company, Deseronto, Ont., has an order for 200,000 square feet of timber for the new railway bridge at Cornwall.

THE Toronto Paving Brick Co., Limited, has been incorporated, capital $190,000. The provisional directors are: A. E. Ames, J. Kilgour, A. A. McMichael, Wm. Crawford and J. B. Noble.

AN Ontario charter of incorporation has been granted to D. B. Wallace, Simcoe, Ont.; C. M. Richardson, G Deighton, J Flynn, and F. W. Hodson, Toronto, as the Winnipeg Heater Company of Toronto, Limited; capital, $24,000.

AN Ontario charter has been granted to H. C. Hunter, J. D. Wilson, J. J. Scott, Wm. Lees, and T. Hobson, Hamilton, as the Canister Machine Co., Limited, to carry on a packing business and manufacture cans and canisters, etc.

THE property of the Guelph, Ont., Norway Iron and Steel Co., Limited, failed to sell at auction on October 6th. It comprises a complete rolling mill plant, and about 80 tons of rails, boiler plates, etc. Jas Naismith, Guelph, is liquidator of the company.

NOTICE is given by the Ontario Government that all companies not incorporated must before November 1, 1897, send to the Provincial Secretary returns of particulars relating to their work. Failure to comply with this means a fine of $20 a day, which will be levied, not only upon the company, but upon all directors, managers, secretaries, agents, travellers and salesmen, who with notice of such default transact in Ontario any business whatever for such company.

LORD MOUNT ROYAL wrote recently to the Minister of Trade and Commerce to lay before the Canadian lumbermen an opening for their product in London. He stated that almost the entire metropolis is paved with wooden blocks covered with a coating of asphalt. The blocks are described as "yellow deal," and are imported from Norway and Sweden A single block of the yellow deal accompanied the High Commissioner's letter. If any Canadian firm were to undertake the experiment, the Canadian article could be tried in London, and possibly a very large trade worked up.

AT the meeting of the British Medical Association in Montreal recently, the question of sewage disposal was opened for discussion by a paper written by George Janin, C.E., formerly of the Corps de Ponts et Chaussees of France, and now of Montreal. The title of the paper was, "On the different processes recommended for the treatment of sewage—mechanical, chemical and epuration by the arable soil." In a concise manner the paper described the various attempts which had been made in other countries to purify sewage, with the indifferent results attending the same This led up to purification through filtration or irrigation of permeable soil—a system of which Mr. Janin is an enthusiastic exponent. It was pointed out that enormous profits had been made from land on which sewage was poured in Germany and France Dr Bryce, of Toronto, pointed out the success of the system at the London, Ont., Asylum, even in the coldest weather.

Mining Matters.

THE people of Shawville, Que., will sink a well in search of natural gas or petroleum.

THE Jenckes Machine Co., of Sherbrooke, Que., shipped last week a complete tramway plant to the Lucky Jim mines, at Sandon, B.C.

THE Foley Mines, Seine River, Ont, are now installing two 100 h.-p. steel boilers, built by the Jenckes Machine Co., of Sherbrooke, Quebec.

A REPORTER for a Quebec paper, on a recent visit to Jersey Mills, Beauce county, Que., washed a pan of dirt which gave 21 dwts. 9 grs. of gold

AN extensive find of copper and silver-bearing ore is reported from Pugwash, N.S., on Canfield Creek. Wm. Murray is the lucky prospector.

THE boring for oil at Pelican Rapids, Arthabasca Landing, N.W.T., has been suspended after the shaft had been sunk 800 feet, the pipe having become choked with tar.

WM. MILES, who recently staked a gold claim in the streets of Victoria, B.C., opposite the post office, is meeting with a great deal of opposition in his attempts to work the lead.

THE 30-stamp mill at the Sultana Mines is almost ready to commence operations. This mill is probably the most modern one in the district, and the entire complete plant with which Mr Caldwell is equipping the property was furnished by the Jenckes Machine Co., of Sherbrooke, Que.

AT Tache station, on the C.P.R., 135 miles west of Port Arthur, alluvial gold is reported. The finds are said to reach at least five cents to the pan.

SPECIMENS from Gainer Creek, near Ferguson in the Lardeau district, British Columbia, were recently assayed at Kaslo Sampling Works, and were found to be enormously rich in gold.

THE Brookfield Mining Co., of North Brookfield, N.S., has placed an order with the James Cooper Manufacturing Co., Montreal, for a five-drill Ingersoll-Sergeant compressor, receiver, drills, etc.

THE Crow's Nest Mine, Melrose, N.S., has placed an order with the James Cooper Manufacturing Co., Montreal, for a duplex cross compound Ingersoll-Sergeant compressor, drills, receiver, etc.

THE Monte Cristo Mining Co., of Rossland, have made a fresh strike, and have ordered a complete new hoisting and pumping plant from the Jenckes Machine Co., of Sherbrooke, Que., which has been supplied from their Rossland stock.

THE statement that the Bannockburn Mining Company had taken over a large number of other mineral properties in Hastings county is unfounded. The company did take an option on several properties, but the arrangement has fallen through.

