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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.

CHAPTER II.

TRAIN RESISTANCES AND THEIR COST.

ART. 6.—TRAIN RESISTANCES.—(*Continued*).

(C.) CURVE RESISTANCES.

In America a curve is designated by the number of degrees which a hundred foot chord subtends at the centre of the circle, thus a 1° curve subtends 1°, etc. The radius of a 1° curve=5730 feet, and the radius of a

$D°$ curve is (approx.) $= \frac{5730}{D}$ feet.

The centrifugal force of a train passing around a curve at v feet per second $= C = \frac{Wv^2}{gr}$ .... (6)

If we change v into V (miles per hour) and r into D (degree of curve) we will get $C = \frac{W}{32.2} \times \frac{V^2(1.467)^2}{1} \times \frac{D}{5730} = \frac{WV^2D}{85666}$ .... (7)

Now, in order to counterbalance this force, the outer rails, on curves, are elevated sufficiently above the inner ones (super-elevation) to make the resultant of gravity and centrifugal force to pass midway between the rails and at right angles to the track, and the floor of the car will then be parallel to the track (see Fig. 3). It is evident from the figure that by similar triangles

$$\frac{\text{Super-elevation}}{\text{Gauge}} = \frac{\text{Centrifugal Force}}{\text{Weight}} \text{ or}$$

Elevation $= E = G \times \frac{C}{W} = \frac{59V^2D}{85666}$ {from (7)} .... (8)

by which it will be seen that the required elevation varies directly with the degree of curve and with the square of the velocity.

For a 1° curve, $E = \frac{59}{85666} V^2 = .00069\ V^2$ .... (9)

TABLE VII.

TABLE OF SUPER-ELEVATION OF OUTER RAIL, PER DEGREE, FOR DIFFERENT VELOCITIES.

V (miles per hour) ...	5	10	15	20	25	30	35	40	45	50	60	70	80	90	100
E (inches) ...	.02	.07	.15	.28	.43	.62	.84	1.10	1.40	1.72	2.48	3.36	4.40	5.60	6.90

It is evident, however, that only at that particular speed for which the outer rail is elevated will the car body be normal to the track. At slower speeds, the inner springs will compress and outer ones extend somewhat, while for higher speeds the reverse will be the case. The custom, on general traffic roads, is to elevate for medium passenger speeds of say 30 miles per hour, which is slightly over one-half inch per degree, while on high speed passenger tracks of roads having only light curves, particularly, elevations of as much as one inch per degree are common.

It may be assumed that a safe maximum riding speed will exist when the car body becomes level. Wellington's assumption is that the weight of a passenger-car will compress its springs six inches, and that the distance of the centre of gravity of the car body above the springs is equal to the distance of the springs apart giving equal turning couples. The total centrifugal force necessary for this action will be approximated.

$$C = \frac{WV_1^2D}{85666} = \left(\frac{E}{6} \times \frac{W}{2}\right) + \left(\frac{WV^2D}{85666}\right) = \frac{59V^2DW}{12 \times 85666} + \frac{WV^2D}{85666}$$

or, eliminating, $V_1^2 = \left(\frac{59}{12} + 1\right) V^2 = \frac{71}{12} V^2$

$\therefore V_1 = 2.43 V$ .... (10).

(where V_1 = speed to bring car body level.)

(V = speed for which track is elevated.)

This speed is, evidently, independent of the curvature.

The speed at which trains, running on tracks properly elevated, will overturn, is very high, and not of sufficient interest to calculate, and will depend on the amount of compression possible in the springs before the car body comes down on the buffers, and upon the amount of elevation per degree of curve given to the track.

Those roads which have sharp curves will always run at moderate speeds around them; the sharper the curve the less the speed. This fact and practical ballasting difficulties have limited the total super-elevation to about six or eight inches, which corresponds to a curve of 8° to 12°, depending on the speeds expected, on curves of greater sharpness the lessened speeds will require less elevation per degree.

The position which a short rigid truck assumes in passing around a curve is as in Fig. 4; the front outer wheel flange against the rail head, and the rear wheels radial to the curve and midway between the rails, unless

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

the curve is so sharp or the truck so long as to render this impossible, when the rear inner wheel flange will also jam against the rail. This, however, will not happen with a 5-foot American truck on any ordinary curve. Wheels are still made with a modified coning (see chapter on track), but this is intended only to provide for future wear, as it is proven that it does not aid in passing around curves by the whole truck moving to the outside, as was formerly supposed to happen.

In passing around a curve the wheels slip in two directions, besides flange friction: (1) Longitudinal, due to the inner and outer rails being of different lengths; (2), lateral, due to a continuous sidewise movement in changing direction. This latter is confined to the front axle, as the rear one keeps radial always to the curve. The amount of these slippages are calculated, if necessary, as fol.ows: (See Fig. 5.)

(1) Longitudinal slippage $= \frac{\text{gauge}}{\text{radius}} \times$ distance travelled.

(2) Lateral slippage = sin. angle a × distance travelled for 5-foot American truck, sin. a = .00087, and lateral slip = .00087 d.

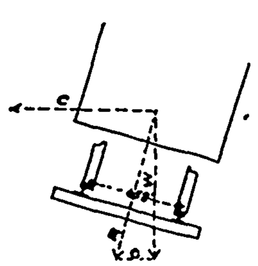


Fig. 3.

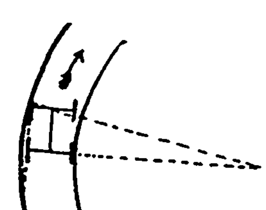


Fig. 4.

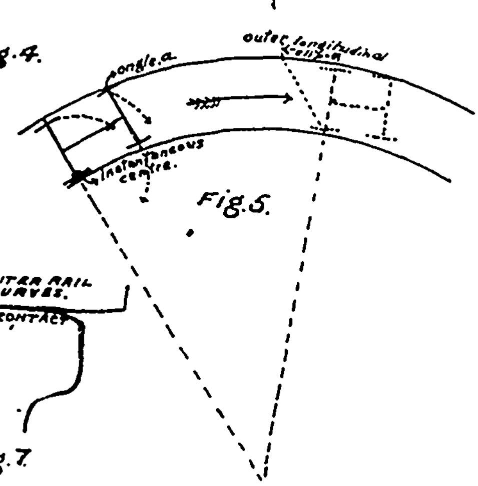


Fig. 5.

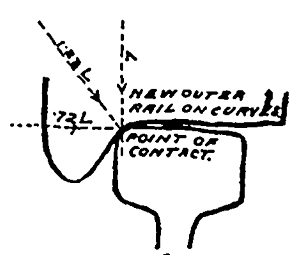


Fig. 6.

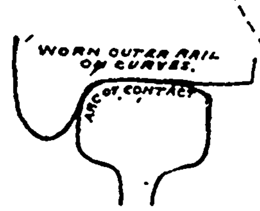


Fig. 7.

It will be seen by Fig. 5 that the truck is turning continually around the inner rear wheel as a centre, and the aggregate slippages are as follows:

(1) Rear inner wheel does not slip at all.

(2) Rear outer wheel slips longitudinally.

(3) Front inner wheel slips laterally.

(4) Front outer wheel slips laterally and longitudinally.

TABLE VIII.

	1° Curve Ft.	5° Curve. Ft.	10° Curve. Ft.	20° Curve. Ft.
Average slippage per wheel, per foot	.00073	00363	.00730	.0145
Average velocity of slippage (in feet per second), train going at 30 miles per hour	.043	.21	.43	.86
Ditto (miles per hour)	.029	.145	.29	.54

It is noticeable that the slipping is at a very low rate, being for ordinary curves and speeds only a fraction of one mile per hour, and which ever wheel starts slipping, whether inner or outer, will continue to do so around any particular curve; but this is immaterial.

Now, the coefficient of sliding friction between steel tires and steel rails under different velocities is about as follows:

0+	miles per hour	.242
7	" "	.088
13	" "	.072
34	" "	.065
52	" "	040

And as anything in the above table is nearly at zero miles per hour, we can be safe in assuming a coefficient for this slippage at from .24 to .20, with a tendency to get less as the curve gets sharper (contrary to earlier notions on curve resistances.)

In addition to these slippages we have flange friction (see Fig. 6). When the rail is new the line of pressure is nearly a point; the two forces acting on the front outer wheel are the load on the wheel and a lateral horizontal force sufficient to cause the slippages to take place, which have already been mentioned. If we take the coefficient of friction at .24, then there will be a total force of .72 ∠. This is combined with the vertical force ∠ to give a resultant force 1.23 ∠, acting as shown in Fig. 6. This causes the radius of the outer wheel at its line of bearing to be ⅛ inch to ¼ inch larger than the inner one, and a consequent slippage takes place which is constant for all curves. The amount of friction caused by this increases rapidly as the rail becomes worn and the surface of contact increases. (See Fig. 7). So that any estimate of its actual amount will be useless unless we know the exact condition of the rail head and wheel flange.

Wellington estimates it to be 1 lb. per ton for new rails, with a considerable addition as rails become worn. This will not vary with the curvature, and is to be added to the amount calculated from Table VIII., which, taking the coefficient of friction at .24, amounts to .35 lbs. per ton per degree. The results of experiments confirm the theory that the total amount varies from ½ to ⅝ lbs. per ton per degree, increasing as the condition of the rail becomes worse, and the surface of contact, for flange friction, greater. The total curve resistance does not increase quite as fast as the curvature when the rails are new, but as the rails become worn the opposite is the case; and as the rails on curves become worn more quickly the sharper the curve, it is probably safe, as an average, for ordinary use, to assume that curve resistance varies with the curvature, and equals ½ lb. per ton per degree. Referring back to grade and level tangent resistances, we see that—

6 lbs. per ton = resistance on 12° curve.
= resistance on $\frac{3}{10}$% grade.
= level tangent resistance at low speed.

Or that a 12° curve doubles the level resistance, or that a 1° curve is equal in train resistance to a .025%g rade; strictly, therefore, we should lessen gradients on curves by .025 for each degree of curve, to compensate for curve resistance, but this would be scarcely enough, for whenever a train is nearly stalled, curve resistances due to low speed will be much higher, and if the train is once stalled it will be hard to start again on a curve just barely compensated. For this reason it is customary to compensate for curves at a higher rate than is theoretically necessary, the usual amounts being .04 to .05 per degree of curve, depending on how valuable a few feet are, in elevation, on maximum grades.

Art. 7.—The Cost of Train Resistances.

It must not be supposed that the expenses of operating a road vary with the total train resistances found according to the rules given in Art. 6. Even the fuel consumed is only affected partially by variation in train resistances; some are affected very much, as car repairs and rail wear, while others, such as maintenance, general expenses, etc., are hardly affected at all.

(*A*) *Cost of Curve Resistances.*—It is estimated that 36 per cent. of the working expenses vary with the curve resistances, and taking the cost of a train mile at 90 cents, and a continuous 12° curve for a mile = 633° curvature, = one mile of level tangent resistances; then, the cost of operating a train each way for a year around 1° of curvature $= 365 \times 2 \times \frac{90}{633} \times 36$ per cent. $= 37\frac{3}{10}$ cents, therefore, we are justified in spending $\frac{100}{5} \times 37.3$ cents = \$7.46 per daily train, during construction, in eliminating each degree of curvature with money at 5 per cent., any number of trains per day, or degrees of curve in direct proportion, from which it is evident that the worst features of sharp and heavy curves are more questions of appearance, comfort and safety, than of actual cost in operating, especially as the case is always one of more or less curvature only, and not a question of curves or no curves.

With roads expecting light traffic and heavy grading, it is evident that a very great amount of curvature will be justified; and then, too, it must be remembered, that it is the total angle of a curve and not its sharpness that counts in the total train resistances; the only objections to sharp curves are the slightly increased danger of derailment, the necessary slackening down from very high speeds, the slight lengthening in distance, and the sentiment of the public against them.

(*B*) *The Cost of Grade Resistances.*—Grades must be viewed from two standpoints: first, as so many feet of rise and fall, up and down which the trains must be carried; and second, as the limiting features to the maximum load which a given engine can haul at a low speed over a freight engine divisi.n. Under the first heading Wellington divides them into three classes:

(1) Those which are so light or short as to be passed over with uniform steam on and no brakes, the speed only fluctuating. Such grades cost nothing appreciable more to operate than level grades, as the trains going each way in a day gain as much energy as they lose. These grades would be, roughly, anything less than 0.5 per cent.

(2) Those in which steam is cut off in descending, but which do not need brakes in descending nor sand in ascending. It is estimated that one foot of rise and fall, per daily train per year on this class of grade, costs:

Eighty-four cents, if a minor grade, which equals \$16.80 capitalized; \$1.67, if a maximum grade, which equals \$33.40 capitalized. These may be taken roughly as grades between 0.5 per cent. and 0.8 per cent.

(3) Those on which brakes are needed in descending and sand used in ascending. These are estimated to cost per daily train per year, per foot of rise and fall, \$3.50, which equals \$70, capitalized at 5 per cent. These may be taken as any grades over 0.8 per cent., unless of very short length. By multiplying the above sums (\$16.80, \$33.40, or \$70) by the number of daily trains expected, we can arrive at the total expenditure justifiable to save each foot of rise and fall.

Table IX.

(*See Wellington, page 544, for larger table.*)

NET TRAIN LOADS OF VARIOUS ENGINES ON VARIOUS GRADES TAKING 25 PER CENT. AS THE RATIO OF ADHESION.

Grade.	Resistance per ton (in lbs.)	Passenger.		Mogul and 10-wheel			Consolidation.			Mastodon.
		Total Wt.		Total Wt.			Total Wt.			Total Wt.
		52 tons.	58 tons.	60 tons.	64 tons.	67 tons.	70 tons.	75 tons.	80 tons.	87 tons.
		Weight on drivers.		Weight on drivers.			Weight on drivers.			Weight on drivers.
		20 tons.	24 tons.	28 tons.	32 tons.	36 tons.	40 tons.	44 tons.	48 tons.	52 tons.
Level	9	1,198	1,442	1,690	1,938	2,163	2,430	2,675	2,920	3,163 tons
1/10 per cent....	10	918	1,142	1,340	1,536	1,733	1,930	2,125	2,320	2,513 "
3/10 " ...	14	662	799	940	1.079	1,219	1,359	1,496	1,634	1,770 "
5/10 " ...	18	504	609	718	825	933	1,041	1,147	1,253	1,357 "
1 " ...	28	305	371	440	507	576	644	711	777	842 "
1½ " ...	38	211	258	308	357	407	456	504	552	597 "
2 " ...	48	156	192	232	269	305	347	383	420	455 "
2½ " ...	58	120	149	181	212	243	275	304	334	361 "
3 " ...	68	95	118	146	171	198	224	249	273	295 "
4 " ...	88	62	78	99	118	138	157	175	193	208 "
5 " ...	108	41	53	70	84	100	115	129	142	151 "
10 "	208	0	0	7	13	20	26	31	35	38 "

Remember the above sums are not supposed to be precise, but to be as near as it is possible to arrive at the truth. These figures refer to the cost of grades regarded merely as so many feet of rise and fall, and are entirely independent of and distinct from the effect which the maximum grade has on the train load, which is a far more important matter. In special cases, as on the N. Y. C. and H. R. Railway, where the grades are very light, the curves are the limiting features, but usually grades limit and determine the load which a given engine can haul. The hauling capacity usually depends on the weight on the drivers, and the ratio of adhesion, although for high speeds the limits of boiler capacity or cylinder power may be reached first; for freight work, however, the former are all we need to consider. The ratio of adhesion varies from 20 per cent. on slippery rails to 25 per cent. in ordinary weather, and to 33 per cent. where sand is used, but falls at once to about 10 per cent. when the driving wheels begin to slip. For any assumed ratio of adhesion it is easy to compute the load which an engine of known weight on drivers can haul up any grade. The total load includes the engine itself, but on light maximum grades it is not usual to haul maximum loads because of the difficulty in handling long trains and making couplings strong enough to transmit a very heavy pull when combined with the severe jerks caused by the great amount of slack in link and pin couplers. The increasing use of automatic vertical plane couplers having very little slack will soon do away with this difficulty and enable longer trains to be handled with facility. Table IX. enables us to compute the increased or decreased engine mileage due to a change in maximum grades, for any given amount of traffic. For light traffic such calculations must be modified, as more trains will be run to accommodate traffic than are strictly required to carry it, and only as traffic increases so as to afford at least two or three fully-loaded freight trains per day will such calculations be rigidly true—even then many roads estimate so many cars as a train load irrespective of the load on the car, and the adoption of a tonnage system for making up train loads will, in many cases, effect great economy.

It is noticeable that, on heavy grades, the level tangent resistance forms a very small proportion of the total resistance, and also that, for any given increment of grade, the increase per cent. of engine mileage is much less as the grades become heavier.

Decreased hauling capacity, on heavy grades, may be met in two ways, either by increased weight of engines, especially the weight on the drivers, as is evident from Table IX., or by increasing the number of trains (*i.e.*) the engine mileage.

The former is, of course, the cheaper method, but as the changes in grades that an engineer is called on to discuss are usually relatively small, it is only fair to suppose that the economy of heavy engines will have been realized in both cases; but supposing it possible to increase the weight of engines for heavier grades, only very few of the expenses of operating are increased. Wellington estimates that track maintenance, renewals and engine repairs are increased 50 per cent. as fast as the weight of the engine increases; fuel 25 per cent. and other items practically unaffected. Altogether, the operating expenses will only increase 14 per cent. as fast as the increase in weight of engines.

On the other hand, the usual necessary course on heavier grades will be to run more trains of less tonnage, with the same weight of engine, for a given traffic. This is a more expensive matter.

TABLE X.

INCREASE OF OPERATING EXPENSES WITH INCREASED ENGINE MILEAGE.

Item.	Cost of Item.	Per cent. increase.	Extra cost
Fuel, oil, and waste	8.8 %	67 %	5 9 %
Engine repairs	5.6 "	75 "	4.2 "
Switching engines	5.2 "	0 "	.0 "
Train wages	15 4 "	100 "	15.4 "
Car maintenance	12.0 "	− 10 "	− 1 2 "
Track maintenance, etc	17.5 "	100 "	17.5 "
Bridges and buildings	5.5 "	0 "	0.0 "
Station and general	30.0 "	20 "	6 0 "
Interest on extra engines	....	..	1.7 "
	100 %		49 5 %

It will be seen that, say, 50 per cent. of the operating expenses increase with an engine mileage increase, as compared with 14 per cent. in the first case. This is why the weight on drivers is being continually increased, and the strength of the track to carry it, on all roads having much traffic to handle, as being the cheaper expedient.

We are now prepared to estimate the cost of increasing the ruling gradient on an engine division (100 to 125 miles).

Taking a train mile to cost 90 cents, we have 90c. $\times 365 \times 2 = \$657$, as the cost of hauling a daily train (both ways) per mile, per year. If we take this *yearly train unit*, multiply it by the number of miles in a given engine division, by the increase in the number of daily trains necessitated by the heavier grades, and then by 50 per cent. (see Table X), we will have the amount which it will probably cost per year more to operate on the heavier grades than the lighter ones. If we capitalize this sum we get the amount which, for a given traffic, it would be wise to expend to construct a road with the lighter ruling grades rather than the heavier ones. (*e.g.*) To avoid changing our ruling grades from 1.0 per cent. to 1.5 per cent. on a hundred mile division, we would be justified in expending anything less than

$$\left(\frac{1000}{504}-\frac{1000}{711}\right)\times \$657\times 100\times 50\%\times\frac{100}{5}=\$328,500$$

for every 1,000 tons of gross freight per day, taking a seventy five ton consolidation engine as the basis of comparison, and, roughly, two trains per day in one case and one train one day and two trains next day, in the other case, or one-half train per day difference. Now this is a very modest traffic, and yet we could afford to expend $3,285 per mile more in one case than the other, and it is really very much more than it appears, for two reasons:

(1) Because ruling grades in most cases will probably not extend over more than one half of the road as a maximum, and we can therefore spend twice as much per mile on them, or $6,570 per mile as a minimum, on the portions to be improved.

(2) Because all this money can be used below the ballast since track, equipment, stations, etc., in fact, all other items, remain unchanged, now to show how moderate a proportion the cost of substructure is of the cost of the whole road, the following table is given:

TABLE XI.

COST OF FOUR TRACKS OF N Y.C. AND H.R. RAILWAY PER MILE.

Grading and masonry	$22,000	=	18.9	per cent.
Bridges	3,030	"	2.6	"
Superstructure	32,500	"	27 9	"
Stations, etc	15,400	"	13 3	"
Land and damages	15,740	"	13.6	"
Engines and cars	24,077	"	20.7	"
Engineering and incidentals	3,453	"	3.0	"
	$116,200	"	100	"

This is an extreme instance, as grading was light and equipment expensive; the items affected (1 and 2) are only 21½ per cent. of the total, and probably 25 to 40 per cent. will give a good average for ordinary single track roads. Each country traversed is suited to certain maximum gradients, and an endeavor to modify them extensively will bring very heavy additional expenses, but within narrow limits, such as a change of ruling grades by as much as $\frac{2}{10}$ or $\frac{3}{10}$ per cent., the advantages of a liberal expenditure of money to obtain the lesser grade are often overlooked and the "penny wise" maxim adopted. Every engineer who has the decision of the ruling grade should study such figures carefully, and by as extensive surveys as possible determine what is the least ruling grade that he can get at a cost which will be justified by present or expected traffic, always, of course, considering how much money can be got at all, for no expenditure can be justified that will in any way endanger the successful completion of the road; he must consider each item of expenditure or economy, *per se*, whether it is wise or not, remembering always that it is the *difference* of gross receipts, working expenses and fixed charges that is to be thought of in determining the best general route.

Note, however, that these calculations and estimates do not hold strictly true for roads of very light traffic, because some trains must be run in any case to accommodate traffic at certain intervals, and if they are not fully loaded, then an increase of grade will not have any effect until it causes an increase in the number of trains, as a change in the rate of grade does not usually mean any increase in the total rise or fall.

In comparing two routes for costs of operation the best method is to assemble the curves and grades of different classes and take their differences, pro or con, also the difference in the number of trains per day necessary to handle the probable traffic. These differences multiplied by their proper multipliers will give a comparison of how much more valuable one route will be than the other for a given traffic, and will determine consequently how much more can be justifiably spent to construct one route rather than the other, *other things being equal.* In such a comparison it will be found that any difference in the ruling grades is usually the preponderating item.

(*To be continued.*)

For The Canadian Engineer.

NATURAL VENTILATION.

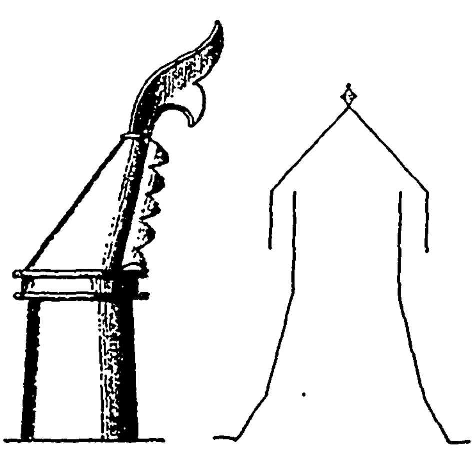
BY W. M. WATSON.

There are several means of thoroughly purifying and ventilating buildings by mechanical appliances. There is also a good method of forcing ventilation by the semi-natural process of passing the raw atmospheric air over hot steam or water pipes, which largely increases the temperature of the fresh air, causing it to expand and become lighter, and so ascending through tubes to any required room. This is only useful in cold weather, and where adopted there must be other means provided to ventilate in warm and temperate seasons. The same result is got by using a hot-air furnace in place of the steam or hot water heater, but the air after passing over the hot plates is dry, and soon injures the respiratory organs.