PROF. MILLER, of the Kingston School of Mining, was at Brudenell, Renfrew county, Ont., recently, assaying some mineral specimens which were brought in from the surrounding country. Large deposits of corundum have been found in this vicinity.

F. BLANCHARD, A. Barclay, R. and D. Mosher, Fort Frances, recently sold mining locations H. W. 54 and 87 to the Neepawa Gold Mining Co. for $16,000 cash. The property, which is situated in the Manitou district, near Blanchard Lake, is said to be very rich.

THE Hay Island Mining Co., Rat Portage, Ont., has placed an order with the James Cooper Manufacturing Co., Montreal, through the Rat Portage branch office, for a complete mining outfit, consisting of Ingersoll-Sergeant compressor, rock drills, hoisting engine, etc.

THE Old Ironsides Mine, at Greenwood, B.C., have got their new plant, which was furnished by the Jenckes Machine Co., of Sherbrooke, Que., into position, and are now about ready to ship ore. This property is expected to enter the list of dividend payers within the next few months.

THE agents of the Bank of Montreal in New York received last month from the Cariboo, B C., Hydraulic Mining Companies a cone of gold worth $61,987 and weighing 3,606 ounces. This is the second shipment from the company's mines this summer, the first having been a clean-up of $70,921 in July.

THE Cariboo, B.C., Gold Fields, which own ground for one and three-quarter miles of the bed of Williams Creek, has at present about one hundred men at work constructing a ditch, so that when completed this company will have about fourteen miles of ditches, with a capacity of 2 000 inches of water The ditch is nine feet wide at the top, four feet at the bottom, and two and one-half deep, with a grade of 9.60 to the mile.

THE Hall Mines, Limited, Nelson, B.C., has placed an order with the James Cooper Manufacturing Co., Montreal, through the Rossland, B.C., branch, an order for another ten-drill Ingersoll-Sergeant compressor, and five more Sergeant drills. This is the third compressor plant that the Hall Mines Co. has ordered from this company, and when it is installed the machinery at the Silver King mine will have a capacity of twenty-five drills.

THE news of the new coal discovery in the Codroy valley, Newfoundland, is confirmed. The seam is over six feet wide, and the quality is reported to be equal to the best North Sydney. It is also stated that the Messrs. Reid, the railway contractors, on whose land concessions the seam is found, will commence working it at an early date It is altogether probable that in these extensive Codroy valleys more seams will be found. The Hon. H. J. B. Woods says 60,000 tons are in sight.

DR WOLFORD NELSON, F.R.G.S., New York, who was in Montreal for the meeting of the British Medical Association, visited the Calumet mines on the Ottawa River, opposite Bryson, Que. In referring to the Meyer mine on Calumet Island, Dr. Nelson stated that Charles L Meyer, of New York, had associated with him E. P. Cowes, an American miner of large experience, and Leopold Meyer, of Madrid. This Meyer mine, he said, yielded a rich argentiferous galena, carrying a small percentage of gold. The Russell mine, near the Meyer property, furnished a zinc blend, which carried 13 to 15 ounces of silver per ton. From the 45-foot level of that mine a good ore was being obtained, and it was bagged and shipped to Swansea, in Wales. The general outlook at Calumet, Dr. Nelson remarked, summing up the result of his visit in a few words, was exceedingly promising.

WM. KIRBY, Callendar, Ont., reports a find assaying $18 per ton in gold at that place.

SOME exceedingly rich finds of free gold are reported from around Lytton, B.C.

THE boring for oil at Fredericksburg, Ont., has been abandoned at a depth of 550 feet.

THE Harvey Hill copper mine, Megantic county, Que., has been closed, owing to the new duty.

THE coal mines at Lethbridge, N.W.T., will produce 12,000 tons per month during the winter.

VERY rich finds of placer gold are reported from the north fork of the McMillan River, another tributary of the Yukon.

AT the Dalhousie gold mine, near Lanark, Ont., the shaft is now sunk to the depth of forty feet and gives good indications of gold.

J. M. DOUGLAS, M.P., for East Assiniboia, reports at Winnipeg the discovery of a seam of what is claimed to be anthracite coal, on the Qu'Appelle River, near Wapella.

NOW that there is some question of the iron ore deposits of the Bilbae district of Spain giving out, or becoming leaner, it might be advisable for our ironmasters to investigate the iron ores of Newfoundland. According to Dr. Grenfell there are immense—even unlimited—quantities of hematite ores of excellent quality at Bell Island, magnetic iron and pyrites in many places, and chrome-iron ore in abundance at Port-a-Port There are also deposits of nickel ores, asbestos, copper, coal, etc., in many parts of this our oldest and nearest colony. We ought not to let these minerals drift into the hands of American firms.—*The Ironmonger, London.*

REPORTS to THE CANADIAN ENGINEER from the Wabigoon district show that mining business is rather dull there at present. As investigation proceeds it becomes evident that there are some promising properties there, but a good deal of money needs to be spent before the extent of value of the claims can be determined. One difficulty is that a number of the claims are in the hands of men whose capital is too small to develop them, and another is that speculators are holding their claims at figures that are altogether too high, when it is considered that many of the properties will prove on development to be non-paying.