These methods are more or less costly; they often take up considerable room, and require attention to work them properly. Therefore it is necessary to provide natural means of purifying the interior of rooms that will be almost self acting in all weathers, that will be permanent in fixture, work mildly without creating any perceptible chilling draught; also that can be erected without curtailing any floor space, and that can be arranged at a very moderate cost, so that every dwelling, however cheaply built, can have its advantages. Such a method of purifying the air is called natural ventilation.

It has been proved that an average adult discharges $\frac{6}{10}$ of a cubic foot per hour of carbonic acid gas by respiration, together with some impurities from the skin by transpiration, and that to have a healthy atmosphere each person should have 600 cubic feet of air space, and the air of the room should be totally changed twice during the first, and three times during every other hour the person remains in the room. Common gas burners consuming 4 c. ft. per hour produce about 8 c. ft. of carbonic acid gas, which requires about 5,000 c. ft. of fresh air per hour to properly dilute it, unless some special provision is made to carry it away without allowing it to mix with the air of the room. The fumes from the light of gas made from water, and afterwards enriched by introducing kerosene oil, should never be allowed to mix with air that is to be breathed.

On account of the heat of the climate having a variation of about 100 degrees, it is somewhat difficult to provide natural ventilation that will answer at all seasons of

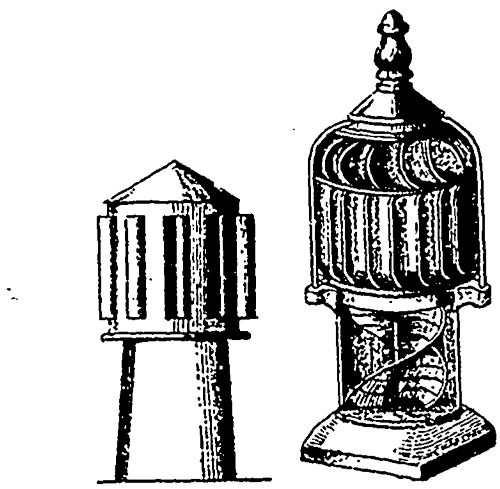


FIGS. 1 AND 2.

the year, because it is out of the question to ventilate an apartment by bringing in air at the freezing point without first warming it; and it is equally necessary to cool the hot summer atmosphere before using it for purifying purposes.

During the hot season a large hole in the roof shielded from the rain, with doors and windows open, seems acceptable, or a single flued ventilator having only an up-draught which requires an air duct from the outside to bring in the air necessary to form the current, or having some window or door open to cause the air of the room to move and pass up through the tube, similar to Figures 1, 2 and 3.

Howorth invented a ventilator that drew the air from the room by a powerful screw, but it could not draw more out than was let in. It had an advantage over the plain tube ones, because it considerably increased the speed of the current, and an 18-inch Howorth's would do as much work as a 24-inch plain one. They are made so well and accurately, having a neat provision for oiling and keeping the pivot and foot-block clean, that they will run about 100 revolutions per minute for about five years in a light wind without attention. (See Fig. 4.)



FIGS. 3 AND 4.

Any kind of one-flued ventilator will answer to pass out the tainted air of dwellings that are heated by hot air, because the atmospheric air is brought into the basement to be heated, and must necessarily travel upward and out at the highest point after performing its duty. By making a by-pass from the cold air duct and the hot air flues the same ducts and air channels could be used to ventilate when no heat was needed.

In most cases, especially for private houses, natural ventilation, together with making use of such powers of extraction as can be got by utilizing the sources of warming and lighting, is sufficient, if we so arrange things that the air can take its proper share in the constant changes Several scientists have made experiments, and all agree that where no artificial means are used to move and guide the currents of air intended to purify the interior of rooms without opening doors or windows, the outside atmosphere should enter the room at the ceiling at the point where the atmosphere of the room possesses the most heat. It will, on entering, fall through the heated air (because it is heavier and denser than the hot, tainted air that is rising to pass out), down to the floor level, and during its passage will extract and absorb some of the heat from the foul air, which will take off the chill and make the fresh air pleasant to inhale by the time it gets low enough to be used by the inmates.

I am told that the ancient system can yet be seen in many places in Egypt of ventilating by a bent tube facing the wind, similar to the ones used on steamships, being placed on the roof, the air being pressed down into the interior by the pressure of wind, which is one pound to the foot when travelling at the rate of three and a half miles per hour, but when this method is adopted on permanent buildings it is a failure, because when ventilation is most necessary there is no wind with power enough to create a current.

TABLE *to show the Discharge of Air in linear feet per minute. Calculated from Montgolfier's formula; the expansion of air being taken as 0·002 for each degree Farenheit, and one-fourth being deducted for friction (Round numbers have been taken)*

Height of column.	Difference between Internal and External Temperature.																						
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	30
10	88	102	114	125	135	144	153	161	169	176	183	190	197	204	210	216	222	228	233	239	244	249	254	279
11	92	107	119	131	141	151	160	169	177	185	192	200	207	213	220	226	233	239	245	250	256	261	267	292
12	96	111	125	136	147	158	167	176	185	193	201	209	216	223	230	237	243	249	255	261	267	273	279	305
13	100	116	130	140	153	164	174	183	192	201	209	217	225	232	239	246	253	259	266	272	278	284	290	318
14	104	120	135	147	159	170	181	190	200	209	217	225	233	241	248	255	262	269	276	282	289	295	301	330
15	108	125	139	153	165	176	187	197	207	216	225	233	241	249	257	264	272	279	286	292	299	305	312	341
16	111	129	144	158	170	182	193	204	213	223	232	241	249	257	265	273	281	288	295	302	309	315	322	353
17	115	133	148	163	176	188	199	210	220	230	239	248	257	265	274	282	289	297	304	311	318	325	332	363
18	118	136	153	167	181	193	205	216	226	237	246	255	264	273	282	290	298	305	313	320	327	335	342	374
19	121	140	157	172	186	198	210	222	233	243	253	262	272	281	289	298	306	314	321	329	336	344	351	384
20	126	144	161	176	190	204	216	228	239	249	259	269	279	288	297	305	314	322	330	338	345	353	360	394
21	128	147	165	181	195	209	221	233	243	255	266	276	286	295	304	313	321	330	338	346	354	361	369	404
22	131	151	169	185	200	214	226	239	250	261	272	282	292	302	311	320	329	338	346	354	362	370	378	414
23	134	154	173	189	204	218	232	244	256	267	276	287	297	307	316	327	336	346	354	362	370	378	386	423
24	136	158	176	193	209	223	237	249	261	273	284	295	305	315	325	335	344	353	361	370	378	386	394	432
25	139	161	180	197	213	227	241	254	267	279	290	301	312	322	332	342	351	360	369	378	386	394	402	441
26	142	164	183	201	217	232	246	259	272	284	296	307	318	328	338	349	359	367	376	385	394	402	410	450
27	145	167	187	205	221	237	251	264	277	290	302	313	324	335	345	355	365	374	383	392	401	410	418	458
28	147	170	190	207	225	241	255	269	282	295	307	319	330	341	351	361	371	381	390	399	408	417	426	467
29	150	173	194	212	229	245	260	274	287	300	312	324	335	347	357	368	378	388	397	407	416	425	433	475
30	153	176	197	216	233	249	264	279	292	305	318	330	341	355	363	374	384	394	404	414	423	432	441	483
31	155	179	200	219	237	253	269	283	297	310	323	335	347	358	369	380	391	401	411	420	430	439	448	491
32	158	182	204	223	241	257	273	288	302	315	328	341	353	364	375	386	397	407	417	427	437	446	455	499
33	160	185	207	226	245	261	277	292	307	320	333	346	358	370	381	392	403	414	424	434	443	453	462	506
34	162	188	210	230	248	265	282	297	311	325	338	351	363	375	387	398	409	420	430	440	450	460	469	514
35	165	190	213	233	252	269	286	301	316	330	343	356	369	381	393	404	415	426	436	447	457	467	476	522
36	167	193	216	236	255	273	290	305	320	334	348	361	374	386	398	410	421	432	442	453	463	473	483	529
37	170	196	219	240	259	277	294	310	325	339	353	366	379	392	404	415	427	438	448	459	470	480	490	536
38	172	198	222	243	262	281	298	314	329	344	358	371	384	397	409	421	432	444	454	465	476	486	496	543
39	174	201	225	246	266	284	302	318	333	348	362	376	389	402	414	426	438	450	461	471	482	492	503	551
40	176	204	228	249	269	288	305	322	338	353	367	381	394	407	420	432	444	455	467	477	488	499	509	558
45	187	216	241	264	286	305	324	341	358	374	389	404	418	432	445	458	471	483	495	506	518	529	540	591
50	197	228	254	279	301	329	341	360	377	394	401	426	441	455	469	483	496	509	522	534	546	558	569	623
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	30

To use the table, determine the height of the warm column of air from the point of entrance to the point of discharge. Ascertain the difference between its temperature and that of the external air. Take out number from table, and multiply by the section area of the discharge-tube or opening, in foot or decimals of a foot. The result is the discharge in cubic feet per minute, multiply by 60—result, discharge per hour. *Example*—Height of column, 32 feet; difference of temperature between internal and external air, 17 deg. Looking in the table, we find opposite to 32 and under 17,375 feet. That would be for an area of 1 square foot.

But supposing our air opening to be only ¾ of a foot, we must multiply 375 by ¾ or 0·75 of a foot.

	·375
	·75
	1875
	2625
	281·25

Therefore we get 281 feet (per minute), multiplied by 60 — 16,860 feet per hour.

With a view to prevent wind acting upon the currents all air ducts should be bent, having two or more elbows, and the mouth should either face up or downward. To avoid the chilling sensation of drafts when ventilation is secured by air ducts, the inlet should be sufficiently large to allow the necessary quantity to enter the room slowly, say about the rate of one mile per hour, and the inlet should be larger than the outlet. It is the size of the outlet that regulates the quantity of air entering and passing out of a room. Therefore it is necessary to know the size of tube or valve required to pass the proper quantity of air. Montgolfier's formula gives a valuable table showing the size needed under many variations between the temperature outside and inside, and also the height of the rooms, which will answer if the inlet end of the air duct is well shielded against the pressure of wind.

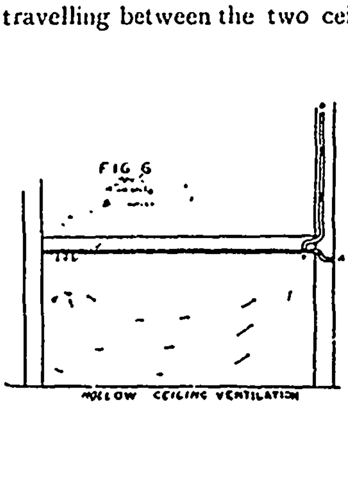
It is not necessary to make channels large enough to pass all the air needed, except the house be as tight as a glass show case, because there are generally streams of air passing in and out of the chinks of windows and doors, and even walls and plaster, except they happen to be painted and papered. Marcker proved by experiments that the following amount of air passes in one hour through a square meter of wall when the difference in the temperature was only 1° C., viz.: Sandstone, 1.69; limestone, 2.32; good brick, 2.83; loamy brick, 5.12, and that it increased in the ratio of the increase in the difference of the temperature between the outside and the interior.

No doubt the best way to venti'ate is by bringing in the fresh air at or near the ceiling at one end of the room, and extracting the tainted air at or near the floor line at the opposite end of the room, but this can only be done when an exhaust fan is used or there is a long chimney at least three times the height of the room. And even when a chimney is used, some method should be made to create some artificial heat at the bottom, to increase the draught at times when the temperature is nearly equal inside and out, because of the resistance to be overcome in drawing down the warm air in the room.

Dwellings can be simply and well ventilated by leaving all the interior partition walls two inches short of the ceilings, so that the air of every room can freely pass slowly out in long thin volumes into the entrance hall and staircase well. Then fix one double draught ventilator with a 24 to 30-inch body over the well on the roof. This will keep the air fresh and pure.

When a house is in course of erection a proper system of ventilation can be made for each room separately by building the outside walls hollow, having a 4-inch space carefully plastered smooth on both sides inside. This space would greatly benefit the house by keeping it warmer in winter and cooler in summer, but the space would also answer for an air duct leading to every room which would convey the necessary amount of air in slowly and cool the current a little in summer and warm it in winter. To draw off the tainted air of each room the main chimney should be so built as to be handy for inserting every tube drawing the foul air from the rooms, also handy to receive the smoke pipes serving all the needed fires. There should be a wrought iron tube inside the chimney, with branches to receive the smoke. Round the smoke-tube there should be about 6 inches of space to act as an air flue, and into that air space all air ducts should be carried. The chimney should have a couple of slow-turned elbows near the top in order to prevent the pressure of the outside atmosphere bearing its weight down the full length of the chimney, injuring the chimney efficiency. A straight vertical chimney or air flue is of little use for creating a draught, except it is carried to a great height, besides having plenty of heat or a forced draught at the bottom.

The space between joists could be made useful for bringing in and tempering the incoming current in winter, or better still, if the ceilings could be made with two plates having a half-inch space between, coupled at one end of the room with the outside atmosphere, by a long bent flue, and pierced with holes at the other end of the room to allow the fresh air to enter. The fresh air while travelling between the two ceiling plates across the top of



HOLLOW CEILING VENTILATION

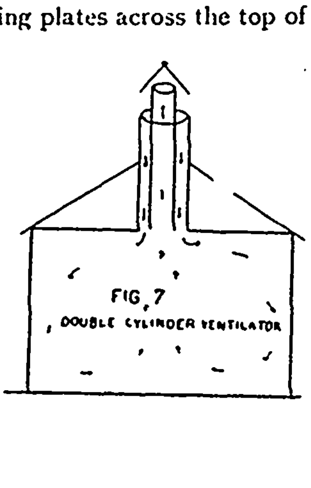


FIG. 7
DOUBLE CYLINDER VENTILATOR

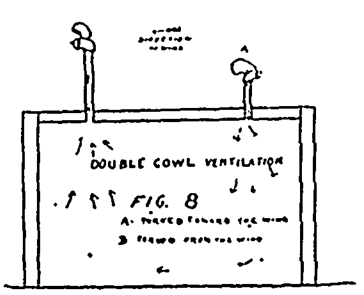
the warm room would increase in temperature so much that very little heat would be lost by changing the atmosphere of the room twice an hour (see fig. 6). By this method the extractor would have to be so arranged that it would have a keen draught.

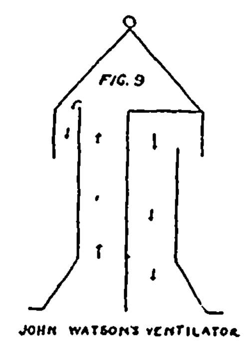
Potts describes a similar system of ventilation to this by having a hollow cornice round the room, with a double row of holes, one row connected to the outside air and the other row connected with a heated flue of a chimney, and the system worked well.

Seventy years ago Sylvester used a hot air furnace of a far superior type, and more economical with fuel than any of those made at the present day to force ventilation and warm houses. His stove had plenty of wing plates that increased the radiating power. He placed a large pipe finishing with a cowl a little distance from the building, where it could face the wind in which ever direction it happened to blow, at a height of about six feet from the ground. The wind entering the cowl continued on through an underground channel to the basement of the house, where it entered a chamber containing a stove which heated the air and conveyed it through pipes to each room.

McKennell ventilated by placing two cylinders in the ceiling, one inside the other, the inner one terminating about 3 inches higher than the outside one. The space between the two tubes was equal to the area of the inside cylinder. By this method he caused an in and out draft by one machine. (See Fig. 7).

Arnott took advantage of the unequal density of the masses of air at different elevations. He ventilated by placing two moving cowls on the roof, one arranged to face the wind and the other to face the way it was blowing. The one that faced the wind was set several feet lower than the other and formed the inlet; the high one that faced the way the wind was going made a good ex-

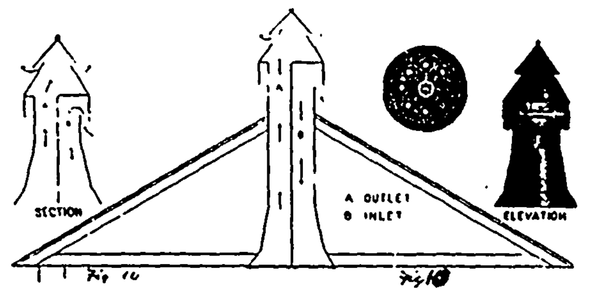




JOHN WATSON'S VENTILATOR

tractor. The machine was valuable for large meeting rooms. (See Fig. 8).

The late John Watson crystallized some ideas and built a double current ventilator having a compact and graceful form. It had a perfectly air tight division vertically through the centre, the half moon shaped tube on one side terminating about 6 inches higher than the other side. (See Fig. 9.) This little difference in the height of the half tubes caused an inlet and outlet action. These ventilators are at present purifying the air of many of the English public buildings. The first time I fixed this class of ventilator I considered Mr. Watson did not get all the work out of his design that he might, and I afterwards designed one that gave a space of 30 inches between the inlet and outlet, by so doing increasing its extracting power. (See Fig. 10). I made a small one with an 8-inch body to test with, and fixed it on an air-tight glass show case containing 8 cubic feet of air space. Inside at the bottom of the case were placed four lighted gas burners, burning 5 feet per hour each. I fixed wires with feathers attached all over inside the case to indicate the way the air moved. The case was outside for a week during one of the coldest spells in winter. The test proved that the air dropped to the floor level, penetrating every corner of the case; then,



after making a circular tour, it again passed to the outside up through the other half of the ventilator. The whole of the glass of the case and the down draught half of the ventilator kept cool all the time, while the upcast side was hot. And if passage of air stopped the lights would at once die out.

None of the systems of ventilating that I have here described are covered by patents, and if the reader fancies any of them he can use the ideas freely, and I hope improve them, and then give publicity to his ideas.

For THE CANADIAN ENGINEER.

THE OTTAWA VALLEY CANAL.

BY ANDREW BELL, C E

When referring to the scheme—now exciting so much interest—to construct a deep-water canal via the Ottawa River to Georgian Bay, it is now well recognized that the most difficult engineering problem to be solved is how to get deep water on what is generally called the Lower Ottawa—say between Lachine and Arnprior. That part of the river flows over flat limestone rock, consequently the still water reaches are wide and shallow—the shallowest parts often extending some distance up and down stream—and this difficulty seems to be greatest towards the lower end, namely, from a short distance above Lachine to above St. Ann's—due, but only partly, to the river dividing above the latter place, and the larger part going north of the Island of Montreal. At present not more than 8 feet depth for navigation can be depended upon between Lachine and Ottawa city in low water.

The rapids between Lachine and Arnprior are St. Ann's, 3 ft. fall; Carillon, 16 ft.; Long Sault, 44 ft.; Chaudiere and Des Chenes, 60 ft. (about); and Chatts, 40 ft.

Deep water can be made by raising the surface, or by lowering the bottom, or by both.

As the banks of the lower river are generally low and thickly settled, raising the surface permanently, even a few feet, seems to me to be totally out of the question. The dams would be extremely expensive to construct and expensive to keep in repair; the raising of the water would be resisted to such an extent as to almost cause a rebellion, besides destroying the appearance and value of a large area of country. Where it is possible to widen the channel for high water by excavating the banks above low water marks, low dams could be put in at head of rapids to such an extent as can be compensated for by that widening for high water; thus raising low water but keeping down high water to its original height. Two or three feet might be gained in that way for low water, and the low dams would enable the water to be "laid hold of" for power purposes.

To get the required depth, over the part of river referred to, lowering the bottom where necessary must be generally resorted to in some manner. Where the shallows are earth they can be dredged ; where they are rock, as is generally the case, if short they can be sub-marined; if long, resort must be had to excavation inland, or along shore, where the expense of un-watering is the least.

The question cannot be settled until more and better information is obtained, based on the changed conditions of the present proposals. All the surveys heretofore made for canalling the Ottawa only looked for 10 or 12 feet deep. I made extensive surveys in 1870-82 from above Grenville to below Carillon, and also (by an assistant), above and below St. Anns, but my instructions only required me to look for 10 feet depth. The public would not be satisfied in the new scheme with less than 20 feet. Careful and exhaustive surveys must be made and from them the best solution of the problem studied out, when it is to be hoped the difficulties will, to a great extent, disappear.

It may be found best to take the canal by way of the Back River from Lake of Two Mountains, instead of by Lachine and Montreal. The rapids can be overcome as is done at present below Ottawa, by excavating channels along shore, either a little inland or by " fencing in " part of the bed of river at the shore.

There is considerable difference between high and low water in the Lower Ottawa. This varies at different places, being least at Carillon, where it averages about 10 feet. By making deep water on the middle parts of the canals around rapids, that is, the parts where the surface is not effected by the rise and fall of the river, there would at present be 20 feet navigation in high water, and 12 to 15 feet for a considerable part of the season. Unfortunately, as the navigation is most required at the time of the year when the water is lowest, not much would be gained by utilizing high and medium water in that way, but it might be adopted to som extent while work at deepening the slack water stretches was in progress, which will necessarily be slow.

Above Arnprior the river flows through laurentian rocks. The banks are generally high and as yet thinly populated. The slack water reaches are almost always deep, and shallows, where they occur, are mostly short. The channels at rapids are narrow, and all conditions for damming good ; so that where deeper water than exists is wanted it can be obtained by raising the surface where that is found to be cheaper than excavating.

The amount of water power which can be developed is an interesting subject, but is little known. From a series of measurements I took at Carillon, between 1872 and 1882, with rather imperfect appliances, I made out the flow of the river there to be in very high water 200,000 cubic feet per second, and in extreme low water, 25,000 cubic feet per second, ordinary low water being about 30,000 to 35,000 cubic feet per second. When the Ottawa canal is made the dams which must be built on the Upper Ottawa will of course regulate the flow by retaining a portion of the spring floods for use during low water. It is safe to say that this will be done to such an extent that at least 42,000 cubic feet per second can be depended upon as the lowest at any time of the year between St. Ann's and Mattawa. That would give, taking 20 per cent. off for loss in application, 4,000 horse power per foot fall. The tributaries emptying into the river between the points mentioned should give about a quarter more in the vicinity of the Ottawa before they fall into it. That would make on the Ottawa, from Mattawa downward and its branches, close to main stream, about 2,500,000 horse power to be depended on all the year round—not including the extra power which might be developed for three months or more during high water.

ONTARIO AND ALASKA.

We Canadians are so used to the idea of our vast territories and their boundless wealth that we feel deep annoyance at times to find that some foreigner, or even traveller from the motherland, is not familiar with our riches. Now we find ourselves with new discoveries every day, and look back on our former knowledge of our country's greatness in much the same way as we look on the foreigner's total ignorance of it. The lands which some of us thought to be producing a good crop when we read over the report of the Hudson's Bay fur sales, are now known to be as valuable as any in all our wide Dominion.