GREAT progress is being made at the Foley mine, Rat Portage, Ont. A contract has been let to the Canadian Rand Drill Company, Montreal, for what will be the largest mining plant in the Rat Portage district. The compressor has compound steam cylinders operated in conjunction with a condensor. Air is to be conducted all over the different workings, so that when completed, operations may be carried on all over the property by means of compressed air as a power. As these workings are scattered, the change will do away with the use of several small boilers and effect a very considerable saving in the fuel bill and the pay roll.

How little is done for the country by even a mine whose ore is highly refractory, is shown by the following picture of the advantages accruing to Rossland, B.C., from the Le Roi mine: "The $50,000 paid as dividends every month to the stockholders of that mine do not reach Rossland, at least not much of it. It is paid in Spokane, mostly to Spokane people. All the miners are compelled to board at the company's boarding-house, and all the supplies for that boarding-house are purchased in Spokane. Many of the men have wives and families in the States, and the greater portion of their wages is sent to their families, so that Rossland derives very little benefit from its biggest mine."

DURING the past month the James Cooper Manufacturing Co., Limited, of Montreal, has supplied the following mining plants:—Canadian Goldfields Syndicate, Rossland, B.C., for Sunset Mine, a 7-drill Ingersoll-Sergeant compressor with full complement of Sergeant drills, boiler, hoisting and pumping plant; Ruth Mines, Sandon, B.C., a 5-drill Ingersoll-Sergeant compressor, necessary complement of Sergeant drills, boiler, and all accessories; G. Alexander, Kaslo, B.C., for Northern Bell and Jackson Mines, a 3-drill compressor, full complement of drills, etc; Burley Gold Mining Co., Rat Portage, Ont., Ingersoll Sergeant compressor, Sergeant drills, double compartment shaft hoisting engine, etc.; Guffey-Jennings Mining Co., Cariboo, N.S., an Ingersoll-Sergeant five drill air compressor, drills, etc.

SPEAKING of the enormous electrical power in the neighborhood of Cornwall, Ont., a contemporary says. "With 1,000,000 horse-power at Massena and almost unlimited power on this river, furnished by the Cornwall Canal through the Sheik's Island reservoir, an international bridge and railways running north and south and east and west, on both sides of the river, this section of country offers unsurpassed advantages for manufacturing industries and general commerce."

Electric Flashes.

THE Royal Electric Co. is doing the lighting of the Montreal Post Office building.

THE long-distance telephone between Ottawa and Boston is now complete.

AT Vernon, B C., a by-law to raise $12,000 for an electric light plant has been carried by the ratepayers.

GEO. WILSON town clerk, Glencoe, Ont., calls for tenders for the electric street lighting of the town for a term of five years.

THE Electrical Supply Co., of Hamilton, Ont., Limited, has changed its name to Electrical Power and Manufacturing Co., of Hamilton, Limited.

R. C. C. TREMAINE and others, of Exeter, Ont., have been incorporated as the Exeter Electric Light and Power Co., Limited; capital, $15,000.

THE street railway in Victoria, B.C., is being greatly improved. Government street is being double-tracked, and a large number of new motors brought into use.

A BOILER explosion occurred recently at the Chambers Electric Light Works, Truro, N.S. The fine new engine lately put in was seriously damaged. None of the employees were injured, though there were some narrow escapes.

WILLIAM BATHGATE, for 14 years manager of the Electric Light and Gas Company, Winnipeg, Man., has resigned, the company having been amalgamated with the Electric Street Railway Company. No successor will be appointed.

THE directors of the Halifax Street Railway have decided to issue an additional $200,000 worth of stock. This will make the capital of the company $800,000. The new stock will be issued to shareholders on record in the proportion of one share to every four held. A quarterly dividend of 1¼ per cent. was paid Oct. 1st.

THE Bridgewater Power Co., Bridgewater, N.S., has lately been reconstructing and enlarging the electric light plant, and has replaced their three-wire system by an alternating current system, for which purpose they they have purchased a 40 K. W. "S.K.C." two-phase generator from the Royal Electric Co., and 600-light capacity in transformers.

GEO. EASTERBROOK, who is about taking his departure for Delago Bay, South Africa, where he is erecting flouring mills and other industries for a wealthy syndicate of Canadians, is taking with him a complete electric lighting plant. The apparatus and material complete are being purchased from the Royal Electric Co. This, we believe, is the first instance where a Canadian electric lighting plant has been sold for service in the antipodes.

THE Kingsville Electric Light Co., a corporation recently organized in that town, has decided to light the town, stores and residences by electricity, displacing natural gas, and for this purpose has bought from the Royal Electric Co. an "S K.C." 500 light two-phase generator, with the necessary transformers and material requisite to wire up 500 lights, which is the amount intended to start work with. The Kingsville Electric Light Co. has made a contract by which it will use natural gas for fuel. It is intended to furnish incandescent and arc lights, as well as motors.