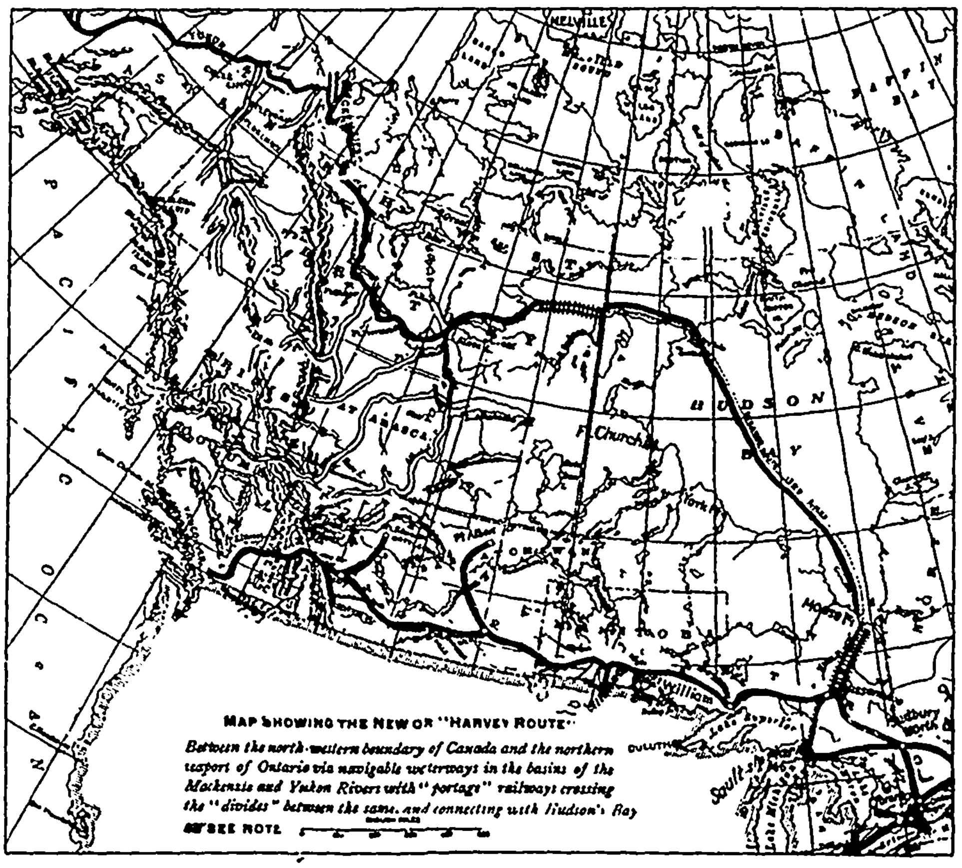
There are two great obstacles to the development of our northern regions, the rigor of the climate, and the enormous distances to be traversed. If facilities could be provided for rapidly handling the freight and passenger traffic of these regions during the warm season, the extreme cold of the winter months would not be so serious a handicap. At present all eyes are turned toward the Klondyke, and there is, therefore, the more interest in considering the prospectus of the Sault Ste. Marie and Hudson's Bay Railway Co., which proposes not only to reach the Klondyke, but to open up the million and a quarter square miles of lands which lie in the basin of the Mackenzie river, which abound, as we know they do, in timber and fish, and contain coal and petroleum areas unapproached elsewhere upon the globe.

The resources of this country were examined into by a select committee of the Senate of the Dominion of Canada, and a report published by authority of Parliament in 1888. The committee was appointed to enquire into the resources of that part of the Dominion lying north of the Saskatchewan watershed, east of the Rocky Mountains, and west of Hudson's Bay, and comprising the Great Mackenzie Basin—its extent of navigable rivers, lakes and sea coast, of arable and pastoral land, its fisheries, forests and mines, and to report upon its possible commercial and agricultural value. The committee reported that the Mackenzie Basin comprised an area estimated at 1,260,000 square miles ; also that the three great lakes, Athabasca, Great Slave Lake, and Great Bear Lake, have navigable coast lines of over 4,000 miles, with an area probably exceeding that of the great lakes of the St. Lawrence Basin, excluding Lake Michigan. That there are 2,750 miles of navigable water in the Mackenzie River and main tributaries, of which 1,360 miles are north of the rapids of the Great Slave River, and can be navigated by ocean steamers of medium draught.

The eastern extremity of Great Slave Lake is only a short distance from the navigable waters of Hudson's Bay. The report stated that within the Mackenzie River there is a possible area of 656,000 square miles fitted for the growth of potatoes, 407,000 square miles suitable for barley, and 316,000 square miles suitable for wheat. That there is a pastoral area of 860,000 square miles, 26,000 miles of which is open prairie with occasional groves, the remainder being more or less wooded; 274,000 square miles, including the prairie, may be considered as arable land. That about 400,000 square miles of the total area is useless for the pasturage of domestic animals or for cultivation. This area comprising the Barren Grounds and a portion of the lightly wooded region to their south and west. That throughout this arable and pastoral area latitude bears no direct relation to summer isotherms, the spring flowers and the buds of deciduous trees appearing as early north of Great Slave Lake as at Winnipeg, St. Paul and Minneapolis, Kingston, or Ottawa, and earlier along the Peace, Laird, and some minor western affluents of the Great Mackenzie River, where the climate resembles that of western Ontario. That the native grasses and vetches are equal and in some districts superior to those of eastern Canada. That the prevailing south-west summer winds of the country in question bring the warmth and moisture which render possible the far northern cereal growth, and sensibly affect the climate of the region under consideration as far north as the Arctic circle and as far east as the eastern rim of the Mackenzie Basin.

Fish were found in abundance and salmon in nearly all the rivers.

The forest area, the report says, has upon it a growth of trees well suited for all purposes of house and ship-building, for mining, railway and bridging purposes, far in excess of its own needs, and of great prospective value to the treeless regions of Canada and the United States to the south, the growth on the Laurentian formation being scant, but the alluvial portion has upon it the "Liard," a balsam poplar, sometimes called Balm of Gilead or rough bark poplar, 120 feet high, with a stump diameter of five or six feet. The *white spruce*, 150 feet high, with a stump diameter of four to five feet; the *larch* of about the same size, and the *banksian pine*, whose straight stem is often 100 feet long, with only two feet of diameter at the stump.



MAP SHOWING THE NEW OR "HARVEY ROUTE"

Between the north-western boundary of Canada and the northern seaport of Ontario via navigable waterways in the basins of the Mackenzie and Yukon Rivers with "portage" railways crossing the "divides" between the same, and connecting with Hudson's Bay

SEE NOTE

This is the country to which we wish to secure ready access. The route proposed is shown by the accompanying map. From Missanabie on the C.P.R., to Moose Factory on James' Bay, the southern extremity of Hudson's Bay, is 250 miles; from Moose Factory to the head of Chesterfield Inlet, the north-western extremity of Hudson's Bay, is 1,300 miles of deep water navigation; from the head of Chesterfield Inlet to Great Slave Lake is not more than 175 miles, where a portage railway would be built; from Great Slave Lake to the mouth of the Mackenzie River is 1,400 miles; a railway line 50 miles long would connect the mouth of the Mackenzie river with the Porcupine, a branch of the Yukon, which affords navigable water for 1,500 miles to the Behring Sea.

The line from Missanabie to Moose Factory is estimated to cost $30,000 per mile, or $7,500,000, and this sum it is proposed to raise partly by means of land and money grants which are to be asked from the Ontario and Dominion Governments on the following conditions: First—That no payments should be made until a considerable part of the work was actually done, and that a large reserve should be made until the road was actually finished to Hudson Bay. Second—That the stock control of the enterprise should be deposited in Toronto as a trust, and that it should be retained in that condition until the railway was completed and open for traffic. Then that the Dominion Government, and after that the Provincial Government, and following these the citizens of Canada and of Toronto, should have an opportunity of taking a controlling interest in the stock at par, which should be valued in the construction operations at the same rate.

The charter under which the first line in this new chain of connection is to be built was granted to a number of Sault Ste. Marie men seven years ago, and was transferred by them a short time since to a group of well-known Toronto capitalists, among whom are Stapleton Caldecott, S. H. Blake, J. W. Langmuir, Robt. Kilgour, and James Scott.

The engineer in charge of the preparatory work is Charles T. Harvey, C.E., whose work is well known in connection with a number of important works.

THE DEEP WATERWAYS QUESTION.

The United States commission appointed to consider the question of an international deep waterway route from the Great Lakes to the sea has reported to Congress, and the Canadian commission appointed to co-operate with the American commission have also sent in their report. The

American commissioners' report was promptly published and sent to the Canadian Government, but the Canadian report, though rendered last June before Parliament prorogued, has not yet seen the light. This is much to be regretted, because apart from the fact that the Canadian public should be in a position to study this question, it is demanded by international courtesy that the American Government and public should have the same prompt access to the information gathered by the Canadian commissioners as they have given us of theirs. To delay the Canadian report would appear all the more strange, seeing that the Minister of Railways and Canals has himself reprinted the American commissioners' report in his own departmental blue book.

Following up their commissioners' report, the United States Congress has appropriated a further sum of $150,000 for new surveys bearing on the contemplated international deep water channel to the seaboard. These new surveys will be in charge of a commission more exclusively composed of engineers, the commercial aspect of the case having already been fully gone into in the last report. It is thought that the Canadian Government will co operate in these new surveys, and then the question of the cost of the deepening and the further question of control and regulation of the proposed great water route will be considered. It is to be hoped that our Government will not lose any more valuable time in dealing with a subject of such great importance to the marine interests of Canada.

Meantime, it may be observed that a commission of military engineers appointed by the U.S. Government have enquired into the question as to how the levels of the Upper Lakes will be affected by the Chicago drainage canal, and have condemned the scheme as likely to have a serious effect on the navigation of the Great Lakes. If it is found that the City of Chicago, by creating a large river here—for that is what the new canal means—causes the lowering of the lake levels, the Government will step in and compel the city to reduce the flow of water to the limits of safety. Happily for Canada, there are more populous cities on the American shores of the Great Lakes that would be damaged or ruined by the Chicago canal than on the Canadian shores, and the international riparian rights, as well as the local commercial interests all along the lakes and rivers, combine to make an influence that will outweigh the selfish interests of even a Chicago. So we may hope that the American Government will not allow Chicago to lower the lakes by a single inch ; for the deepening of the canals from the Great Lakes to the ocean will be as important for that emporium as for the other cities and towns scattered along the shores of these vast fresh water seas.

Last month the American Government received a report from Major T. W. Symons, of the U. S. Corps of Engineers, a preliminary report on the question of a ship canal to the sea exclusively through United States territory. A synopsis of the report will be found in another column.

THE VICTORIA JUBILEE BRIDGE AT MONTREAL.

When the present Victoria Tubular Bridge across the River St. Lawrence at Montreal was built, it created at the time universal admiration for its noble proportions and the skill displayed by its engineers, as well as amazement at its gigantic size and stability—in fact it was looked upon as one of the wonders of the world. Built between 1854 and 1859, and with little or no precedent for many important details connected with the structure, one is bound, even at this day, to acknowledge the wisdom and foresight of the engineers and contractors who planned and built it. Far-sighted, however, as the promoters of this bridge were, in regard to details of construction, the most sanguine of them, in all probability, never realized that within thirty years from its opening the demands upon its capacity would be so great as to make a larger structure a necessity. This need has been specially felt in recent years, as the traffic of the Grand Trunk Railway developed and increased so enormously, and, as far as the bridge itself is concerned, will the more easily be understood when it is considered that over eighty trains pass through the bridge during the twenty-four hours. It is well known that the passage of trains through the bridge has always been conducted on the absolute block system, and no train received orders to proceed through until the preceding one had reported to the telegraph station at either end.

This famous bridge will soon only be a matter of history, for it is about to be replaced by one modern in design, built in accordance with the best practice of the present day, and of accommodation sufficient probably to meet all future requirements. The superstructure of the bridge which is to replace the present tubes, will consist of twenty-four spans of pin-connected, through, steel trusses, each of a length of 254 feet between centres of end pins, and one span of 348 feet over the steamboat channel. The trusses will carry two railway tracks to be used by ordinary steam railway trains, as well as by electric railways, and the floor beam system will be extended beyond the trusses of sufficient length for an ordinary vehicle roadway and sidewalk on either side. The clear width between the trusses will be 28 feet. For each railway track there will be four lines of stringers, spaced two feet five and a half inches from centre to centre. There will also be two lines of stringers for each roadway, and one line placed at the ends of the projecting beams for the support of the outer edge of the sidewalk. The clear headway from the base of track rails to the struts under the overhead lateral bracing will be 22 feet.

The trusses have been proportioned to carry the undermentioned loads :—

First.—The total weight of metal in them.

Second.—The weight of the wooden floor beams, planking, sidewalks, guard timbers, railings, rails and fastenings, etc., amounting in the aggregate to 2,800 lbs. per lineal foot.

Third.—A moving load in either direction on each side of the two tracks, of two consolidation engines and tenders, coupled, followed by a uniformly distributed load weighing 4,000 lbs. per lineal foot, or 100,000 lbs. equally distributed on two pairs of driving wheels spaced 7½ feet centre to centre.

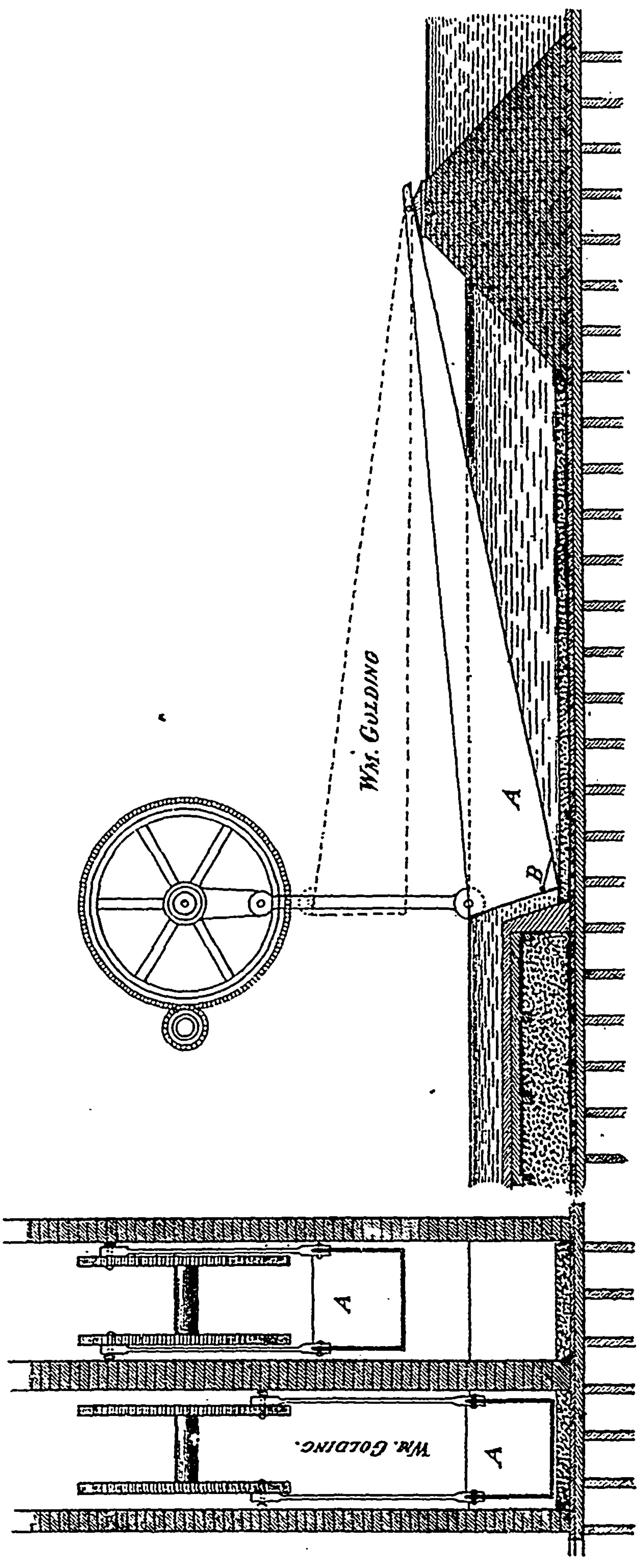
Fourth.—A moving load in either direction on each of the roadways of 1,100 lbs. per lineal foot.

Fifth—A live load on each foot-walk of 200 lbs. per lineal foot.

The trusses are now under construction by the Detroit Bridge and Iron Works, and the Dominion Bridge Company. Of the 25 spans, 19 will be turned out by the former company, and six by the latter.

At the present time the masonry of the piers is undergoing the extension necessary to meet the requirements of the enlarged bridge. It is expected that work will be commenced on the erection of the new bridge about the middle of August, and it is the intention to have the whole of the work completed by the 1st June, 1898.

On the application of Edward Major, a creditor, an order of the court has been granted for the winding up of the Canadian Mineral Wool Co., of Toronto, as insolvent.



For THE CANADIAN ENGINEER.

WATER LIFT.

This sketch illustrates a new system of water lift, which is claimed to be especially adapted to the displacement of heavy fluids, and in shallow lifts will have the advantage in not having to raise the water any higher than required to effect the discharge. The sketch is one-sixteenth to the foot of a combination to discharge 500 cubic feet per second over an embankment six feet high.

There are two wedged-shaped dippers, *A*, pivoted at the small end and suspended by lifting arms at lower end. There are 4 spur wheels which form the cranks; there is also a cross shaft upon which are secured 4 pinions, which engage the 4 spur wheels in such a manner as to require one of the dippers to descend while the other is coming up, thus effectually balancing the dippers and all other parts. A large valve is placed at *B*, through which the burdened water enters while the dipper is descending.

The motive power will be applied to the pinion shaft in any manner deemed best. This lift is the invention of Wm. Golding, New Orleans, Va.

NATIONAL CONVENTION OF MASTER PLUMBERS OF CANADA.

The first four days in July were marked by the meeting of the Master Plumbers of Canada in Toronto for their second annual convention. There were thirty-four delegates present against eighteen last year at the first convention. The representation was one delegate to every ten members. The following delegates were present:

Quebec—R. Sampson, A. Forrest, J. R. Cane, J. O. Matte, A. Pickard. Montreal—Thos. Moll, E. C. Thibault, J. W. Harris, John Watson, P. C. Ogilvie, Arthur Martin, P. J. Carroll, E. C. Mount, Wm. Briggs, J. W. Hughes, Joseph Lamarche. Windsor, Ont.—M. B. Squires, Halifax—John Borton, Geo. A. Perrier. Ottawa—John McKinley, F. J. Johnson. St. John, N.B.—W. H. Dunbrack, J. H. Doody. St. Catharines—J. A. Caslake. Toronto—J. B. Fitzsimons, Joseph Wright, A. Purdy, H. Beavis, J. K. Allison. Winnipeg—J. W. Hughes. London—W. H. Heard, W. Smith, E. Holland, Benjamin Noble. West Toronto Junction—Represented by the five Toronto delegates. St. Thomas—W. Flaherty. Peterborough—Adam Hall. The Executive Committee reported that during the year local associations in affiliation with the Dominion Association had been organized in Winnipeg, Man., and Windsor, Stratford, St. Thomas, and St. Catharines, Ont. Negotiations are now going on that will, it is hoped, result in the formation of an Association in Vancouver, B.C.

Notice was given of a motion to form Provincial organizations, each to be part of the larger association, whose officers would then be known as the supreme officers.

Drafts of by-laws which the association will endeavor to have passed in the various municipalities were submitted to the association. They comprised by-laws to license and regulate plumbers; to provide plumbing inspectors, plumbing examiners and their duties. The legislative committee reported against the proposed incorporation of the association.

President Lamarche reported the progress of the association during the first year of its existence. A great deal of work had fallen on the officers, and a great deal of correspondence had been necessary in perfecting their organization. The resolution of the master plumbers had been signed by most of the wholesale dealers in Toronto, Montreal and Quebec. He urged the members to be most careful in sending the names of all master plumbers in their neighborhood, so that the wholesale men should know the names of all the master plumbers. The president said: "Too much trouble cannot be taken to see that this is carried out, as the wholesale men are not able to distinguish between master plumbers, journeymen plumbers and contractors. If a man comes in the store with his money, calling himself a master plumber, the wholesale man will not nor cannot take time to go after possible information to see if he is the right man to whom he should sell. It is, therefore, our duty to see that they receive a complete list of *bona fide* master plumbers, monthly notices of changes, and the deserved help from us. Complaints of the agreement being broken should always be very carefully made and positive proof sent in to the National office. It alone has a right to deal with trade relations which have been decided by the convention."

The new officers elected are:—President, Joseph Wright, Toronto; vice-president, W. Smith, London; vice-president for Ontario, John McKinley, Ottawa; vice-president for Quebec, P. J. Carroll, Montreal; vice president for New Brunswick, J. H. Doody, vice-president for Nova Scotia, John Borton, Halifax; vice-president for Manitoba, —. Irwin, Winnipeg; secretary, —. Mansell; treasurer, W. Briggs, Montreal; executive committee, one from each Province-Ontario, J. B. Fitzsimons, Toronto; Quebec, Arch. Picard, Quebec; New Brunswick, Thomas Campbell, St. John; Nova Scotia, Geo. A. Perrier; Manitoba, —. Stevenson, Winnipeg.

The social features of the convention included a drive given the members by the city, a banquet and a trip to Niagara Falls. The banquet was a magnificent affair, and was held in the Harry Webb Co.'s building, Yonge and Melinda streets. About 140 members and guests sat down to a dinner which was beautifully served and in which every dish was well worth the serving. Chairman Burroughes opened the toast list and a couple of hours were spent in speeches and song.

DETERMINATION OF THE HEATING POWER AND STEAM-PRODUCING VALUE OF COALS FROM A PRELIMINARY EXAMINATION.*

BY WILLIAM THOMPSON, MONTREAL WEST.

The principle of getting the best returns and most efficient service should underlie our system of purchasing our fuel, as of anything else. It is not my intention to discuss the merits or demerits of any particular variety of coal, but to try to establish a method whereby the heating power, and consequently, the value of any fuel, can readily be determined, and when the knowledge of conditions under which combustion must take place are understood, we shall, in some measure at least, be able to intelligently choose between any number of samples and varieties of coals that are most suited to our purpose. Undoubtedly the most correct method of determining the actual heating power of any substance is by the aid of the calorimeter, but when we consider the high cost and delicate manipulation required in an instrument of this kind, we find it is practically debarred from use, except by the expert chemist in his laboratory. Efforts have been made by scientists to construct a formula whereby the actual heating power of coals could be accurately ascertained by computation. That published by Dulong and also by Mahler, is perhaps the best. It is based upon an elementary analysis of the coal under examination, and the fact that the heating powers of coals of a like composition remained constant. They also establish the fact that the heating power of fixed carbon remains constant, as does also that of hydrogen when in combination with the same proportions of oxygen and nitrogen. Dulong accepts as the heat-producing elements of coal, carbon and hydrogen, giving each a constant calorific value, and at the same time determined that the oxygen of the coal renders unavailing for heating purposes one-eighth of its own weight of the hydrogen, and on this basis constructs the following formula:

$$Q = 14.544\ C + 62{,}100\ (H - O.)$$

which for convenience might be written:

$$Q = 14.544\ C + 62{,}100\ H - 7{,}762.50$$

Where Q equals calorific value of fuel,

14.544 = constant heating power of carbon
62,100 = " " " hydrogen
7,762.5 = " neutralizing power of oxygen

Mahler, at more recent date, and after a series of lengthy experiments, amended Dulong's formula slightly by accepting Berthelet's more recent determination of the heating power of carbon as 14.52 B.T.U., and using the empirical constant, 5,400, at the same time taking note of the effect of nitrogen as well as that of the oxygen. Mahler's formula then became:

$$Q = 14.652\ C + 62{,}100\ H - 5{,}400\ (O + N)$$

Where Q equals calorific value of coal,

14.652 = constant value of carbon
62,100 = " " hydrogen
5,400 = " neutralizing effect of oxygen, less heat formed by formation of nitric acid.
$(N_2 O_5 + H_2 O)$ †

*Abstract of a paper read before the Canadian Electrical Association.

† $N_2 O_5 + H_2 O = 2\ H N O_3$. The calorific value of 1 lb. nitric acid equals 157.79 B.T.U.

Both of these formulas are based upon an elementary analysis, which is difficult to make, and will give an inaccurate result, unless conducted by a chemist, experienced in this class of work. Consequently we must look for a formula constructed on the basis of a proximate analysis. An elementary analysis of coal is a definition used when it is understood that the whole of the elements composing the coal are determined and separately enumerated. A proximate analysis determines the moisture, volatile combustible matter, fixed carbon, and ash. The volatile combustible may consist of several elements, but is chiefly composed of carbon and hydrogen in combination as "hydro-carbons." This carbon is hereafter usually referred to as volatile carbon, and the carbon remaining in the free or solid state is referred to as fixed carbon. For example, the coke from gas works contains fixed carbon plus ash.

M. E. Goutal published in Progressive Age, Jan. 15, 1897, the following formula:

$$Q = 14670\ F\ C + A \times \text{volatile matter}$$

when Q equals calorific value of coal

14670 = constant heating power of fixed carbon.
A = 23400 when volatile matter equals from 2 per cent. to 15 per cent. of total combustible.
A = 18000 when volatile matter equals from 15 per cent. to 30 per cent of total combustible
A = 17100 when volatile matter equals from 30 per cent. to 35 per cent. of total combustible.
A = 16200 when volatile matter equals from 35 per cent. to 40 per cent of total combustible.

This formula may be taken as useful for the calorimetric value from a proximate analysis of coals of an anthracite, semi-bituminous and bituminous nature, but should not be used in cases where the volatile matter exceeds 35 per cent. of total combustible.

Up to this point I have dealt entirely with the estimation of the actual calorimetric value of coals. This, however, does not give us the information we require as engineers. Experience teaches us that there is often a wide difference between the industrial value of bituminous and anthracite coals, owing apparently to the increased percentage of volatile matter in bituminous varieties. A review of Mahler's calorimetric tests shows the interesting fact that the total calorimetric values of coals vary but little, and that a decrease of fixed carbon does not reduce the heating power of the coal in proportion to the increase of volatile combustible matter, while on the other hand repeated tests prove that the industrial value of coals decreases almost in the same proportion that volatile combustible increases.

We can safely take it as an established fact that the heating power of fixed carbon will remain constant. The same can be said of hydrogen in the absence of oxygen in the combustible, and the heating value of the hydrogen in the combustible will decrease in proportion to the increased percentage of oxygen within the combustible. Both Dulong and Mahler recognize this fact, and construct their formula accordingly. The actual calorific value of coals decreases in nearly the same proportion as the neutralizing effect of the oxygen on the hydrogen increases, and that the industrial heating value of the coals under the boiler decreases as the proportion of volatile carbon increases. We have this strongly exemplified in our daily practice. It requires but ordinary observation for us to readily see that anthracite coals produce practically no smoke, semi-bituminous coals very little, while bituminous coals produce dense, black clouds of smoke, varying in density and volume according to the quantity and composition of the volatile combustible matter in our fuel.

It has been said that the industrial value of a coal for steam-making purposes is practically fixed by the percentage of fixed carbon in the fuel, but we cannot take this method of determination as a permanent basis for calculation with any degree of accuracy. It has been established fairly satisfactorily, however, that volatile matter of similar composition will give off like quantities of heat. The adoption of the principles underlying Goutal's formula, and multiplying by the average percentage of efficiency of the various classes of coals for industrial steam-making purposes, as determined by Schurer-Kestner on European coals and Johnston on American coals, leads me to the belief that a formula constructed as follows will be of especial benefit in enabling engineers to arrive at the steam-making capacity of their coals .

$$Q = 14652 \times C + A \times \text{volatile matter} \times B.$$

Where A equals 23,400 when volatile combustible is equal to from 2 to 15 per cent of total combustible,

A equals 20,000 when volatile combustible equals from 15-30 per cent. of total combustible,

A equals 17,100 when volatile combustible equals from 30.35 per cent. of total combustible.

A equals 16,200 when volatile combustible equals from 35-40 per cent. of total combustible.

Where Q equals industrial value of coal for steam-making purposes, and where

B equals .64 when fixed carbon equals 82-90 per cent. of total combustible,

B equals .65 when fixed carbon equals 74-82 per cent. of total combustible,

B equals .662 when fixed carbon equals 68.74 per cent. of total combustible,

B equals .551 when fixed carbon equals 50-60 per cent. of total combustible.

In reviewing this formula I may say I was guided in its construction by the fact that the heating value of the volatile combustible is a constantly changing quantity, but remains constant in accordance with its composition of the elements, and that these elements occur in practically fixed proportions, determined by the total volatile combustible matter in the coal. With this formula and the proximate analysis before us, we are readily enabled to determine which of two coals are likely to be the most economical and best suited to the conditions under which combustion must take place, and will, I hope, be found useful by my hearers in enabling them to arrive at the real value of any sample of coal placed before them for their examination and opinion.

In presenting his paper Mr. Thompson said the present mode of determining the efficiency of boilers and furnaces was somewhat crude We can with a little practice determine the heat-producing value of the coal we are using, but we want to trace that heat. We, as engineers, get the quantity of water that we have evaporated and made into steam, and we call that efficiency, but it does not give us the information that we actually require. We want to know, if there is a loss, where that loss occurs. Let us trace it out in this way : We start by knowing the maximum quantity of heat that the coal will give ; we then collect a sample of our fuel gases and ascertain the composition of them, and from that composition we are enabled to know the exact quantity of air that has been admitted to the furnaces. We are then enabled to determine the exact quantity of carbonic oxide that has been formed during combustion, and if we take and examine our ash and still continue our analysis we are enabled to determine the exact quantity of combustible matter that still remains in the ash, because none of our furnace or grate bars are perfect enough to give nothing but pure ash We have first the composition of the gases, we have then the quantity of air admitted, we have the heat lost through the formation of carbonic oxide, or heat lost through imperfect combustion.

Mr. Milne : The determination of the heat value in coal is generally done by three methods; first, chemical analysis ; second, by combustion in a coal calorimeter ; and third, by actual burning under the boiler. There is some doubt as to the correctness of chemical analysis. The coal calorimeter is certainly, I think, the most correct method of arriving at it, but if the two experiments are properly conducted—the chemical analysis and the combustion in the coal calorimeter—the results do not vary very much ; but at the same time, when you test a sample of coal, or take a variety of samples from the coal pile and mix them all up and burn them in the coal calorimeter, that does not say the coal that we are going to get for that day is of the same quality, because, although you are getting coal from the same mine, you will get good and bad cars of coal. I do not see, even if we determine the exact value of the heating properties of that sample or set of samples, that it is going to be of very much value to us. There is an instrument—probably my friend Mr. Thompson is acquainted with it ; it is invented by a Mr. Thompson and is used by the North British and some of the leading railways in the Old Country—which I think it might be advisable to describe. It gives you the heating value of coal at once, almost without any calculation. You take a gramme or two grammes of coal ; after you have powdered it up, put it in a vessel and put in a certain amount of oxygen, you immerse this little combustion chamber in 966 grammes of water, or double that quantity if you are using two grammes of coal, and if that amount of water is raised one degree Fahrenheit, then that would indicate that we have one pound of water evaporated or boiled off into steam for the raising of the water one degree Fah. If you raise that 10 degrees, it is equivalent to 10 lbs. of water boiled off. If you want to find the thermal value of the coal you are testing you would simply take your 1,934 grammes—that is the amount of water—multiply that by the rise in temperature, and divide by the number of grammes of coal you are burning ; that would give you the exact heat value in the coal. I think that is the simplest method, and it is accurate enough for all practical purposes.

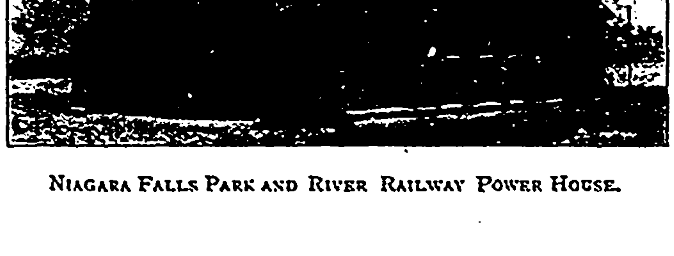
Mr. Thompson said he knew the instrument referred to, but did not consider it reliable. In dealing with so small a quantity of fuel the metal itself absorbed enough heat to lead one astray. He did not say the instrument was useless, but the average engineer is not able to use it. As to the value of a calorimeter, he heard that during last year the Royal Electric Company saved some 6,000 tons of coal, and the Street Railway Company saved a large amount. Now, wouldn't it pay large concerns like those, where they are turning over thousands of dollars' worth of coal every year, to give their engineer the apparatus whereby he could intelligently determine the value of the fuel, and also determine how to use that fuel ? The use of a calorimeter is a delicate operation, and is liable, even with the Thompson calorimeter, to give a great deal of error. He then described his own method as follows : I take a large quantity of coal and grind it up, and so intermix it that I get as nearly an average sample as possible ; then I go to the other side of the pile and make from 15 to 25 analyses and get as nearly as possible a fair average analysis of the coal in question, and it is surprising how these analyses will vary. No intelligent engineer would go and take the best coal he could see ; he would make an effort to get as nearly as possible an average sample, then the making of the proximate analysis becomes an easy matter. They are more liable to get correct results from a chemical analysis than the average engineer is from the use of a Thompson calorimeter.

Mr. Wickens said these ideas were right for a large plant, but the average engineer is not expert enough at such delicate tests to get correct results. A firm burning say $2,000 worth of coal a year, hardly pays enough for an engineer of such ability. The ordinary engineer goes at it in a thumb-handed way, but he is often as near right as the scientific man. He doubted whether there was an expert in one of our colleges who could declare that he was absolutely correct. He finds he has to allow for this and that, and it is partly guess-work.

Mr. Wright said it was nice to be able to determine the exact value of a sample of coal, but before that can be of value to the large coal user it will be necessary to concoct a scheme to compel the mining companies to send in the same kind of coal that we get in the sample.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

At the convention of the National Electric Light Association at Niagara Falls, N.Y., in June, there were a number of Canadians well-known in electrical circles on both sides of the line. Among them were noticed F C. Armstrong, Toronto, T. A. Badger, jr., Quebec; E B. Biggar (THE CANADIAN ENGINEER), F. A. Bowman, New Glasgow, N S; John Carroll, Montreal, Prof. C. A. Carus-Wilson, Mon-



NIAGARA FALLS PARK AND RIVER RAILWAY POWER HOUSE.

treal; E E Cary, St. Catharines, E T. Freeman, Halifax, N.S., W. A. Johnson, Toronto; J. A Kammerer, Toronto; R S. Kelsch, Montreal, John Langton, Toronto, Frank LeBlond, Niagara Falls. Ont; E. D McCormack, Toronto, Charles Morton, Montreal, John Murphy, Ottawa, Frederic Nicholls, Toronto, Geo A Powell, St; Catharines, Ont. J. F Rothsay, Niagara Falls, Ont., A. E Smaill, Montreal, W McLea Walbank, Montreal; Geo. W Watts, Toronto.

The president, Frederic Nicholls, to whose most able management of the affairs of the association during his term of office we referred in our last issue, stated in the opening address the reasons for the selection of Niagara Falls as the place of meeting, on account of its pre-eminence as an electrical power distribution centre.

"In this connection, I am of the opinion," said Mr. Nicholls, "that the lecture to be given by L. B. Stillwell will serve as a tidal mark. At the Buffalo convention we occupied ourselves in discussing the possibility or otherwise of transmitting Niagara power to Buffalo; Mr Stillwell's paper will set forth the various actual appliances of Niagara power at the present time, including transmission to Buffalo, and future presidents of this association will, in all probability, refer to his paper and draw comparisons when adverting to the strides which will then have been made in the wider utilization of this mighty power, which for countless ages has been simply running to waste, so far as any economic use is concerned, and apart from its value as the greatest scenic wonder of the world.' I fully appreciate the honor of presiding at this meeting, which, for the reasons I have just referred to, will be embodied in the annals of the association as marking an historic epoch in the advancement of the science of electricity as applied to industry and it is therefore with more than ordinary satisfaction that I am authorized to state that at no previous period has this association been as prosperous, shown greater vitality, or commanded such respect. It is now an acknowledged authority on matters electrical, its membership confers a privilege that has more than a sentimental value, and its gathering strength will offer a bar to use of powers municipal or corporate unjustly or arbitrarily directed for the purpose of destroying the capital investment of those who look to it for protection. In union is strength, and to-day our membership numbers more active members than ever before, and the financial statement to be presented in due course by the chairman of the finance committee will show that after making provision for all expenditures necessary to maintain the useful ness of the association, an unusually large credit balance is at your disposal. It is certainly cause for congratulation that increasing prosperity has been followed by an access of dignity and influence, and the more recent meetings have been remarkable for the greater interest that has been taken in the actual work of the association, and the lesser attention that has been given to the merely social and entertainment features of the programme. At this meeting, although offers of entertainments and privileges had been numerous, only those from electrical concerns had been accepted, it being felt that this was more purely a business meeting, held for the furtherance of the immediate objects of the association." In conclusion, President Nicholls said that the asso-

NIAGARA FALLS PARK AND RIVER RAILWAY—INTERIOR OF POWER HOUSE.

NIAGARA FALLS PARK AND RIVER RAILWAY—BRIDGE AT DUFFERIN ISLAND.

ciation and the electrical profession owed a deep debt of gratitude to the electrical press, and that the importance of its labors in behalf of electrical industries could hardly be over-estimated.

The Committee on Data made its report through H. M. Swetland, its chairman. It embodies the results obtained by an engineering expert engaged for this purpose, but covers only fourteen plants. The majority of station managers object to the publication of their data, hence the restricted ground of the report. The report of the Finance Committee showed that the association possessed net assets of $52,572 23, of which $1,385 94 consisted of cash, and that there was no indebtedness.

J. B. Cahoon, Elmira, N.Y., read a paper on "The Establishment of a Base Price for Current," which dealt chiefly with the lack of knowledge of the cost of incandescent lights, and the difference between charges for these lights and arcs. He thought the variation in cost between place and place should be largely based on the price of coal. The Committee on Wiring brought in a code which it was hoped would unite the interests of those who are insured and those who do the work in the adoption of a common standard code. The code was adopted.

J. G. White, in his paper on "The Niagara Power Transmission Line," included an interesting review of the history and an account of the construction of the line, and the reasons adopted for the various specific modifications in the usual design of power transmission lines adopted in this instance. At its conclusion Mr. White explained that it was perfectly practicable to replace insulators on the line without shutting off the current. This has been done by the use of a large insulated stool, on which a ladder is placed, or by handling the wire with an insulator mounted on the top of a pole, which is forced up under it, thus lifting it up off of the pin insulator and permitting the ladder to be replaced. With current of 10,000 volts the capacity of a man is sufficient to cause a flow of current which will give him a considerable shock, and a nervous man might be knocked off the ladder by this. The consequence is that replacing insulators is neither a very safe nor a very pleasant task. The lightning arrester problem is still in process of solution, and is largely in the experimental stage. The line is protected by barbed fence wires, which are run on top of the poles and on the outer end of the cross-arms, in a little fork at the top of an iron pin stuck through the end of the arm. At every fifth pole these fence wires are grounded with a number six copper wire running to a coil at the bottom of the pole.

PICTURESQUE NIAGARA—THE CANADIAN SIDE.

INDUSTRIAL NIAGARA—THE AMERICAN SIDE.

Arthur Wright, of Brighton, England, read a summary of his paper on "Profitable Extension of Electricity Supply Stations." This was an interesting thesis upon the desirability of domestic lighting and of certain other forms of custom which can be secured by the use of more equitable systems of charging for current. The author contended that the only available method is the sliding scale of hours of consumption. This paper was followed by a long discussion. Mr.

Wright, in replying to a number of questions, gave the practical details of the operation of his system in Brighton; the instruments used sum up the consumer's bills without the necessity for any calculation, and could be read by an ordinary meter reader. In reply to further questions Mr. Wright stated that the maximum demand was measured by a recording ammeter, which is used during the four winter months, and its maximum for that time taken as the maximum demand.

At the closing session of the convention Lieut. F. Jarvis Patten, of New York, presented his paper on "Frequency Transformation," and C. F. Scott, of Pittsburg, read his paper on "Rotaries for Transforming Alternating into Direct Current." The report of the committee on Standard Candle Power of Incandescent Lamps was also presented by James I. Ayer, Dr. Louis Bell, the chairman of the committee, not being present. This report will be found in another column.

The officers which were elected to preside over the destinies of the association during the coming year were Samuel Insull, of Chicago, president; A. M. Young, of Waterbury, Conn., first vice-president; George R. Stetson, New Bedford, Mass., second vice-president. The following were chosen as members of the executive committee: Frederick Gilbert, Boston; W. Worth Bean, St. Joseph, Mich.; Mr. Stevens, Elizabeth, N.J.; W. McLea Walbank, Montreal.

The views of Niagara Falls and its neighborhood on both sides of the river, which we give in connection with this report of the National Electric Light Association, were crowded out of our report of the Canadian Electrical Association's meeting in our July number.

CANADIAN ASSOCIATION STATIONARY ENGINEERS.

We report the results of the annual election in the different branches C.A.S.E., in addition to those which appeared in the July number of THE CANADIAN ENGINEER, as follows:

Hamilton—Wm. Norris, president; G. Mackie, vice-president; Joseph Ironside, recording secretary, Markland street.

Stratford—John Hoy, president; Samuel H. Weir, secretary.

Brantford—J. B. Forsyth, president; Joseph Ogle, vice-president; T. Pilgrim, Continental Cordage Company, secretary.

London—D. G. Campbell, president; B. Bright, vice-president; W. Blythe, secretary.

Guelph—H. Geary, president; Thos. Anderson, vice-president; H. Flewelling, recording secretary; P. Ryan, financial secretary; C. F. Jordan, treasurer.

Ottawa—Frank Robert, president; T. G. Johnson, secretary.

Peterborough—W. L. Outhwaite, president; W. Forster, vice-president; A. McCallum, secretary.

Brockville—Archibald Franklin, president; John Grundy, vice-president; James Aikins, recording secretary.

Carleton Place Branch No. 16—Joseph McKay, president; J. D. Armstrong, secretary.

Kincardine—Daniel Bennett, president; Joseph Lighthall, vice-president; Percy C. Walker, secretary, waterworks.

Dresden—Thos. Steeper, secretary.

Berlin—J. R. Utley, president; G. Steinmetz, vice-president; secretary and treasurer, W. J. Rhodes, Berlin, Ont.

St. Laurent—R. Drouin, president; Alfred Latour, secretary, 306 Delisle street, St. Cunegonde.

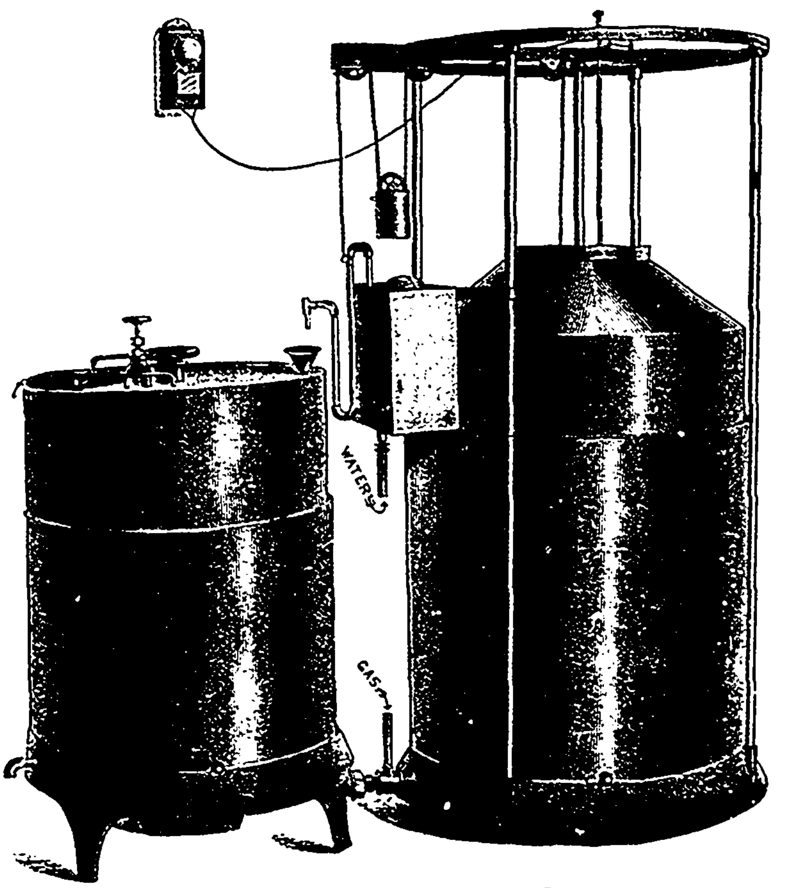
Brandon, Man., Branch No. 1.—A. R. Crawford, president; Arthur Fleming, secretary.

Winnipeg—G. M. Hazlett, President; J. Sutherland, rec. secretary; A. B. Jones, financial secretary.

A NEW ACETYLENE GAS GENERATOR.

The success of any acetylene gas generating apparatus depends largely on the regulation of its water supply to the carbide. In the machine here illustrated, the device for this purpose can be said to be both old and new; old, in being a syphon, the common principle of which has been known for ages; new, in its ingenious arrangement whereby the discharging end of the syphon can be raised above its source of supply, thereby arresting its operation without causing the water in it to "break" and run back to the supply tank, as would occur in doing this with the old simple form of syphon; yet it has no valves or obstructions contained within it, simply a crooked piece of pipe. The secret of its operation is contained in the crook; it will be observed that the water must enter that end of the syphon immersed in the tank and pass up over the edge of the tank, then down again to near the bottom of the tank, where it again takes an upward turn, its end terminating in a spout about on a level with the top of the tank. The "U" shaped bend on the outside of the tank serves to contain sufficient water to more than counterbalance that of the column in the pipe within the tank; hence, when the discharging end of the syphon is raised above the water in the tank the lower part of the syphon outside the tank is still below it. If the discharging end of the syphon be lowered slightly below the surface of the water in the tank, water starts to run, increasing in volume as the syphon is lowered; thus a simple and efficient means is provided for regulating the supply of water, a drop or a stream being furnished as required, depending on the number of lights in use.

The illustration shows the machine in its working position, the gasometer top being at a height just sufficient to stop the flow of water from the syphon, the discharging end of which is shown as just above the water in the small tank to which it is connected; a slight lowering of the gasometer dome pulls downward on the chain, which is attached to the gasometer



A NEW ACETYLENE GAS GENERATOR.

dome, and which passes over pulleys to the syphon. As the dome descends the chain is drawn around the pulleys in the weight until a small obstruction, on the chain, reaches the weight, when the latter is lifted entirely by that part of the chain below the weight, and the gasometer dome. This takes the tension from that part of the chain going to the syphon, when the latter lowers from its own weight, till its discharging end becomes lower than the water in the supply tank; water then flows from the syphon to the carbide in the generator, gas is generated, which passes to the gasometer, and the dome of the latter raises again till the obstruction on the chain passes from the weight, when the latter, exerting its weight equally on both ends of the chain, overcomes the weight of the syphon, causing it to raise till the discharging end is again above the water in the tank. The syphon is prevented from raising too high by an obstruction on the chain, which comes in contact with the pulley over which the chain passes, just above the syphon. The dome of the gasometer is guided up and down by a central rod extending from the frame above, down through a tube in the gasometer dome; the lower end of the rod is secured in a socket in the bottom of the gasometer. The tube through which the rod passes serves to prevent the escape of gas from the gasometer, as its lower end reaches into the water in the gasometer sufficiently to prevent this, the tube also serving to hold the dome in position. Experience has shown this to be the simplest and best method of guiding the dome without effecting the pressure of gas in the gasometer or the steadiness of the lights in the slightest degree.