THE Cockshutt Plow Co., of Brantford, have bought additional premises, and are doubling the capacity of their works. Among the important changes being made is the substitution of electricity for gas. They have placed their order for a 30 K. W. Generator and 250 lights installed, with the Royal Electric Co. The generator is to be of the "S.K.C." two-phase type, wound to deliver 110 volts direct to the mains. This system for isolated lighting is a radical departure from the old lines, and is the second instance in Canada where it has been placed in use for factory lighting.

THE Penman Manufacturing Co., Paris, Ont., which operates some of the largest mills in Canada, has made a number of improvements and additions to the mills in Paris lately, and among the improvements has decided to light their mills by electricity. The contract for a 500 light "S.K.C." machine and the wiring of the factories has been awarded to the Royal Electric Company, which purpose using for this its "S.K.C." two-phase alternating current apparatus: the dynamo wound to deliver to the mains current at a pressure that can be used directly in the lamps, from 100 to 115 volts. This is the first instance in Canada where alternating current is used for factory lighting. It has been held heretofore by electrical manufacturers that it was not practical to use alternating current for factory lighting. This plant will be a demonstration of the incorrectness or otherwise of the theory.

E. W. CUMMINGS is engineer in charge of the water-power development of the Kootenay, B C., Electric Co.

THE ratepayers of Lanark. Ont , recently expressed themselves at a public meeting as strongly in favor of the Lanark county electric railway.

THE electric plant belonging to R Prefontaine, at St Agathe, has recently been considerably enlarged ; a new dam and power-house have been built.

THE London, Ont., Street Railway and the London township council have come to terms, and the street railway extension to Pottersburg is to proceed at once.

C B MCALLISTER, Peterboro, Ont., is lighting his new flouring mill by electricity, and has placed his order for the dynamo and fixtures with the Royal Electric Company.

AT Magog, Que., a special committee of the town council has reported in favor of borrowing $10,000 to purchase an electric light plant and develop the water power.

IT is reported that Duncan McDonald, superintendent of the Montreal Street Railway, will shortly assume the duties of General Manager of the Toronto Street Railway.

AHEARN & SOPER, Ottawa, will build the telegraph line on the New York and Ottawa Railway from Ottawa to Moira, N.Y. It will include a cable across the St. Lawrence River.

A. W. PETTES and E. E. Mills have arranged with W. Foster, Knowlton, Que., for the power to run the electric light. It is intended to give an all-night service to residents and on the street at a reduced rate.

THE Stevens Manufacturing Co., London, Ont., advertises for sale in another column, a number of machines in good running order which have been replaced by its improved Eastern or Imperial apparatus.

AN English syndicate with large capital is said to be negotiating for the purchase of Canadian lighting companies, both gas and electric. The purchase of Fredericton, N.B., gas company is said to be under negotiation.

AN Ontario charter has been granted to F N. Saylor, G. M. Haldane, J. C. Scott, A Reed, H. McColl, Strathroy, Ont., as the Strathroy Electric Co , Limited, to supply heat, light, and power; capital, $20,000.

THE Hamilton Board of Works recently put through the Hamilton, Chedoke and Ancaster Electric Railway by-law of incorporation. It gives the road the right of way on Queen street south from Aberdeen avenue to Beckett's Mountain-drive. At Aberdeen avenue the H., C. & A. is empowered to cross the H. & D. line and run along the street railway tracks from Herkimer street to James and King The new road has to be running by 1899, and will have a charter of 20 years.

H. M. WHITNEY, Boston, Mass ; F. S. Pearson, New York ; James Ross, Montreal ; Wm. McKenzie, Toronto ; W. B. Ross, Q.C., Halifax ; R. C. Brown, Halifax ; B. F. Pearson, Halifax ; R D. McGibbon, Q.C., G. C Cunningham, and W. B. Chapman, Montreal, have secured a charter and franchise from the Jamaica Government to build electric tramways on the island, which will need $500,000 capital or more. Montreal and Halifax capitalists are to furnish most of the money. The earliest construction will be in the city of Kingston and its suburbs. A large power house will be built on the foreshore, and electric lighting will also probably be provided.

THE Dominion Government has recently, under the superintendency of D. H. Keeley, C.E., completed forty more miles of the telegraph line on the north shore of the St. Lawrence from the former terminus at Pointe Esquimaux, and an office has been opened at Piastre Bay. It is intended to extend the line 488 miles more to Natashquan, where an office will be opened this Fall. The North Shore line will still be about 250 miles from Belle Isle, but it is the intention to complete this section as rapidly as possible, so that the entrance to the Straits of Belle Isle will be in direct telegraphic communication with Quebec and Montreal

THE Berlin, Ont., Gas Co has been operating an incandescent lighting plant on the three-wire system, but are now extending the incandescent lighting service so as to furnish light to the residential portion of the town It has been decided to use alternating current, and the order has been placed for the new equipment with the Royal Electric Co., using the "S K C." system throughout. Extensive alterations have been made in the station, and there are now in position two 100 k.w Edison 500-volt generators for furnishing current to the Berlin and Waterloo Street Railway. The company also operates a local power service from its three-wire low tension system besides furnishing the town with arc lamps, for which purpose it operates two 50-light, 4 amp. Ball dynamos.