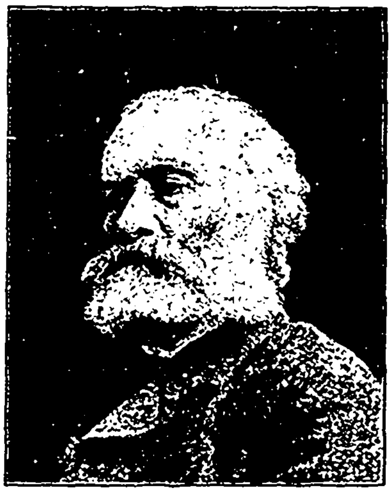
The desirability of some simple means for preventing the accumulation of more gas in the machine, from any reason whatever, than it can safely contain, and which will prevent the pressure of the gas from increasing its normal condition, is conceded not only to be a distinct advantage to the machine itself, but an absolute necessity. This feature of an acetylene gas machine is like the safety valve on a steam boiler; it is placed there, not for the purpose of using it, but to prevent an accident by interference with the working of the machine, either by design or otherwise. To accomplish this desirable object, a large tube, six or eight inches, is connected to the dome of the gasometer and reaches down to within a few inches of the bottom of the dome, passing up through the bottom of the gasometer, and slightly above the water therein, and within the tube referred to is an overflow pipe, the outer end of which can be carried without the building if desired. In operation, should the dome of the gasometer ascend sufficiently to cause the suspended tube to be raised out of the water in the gasometer, the gas would pass within said tube, where it would enter the overflow pipe, and be carried to the outside of the building. When the gasometer dome again descends the tube enters the water, inclosing within it the overflow pipe, which prevents any further escape of gas. It will therefore be readily seen that a simple and sure means is provided for the protection of the machine, and the prevention of the escape of gas within the building. It will also be readily understood that this arrangement does not operate by friction, or in any way vary the pressure of gas.

An appreciable improvement, has, it is claimed, been made in the construction of the gasometer. By reference to the engraving it will be seen that the upper part of the generator slides within the lower part, double walls in the lower part being provided for, the space between the two walls into which the upper part of the generator slides is filled with a liquid, which provides an effective seal to prevent the escape of gas. Within the generator is a round table, which turns on a shaft that extends through a liquid seal to the top of the generator. This table has a rim around it, several inches deep; within the table is secured four cells, separated from each other about half an inch, the space between them and within the rim of the table being filled with an inexpensive liquid, whose presence does not cause moisture, hence no gas is generated. Suspended from the top of the generator, at a position just above one of the cells, is a tube, open at both ends and slightly larger than the cells, in the table. The top of this tube is closed by a liquid sealing cover, which enters double walls. In the top of the generator beneath the discharging end of the syphon, is seen the funnel-shaped opening, into which water passes, to reach the carbide, which is placed in cans, and set within the cells on the table. To operate the generator, the top is pressed down as far as it will go. This causes the tube connected with the generator to surround one of the cells which is directly beneath it. The tube entering the liquid surrounding the cell, completely isolates the cell from the remainder of the generator. The cover over the top of the tube, now being removed, the can within the cell and containing the spent carbide, is exposed, the escape of gas from the generator being prevented by the lower end of the tube being immersed in the liquid in the table. To replenish the supply of carbide, the can containing the spent carbide is removed, and a fresh can set within the cell. The cover is then replaced and the catch which held the top down, released, when the top of the generator raises of itself by the pressure of the gas in the gasometer, which passes into the generator, as its top continues to raise, this gas having originally passed from the generator to the gasometer when the top of the former was pressed down and the gasometer dome rose to accommodate it. When it is necessary to replenish another cell, the table is turned by grasping a wheel on the top of the generator, and giving it a quarter turn, its correct position being indicated by a rib on the base of the table engaging in a slot on the bearing, on which the table turns. It will thus be seen that the spent carbide can be removed and the supply replenished while the machine is in operation without the escape of gas and without soiling the hands, the whole operation requiring less than two minutes' time.

As the odor from acetylene gas is decidedly objectionable, it will thus be seen what desirable features this apparatus contains, in not permitting the escape of gas at any time, within the house or other building within which it is kept. The exhaustion of the cells is indicated by an electric bell connected by wires to the gasometer, and located any desirable place within the building. When the alarm is given it is only necessary to turn the wheel on the top of the generator one-quarter of a revolution. This turns the table in a like manner, and places a fresh cell of carbide beneath the water feed. The operation requires but a moment's time.

From this extended description it must not be inferred that the machine is complicated, having respect to what the machine accomplishes. It is quite the reverse. The machine here illustrated is capable of sustaining from fifty to a hundred lights. A machine suitable for lighting residences where but ten to twelve lights are required is made in a modified form, the gasometer and generator being constructed together, so that little space is occupied. Arrangements for the manufacture and sale of this invention will be made at once. Those interested in acetylene gas lighting may communicate with Messrs. Kerr & Fry, of Niagara Falls, Canada, who at present control the patents.

SIR SANFORD FLEMING.



Sanford Fleming, K.C.M.G., LL.D., C.E., Ottawa, is the most prominent and original of Canadian civil engineers. He was born at Kirkcaldy, Fifeshire, Scotland, January 7th, 1827. He received his early education near his birthplace, and came to Canada at the age of eighteen. He was on the engineering staff of the Northern Railway from 1852-1863, the latter half of service being as chief engineer. In 1863 he was sent as delegate to the Imperial Government in reference to a railway from the Provinces of Canada to British Columbia. He was appointed in 1863 by Governments of Canada, New Brunswick and Nova Scotia, and by the Imperial Government, chief engineer of the Intercolonial Railway. In 1871 he was made engineer-in-chief of the Canada Pacific Railway. When the construction of the C.P.R. was well advanced, political questions arose, and in 1880 he resigned—and though he was not thereafter concerned in the construction of the work, no one has sought to take away from him the reputation of the pioneer engineer of Canada, and the country's benefactor. On his retirement in 1880, he was elected Chancellor of Queen's University, re-elected 1883, 1886, 1889 and 1892. In 1884 he received the honorary degree of LL.D., from St. Andrew's University, Scotland. In 1881 he went as delegate from the Canadian Institute and Meteorological Society to the International Geographical Congress, at Venice, and in 1884 he was appointed delegate of Great Britain to represent the Dominion at the International Prime Meridian Conference at Washington. Mr. Fleming was engineer of the Hoosac tunnel, the greatest achievement of its kind at the time of its construction. Mr. Fleming has been a contributor to various scientific and other publications, and has been a mover in the "time reform" and Pacific cable movements. Mr. Fleming married in 1855 Miss Hall, daughter of Sheriff Hall, Peterboro', Ont. On the occasion of the Queen's Diamond Jubilee, no honors were more worthily bestowed than that of knighthood conferred on Sir Sanford Fleming.

THE NEW METAL TARIFF.*

The following is the new Canadian tariff, as now officially proclaimed, affecting the iron and other metal trades, and including building material :

EARTHENWARE, CEMENTS, SLATE AND STONEWARE.

Building brick, paving brick, stove linings, and fire brick, n.e.s., and manufactures of clay or cement, n.o.p., 20 per cent. ad valorem.

Earthenware and stoneware, viz.: demijohns, churns or crocks, 30 per cent. ad valorem.

Drain tiles, not glazed, 20 per cent. ad valorem.

Drain pipes, sewer pipes, chimney linings, or vents, chimney tops and inverted blocks, glazed or unglazed, and earthenware tiles, 35 per cent. ad valorem.

China and porcelain ware, also earthenware and stoneware, brown or colored and Rockingham ware, white granite or iron stoneware, "c.c." or cream-colored ware, decorated, printed or sponged, and all earthenware, n.e.s., 30 per cent. ad valorem.

Baths, tubs and wash-stands of earthenware, stone, cement, or clay, or of other material, n.o.p., 30 per cent. ad valorem.

Cement, Portland and hydraulic or water lime, in bags, barrels or casks, the weight of the package to be included in weight for duty, 12½ cents. per one hundred pounds.

Plaster of Paris, or gypsum, ground, not calcined, 15 per cent. ad valorem.

Plaster of Paris, or gypsum, calcined or manufactured, the weight of the package to be included in the weight for duty, 12½ cents per one hundred pounds.

Lithographic stones, not engraved, 20 per cent. ad valorem.

Grindstones, not mounted, and not less than 36 inches in diameter, 15 per cent. ad valorem.

Grindstones, n.e.s., 25 per cent. ad valorem.

Flagstones, sandstone and all building stone, not hammered or chiselled ; and marble and granite, rough, not hammered or chiselled, 15 per cent. ad valorem.

Marble and granite, sawn only ; flagstone and all other building stone, dressed ; and paving blocks of stone, 20 per cent. ad valorem.

Marble and granite, n.e.s., and all manufactures of marble or granite, n.o.p., 35 per cent. ad valorem.

Manufactures of stone n.o.p., 35 per cent. ad valorem.

Roofing slate, 25 per cent. ad valorem ; provided that the duty shall not exceed 75 cents per square.

Slate mantels and other manufactures of slate, n.es., 30 per cent. ad valorem.

Slate pencils and school writing slates, 25 per cent. ad valorem.

Mosaic flooring of any material, 30 per cent. ad valorem.

METALS AND MANUFACTURES OF

Iron or steel scrap, wrought, being waste or refuse, including punchings, cuttings of clippings of iron or steel plates or sheets having been in actual use; crop ends of tin plate bars, or of blooms, or of rails, the same not having been in actual use, one dollar per ton.

Nothing shall be deemed scrap iron or scrap steel except waste or refuse iron or steel fit only to be re-manufactured in rolling mills.

Iron in pigs, iron kentledge, and cast scrap iron, two dollars and fifty cents per ton.

Ferro-silicon, ferro-manganese, and spiegeleisen, 5 per cent. ad valorem.

Iron or steel ingots, cogged ingots, blooms, slabs, billets, puddled bars and loops or other forms, n.o.p., less finished than iron or steel bars, but more advanced than pig iron, except castings, two dollars per ton.

Rolled iron or steel angles, tees, beams, channels, girders and other rolled shapes or sections, weighing less than 35 pounds per lineal yard, not punched, drilled or further manufactured than rolled, n.o.p., seven dollars per ton.

Rolled iron or steel angles, tees, beams, channels, joists, girders, zees, stars, or other rolled shapes, or trough, bridge, building or structural rolled sections or shapes, not punched, drilled or further manufactured than rolled, n.e.s., and flat eye-bar blanks not punched or drilled, 10 per cent. ad valorem.

Bar iron or steel, rolled, whether in coils, rods, bars or bundles, comprising rounds, ovals and squares, and flats ; and rolled shapes, n.o.p.; and rolled iron or steel hoop, band, scroll or strip, eight inches or less in width, number eighteen gauge and thicker, n.e.s., seven dollars per ton.

Universal mill or rolled edge bridge plates of steel when imported by manufacturers of bridges, 10 per cent. ad valorem.

Rolled iron or steel plates not less than thirty inches in width, and not less than one-quarter of an inch in thickness, n.o.p., 10 per cent. ad valorem.

Rolled iron or steel sheets or plates, sheared or unsheared, and skelp iron or steel, sheared or rolled in grooves, n.e.s., seven dollars per ton.

Skelp iron or steel, sheared or rolled in grooves, when imported by manufacturers of wrought iron or steel pipe for use only in the manufacture of wrought iron or steel pipe in their own factories, 5 per cent. ad valorem.

Rolled iron or steel sheets number seventeen gauge, and thinner, n.o.p.; Canada plates ; Russia iron ; flat galvanized iron or steel sheets, terne plate, and rolled sheets of iron or steel coated with zinc, spelter or other metal, of all widths or thickness, n.o.p., and rolled iron or steel hoops, band, scroll or strip, thinner than number eighteen gauge, n.e.s., 5 per cent. ad valorem.

Chrome steel, 15 per cent. ad valorem.

Steel, in bars, bands, hoops, scroll or strips, sheets or plates, of any size, thickness or width, when of greater than two and one-half cents per pound, n.o.p., 5 per cent, ad valorem.

Swedish rolled iron and Swedish rolled steel nail rods under half an inch in diameter for the manufacture of horseshoe nails, 15 per cent. ad valorem.

Iron and steel railway bars or rails of any form, punched or not, n.e.s., for railways, which term for the purpose of this item shall include all kinds of railways, street railways and tramways, even although they are used for private purposes only, and even although they are not used or intended to be used in connection with the business of common carrying of goods or passengers, 30 per cent ad valorem.

Railway fish plates and tie plates, eight dollars per ton.

Switches, frogs, crossings and intersections for railways, 30 per cent. ad valorem.

Locomotives for railways, n.e.s., 35 per cent. ad valorem.

Iron or steel bridges, or parts thereof ; iron or steel structural work, columns, shapes or sections, drilled, punched or in any further stage of manufacture than as rolled or cast, n.e.s., 35 per cent. ad valorem.

Forgings of iron or steel of whatever shape or size or in whatever stage of manufacture, n.e.s.; and steel shafting turned, compressed, or polished ; hammered iron or steel bars or shapes, n.o.p., 30 per cent. ad valorem.

Iron or steel castings, in the rough, n.e.s., 25 per cent. ad valorem.

Stove plates, stoves of all kinds, for oil, gas, coal or wood, or parts thereof, and sad or smoothing, hatters' and tailors' irons, plated wholly or in part, or not, 25 per cent. ad valorem.

Spring axles, axle bars, n.e.s., and axle blanks, and parts thereof, of iron or steel, for railway or tramway, or other vehicles, 35 per cent. ad valorem.

Cart or wagon skeins or boxes, 30 per cent. ad valorem.

Cast iron pipe of every description, eight dollars per ton.

Wrought iron or steel boiler tubes, n.e.s., including flues and corrugated tubes for marine boilers, 5 per cent. ad valorem.

Tubes of rolled steel, seamless, not joined or welded, not more than one and one-half inch in diameter ; and seamless steel tubes for bicycles, 10 per cent. ad valorem.

Wrought iron or steel tubing, plain or galvanized, threaded and coupled or not, over two inches in diameter, n.e.s., 15 per cent. ad valorem.

Wrought iron or steel tubing, plain or galvanized, threaded and coupled or not, two inches or less in diameter, n.e.s., 35 per cent. ad valorem.

Other iron or steel pipe or tubing, plain or galvanized, riveted, corrugated or otherwise specially manufactured, n.o.p., 30 per cent. ad valorem.

Iron or steel fittings for iron or steel pipe, of every description, and chilled iron or steel rolls, 30 per cent. ad valorem.

Iron or steel cut-nails or spikes (ordinary builders') ; and railroad spikes, one-half of one cent per pound.

*The expression "gauge," when applied to metal sheets or plates or to wire, means the thickness as determined by Stubb's standard gauge; the expression "in diameter," when applied to tubing, means the actual inside diameter; the expression "sheet," when applied to metals, means a sheet or plate not exceeding three-sixteenths of an inch in thickness; the expression "plate," when applied to metals, means a plate or sheet more than three-sixteenths of an inch in thickness

Wrought and pressed nails and spikes, trunk, clout, coopers', cigar box, Hungarian, horse-shoes, and other nails, n.e.s., horse, mule and ox shoes, 30 per cent. ad valorem.

Wire nails of all kinds, n.o.p., three-fifths of one cent per pound.

Composition nails and spikes and sheathing nails, 15 per cent. ad valorem.

Iron or steel shoe tacks, and ordinary cut tacks, leathered or not, brads, sprigs and shoe nails, double pointed tacks, and other tacks of iron and steel, n o.p., 35 per cent. ad valorem.

Screws, commonly called "wood screws," of iron or steel, brass or other metals, including lag or coach screws, plated or not, and machine or other screws, n.o.p., 35 per cent. ad valorem.

Coil chain, coil chain links, and chain shackles, of iron or steel, five-sixteenths of an inch in diameter and over, 5 per cent. ad valorem.

Barbed wire, and galvanized wire for fencing, numbers nine, twelve and thirteen gauge, 15 per cent. ad valorem, until 1st January, 1898; thereafter free.

Buckthorn strip fencing, woven wire fencing, and wire fencing, of iron or steel, n.e.s., 15 per cent. ad valorem.

Wire, single or several, covered with cotton, linen, silk, rubber or other material, including cable so covered, n.e.s., 30 per cent. ad valorem.

Brass wire, plain, 10 per cent. ad valorem.

Copper wire, plain, tinned or plated, 15 per cent. ad valorem.

Wire cloth, or woven wire of brass or copper, 25 per cent. ad valorem.

Wire of all metals and kinds, n.o.p., 20 per cent. ad valorem.

Wire rope, stranded or twisted wire, clothes line, picture or other wire, and wire cable, n.e.s., 25 per cent. ad valorem.

Wire cloth or wove wire, and wire netting, of iron or steel, 30 per cent. ad valorem.

Needles, of any material or kind, and pins manufactured from wire of any metal, n.o.p., 30 per cent. ad valorem.

Lead, old, scrap, pig and block, 15 per cent. ad valorem.

Lead, in bars, and in sheets, 25 per cent. ad valorem.

Lead pipe, lead shot and lead bullets, 35 per cent. ad valorem.

Lead, manufactures of, n.op., 30 per cent. ad valorem.

Brass and copper nails, tacks, rivets and burrs or washers: bells and gongs, n.e.s., and all manufactures of brass or copper, n.o.p., 30 per cent. ad valorem.

Zinc, manufactures of, n.o.p., 25 per cent. ad valorem.

Nickel anodes, 10 per cent. ad valorem.

Iron or steel nuts, washers, rivets, and bolts, with or without threads, and nut, bolt and hinge blanks, and T and strap hinges of all kinds, n.e.s., three-quarters of one cent per pound and 25 per cent. ad valorem.

Builders', cabinet-makers', upholsterers', harness-makers', saddlers', and carriage hardware, including butt-hinges, locks, curry-combs or curry-cards, horse-boots, harness and saddlery, n.e.s., 30 per cent. ad valorem.

Skates of all kinds, roller or other, and parts thereof, 35 per cent. ad valorem.

Gas meters, 35 per cent. ad valorem.

Safes, doors for safes and vaults; scales, balances, weighing beams, and strength testing machines of all kinds, 30 per cent. ad valorem.

Carvers, knives and forks of steel, butcher and table steels, oyster, bread, kitchen, cooks', butcher, shoe, farrier, putty, hacking and glaziers' knives, cigar knives, spatulas or palette knives, razors, erasers or office knives, pen, pocket, pruning, sportsmen's or hunters' knives, manicure files, scissors, trimmers; barbers', tailors', and lamp shears, horse and toilet clippers, and all like cutlery, plated or not, n.o.p. When any of the above articles are imported in cases or cabinets, the cases or cabinets shall be dutiable at the same rate as their contents—30 per cent. ad valorem.

Knife blades or blanks, and table forks of iron or steel in the rough, not handled, filed, ground or otherwise manufactured, 10 per cent. ad valorem.

Celluloid, moulded into sizes for handles of knives and forks, not bored nor otherwise manufactured; also, moulded celluloid balls and cylinders, coated with tin-foil or not, but not finished or further manufactured, and celluloid lamp shade blanks, 10 per cent. ad valorem.

Bird, parrot, squirrel and rat cages, of wire, and metal parts thereof, 35 per cent. ad valorem.

Files and rasps, n.e.s., 30 per cent, ad valorem.

Adzes, cleavers, hatchets, saws, wedges, sledges, hammers, crow-bars, cant-dogs and track tools; picks, mattocks, and eyes or poles for the same: anvils, vises; and tools, of all kinds, for hand or for machine use, including shoemakers' and tinsmiths' tools or bench machines, n.o.p., 30 per cent ad valorem.

Axes, scythes, sickles or reaping hooks, hay or straw knives, edging knives, hoes, rakes, pronged forks, snaths, farm, road or field rollers, post-hole diggers, and other agricultural implements, n.e.s., 25 per cent. ad valorem.

Shovels and spades, iron or steel, n.e.s.; shovel and spade blanks, and iron or steel cut to shape for the same; and lawn mowers, 35 per cent. ad valorem.

Britannia metal, nickel silver, Nevada and German silver, manufactures of, nc. plated, and manufactures of aluminum, n.o.p. 25 per cent. ad valorem.

Sterling or other silverware, nickel-plated ware, gilt or electro-plated ware, wholly or in part, of all kinds, n.e.s., 30 per cent. ad valorem.

Telephone and telegraph instruments, electric and galvanic batteries, electric motors, dynamos, generators, sockets, insulators of all kinds; and electric apparatus, n.e.s., 25 per cent. ad valorem.

Electric light carbons and carbon points, of all kinds, n.e.s., 35 per cent. ad valorem.

Carbons over six inches in circumference, 15 per cent. ad valorem.

Lamps, side-lights and head-lights, lanterns, chandeliers, gas, coal or other oil fixtures and electric light fixtures, or metal parts thereof, including lava or other tips, burners, collars, galleries, shades and shade-holders, 30 per cent. ad valorem.

Lamp springs, and glass bulbs for electric lights, 10 per cent. ad valorem.

Babbitt metal, type metal, phosphor tin and phosphor bronze in blocks, bars, plates, sheets and wire, 10 per cent. ad valorem.

Type for printing, including chases, quoins and slugs, of all kinds, 20 per cent. ad valorem.

Plates engraved on wood, steel, or other metal, and transfers taken from the same, including engravers' plates of steel, polished, engraved or for engraving thereupon, 20 per cent. ad valorem.

Stereotypes, electrotypes, and celluloids for almanacs, calendars, illustrated pamphlets, newspaper advertisements or engravings, and all other like work for commercial, trade or other purposes, n.e.s., and matrices or copper shells for the same, one and one-half cent. per square inch.

Stereotypes, electrotypes and celluloids of newspaper columns, and bases for the same, composed wholly or partially of metal or celluloid, one-fourth of one cent per square inch.

And matrices or copper shells for the same, one and one-half cents per square inch.

Clothes wringers for domestic use, and parts thereof, 35 per cent. ad valorem.

Buckles of iron, steel, brass or copper, of all kinds, n.o.p., (not being jewellery), 30 per cent. ad valorem.

Guns, rifles, including air guns and air rifles, not being toys, muskets, cannons, pistols, revolvers, or other firearms: cartridge cases, cartridges, primers, percussion caps, wads, or other ammunition, n.o.p.: bayonets, swords, fencing foils and masks; gun or pistol covers or cases, game bags, loading tools and cartridge belts, of any material, 30 per cent. ad valorem.

Agate, granite or enamelled iron or steel hollow-ware, 35 per cent. ad valorem.

Enamelled iron or steel ware, n.e.s.: iron or steel hollow-ware, plain black, tinned or coated: and nickel and aluminum kitchen or household hollow-ware, n.e.s., 30 per cent. ad valorem.

Tinware, plain, japanned, or lithographed, and all manufactures of tin, n.e.s., and manufactures of galvanized sheet iron or of galvanized sheet steel, n.o.p., 25 per cent. ad valorem.

Signs, of any material, framed or not; and letters of any material for signs or similar use, 30 per cent. ad valorem.