THE proposed purchase of the Chemong and Lakefield railway lines and their conversion into electric roads, which is announced as being under negotiation, would mean a great deal for Peterboro, Ont.

THE Whitney Electrical Instrument Co., of Penacook, N.H., and Sherbrooke, Que., have issued the following circular to their patrons in Canada, "We beg to inform our friends and patrons that C. E. Shedrick will hereafter manufacture and sell our line of apparatus in Canada. In transferring to him this branch of our business, we bespeak for Mr. Shedrick a continuance of the very cordial relations that have always existed between our customers and ourselves, assuring them in advance of an honorable and business-like treatment at his hands." We may add that Mr. Shedrick will have sole control of the manufacture and sale of the well-known Whitney electrical measuring instrument in the Dominion. He has been manager for the American Company for the past five years, during which he has worked up a large business, and now starts on his own account with a thorough knowledge of the trade, and the good will of a large clientele. Mr. Shedrick has a well-equipped laboratory of his own, and has been the inventor of a number of very ingenious devices in the way of electric alarms, regulators, etc. In addition to the manufacture of the Whitney instrument, he is sole maker in Canada of the celebrated Knott X-ray and therapeutic machines. The factory will remain at Sherbrooke."

Railway Matters.

A CENTRAL office building for the G.T.R. in the business portion of Montreal is spoken of.

THE Baie des Chaleurs Ry. Co., has succeeded, it is said, in raising the money to carry on construction.

W. NEWCOMBE, Hamilton, Ont., has been appointed road foreman of the locomotive department of the G.T.R.

OWING to the increased business on the C.P.R., 200 flat cars have been ordered from Rhodes, Curry & Co., Amherst.

THE C.P.R. has placed an order for 100 box cars with Crossen & Co., of Cobourg, Ont., who have been delivering in Toronto at the rate of five per week, commencing Sept. 13th.

THE G.T.R. has decided to build a thousand box cars for freight traffic. Of this number 500 will be built in Canada at the shops in Montreal and London. The other 500 have been contracted for in the United States.

THE directors of the Quebec Bridge Company are calling in twenty-five per cent. of their subscribed capital before November 15th. Meanwhile the work of verifying the soundings at the proposed site between the Chaudiere and Sillery is being actively pushed forward.

J. B. MCARTHUR, president of the Rossland, B.C., Board of Trade, said after a recent conference with Mr. Shaughnessy, vice-president of the C.P R., that the C.P R. will build a line to Rossland at once, and capitalists connected with the company will erect a smelter there, so that Canadian ore can be smelted in Canada.

THE Canadian Pacific Railway Company has completed surveys for steam tramways to be constructed across the portages, and connect Lake Wabigoon with the Manitou chain of lakes and the latter with Rainy Lake, giving easy facilities for transportation of supplies to all points in the Manitou and Seine River mining regions, and also completing a circuit from Rat Portage to Wabigoon.

THE I.C.R. extension to Montreal is being rapidly pushed. The grading is now completed, and the rails will shortly be laid, and construction trains can run through from Levis to St. Hyacinthe. There are six trains and six hundred men employed on the extension, the masonry on eleven bridges is progressing rapidly, three new stations are being built, and the manager says there will be no trouble in opening through traffic on November the first.

THE Robb Engineering Co., Amherst, N.S., has just constructed and tested a locomotive for the new Pole Railway, running from Weymouth, Digby county, to New France. It resembles an ordinary locomotive, boiler and engine mounted on a flat car, the wheels of which are concave to fit the wooden rails of the road, which are about a foot in diameter. Some years ago McPherson & Co., of Oxford, made one for the Fossil Flour Company, of Bass River, but this boiler was of the upright pattern.—*Colchester Sun.*

A REMARKABLE test of a recently patented train signal was made a short time ago on one of the Canadian Pacific stock trains between Winnipeg and Montreal. This new device—the invention of Rev. Prof. Devine, S.J., of St. Mary's College, Montreal—enables railway companies to use electricity for signalling purposes, instead of the bell-rope or compressed air. Prof. Devine claims for his train signal three

important functions: First—It enables trainmen to keep up communication between the van and engine while trains are in motion. Secondly—On long freight trains, signals may be given instantaneously to front and rear trainmen from any car in the train. Thirdly—Danger signals are given automatically to front and rear directly a train breaks in two. The reverend professor personally superintended the recent successful test on the Canadian Pacific.

THE Canadian Pacific Railway have nine parties in the field at present locating the line of the Crow's Nest Pass Railway. The following well-known Eastern engineers are in charge of these parties: Chas. Garden, of Winnipeg, and E. Force of Ottawa, are locating the line west of the Pass to Michael Creek. Wm. McCarthy, of Ottawa, and Wm. Burns, of Renfrew, are completing the location along Elk River west to the crossing. H. W. D. Armstrong, of Toronto, is working between Elk River and Kootenay River. G. H. Garden, of Montreal, is closing up his work between Fort Steele and Cranbrook. W. S. Cranston, of Ottawa, is locating some heavy work along Moyie Lake, and W. J. Earl and G. Hannington, of St. John, N.B., are locating the line between Moyie Lake and West Kootenay. The location of the line will soon be completed to West Kootenay.

THE reported discoveries of very rich gold bearing quartz in the Michipicoten district of Ontario are yet unconfirmed. While there is certainly gold there in considerable quantities, the extent of the deposits will not be known till Prof. Wilmott, who has been sent out by the Ontario Government, makes his report.

FIRES OF THE MONTH.

Aug. 31st.—G.T.R. station, at Deseronto, Ont.——Aug. 31st.—A. H. Davidson's saw mill, Colpoy's Bay, near Wiarton, Ont.——Sept. 5th.—W. N. Roberts' sash and door factory, Renfrew, Ont. Loss, $15,000.——Sept. 7th.—David Donaldson's planing mill, Lanark, Ont. Loss, about $4,000.——Sept. 17th.—McMillan's 30,000. bushel elevator, at Emerson, Man. Loss, $15,000.——Sept. 17th.—The St. Maurice Lumber Company's saw mill, Three Rivers, Quebec. Damages, $80,000; insurance, $40,000.——September, 20th.—The Hull Lumber Co.'s mill, Ottawa. Loss, about $100,000.——Sept. 20th.—The Goldie Milling Co.'s cooper shop, Highgate, Ont. Loss, $400.——Sept. 21st.—Terreall & Racine's foundry, Quebec, moulding shop and pattern room. Loss, $15,000.——Sept. 24th.—Damages to extent of $1,000 to the moulding shop of Kingston foundry.——Sept. 28th.—Gillies & Co.'s shingle mill, Sand Point, Ont. Loss, about $8,000.——Sept. 29th.—Perry & Black's sawmill, Fergus, Ont. Loss, $1,200.——Oct. 4th.—Damage to Central Prison, Toronto, twine and broom factories, $80,000.—Oct. 5th.—Damage to Graham Nail Works, Toronto, amounting to $150.

Personal.

P. S ARCHIBALD, C.E., late chief engineer I.C.R., is practising as a consulting engineer.

I. C. BURPEE has been appointed to succeed W. B. Mackenzie as assistant engineer, I.C.R.

H. M. JACQUES, B.A.Sc., has been appointed demonstrator in mining, in McGill University.

THE death occurred recently at Truro, N.S., of James Odell, C.E., at the advanced age of 75 years.

ALEX. BEGG, editor of the *British Columbia Mining Record*, is dead, at Victoria, B.C., aged 65.

JOHN STARK, a boiler-maker in the C P R. shops, Toronto Junction, was run over and killed by a train at Guelph, Ont., recently.

J O. Wisner, who was one of the earliest manufacturers of agricultural implements, in Brantford, Ont., died at his home there, Oct. 3.

ROBERT PATTERSON, who resigned his position as engineer at the Hamilton General Hospital to go to the Klondyke, was drowned in the Athabasca.

E. HAY, a member of the Amalgamated Society of Engineers, who was employed as engineer by the Montreal rolling mills, died suddenly, Sept. 24th.

THE governors of the Kingston, Ont., School of Mines have appointed H. R. Landis, New York, mining engineer for one year at a salary of fifteen hundred dollars.

M. F. CONNERS, B.A., Sc., analyst and assayer, Bank Street Chambers, Ottawa, whose card appears in another column, announces that he is prepared to make analyses and assays of ores, minerals, etc.

THE chair of mining engineering, at the Kingston, Ont., School of Mining, has been filled by the appointment of Courtney De Kalb, who lately resigned a similar position in the Rolla School of Mines, in Missouri, U.S.

F. J. RASTRICK, architect and civil engineer, died on the 13th September 18th, at his residence, in Hamilton. He was a native of Staffordshire, England, and had resided in Hamilton since 1853. He was a member of the council of the Ontario Association of Architects, Toronto, and was instrumental in establishing the Public Library and Art School in Hamilton.

Marine News.

J & R. WEIR, Montreal, recently launched a tug which they built for W. Davis & Sons, contractors.

A. DEVOE, Cape Breton, and John F. Devoe, of Little Bras d'Or, have invented a one blade spiral propeller.

JOSEPH L'ETOILE, of Ottawa, has invented a submarine searchlight which was, it is said, successfully tested in the Ottawa River recently.

THE amount of freight handled this year by the steamers plying between Toronto and Montreal, is the largest in the history of both the R. & O. Navigation and Merchant Line steamers.

POTTER BROS., of Canning, N.S., have completed their steamer the "Beaver," which will at once be put on the route between St. John, N.B., and Parrsboro, Canning and Wolfville, N.S.

IT is said in London that Sir Weetman Dickinson Pearson's company has submitted a proposal to complete the canal from Ottawa to Georgian Bay, on conditions which are believed to be satisfactory.

CAPT. COATES, Fort Frances, Ont., and Capt. Mosher, are building another steamer, "City of Alberton," for service on Rainy Lake. It will be somewhat similar to the "Maple Leaf," but a little more elaborate in finish.

PLANS and specifications are out for the construction of a very large barge to carry coke-laden cars from Comox to Vancouver, B.C. The craft, which is to be built for the Messrs. Dunsmuirs, will be capable of receiving twelve loaded cars at a time. It will be 190 feet long, and will have a beam of 45 feet.