Fire engines and fire extinguishing machines, including sprinklers for fire protection, 35 per cent. ad valorem.

Brass pumps of all kinds, and garden or lawn sprinklers, 30 per cent. ad valorem.

Printing presses, printing machines, lithographic presses and type-making accessories therefor; folding machines, book-binders' book-binding, ruling, embossing and paper cutting machines, and parts thereof, 10 per cent. ad valorem.

Sewing machines, and parts thereof, 30 per cent. ad valorem.

Steam engines, boilers, ore crushers and rock crushers, stamp mills, Cornish and belted rolls, rock drills, air compressors, cranes, derricks, percussion coal cutters, pumps, n.e.s., windmills, horse-powers, portable engines, threshers separators, fodder or feed cutters, potato diggers, grain crushers, fanning mills, hay tedders, farm wagons, slot machines and type-writers, and all machinery composed wholly or in part of iron or steel, n.o.p., 25 per cent. ad valorem.

Machine card clothing, 25 per cent. ad valorem.

Mould boards or shaves, or plough plates, land sides, and other plates for agricultural implements, when cut to shape from rolled plates of steel, but not moulded, punched, polished or otherwise manufactured, 5 per cent. ad valorem.

Mowing machines, harvesters, self-binding or without binders, binding attachments, reapers, cultivators, ploughs, harrows, horse-rakes, seed drills, manure spreaders, weeders, and malleable sprocket or link belting chain for binders, 20 per cent. ad valorem.

Trawls, trawling spoons, fly hooks, sinkers, swivels, and sportsmen's fishing bait, and fish hooks, n.e.s., 30 per cent. ad valorem.

Patterns of brass, steel, or other metals (not being models), 30 per cent. ad valorem.

Manufactures, articles or wares not specially enumerated or provided for, composed wholly or in part of iron or steel, and whether wholly or partly manufactured, 30 per cent. ad valorem.

VEHICLES.

Freight wagons, drays, sleighs, and similar vehicles, 25 per cent. ad valorem.

Buggies, carriages, pleasure carts and similar vehicles, n.e.s., including cutters, children's carriages and sleds, and finished parts thereof, n.o.p., 35 per cent. ad valorem.

Railway cars (or other cars), wheel-barrows, trucks, road or railway scrapers and hand-carts, 30 per cent. ad valorem.

Bicycles and tricycles, 30 per cent. ad valorem.

MINERALS.

Asbestos in any form other than crude, and all manufactures thereof, 25 per cent. ad valorem.

Plumbago, not ground or otherwise manufactured, 10 per cent. ad valorem.

Plumbago, ground, and manufactures of, n.e.s., and foundry facings of all kinds, 25 per cent. ad valorem.

SUNDRIES.

Ships and other vessels, built in any foreign country, whether steam or sailing vessels, on application for Canadian register, on the fair market value of the hull, rigging, machinery and all appurtenances: on the hull, rigging and all appurtenances, except the machinery, 10 per cent. ad valorem; on the boilers, steam engines and other machinery 25 per cent. ad valorem.

Canoes, skiffs, or open pleasure sail-boats, of any material, 25 per cent. ad valorem.

Canvas, and sail twine of hemp and flax, when to be used for boats' and ships' sails, 5 per cent. ad valorem.

Blasting and mining powder, two cents per pound.

Cannon, musket, rifle, gun and sporting powder and canister powder, three cents per pound.

Nitro-glycerine, giant powder, nitro and other explosives, three cents per pound.

Glycerine, when imported by manufacturers of explosives, for use in the manufacture thereof in their own factories, 10 per cent. ad valorem.

Torpedoes, firecrackers, and fireworks of all kinds, 25 per cent. ad valorem.

Fertilizers, compounded or manufactured, 10 per cent. ad valorem.

Photographic dry plates, 30 per cent. ad valorem.

Emery wheels, and manufactures of emery, 25 per cent. ad valorem.

Among the free goods are the following items:

Anchors for vessels.

Blast furnace slag.

Brass and copper, old and scrap, or in blocks; and brass or copper in bolts, bars and rods in coil or otherwise, not less than six feet in length, manufactured, and brass or copper in strips, sheets or plates, not polished, planished or coated, and brass or copper tubing, in lengths of not less than six feet, and not polished, bent or otherwise manufactured, and copper in ingots or pigs.

Britannia metal in pigs, blocks or bars.

Burr-stones, in blocks, rough or unmanufactured, not bound up or prepared for binding into mill-stones.

Emery in bulk, crushed or ground.

Felt, adhesive, for sheathing vessels.

Fire bricks, for use in processes of manufacture, or for manufacturing purposes.

Hoop iron not exceeding 3-8 inch in width and being 25 gauge and thinner, used for the manufacture of tubular nuts.

Ingot moulds; iron, sand or globules, or iron shot and dry putty for polishing glass or granite.

Iron or steel masts, or parts thereof, and iron or steel beams, angles, sheets, plates, knees, and cable chain for wooden, iron, steel or composite ships and vessels; and iron, steel or brass manufactures which at the time of their importation are of a class or kind not manufactured in Canada, when imported for use in the construction or equipment of ships or vessels.

Locomotive and car wheel tires of steel in the rough.

Machinery imported exclusively for mining, smelting and reducing, viz.:—Coal cutting machines, except percussion coal cutters, coal heading machines, coal augers and rotary coal drills, core drills, miners' safety lamps, coal washing machinery, coke-making machinery, ore-drying machinery, ore-roasting machinery, electric or magnetic machines for separating or concentrating iron ores, blast furnace water jackets, converters for metallurgical processes in iron or copper, briquette making machines, ball and rock emery grinding machines, copper plates, plated or not, machinery for extraction of precious metals by the chlorination or cyanide processes, monitors, giant and elevators for hydraulic mining, amalgam safes, automatic ore samplers, automatic feeders, jigs, classifiers, separators, retorts, buddles, vanners, mercury pumps, pyrometers, bullion furnaces, amalgam cleaners, gold mining slime tables, blast furnace blowing engines, wrought iron tubing, butt or lap welded, threaded or coupled or not, not less than 2½ inches diameter, when imported for use exclusively in mining, smelting, reducing or refining.

Nickel; and ores of metal of all kinds; and silex or crystallized quartz.

Rolled round wire rods in the coil, of iron or steel, not over three-eighths of an inch in diameter, when imported by wire manufacturers for use in making wire in the coil, in their own factories.

Scrap iron and scrap steel, old and fit only to be re-manufactured, being part of or recovered from any vessel wrecked in waters subject to the jurisdiction of Canada.

Silver, nickel and German, in ingots, blocks, bars, strips, sheets, or plates, unmanufactured.

Steel rails, weighing not less than 45 pounds per lineal yard, for use only in the tracks of a railway which is employed in the common carrying of goods and passengers, and is operated by steam motive power only; provided that this item shall not extend to rails for tracks of a railway which is used for private purposes only, nor shall this item extend to rails for use in the tracks of any electric railway, street railway, or tramway.

Steel bowls for cream separators, and cream separators.

Steel saws and straw cutters cut to shape, but not further manufactured.

Crucible sheet steel, eleven to sixteen gauge, two and one-half to eighteen inches wide, for the manufacture of mower and reaper knives, when imported by the manufacturers thereof for use for such purpose in their own factories.

Steel of number twenty gauge and thinner, but not thinner than number thirty gauge, for the manufacture of corset steels, clock springs and shoe shanks, when imported by the manufacturers of such articles for exclusive use in the manufacture thereof in their own factories.

Flat steel wire, of number sixteen gauge or thinner, when imported by the manufacturers of crinoline or corset wire and dress stays, for use in the manufacture of such articles in their own factories.

Steel valued at two and one-half cents per pound and upwards, when imported by the manufacturers of skates, for use exclusively in the manufacture thereof in their own factories.

Steel, under one-half inch in diameter, or under one-half inch square, when imported by the manufacturers of cutlery, or of knobs, or of locks, for use exclusively in the manufacture of such articles in their own factories.

Steel of number twelve gauge and thinner, but not thinner than number thirty gauge, for the manufacture of buckle clasps, bed fasts, furniture casters, and ice creepers, when imported by the manufacturers of such articles, for use exclusively in the manufacture thereof in their own factories.

Steel of number twenty-four and seventeen gauge, in sheets sixty-three inches long, and from eighteen inches to thirty-two inches wide, when imported by the manufacturers of tubular bow sockets for use in the manufacture of such articles in their own factories.

Steel for the manufacture of bicycle chain, when imported by the manufacturers of bicycle chain for use in the manufacture thereof in their own factories.

Steel for the manufacture of files, augers, auger bits, hammers, axes, hatchets, scythes, reaping hooks, hoes, hand-rakes, hay-rakes, hay or straw knives, windmills and agricultural or harvesting forks when imported by the manufacturers of such or any of such articles for use exclusively in the manufacture thereof in their own factories.

Steel springs for the manufacture of surgical trusses, when imported by the manufacturers for use exclusively in the manufacture thereof in their own factories.

Flat spring steel, steel billets and steel axle bars, when imported by manufacturers of carriage springs and carriage axles for use exclusively in the manufacture of springs and axles for carriages or vehicles other than railway or tramway, in their own factories.

Spiral spring steel for spiral springs for railways, when imported by the manufacturers of railway springs for use exclusively in the manufacture of railway spiral springs in their own factories.

Steel strip and flat steel wire when imported into Canada by manufacturers of buckthorn and plain strip fencing, for use in the manufacture of such articles in their own factories; and barbed fencing wire of iron or steel after January 1st, 1898.

Galvanized iron or steel wire number nine, twelve, and thirteen gauge, after January 1st, 1898.

Stereotypes, electrotypes and celluloids of newspaper columns in any language other than French and English, and of books, and bases and matrices and copper shells for the same, whether composed wholly or in part of metal or celluloid.

Surgical and dental instruments (not being furniture) and surgical needles, after January 1st, 1898.

Tagging metal, plain, japanned, or coated, in coils, not over one and a half inch in width, when imported by manufacturers of shoe and corset laces for use in their factories.

Tin, in blocks, pigs, bars and sheets, tin plates, tin crystals, tin strip waste, and tin foil, tea lead.

Tubes, rolled iron not welded or joined, under one and one-half inch in diameter, angle iron, nine and ten gauge, not over one and one-half inch wide, iron tubing lacquered or brass covered, not over one and one-half inch in diameter, all of which are to be cut to lengths for the manufacture of bedsteads, and to be used for no other purpose, and brass trimmings for bedsteads, when imported by or for manufacturers of iron or brass bedsteads to be used for such purposes only in their own factories, until such time as any of the said articles are manufactured in Canada.

Wire, crucible cast steel.

Wire, rigging for ship and vessels.

Wire, of brass, zinc, iron or steel, screwed or twisted, or flattened or corrugated, for use in connection with nailing machines for the manufacture of boots and shoes, when imported by manufacturers of boots and shoes, to be used for such purposes only in their own factories.

Steel wire, Bessemer soft drawn spring, of numbers ten, twelve and thirteen gauge, respectively, and homo steel spring wire of numbers eleven and twelve gauge, respectively, when imported by manufacturers of wire matresses, to be used in their own factories in the manufacture of such articles.

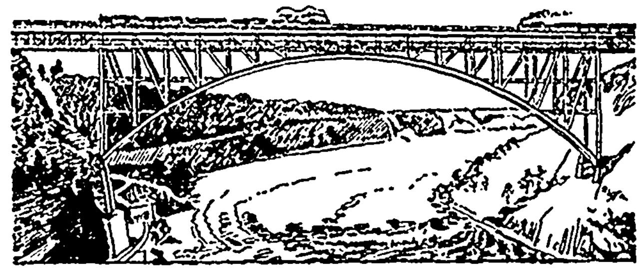
Yellow metal, in bolts, bars and for sheathing.

Zinc spelter and zinc in blocks, pigs, sheets and plates; seamless drawn tubing.

THE NIAGARA ARCH BRIDGE.

The Niagara River is now spanned by three bridges, each of which was at the time of its erection a landmark in the engineering world, not only by reason of its vast proportions, but on account of those natural features which make the Niagara Gorge one of the world's wonders. These bridges represent distinct types of structure, the suspension, the cantilever, and the arch. The construction of an arch of such proportions never was attempted before.

The bridge which the arch has replaced was completed in 1855, the first train passing over it on March 8th of that year. Seven years were consumed in its construction. The original bridge had wooden trusses suspended on stone towers. In 1880 the suspended structure was changed to steel, and in 1886 the stone towers were replaced by towers of steel, both changes being made without any cessation of train



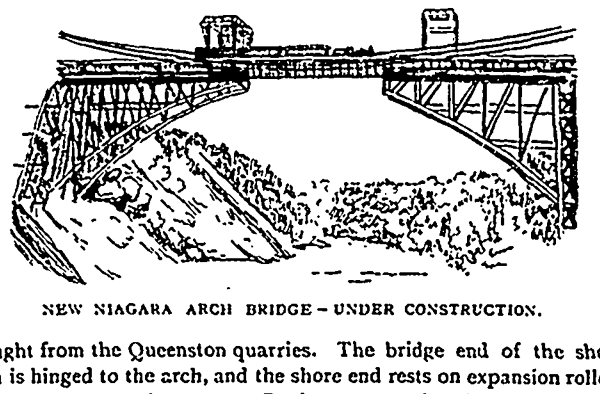
NEW NIAGARA ARCH BRIDGE.

traffic. The bridge had a span of 821 feet from centre to centre of the towers, and was suspended on four wire cables 10¼ inches in diameter, which carried a single track railway above and a carriage way on the lower deck. The engineer who designed and superintended the changes in the bridge was L. L. Buck, of New York, who also prepared the plans for the new structure.

The new arch has a span of 550 feet between the end piers, and a trussed span at each end 115 feet long connects the arch with the bluff The total length of the bridge with its approaches is 1,100 feet, and the centre of the arch 226 feet above the water. The steel ribs or main arches are four feet deep and three feet wide.

The bridge has two floors. On the upper floor there are two railway tracks, and on the lower floor a central carriageway, a double trolley track and sidewalks on each side. The width on top is 30 feet. The lower floor is 57 feet wide. The arch will support on each upper track at the same time two locomotives of the heaviest kind, followed by trains weighing 3,500 pounds to the square foot of bridge, and in addition a load of 3,000 per square foot on the lower floor. Seven million pounds of steel have been used in the building of this wonderful arch.

On the United States side of the river the bed plates of the arch rest on masonry built on the limestone rock, but on the Canadian side it was found necessary to build a foundation of concrete on which the masonry rests. The abutments are built about half way up the slope on each side. The stone for the abutment on the Canadian side was



NEW NIAGARA ARCH BRIDGE—UNDER CONSTRUCTION.

brought from the Queenston quarries. The bridge end of the shore span is hinged to the arch, and the shore end rests on expansion rollers on heavy masonry abutments. During construction the arch was supported as it was built out by a chain of vast strength made fast to a huge anchor sunk in solid masonry.

The test of the bridge was made July 29th, and R. S. Buck, the engineer in charge, said that "the test was very satisfactory in every respect. The weight which was placed on the bridge was about 2,600 tons, and is in excess of any that the bridge will be required to stand. The deflection was about an inch, which shows that the bridge is one of the strongest of its kind ever constructed. The test was in every way satisfactory to the bridge companies, the engineers, the Grand Trunk Railway, and the Pennsylvania Steel Company." This was endorsed by L. L. Buck, the designing and chief engineer. Among the officials present at the test were: Joseph Hobson, Montreal, chief engineer of the Grand Trunk Railway, George L. Burrows, Saginaw, Mich., president of the Niagara Falls International Bridge Company; T. R. Merritt, St. Catharines, president, secretary and treasurer of the Niagara Falls Suspension Bridge Company, of Canada, these two companies being owners of the new bridge; L. L. Buck, of New York, the designing engineer, who had charge of the test; R. S. Buck, resident engineer, who supervised the construction of the bridge; J. B. Frame, Harrisburg, Pa., superintendent of the Pennsylvania Steel Company; Thomas R. Reynolds, the superintendent of the bridge companies; and Ross Mackenzie, Toronto.

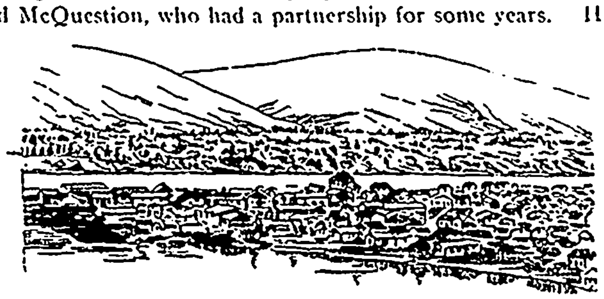
The formal opening of the bridge will not take place for a month or so, when it is hoped that Sir Charles Rivers Wilson, president of the G.T.R., will be able to be present.

BRITISH YUKON MINING REGIONS.

A SKETCH OF THE GREAT CANADIAN ELDORADO OF THE NORTH.

Although the fabulous finds of gold in the placer diggings of the streams and rivers tributary to the Canadian Yukon have only now begun to send a wave of excitement over the civilized world, the existence of rich gold finds there is not a discovery of to-day. For sixteen years or more gold has been mined along the Yukon and its tributaries, and, while the principal mining camps in the early days were in the American territory of Alaska, as long ago as 1887 we have official reports of extensive placer mines on the Canadian side, in which even then 300 miners were at work. The first official investigation of that region was undertaken by direction of the late Hon. Thos. White, then Minister of the Interior, who sent an exploring expedition, under Dr. G. M. Dawson and Wm. Ogilvie, the former one of the ablest geologists, and the latter one of the most skilful and courageous surveyors ever employed by the Dominion Government, and the value of whose technical skill is heightened so much by modesty and integrity.

Their explorations laid a healthy foundation for the developments which have since taken place in the Canadian Yukon region. As long ago as 1840 Campbell was commissioned by Sir George Simpson, of the Hudson Bay Co., to explore the Upper Liard. He traversed a part of the Pelly River Valley, and seven years later Fort Yukon, at the mouth of the Porcupine River, was established by the Hudson Bay Co., under A. H. Murray. In 1848 Campbell erected Fort Selkirk, which, however, was plundered by the Indians in 1852, and is now in ruins. In 1869 the Hudson Bay officers were expelled from Fort Yukon, which was found to be in American territory, and moved their trading post to Rampart House, but in 1890 it was found that this also was a few miles within the United States territory, and they were compelled to shift twenty miles up the Porcupine River. For many years, dating from 1873, private trading was carried on, chiefly by two traders named Harper and McQuestion, who had a partnership for some years. Harper is now at Fort Selkirk, and McQuestion is employed by the Alaska Commercial Co., at Circle City. For some years the trading by corporations in Alaskan territory has been largely a monopoly possessed by the Alaska Commercial Co., who may be called the Hudson Bay Company of the U.S. But in 1892 a Chicago corporation, known as the North American Transportation and Trading Company, started a line of steamers trading to Alaska. From dealing in furs and other northern produce, these and private corporations have become large carriers of passengers and freight for the mining regions. And so rapidly have developments taken place that transportation by rail from British Columbia and the North-West Territories, and even from Ontario via Hudson Bay, west across the McKenzie basin to Yukon, are now problems that require early solution in the handling of traffic.



FORTY MILE CAMP.—FROM A PHOTOGRAPH.

In 1894 the Canadian Mounted Police appeared on the scene of the placer diggings of the Upper Yukon, and established a post at Fort Cudahy, at the confluence of the Forty Mile Creek and Yukon River, under Inspectors Constantine and Strickland. By this date it was estimated that one thousand men were employed in mining there, and that the miners had taken out $300,000 from the Forty Mile Creek. At that time it appeared that the finds were chiefly in streams having their sources in United States territory, but as prospecting proceeded farther up the Yukon and tributary streams it was found that still richer diggings were found in the beds of rivers and streams wholly within Canadian territory. The inspectors estimated that there were 1,400 miles of streams in this district, in all of which gold could be found in paying quantities, and an old Swedish miner, who had been in California and British Columbia in the days of placer digging, said to one of the Government officials: "I never saw a country where there was so much gold, and so evenly distributed." This remark was made in 1887. One stream after another was prospected, and as fresh miners came in the area of discovery widened till creeks and streams almost by the score could be mapped out. When the enormous finds on the Klondike and Eldorado Creek became noised abroad these streams, nearly all of which would yield a good return for the miners' labor, were deserted until Dawson City, the centre of distribution of supplies for the Klondike, was estimated to have a population of from three to four thousand miners at the beginning of this year.

FRONT OF NORTH-WEST MOUNTED POLICE POST—"WOOD-FATIGUE" DAY—WINTER SCENE—YUKON.

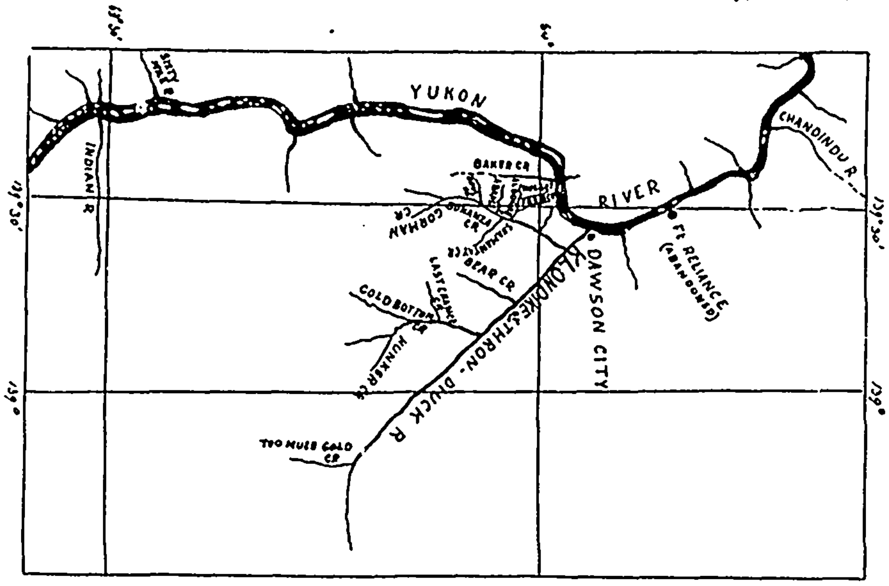
No doubt many of the stories of big finds are exaggerated, but we have before us a variety of evidence sufficient to show that, making due allowance for these exaggerations, the placer gold mines of the Klondike and other streams of the Canadian Yukon are the richest ever discovered in the world, and if this unprecedented richness exists in these alluvial deposits the quartz rock from which these golden grains have been washed must be equally unprecedented. The sources from which these river washings have come have naturally not yet attracted the miners in this inhospitable clime. For while such astonishing results can be obtained by simply washing the river sand with primitive appliances, they have not seen the necessity of attempting to bring up machinery for quartz mining, where transportation and living are so enormously high.

It should be mentioned, however, that the official reports of Dr. Dawson and Mr. Ogilvie show the existence of at least the beginnings of these gold-bearing quartz beds. In June, 1896, they found samples of quartz in a hill called Cone Hill, in the valley of the Forty Mile River, which assayed better than the celebrated Treadwell mine on the coast of Alaska, and the whole hill appeared to contain gold. A ledge of quartz was afterwards discovered on Twelve Mile Creek (the Chandindu), which appeared to be richer even than that of Cone Hill.

The question next in importance to that of the gold itself is the amount and convenience of fuel supply, and it seems a providential combination of the bounties of nature that the coal seams have been discovered which show beyond question that extensive mines of coal exist in the very midst of this wonderful gold mining tract. In fact the Canadian Yukon is another Transvaal, only on a still vaster scale. In the Transvaal the large deposits of coal that were found within convenient distance by rail of the Witwaters Rand field made that country what it is to-day. In 1887 Johannesburg was a Boer farm. Now it is a city of over 70,000 inhabitants, and the mines are equipped with the most scientific machinery known in the history of mining. The climate of the Yukon district may prevent its development from running on parallel lines with the

Transvaal, but there seems to be but little doubt that it will be the source of even greater wealth. Coal has been found on the Lewes River, above Five Finger Rapids. On Coal Creek, five miles below Forty Mile Creek, it has been discovered in ledges five to seven feet thick, and on Twelve Mile Creek there are also extensive deposits, as well as on the Chandindu River.

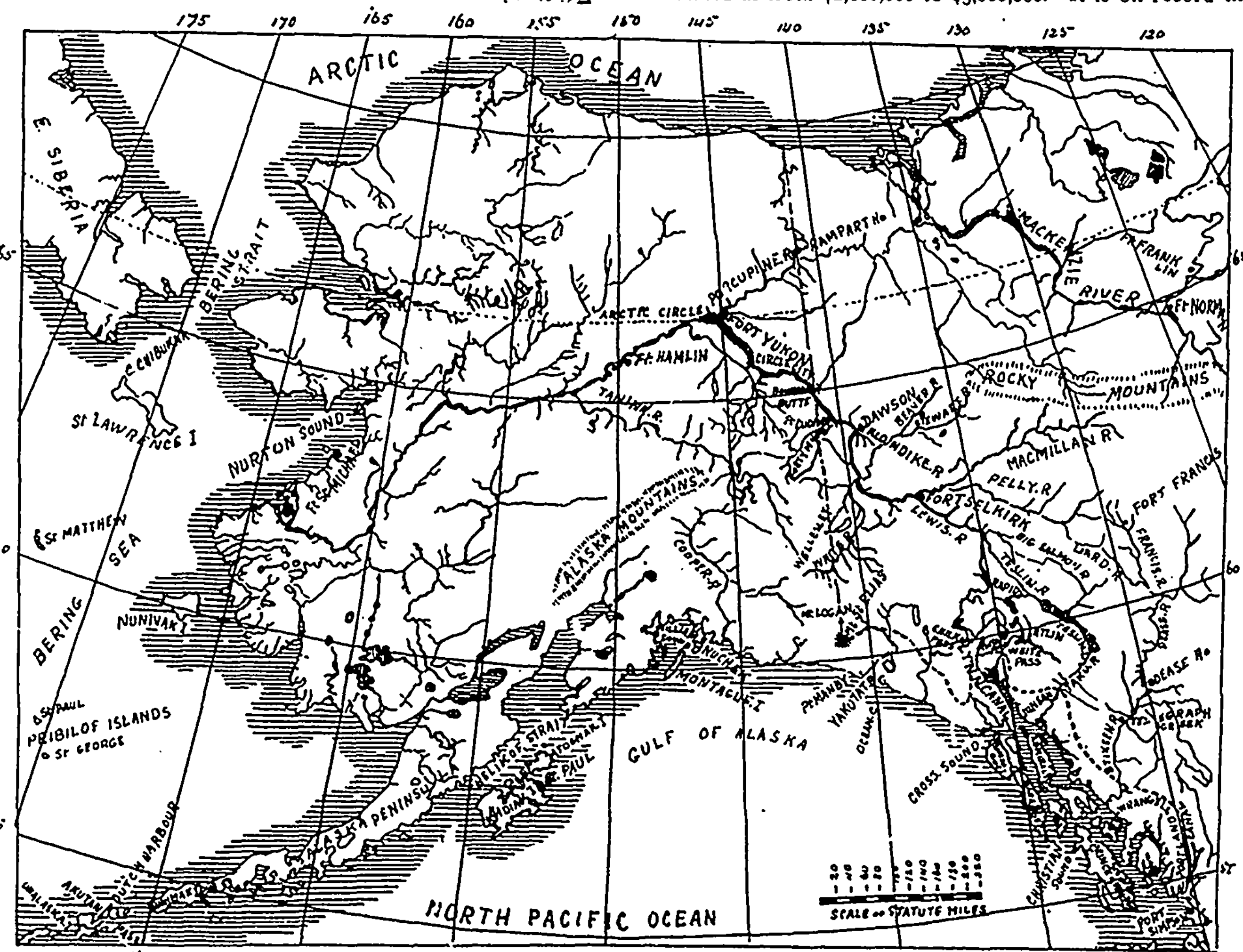
The Klondike is variously recorded on maps and charts as Thron-diuck, Throndik, Chandik, Tondak, Klondik, and Klondike. The first spelling is considered by Mr. Ogilvie to be the correct one. One authority gives "plenty of fish" as the meaning of the word, and another gives "reindeer," and it is put on some charts as the Deer or Reindeer River. The word Klondike seems likely, however, to come into general use.



In January, this year, still further deposits of coal were found in the upper reaches of the Klondike. It appears to be nearly all lignite coal of a good quality, and at the present date there appears to be little doubt that the quantity is sufficient to supply cheap fuel for a large population, not only for manufacturing and mining, but for domestic use.

The other minerals discovered and reported on officially are galena, in combination with gold, asbestos and copper, specimens of native copper having been brought in by Indians during the past year. What other minerals may be found only time and the perseverance of the prospectors in those regions can determine.

It would be impossible to give a correct estimate of the amount of gold already taken out of the Klondike. The table made of the finds made by miners returning on a single small steamer, the "P. W. Weare," showed that eight of these passengers brought down a total of $460,000, and other passengers had amounts varying from $10,000 to $30,000. Some of these passengers, however, refused to disclose the amount of their finds. The captain of another steamer, the "Portland," estimated the amount of gold brought down on his ship at $1,000,000. These and other boats returned from Alaska all within the month of July, and the total amount brought down this season has been calculated at from $2,000,000 to $5,000,000. It is on record that



one man obtained from one pan of dirt $204, from another $212, and from a third $216, these being the three biggest pans authentically reported. Two miners working on claims of their own cleaned up $6,000 from a single day's washing. In Bonanza Creek pans have varied from $1 to $12 per pan, but this means from $1,000 to $12,000 per day by sluicing. Mr. Ogilvie estimates the average in that creek at $5 to $7 per pan, and as this bed is 30 feet deep and 500 feet long, this means at the lower calculation, $4,000,000 in one creek. Mr. Ogilvie says there are here at least 15 miles of rich dirt.

Assuming corresponding riches in the other streams, a faint idea may be gathered of the value of gold stored in this part of Canada.

This wealth, almost surpassing any story in the world's library of fiction, is not to be got without effort, and it would be unwise to conceal the difficulties or to underestimate the self-sacrifice required of adventurers in these parts. The winter lasts nearly nine months of the year, and in midwinter during the last two years Mr. Ogilvie has recorded temperatures as low as 68 deg. below zero. In the Canadian territory, however, the atmosphere is dry by reason of its inland situation, and the winters are more tolerable here than along the

other grasses can be introduced and acclimatized. Mr. Ogilvie estimates that there are about 360 square miles of arable land in the region he explored, but a good deal of this is not rich. It is therefore hardly likely that the farm lands of this region can do more than supplement the importations of food stuffs that would have to be brought from Eastern Canada. But given plenty of gold, railway transportation will in the future carry comfort to the inhabitants of the Yukon to the great advantage of every other part of Canada. While the products of the soil are a question of the future, miners can count on a considerable amount of fish and wild game. Cariboo are to be found on the uplands, and though moose have been killed off from the immediate vicinity of the miners, they are more plentiful in the inland districts. The grizzly, brown, black and silver-tipped bears are more or less plentiful, though not to be had without a spice of danger. The Arctic bear, which mysteriously swarms in countless numbers every seven years, and then, after two or three years, as mysteriously disappears, is a welcome source of food in its plentiful years. The mountain sheep and mountain goat, similar to those in British Columbia, are plentiful in the mountains. Of fur-bearing game there is the grey, black, and red foxes, the marten, the lynx and a few

FORTY MILE TOWN.

American coast in the same latitudes. By dressing warmly in closely-woven woolen garments (but preferably in fur garments, after the Laplander style), many miners pass the winter in tolerable comfort, if not in positive enjoyment. While in the short summer the thermometer sometimes dips to the freezing point, or even below, the temperature frequently runs up to 100 deg. in the shade. This may seem surprising to inhabitants of lower province latitudes, but it must be remembered that in the latitude of between 60 and 65 (in which is enclosed the rivers and streams under present consideration), there is continuous daylight from the middle of June to the middle of August, and even longer as you approach the Arctic circle. The illustrations shown in connection with this sketch, taken as they are from photographs, show a greater profusion of vegetation than one would expect, and it is a fact that vegetables such as onions and turnips have been grown within the last two or three years, and no doubt other vegetables and plants can be grown when the peculiarities of the climate are better understood Two or three kinds of native grasses, which afford food for cattle, are to be found in some of the numerous valleys extending along these rivers: and doubtless

otter. Bird life is not so plentiful. The white-headed eagle, the raven, the magpie, the ptarmigan, wild geese and ducks, loons, and a bird like our Eastern chicadee, but larger, are the principal wild birds. Of these the ptarmigan, geese and ducks are the most plentiful. The fish of the rivers and small lakes are the salmon and lake trout, and a species of Arctic trout.

The timber of this district is chiefly poplar, spruce and pine. It is of a stunted growth in the neighborhood of the present mining camp, but in other parts grows very well. · Even along some of the mining streams poplar is found eight or ten inches in diameter, especially round Lake Labarge.

There are two main routes at present to the Yukon. One is from the mouth of the Yukon, in American territory, up the Yukon to its tributaries. Another is by the Lynn channel, from which three different passages lead to the mines—the Chilcoot and the Taiya mountain passes, and another is by the same channel, through an easier pass, called the White Pass, and named after the late Hon. Thomas White. The old Yukon route is the longest, and, as the river is swift and has many windings and is open for navigation only about three months in the year, it is manifest that a railway from British-Columbia or by Hudson Bay, across the continent, must be the route of the near future. Mr. Ogilvie estimates the rate of discharge of the Yukon River at about 300,000 cubic feet of water per second. This is about one-third of the discharge of the St. Lawrence, but greater than the discharge of the Mississippi, and four times that of the Ottawa. The Yukon is navigable for about 2,300 miles, but in many places is shallow, and has to be navigated by flat-bottomed boats, especially built for this work. A new fleet of 10 or 15 of these boats is now being built by the British Yukon Company for service on the Canadian Yukon, connecting the mining camps with the different mountain passes over British Columbia, a distance of 620 miles. Some will also ply on the lower Yukon. The miner is aided over these passes by dog-sleds and the uncertain help of Indians. But appliances are now being brought in to surmount the most difficult parts, and the next improvement will be the railway. Already the British Yukon Company contemplate a narrow-gauge railway over the White Pass, during the coming spring, and the C.P.R. contemplates making a connection with the Yukon from Edmonton. A line of about 50 miles from Edmonton would reach Athabasca Landing, from which a water route would be open via Athabasca River and Lake, Great Slave Lake and River, and the McKenzie River, to Port McPherson. This would make the distance from Edmonton to Port McPherson (which is quite near to the Klondike divide) 1,800 miles, as against a total of 4,300 miles from Seattle to the mouth of the Yukon, and up that river through American territory. A rail route by the White Pass presents fewer engineering difficulties than was at first imagined, and it would be available all the year round, as against three months by the Yukon route. An American and Canadian Customs port of entry has been established at Dyea, within Canadian territory, and this step may be accepted as an admission of the independence of the Lynn Channel route. The question of the main boundary along the British Columbia coast being yet undefined, the Dominion Government is taking steps to conserve the public interests by regulations providing for the reservation of alternate claims, and for the payment of royalties on the claims already allotted. But judging by the reports of the influx of miners from all quarters, it would be well for the Government to increase the detachment of the Mounted Police sent up to maintain order, this detachment at present numbering 80.

Meantime only active, healthy men should undertake this journey, and ample provision should be made in the way of supplies and food.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the metal imports from Great Britain for June, 1896 and 1897, and the six months ending June, 1896 and 1897:

	Month of June.		Six months ending June.	
	1896.	1897.	1896.	1897.
Hardware and cutlery	£4,618	£6,283	£32,111	£31,930
Pig iron	2,086	1,847	9,866	2,865
Bar, etc.	2,202	808	6,501	5,013
Railroad	25 437	——	47,475	20,286
Hoops, sheets, etc	4,446	6,245	16,142	22,690
Galvanized sheets	7,682	3,377	23,854	19,375
Tin plates	11 435	7,981	67,554	88,953
Cast, wrought, etc., iron	4,535	2,369	26,103	17,334
Old (for re-manufacture)	5,865	925	8,926	1,497
Steel	7,680	4,958	44,407	23,438
Lead	2,113	2,806	7,556	7,260
Tin, unwrought	640	909	7 714	9,834

JUNCTION OF FORTY MILE CREEK AND YUKON RIVER. (RIGHT HAND VIEW.)

—Commenting on the treatment which the city engineer of Toronto, E. H. Keating, receives at the hands of the city council, the Toronto *Evening News* says in a recent editorial: "The attack upon the Engineer's department, by the aldermen, is not a new thing in the City of Toronto. As far back as the memory of the oldest inhabitant can go, the Engineer has been treated as good game for designing members of the council to go after when they think their interests demand an exhibition of economy. It is so easy for a contractor like Ald. Gowanlock to criticise an official, and it is such a popular proceeding with a certain section of the electorate, that there need be little wonder at the frequency of the attacks. The same applies to other aldermen. It was not otherwise twenty-five years ago, when Walter Shanly was city engineer. The interference and senseless criticism of the aldermen drove him out of the city's employ. He told his committee candidly that he would not be directed by a parcel of ignorant men as to how he should carry out his work, and sent in his resignation. Mr. Jennings' experience was almost identical with that of Mr. Shanly. He refused to accept the dictation of men who knew no more about engineering than a monkey does about algebra, and the consequence was he had to resign. The aldermen of the City of Toronto worried Charles Sproatt into his grave. They loaded him with work that would have kept four men busy, and when anything went wrong he was made the scapegoat for the meddling members who were to blame."

CORRECTIONS.

In the account of the manufacture of carborundum which appeared in last issue, "sugar" was given as one of the ingredients. It should have been "coke." A slight error also appeared in the description of the London and North-Western Railway, in which the distance between London and Liverpool was given as 100¼ miles. It should have been 200¼ miles.

FIRES OF THE MONTH.

July 16th.—Royal Pulp and Paper Company's new mill, pulp mill and blacksmith's shop, East Angus, Que. Loss, $150,000.——July 13th—Anderson's planing mill, Sudbury, Ont. Loss, $7,500. ——July 19th—The McKay Milling Company's flour mill, Ottawa, Ont., damaged to the amount of $17,000.—-July 22—C. F Langevin & Co.'s saw mill, grist mill and woolen mill, Acton Vale, Que. Total loss.——July 25—T. Bunn's foundry machine shop, Cayuga, Ont. Loss, $2,000.——July 25th—J. Henley's saw mill, St. Gabriel, Que. Totol loss.——July 25th—Toronto Brass Co., Toronto; damage amounting to $2.500.——July 25th—Eastern Abattoir, Montreal. Loss, $100,000.——July 27th—C.P.R. car shops at Carleton Place, Ont.; damages amounted to $2,000.——July 28th—Standard Oil Co.'s warehouse, Winnipeg. Loss, $25,000.

Mining Matters.

The Echo Mining Company, in Slocan, will build a tramway to Sandon, and erect concentrators.

An inventor has recently communicated to the Ontario Bureau of Mines a new method of reducing nickel ores without roasting them. The department will investigate this process.

The Lucky Jim Gold Mining Co., Sandon, B.C., has ordered from the Jenckes Machine Co., Sherbrooke, Que., through its Rossland branch, the iron work for one three-wheel tramway.

The Citizens' Coal Co., Sudbury, Ont., has decided to get machinery to sink a shaft. At 80 feet they struck four feet of mineral. Furnace tests are said to show good burning qualities.

Prof. Goodwin, of the Kingston School of Mines, has recently set up an exhibit of minerals, at Rat Portage, Ont., which will be of much interest and value to everyone there interested in mineral development.

The Colonna Gold Mining Co., Rossland, B.C., is putting in an air pipe line to connect its two properties. This has been bought through the Rossland branch of the Jenckes Machine Company, Sherbrooke, Que.

The Dardanelles Mining Co , at Kalso, B.C., has placed an order with the Rossland, B C., branch of the Jenckes Machine Co., of Sherbrooke, Que., for a complete mining plant for operating its properties in that district.

Alexander McCoy, Sault Ste Marie, Ont. has discovered gold in the vicinity of Michipicotten river, north of the famous island of Michipicotten, where considerable mining for copper was done by H R. Fletcher fifty-two years ago.

A charter has been granted to Hon. Geo Cox, Wm Mackenzie, G H. Bertram, J. S Playfair, A. Horton, A Cox, A. Angstrom, M.E., S. C. Smoke and J. H Bertram, Toronto, as the Mines Investment Association of Ontario, Ltd., to do a general mining business.

The erection of the Fraser & Chalmers' mill at the Saw Bill mine was done under the direction of S. B. Schrontz, one of Fraser & Chalmers' men, who has, it is said, superintended the construction of some of the biggest plants on the continent.

The gold excitement on the Saskatchewan river, N.W.T., still continues. This spring a large number of new dredges were constructed, and several work at night by electric light. Claims are staked out along both sides of the river for a distance of a hundred miles.

The Elgin Field Oil and Gas Company, who have been boring for oil and gas in Dunwich township, near Tyrconnell, Ont., have struck an immense flow of gas at a depth of 130 feet. The gas was found in a twenty-foot bed of gravel just above the rock, and there was no water with the gas.

The Philadelphia capitalists, Stevenson & Son, who own the Highlander mine at Ainsworth, B.C., have arrived with the machinery for putting in the tramway and concentrator. The tram will run from the Highlander to the lake, and it is expected that the concentrator will be running by the end of August.

The Jenckes Machine Co., Sherbrooke, Que., shipped to the American Asbestic Co., Danville, Que., recently, one of their 20-drill air compressors, together with three high speed crushing rolls and two picking tables, being a plant required by the Asbestic Co. in connection with the extension of its operations.

The calcining and refining furnaces of the Hall Mines smelter at Nelson, B.C., not long ago turned out the first copper produced in British Columbia. It carries 97 per cent. of copper, silver and gold, which is as fine as it can be made in furnaces of this nature. The value carried to the ton is $530, including about $50 in gold.

The Jenckes Machine Co., Sherbrooke, Que., has just completed for the Sultana mine at Rat Portage, Ont., one 30-stamp mill, with six vanners, one 150 h.p. Corliss engine, with complete equipment of boilers, compressor and hoisting plant. This is said to be the largest and most complete plant of this kind in the Lake of the Woods district.

The Ibex mine has let a contract for packing 500 tons of ore. Foss & MacDonnell have a contract to build a tramway, which will be 6,000 feet long. Fifty men are now at work on it, and will have it completed by October. The Canadian Pacific Railway surveyors are locating a wagon road from Three Forks to McGuigan and Bear Lake, a distance of five to six miles.

The Hiawatha mine is on Clear Water Lake in the Saw Bill country, and it has four veins from 2 to 8 feet wide, and assaying from $7 to $17 to the ton in gold. Vein No. 1 has been uncovered for 116 feet, No. 2 for 400, No. 3 for 630 and No. 4 for 250 feet. Seven test pits from 6 to 15 feet in depth have been sunk with, it is said, encouraging results, and a shaft is being put down on vein No. 2.

The directors of the Calumet and Hecla Mining Company paid an "extra" dividend of $5 per share, July 7th, to stockholders of record June 11th. The last previous dividend was $5, and was paid April 23rd The total payments thus far this calendar year have been $30 per share, as against $25 for the corresponding period last year The two declarations call for $1,000,000, and bring the company's aggregate dividend disbursements up to $49,850,000.

The Commander Mining and Smelting Co. wrote to the Canadian Rand Drill Co , Sherbrooke, Que , a short time ago as follows. "Gentlemen —We have run 570 feet, 5 x 7 foot tunnel, in the hard rock of this camp in the past 7 months, with one of your 2¼ Seuggar drills and compressors, at an expense for duplicate parts and repairs on the above drill of only $4 65, which expense includes two throttle handles and rubber buffers Yours truly, J Houghton, Supt. Commander Mining and Smelting Co."

We are in receipt of the Directory of Mines for May, 1897, published by the *Mining Record*, Victoria, B C. The book contains a complete synopsis of the mining laws of British Columbia, with amendments passed at the late session of the legislature, compiled by Archer Martin, barrister-at-law, Victoria, B.C. In addition to the above, much useful information relating to the mines and mining generally is included. Those wishing to know the state of the mining laws as they stand to-day should procure a copy of the work.

Petroleum has long been known to exist in the Gaspe peninsula of Quebec, and several years ago a company known as the Petroleum Oil Trust was formed to search. Oil of a light green shade, of fine quality, like that of Pennsylvania, was found in several places, but not in paying quantities. At last, after several years and much money spent in prospecting, oil has been struck in lot 40 in the township of Galt. The day after the strike was made (22nd of July) a ten barrel tank was made and filled in two and a half minutes, or at the rate of over 5,000 barrels a day. There is great excitement among the people in the parishes of Galt and Baillairge.

Nova Scotia gold mining shows much activity and bright prospects. About the middle of last month, Dr. John H. McKay and Geo. W. Stuart returned from Sherbrooke, Goldenville and Wine Harbor, and reported developments on the Napier property at Wine Harbor most encouraging. A trial lot of rock from one lead gave 17 dwt. per ton. Goldenville is now a busy mining camp, besides the Bluenose and New Glasgow Co.'s producing regularly their large bricks. Geo. Hirschfield has recently leased from Mr. Stuart a small area, from which he took, for the month of June, 228 ounces of gold, netting him a profit of $3,000.

W. G. Miller, professor of geology at the Kingston School of Mining, is now employed by the Government in making a geological exploration of the eastern counties of the province, doing for that section practically the same work that Dr. Coleman is doing in the west. The special service in which he is engaged is the examination of known deposits of corundum, with a view to studying the geological relations of this valuable mineral. He will also explore for gold and other ores, and will send in a report of his work to the Bureau of Mines. The counties over which his investigations will range are Peterborough, Hastings, Addington, and Frontenac, particularly in the northern portions, which are mineral-bearing.

THE Le Roi Company paid two dividends of $25,000 each, in July, making $475,000 paid in dividends by the company. To the disappointment of British Columbia people, the company has located its smelter at Northport, on the American side. A correspondent says the "purchase of the Pilot Bay smelter, by the Grant and Omaha Company, is confirmed, and is regarded as a proof that had the Le Roi people really desired to locate their reduction works in Canada, they could have done so with advantage in the end. The various statements made by the company, from time to time, are regarded as so many pretexts to avoid the export duty later on. The precedent is not likely to be followed."

AN important syndicate in London, England, has acquired 108,000 acres of mining lands on the north shore of Lake Superior, including the Silver Islet mine, and has begun exploratory work, with a view to testing the value of the property. The Silver Islet Mining Company has for a number of years past owned some very extensive properties on the north shore of Lake Superior, comprising 108,000 acres, which extend from Pigeon River to the "Soo." These lands, amongst which was the celebrated Silver Islet mine, were obtained from the Montreal Mining Company, which latter had conducted exploratory work on them about the year 1885-6. When operations on Silver Islet mine suspended, silver to the value of over $3 000,000 had been taken out of the mine.