A CHANGE has been announced in the eastern terminus of the Canada Atlantic Railroad from Rouse's Point, N.Y., to Swanton, Vt., and the extension of the line west from Ottawa to Parry Sound, by which it is proposed to open a new trunk line between the great lakes and New England points. It is stated that a line of steamboats will be run from Chicago to Parry Sound, and at Swanton the Canada Atlantic will connect with the Central Vermont and the Boston and Maine Railroads.

MR. MARGARCH, the Government engineer, has recently returned from Manitou, where he has been building a dam, which enables vessels of four feet draught to get within seven miles of Rainy Lake, thus making navigation possible over a distance of sixty miles. Instructions have also been received from the department instructing Mr. Margarch to go on with the building of another dam at Dryden, on Wabigoon River, which will raise Lake Wabigoon to high water level and make another stretch of forty miles of water navigable. So that from the track to Fort Frances can be reached by making two portages only. There are now four steamers on the Wabigoon, and one on the Manitou.

A. P. Low, of the Geological Survey, who went to Hudson Bay last spring with the "Diana," has returned to Ottawa. The "Diana" entered Hudson Strait on Jubilee Day, June 22nd. On July 6th, she met thick weather, and was fast in an ice pack; on the 9th she reached loose ice, and on the 12th clear water in Hudson Bay. On July 16th, Mr. Low's party were landed near Douglas Harbor, a place Mr. Low describes as affording first-rate shelter. On the 18th, the "Diana" steamed away and Mr. Low set forth on his coastwise journey eastwards. On the 26th their yawl became fast in the shore ice and remained until Aug. 1st It was on Aug. 1st the party reached Stupart's Bay, where some years ago the observer, after whom the place is named, established a station. The party reached the southernmost part of Ungava Bay on Aug. 24th. There at Fort Chimo they found the Hudson Bay Company's steamer "Erik," which had arrived on the 20th from Fort Churchill on the west coast of Hudson Bay, the earliest passage on record. The captain reported, however, that the ice pack had been the most formidable in his experience of six years' navigation of these waters. From Fort Chimo, Mr. Low made a trip in his sail boat across to George River, on the east side of Ungava Bay, returning on Sept. 7th. Next day the boat and her outfit were put on the "Erik," which took them out of the strait and around to Nachvak on the Atlantic coast. Dr. Bell and his party made a very successful survey of the coast. They also traveled for seven days into the interior of Baffin Land, and discovered an immense lake over 80 miles long. He further explored the region for gold, but found nothing of much practical use.

THE Kootenay River and Transportation Company has a steamer well under construction at Jennings, B C., for the Fort Steele trade on the Kootenay. She will be 150 feet over all, 30 feet beam, tonnage 250. Her cylinders are 12 inches in diameter, 12-foot stroke. There will be 22 staterooms, electric lights, searchlight, etc.

THE work on the new steamer now building at the shipyard, at Belfast, Ireland, for the service between Liverpool and America for the Dominion Line, is progressing favorably, and the ship will be delivered at Liverpool on April 1. The Dominion Line have decided to name the new steamer "New England" instead of "Dominion," as was at first intended. The "New England will be 50 feet longer than the "Canada," three feet wider beam and two feet more depth of hold. She will carry a cargo of about 15,000 tons measurement She will have more passenger accommodations than the "Canada," the first *cabin staterooms being more spacious and somewhat of an improvement* in the way of furnishings and decorations.

A NEW town site is being surveyed on the shores of Lake Winnipegosis, where the Dauphin Railway will terminate.

H. CORBY, of Belleville, is lighting his distillery and warehouses with electricity, and has placed his order for the dynamo, etc., with the Royal Electric Co.

THE Jenckes Machine Co., Sherbrooke, shipped recently one of its heavy 50-h.p. slide-valve engines, with standard steel tubular boiler, to Desire Thibault, East Hereford, Que.

D. CHAMPOUX & BRO., Disraeli, are installing an electric lighting plant, and have purchased for this purpose a 30-inch Crocker Turbine from the Jenckes Machine Co., of Sherbrooke, Que

THE Ottawa lumbermen have been notified by the Minister of Marine and Fisheries that the law forbidding the dumping of sawdust into rivers will be enforced at Ottawa after July 1st.

THE power station for the Sherbrooke Street Railway, at Sherbrooke, Que., is rapidly nearing completion, and the turbine plant being installed by the Jenckes Machine Co. is also about completed.

THE Chicoutimi Pulp Co. is adding another 40 inch Crocker turbine, arranged to work under 70 foot head, which is being supplied by the Jenckes Machine Co, Sherbrooke, making the fourth of these wheels supplied.

THE dam at Magog, Que., for the civic electric light plant is completed, and the 55 inch Crocker water wheel, which is being furnished by the Jenckes Machine Co., Sherbrooke, is expected to be installed now within a short time.

THE screens and wet presses furnished by the Jenckes Machine Company, Sherbrooke, are now arriving at the Morgan Falls mills of the Acadia Pulp and Paper Co., and the whole plant is expected to be in operation within a short time.

THE Dominion Paper Co., which is extending and enlarging its mills at Kingsey Falls, have placed an order with the Jenckes Machine Co., Sherbrooke, for two of their 30-inch Crocker special turbine wheels. These wheels are mounted on one shaft, set horizontally in a steel case, thus doing away with gearing and attendant evils.

WATER was turned into the flume at the factory of the Boston Rubber Co. at St Jerome on the 25th ult The steel flume, which is 350 feet long, 6 feet in diameter, was furnished complete, including a 55-inch Crocker wheel, by the Jenckes Machine Co., Sherbrooke, Que

THE Shawenegan Falls on the St Maurice, have been sold at auction for $50,100 by the Quebec Government, Sept 9th, to D Russell, Montreal, representing a syndicate which will produce calcium carbide. Within 18 months $4,000,000 will be expended in development. The power reverts to the Government on failure to fulfil these conditions.

WM. WATSON, Toronto, recently visited the Penetanguishene Hotel at Penetang, and made a thorough inspection of the sewage disposal works. Mr. Watson reported the plant as of admirable design and construction, and only requiring careful operation to make it a complete success.

MARSH & HENDERSON, who succeeded to the business of the G. & J. Brown Mfg. Co. of Belleville, have been very successful since they took over the establishment last summer They have made 20 lumber cars for Gilmour & Co's yards at Canoe Lake, Ont., and 15 cars for the Soulanges Canal. They have supplied four steam hoists to Wm. Gibson, contractor, two for the quarries and two for work on the Victoria Bridge, Montreal. The quality of their work has been very favorably commented on.

"MINERAL Wealth of Canada," by Arthur B. Willmott, Professor of Natural Science in Macmaster University, has just been issued from the press of Wm. Briggs, publisher, Toronto. It is a guide to the study of the economic geology of Canada. The ordinary student of the mineral deposits of Canada has not the opportunity of digesting the contents of the reports of the Geological Survey, but this work of 201 pages contains in a small compass the main facts conveniently arranged and in language as plain as can be employed One good feature is that not only is each mineral found in Canada described, as it were, in a "character sketch," but an account is given of the uses to which it is put, and where it is found in Canada, as far as known A list of authorities on each topic is given for the convenience of those who wish to follow up the subject more fully. The topics treated of are iron, manganese, chromium, nickel, cobalt, copper, sulphur, gold, platinum, silver, lead, zinc, arsenic, antimony, tin, aluminum, mercury, salt, gypsum, barite, apatite, mica, asbestos, actinolite, talc, peat, coal, graphite, petroleum, asphalt, albertite, anthroxalite, granite, sandstone, clay, slate, limestone, marble, lithographic stone, cement, fertilizers, etc Recent statistics of production are given in most cases

THE most interesting catalogue on acetylene gas generation yet issued is that of the Niagara Falls Acetylene Gas Machine Company of Niagara Falls, Ont. Besides a description of the method of manipulating the machine, it gives a variety of useful notes and statistics relating to the properties of acetylene as an illuminant. Those interested in the subject will find many valuable points in this catalogue, which will be mailed free on application.

IN the June issue of THE CANADIAN ENGINEER a selected paragraph appeared which gave the error recently established in the longitude of Montreal incorrectly. We append the correct figures, as contained in Prof. McLeod's report: "The final value of the longitude of Montreal (the middle point between the two piers of the transit instruments at this observatory), as determined from the observations of Professors H. H. Turner and C. H. McLeod in 1892, is 4 hours, 54 minutes, 18.67 seconds. This quantity is in excess of the old value, which was obtained by connection with the United States system of longitude, by 0.105 of a second. The determinations upon which the American longitudes have hitherto rested were made by the United States Coast and Geodetic Survey in 1866, 1870 and 1872. When it is considered that the cable signals were then sent by the old flash system, and that the longitude operations, as conducted by the Americans, did not include an interchange of observers, the accordance of the old value with that above announced is quite within the limits of error, which might properly have been assigned to the former."

A VERY interesting experiment with asbestos plaster took place recently, at Washington, in the northwest court of the United States Treasury Department building. It was a practical demonstration of the merits of this plaster for the benefit of the officials of the Supervising Architect's Office. Those present were Mr. Bouche, chief computer, Mr. Raymond, in charge of testing and experimental work, Mr. Adams, chief of the heating and ventilating department, and Chief Engineer Watts. In the court was placed a structure representing a miniature house, the roof of which was about four feet high, the interior being plastered with "asbestic," the name by which this new wall plaster is known Around the structure were piled kindling wood, shavings and paper enough to make a bon-fire to celebrate a great political victory. After being ignited, the light structure was immediately enveloped in flames, which burned fiercely and furiously, but to no avail, as they had found a master. After being subjected to the fire for half an hour an important test was made. A stream of water, through a one and a-half inch nozzle, was poured on the plaster attached to the sides and roof without any effect. The plaster did not drop or crack, but was intact, demonstrating conclusively that it was fire-proof and far superior, in every way, to any plaster now on the market. Asbestic is manufactured by the H. W. Johns Manufacturing *Company of New York.*