A DISCOVERY of fabulously rich milling ore has been reported on the northern shore of the Gulf of Georgia, B.C., 140 miles from Vancouver. Every piece of rock taken out of the vein, which is said to be ten feet wide, is ribbed around with coarse gold, which assays many thousands of dollars to the ton, and the specimens are far richer than any before seen in the province. Like all other rich strikes, this was found by accident. Hundreds of prospectors have scoured the country and the one who made the strike had given up the search. He was digging a trench around his tent when he struck the gold seamed rock. He was found a week later raving mad; the excitement caused by the rich find had turned his head, and the only words he could say were: "I have found it." Very rich free milling finds have also been made in Lillooet and Soquansht.

THE report of the Dominion Coal Company, N.S., for the year ending February 28th, 1897, shows that the net proceeds from coal mined were $303,038 and transportation profits $286,263, a total of $589,301. The payments were:—General expenses, $80,548; interest and sinking funds, $267,937; dividends $166,667; total, $515,152. This leaves a surplus of $74,149, which added to the balance of $18,214 brought forward from the previous year, leaves a surplus of $92,362 carried forward to the current year. President Whitney's report says: "The output for 1896 was 1,169,785 tons. This is larger by 284,881 tons than for the previous year. During the latter part of the year it was found desirable to erect a coal-washing plant. This was proceeded with, and is now in operation. It has proved economical and effective in increasing the market value of the smaller grades of coal. The satisfactory results of last year's work were due largely to our increased output and saving in cost of mining and transporting the coal."

B. E. WALKER, general manager of the Bank of Commerce, said in a recent speech to the directors of the bank: "It is well to remember that if mining pays fair wages to those engaged in it, and a fair dividend on the capital employed, that is all we have the right to expect. The world is full of men looking for only fair wages and of capitalists seeking only a fair dividend. It is also well to remember that mining is a business requiring large capital, and apt to absorb the first earnings as a further investment of capital before settling down to the payment of steady dividends. It also requires, like any other manufacturing venture, absolute knowledge of the business in all its details, if success is to be confidently relied on. But like other manufacturing ventures, if skill and capital are properly applied, the result will, in the majority of cases, justify the venture. We hope, however, it will not be taken amiss if we compare this kind of mining with much that is going on in Canada at the present. Many of the ventures offered to the public do not seem to be backed up by skill in the particular business of mining and adequate capital, and in such ventures hundreds of people are risking sums, not large in themselves, perhaps, but of great consequence to the owners, who in the majority of cases we fear must lose. No one really interested in the great future which mining doubtless has in Canada, will, we think, dispute the wisdom of such a note of warning at the present time."

WM. BUCK, the well known stove manufacturer, of Brantford, Ont., died very suddenly from heart disease, while attending a performance of the Wild West Show recently.

Railway Matters.

MONCTON'S (N.B.) new railway station is to be buffed brick with stone trimmings.

EXTENSIVE changes are being made in the C. P. R. shops, Granby, Que., for the purpose of manufacturing cars.

T. PEGNEM, a sub-contractor for Foley Bros., on the Crow's Nest Pass Railway, took a number of laborers out from Montreal.

PREMIER GREENWAY states that he expects to complete the contract for the construction of the Winnipeg-Duluth Air line before the end of August.

FOLEY BROS., of St. Cloud, Minn., formerly of Almonte, Ont., have the contract for constructing 34 miles of the Crow's Nest Pass Railway from Lethbridge.

THE minister of railways has given notice to the C. P. R. that the arrangement by which it uses the Intercolonial from St. John, N B., to Halifax, N.S., will terminate in a year.

THE South-Eastern Valley Railway Company having obtained leave from the Federal Government to cross the Vermont Central Railway line near Ibervillle, Que., will commence their work of construction.

THE erection of the new east end (Dalhouise Square) station and hotel of the C.P.R. in Montreal is going on rapidly, and the contractors are ahead of their time. The station will have eight tracks for passenger trains and four for baggage and express work.

THE steamer "Coban" is taking a load of material for the bridges on the Newfoundland Railway, which is now nearing completion. As soon as the road is finished the steamer "Jubilee" will make regular trips from the western terminus of the railway to Sydney, N.S. The "Jubilee" is soon expected out from Scotland.

THE Grand Trunk Railway work shops in Toronto are being removed to London. In future the repairing of all heavy cars will be done in the Forest City. There have been 120 men employed at the shops in Toronto; 100 of these will be sent to London, while the others will remain in Toronto to do small repairs.

MACKENZIE & MANN, contractors for the Lake Dauphin Railway, have been notified by Premier Greenway, of Manitoba, railway commissioner, to cease in their construction operations on the road, and the workmen have been recalled. The intention was to construct the additional 25 miles this summer, connecting the line with Lake Winnipegosis.

ON the 1st June the Dominion Government ceased to operate the Baie de Chaleurs Railway, which has been handed over to the Atlantic and Lake Superior Railway Company. The rolling stock of the old road is mostly under seizure, and the A. and L. S. Co. have to supply rolling stock to keep it going The extension will be built when the company can finance its bonds under the arrangement with the late provincial Government.

ACCORDING to the Golden, B.C., *Era*, a recent washout on the C.P.R. swept away sixteen bridges and culverts, including the Kananaskis, Devil's Head and Calgary bridges. The formation, it adds, was swept out for about twelve miles, and fully 500 eastbound passengers were detained at Banff, where they were cared for by the company. Canmore was flooded, Calgary, too, and at Anthracite horses in McNeill's mine were drowned and the mine filled.

THE contract for building the East Richelieu Valley Railway, running from the town of Iberville, Que., to Lacolle bridge, a distance of 23 miles, as been awarded to J. L. Comte, of Montreal. The work will be finished this fall. There are no bridges of importance on the line, which has been subsidized by both the Quebec and Ottawa Governments to the extent of $8,500 per mile. Philip Roy, advocate, of Montreal, is the president of the company.

WHILE at Golden, B.C., recently, General Manager Whyte, of the C.P.R., stated that it had been found necessary for the better working of the Rocky Mountain section between Golden and Laggan, to make Golden the divisional point, and to establish workshops there. Consequently, the workshops will have to be removed from Donald, part going to Revelstoke, and the remainder to Golden. Car repairing shops will also be built. It is understood the C.P.R. shops at Canmore will be moved east to Calgary.

A GRAND TRUNK special train with the passengers from the Boston express, has made a remarkably fast run from Montreal to Sarnia. The train was running to make the connection with the Grand Trunk Chicago express, and left Montreal at 12.50 midnight on the 16th ult. Toronto was reached at 9.05 a.m. on Friday, and Sarnia tunnel at 12.48

in the afternoon. The entire distance, 503½ miles, was covered in 11 hours and 58 minutes, the time between the two points being cut down 2 hours 17 minutes.

A CABLEGRAM from London states that the capital of $100,000 has been subscribed for the Cassiar Railway, in the Cassiar district, in northern B. C. The company are working under a provincial charter which gives a lease of 700,000 acres of land, and rights to all minerals, including gold and silver, found therein. Parties connected with the Transvaal mining enterprises are behind the company, and it is expected it will lead to a large development of the rich Cassiar district, lying as it does between the Kootenay and the Yukon gold fields on the north.

C P R stock has advanced from 46 in April to 72½ at the end of July, and no doubt it will go above this figure if the increased dividend, which has been unofficially announced, is declared in October next. It was in 1892 when the stock went to 90, and the earnings were away up. However, the returns are all right for the last six months. The net increase in the receipts for the six months ending June 30th reaches $558 000 over the same period of last year, so that there can be no difficulty about the increased dividend when the money is already earned to pay it.

IT is said that if the Klondike excitement continues the C.P.R. will extend the Calgary and Edmonton branch to Athabasca Landing, thus reducing the land route from that point to Fort Mackenzie near the mouth of the Mackenzie River, to one portage of less than twenty miles. It is stated that by a direct route from Edmonton the Landing can be reached by forty miles of track, but, as it is not probable that the Saskatchewan can be crossed at Edmonton, the impression is that from fifty to sixty miles of railway will have to be built.

THE contract for the Ottawa and New York Railway from Cornwall to Ottawa, about 52 miles, and the link on the American side of the river, which, with the Northern New York Railway, already built, will complete the connection with the Delaware and Hudson Company, has been let and work will begin as soon as the line is finally located. Two parties of engineers have been at work from both ends of the line and have nearly completed their survey. The contract calls for the completion of the line between Cornwall and Ottawa within 90 days from the time of breaking the ground. The scheme includes the bridges across the St. Lawrence from the main shore, a short distance above the town of Cornwall, to Massena Point, New York State, crossing the main line of the river to Cornwall Island, thence across the south channel to the American shore.

THE annual union meeting of the Brotherhood of Locomotive Engineers of North America was held in Windsor, Ont., July 14th and 15th. The gathering, which was held last year at Ottawa, is more of a social than of a business nature, but in spite of this fact there are about 300 delegates with their wives and daughters in attendance from all parts of Canada and the United States. Among the Canadian delegates present are . Chas. Clarke, London . Jas. Duffy, St. Thomas ; W. H. Anderson, Moncton, N.B ; J Adams, London; Henry Wheatley, Montreal; Jas. Currie, Smith's Falls; Thos. Mans, Hamilton ; C. Lulunireve, Montreal, W. Newcomb, Hamilton ; M. Lenahan, London ; W. Burnip, St. Thomas, J. Neilson, Albert McGuire, Toronto ; G A Kantley, Mandon, N.B.; R. G. Morris, Brockville; J. F. Drummond, Palmerston ; H. Stagg, Ottawa; Thos Bruce, Point Edward; H Clendennen, Ottawa, P Endrock, Stratford ; W. C. Alison, Lindsay, W H. Paisley, Brockville, W. Newcomb, Hamilton. The morning session, which was secret, was presided over by Grand Chief Arthur The principal topic of discussion was one which for years has engaged the attention of all classes of organized labor, namely, the confederation of railway labor organizations. The discussion of the subject was spirited throughout, but it is understood that no definite action was taken. At 11 o'clock a civic deputation, consisting of Mayor Davis and Ald Byron, Bell, Connolly, Duck, and Carney, arrived at Laing's hall, where the sessions are being held, and presented to Chief Arthur an address of welcome. This was replied to in a felicitous manner by Mr. Arthur, who in a few well chosen remarks thanked the deputation for its welcome. This ended the morning session, and after luncheon the ladies of the party were taken for a ride on the river. Another secret session was held in the afternoon, the subject discussed being on much the same lines as at the morning session. In the evening the delegates were entertained at a concert given in their honor at the Opera House. Among the speakers were Mayor Davis, William McGregor, M.P., and M. K. Cowan, M.P. for South Essex. The morning's session of the 15th brought the meeting to a close. The only officers of the brotherhood in attendance are Chief Arthur and Grand Secretary W. B. Prenter, who is also treasurer of the Order.

Personal.

THE assistant city engineer of Toronto, Charles E. Rust, has been appointed on the council of the Canadian Society of Civil Engineers, in place of the late Alan McDougall.

WM. H. DERRY, of Kingston, has been appointed chief engineer of the Kingston Penitentiary in succession to James Devlin, recently dismissed in consequence of the disclosures of the parliamentary commission.

JAMES HERRIOT, who has been for a number of years in the car department of the Grand Trunk at Toronto, has been transferred to the office of Mr. McWood, superintendent of the car department in Montreal.

BY an agreement made between the Quebec City Exposition Company and the Provincial Government, the company has engaged to erect its new buildings at Stadacona, and to contribute $6,000 to the erection of an iron bridge across the St. Charles River, in place of the Bickell bridge.

JOHN S. DENNIS has resigned his position as director of irrigation surveys in the N.W.T., and has accepted the office of director of public works under the North-West Government. He will take with him S C. Wilson, who has been employed for some months in the irrigation office at Calgary.

IT is probable that in the retirement of P. S. Archibald, chief engineer of I.C.R , W. B. Mackenzie, of Moncton, second in rank to Mr Archibald, will be promoted to the chief engineership. Mr. Mackenzie is a native of Barney's River, Pictou county, and an engineer of high standing.—*Halifax Chronicle.*

PROF. J. C K. Laflamme, rector of Laval University, Quebec, left last month for Russia, to attend the international convention of geologists, at St. Petersburg. Prof. Laflamme is not only an eminent geologist, but is a man of varied scientific attainments, and Canada cannot be more ably represented than by him.

R O. KING, B.A , Sc , of 503 Markham street, Toronto, lately referred to as having received the Whitney fellowship at Harvard University, has just received notice of the exceptional renewal of his science research scholarship from the British Association for a third term, which will be taken at Harvard University. The financial value of these awards for the coming term amounts to $1,050.

A JOINT board of surveyors has been appointed by the Governments of Canada, Ontario and Manitoba, to delimit the boundary between Manitoba and Ontario from the northwest angle of the Lake of the Woods, north to English River. E. Stewart, Rat Portage, Ont., Government mining agent, represents the Dominion Government. B. J. Saunders, C.E., Brockville represents the Ontario Government. The survey is necessary at the present time owing to the number of mining claims being taken up in the vicinity of this territory.

DANIEL HUNTER, formerly of the firm of Inglis & Hunter, boilermakers, Toronto, died last month, after a protracted illness, at the age of 57. He first settled in Campbellville, on coming to Canada from Ireland, and afterwards moved to Guelph, where he became a member of the firm of Inglis & Hunter. About fifteen years ago the firm came to Toronto A few years ago Mr. Hunter left this firm, and since then has been connected with the Doty and Bertram companies. He superintended the putting in of the machinery on the "Corona," this being the last contract which he managed. He leaves a widow and family of eight children.

FEW railway officials in this country were more genuinely liked than J J Lanning, late assistant general manager of the Grand Trunk, and there was sincere grief when his death was announced in Montreal last month A biographical sketch of Mr. Lanning appeared in our issue of April, 1894, at which time he was promoted from the position of private secretary to the manager's assistant. He had enjoyed his promotion but a short time when he was laid up with consumption, from which he never recovered, though almost to the last he cherished the hope of soon being "in harness" again. It would have been hard to find an officer more faithful to his work than Mr. Lanning, whose career ran through the regime of four general managers. At the suggestion of General Manager Hays, Mr. Lanning compiled, during his hours of compulsory retirement, a history of the Grand Trunk system, which will, no doubt, see the light in due course, and prove interesting reading.

THE late A. L. Light, M.I.C.E., who died recently at Lac-a-la-Croix, Que., in his early youth, was employed in the construction of the Great Western Railway of Upper Canada. Subsequently he became a member of the Institute of Civil Engineers of London, and entered into partnership with Mr., afterwards Sir James Brunlees, the celebrated Scotch engineer, who built the cantilever bridge over the Firth of Forth. Mr. Light was employed by the New Brunswick Government in building the European and South American Railway from Shadiac to St. John, by the Government of Canada in the construction of the Intercolonial, and by the Government of Quebec in completing the North Shore Railway, now part of the Canadian Pacific. His last engineering work was the Lake St. John Railway, of which he was consulting engineer for many years. Mr. Light was very highly esteemed in England and was selected by the late Duke of Newcastle as civil engineer in charge of the transportation of the troops to Bic, at the time of the Trent affair in 1861. He was chosen by Premier DeBoucherville, of Quebec, in 1877, to take charge of the railways in Quebec province, and he has resided in Quebec city ever since.

It is with feelings of the deepest regret that we refer to the death; on July 20th, of F. B Robb, manager and secretary-treasurer of the Robb Engineering Co., Limited, of Amherst, N.S., which took place while he was bathing at McIvor's Point, Fox Harbor. Mr. Robb was not in particularly robust health at the time, and it is thought that the shock of entering the cold water was so great as to produce heart failure. From early in his life Mr. Robb had been connected with a successful business and was a leading member of the community in which he lived. In everything which concerned the public welfare and the moral advancement of the citizens he took a deep interest. He was chiefly instrumental in organizing the Boys' Branch of the Y.M.C.A., and it was while taking part in the out-door life of this society that he met his death. He was an active member of the Presbyterian church, was an elder and taught the young men's Bible class in Sunday school. Mr. Robb was an excellent musician, and when a leader was required to take charge of a musical programme, he was willing to give his talents to its aid. He was active in the formation of the local bicycle club and contributed largely to its funds. He was a member of the Good Roads Committee of the Canadian Wheelmen's Association, and at the time of his death was identified with many plans for the improvement of the country roads. Thus at every point in which Mr. Robb came in contact with the world his influence was felt for good, and no one could be more missed from his native city than he.

Marine News.

The Furness line steamer "Baltimore City" was wrecked in the Straits of Belle Isle recently.

The new steel barkt. "Hillside," owned by W. L. Lovitt, Yarmouth, N.S., recently arrived at that port.

The new Star line river boat, which has been in the process of construction for several months at McGuiggan's ship yard, St. John, N.B., was successfully launched last month.

The new D. A. R. steamer "Prince Edward," recently launched at Hull, is 700 tons register, with twin screws. She cost over $200,000, and is to be a sister ship to the "Prince Rupert."

The incorporators of the Rainy Lake Navigation Co. are: Geo. H. Bertram, Toronto; W. Ross, Rat Portage; G. A. Graham, A. Thompson, D. C Graham and J. T. Horne, Fort William. Capital, $150,000 chief place of business, Rat Portage, Ont.

In commenting on the novel features of the yachting and fisheries exhibition at the Imperial Institute, London, England, the *Yachtsman* says: "An oil launch, exhibited by Murray & Williams, of Montreal, apart from the points of detail, which we must describe on another occasion, seems calculated, from the manner in which it is prepared for exhibition, to teach even old stagers on this side a lesson or two, and should bring home the fact that white flannels are not so necessarily entirely out of place on a small steam yacht as some would have us think."

Electric Flashes.

The officers of the West Kootenay Light and Power Co. are: Oliver Durant, president; J. B. McArthur, secretary; F. Paul, treasurer.

Waterloo, Ont., is now lighted by electric light. The plant supplied Wm. Snider & Co. by the W. A. Johnson Co., Toronto, is affording every satisfaction.

The Brantford, Ont., Electric and Operating Company have been awarded the contract for wiring and installing an electric light in the main building at the Asylum for the Blind, Brantford, by the Ontario Department of Public Works.

The Royal Electric Co. have the contract for lighting the buildings and grounds of the Montreal Exhibition which is to be held from 19th to 28th Aug., and have a large number of men on the grounds.

The Bell Telephone Co. is building a new exchange in Sherbrooke, Que. It is of pressed brick, with terra cotta facings, about 20 x 45, and three stories high. It will be equipped with the most modern switchboards and will be ready for occupation about December next.

The Sherbrooke Street Railway Company has closed a contract with the Jenckes Machine Company, Sherbrooke, Que., for a 45-inch Crocker turbine, with tubing and wheel cases complete, horizontal setting, for direct connection to generator, which is being furnished by the General Electric Company.

A company is formed to build a telegraph line from Dyea to Dawson, Alaska, with a branch to Juneau. It is the Alaska Telegraph and Telephone Company. The directors are C. W. Wright, Theodore Richart, D. E. Bohenon, J. W. Wright and J. F. Fassett. The capital stock of the organization is $250,000, of which $100,000 has been subscribed by the directors.

The town of Lachute Que., population about 1,700, has an electric light system, operated by Simpson & Boyd, under the superintendence of Henri Tessier. They have a 30-h.p. water power and run 350 incandescent lights. Houses are lighted at 1½ cents per light per night. The consumer pays for installation, and may find his own lamps if he chooses. Accounts are payable monthly.

A St. Catharines despatch of July 9th says: "The well-known car manufacturers, Patterson & Corbin, have been in an exceedingly unfortunate position lately. Their shop has been closed for a few weeks, and a Hamilton bailiff is in charge. Yesterday afternoon the place was to have been put up at auction to satisfy a claim, but Bailiff Boyle stepped in on the behalf of Collector McGibbon, and the sale was put off."

The Montreal Belt Line, the new electric railway, has been formally opened by a band concert, pic-nic and fireworks at Bout de l'Isle, a village at the foot of Montreal Island, forming the present terminus of the road. The road has been excellently equipped by the Canadian General Electric Co., and is very popular with the citizens. The line makes a junction with the city system at Maisonneuve, and is 12 miles long.

The Canadian Power Co., referred to last month, is proceeding with work at Niagara Falls. The plans on file at Ottawa call for a canal 4,000 feet long, 15 feet deep, and 200 feet wide at the bottom, running from Chippewa Creek to the head of Dufferin Islands. The *Globe* says: "The company's organization is held in the background for a time, and the only known representatives are Banker R Paine, of Niagara Falls, and Arthur C. Dennison, of Philadelphia. The company, according to Mr. Paine's statements, will develop 40,000 horse power at once, and about one-fourth of this will be for direct power use for mills, while 30,000 horse power will be developed in electrical form and transmitted."

The water was let into the head race of the big works of the Lachine Rapids Hydraulic Co. on the 31st without any ceremony, but the formal opening will take place somewhere about Sept. 1st. In the meantime the wheels and four of the twelve dynamos will be operated for 30 days by the contractors before the company takes them over. The company have issued a circular stating that they are prepared to furnish light and power to all comers, and claim that their power will be the cheapest in Canada. They will furnish light at ½c. per hour, but do not give figures for power. There is likely to be keen competition between this corporation and the Royal Electric Company, who supply most of the light and power to Montreal.

At the annual meeting of the Royal Electric Co. last mouth, the old board of directors was re-elected, and Hon. J. R. Thibaudeau was re-elected president, and D. Morrice vice-president. The annual report shows that the company has now $1,810,444 invested in machinery, plant and patents; it has $200,000 stock in the Chambly Mfg. Co., and $184,909 in outside plants, etc. These items, with goods manufactured and in process, make the total assets $2,978,095. The net profits (after deducting $43,245 for interest and fixed charges) for the year were $200,634, or 13.38 per cent. on the paid-up capital Adding $75,000 as premium on the sale of new stock, the profits would be over 18 per cent. on the capital. The company are now working actively on the electrical equipment required for the generating station at Chambly and the receiving station in Montreal. The building of the dams, power-house and waterworks is well under way, and in a few months the company will be able to deliver on its lines in Montreal electric power generated at Chambly, and to give its customers the benefit of the reduction in cost to be derived thereby without impairing its own earning powers.

During the past year the Royal Electric Company, of Montreal, have been busy replacing all the old step down transformers in this city with new ones suited for the low frequency alternating current which they are now supplying for incandescent lighting Last summer the alternations were about 15,800 per minute, while this year they have been reduced to 8,920 This change of frequency has had the effect of so much reducing the "back kick" in the iron of the transformers used last year, as to cause them to draw a large amount of current, and consequently render them liable to burn out; hence the replacing with new ones. Alternating current motors have also had to be re-wound to enable them to run on this circuit. The first means employed to adapt high-frequency motors to the low-frequency was to simply place a small kicking coil in the circuit, but this method has been abandoned, as by far the best results are obtained by re winding. This has to be done with smaller wire and nearly double the number of turns We have seen a fan motor wound for the 104 volt high frequency (which is still supplied by the Citizens' Light and Power Co) run splendidly on the 52 volt low frequency In all probability the 104 volt circuit will soon be changed from a high to a low frequency, when all transformers on the line will have to be changed in the same way as the Royal Electric Co have been doing.

Industrial Notes.

Lindsay, Ont., recently ordered a road roller and other good roads machinery.

The J A Sayward Lumber Company has decided to build a saw mill at Nelson, B.C

The new match factory at Buckingham, Que., is reported to be doing a good business.

The Frost Wire Fence Co., of Cleveland, O., contemplate starting a branch factory in Ontario

City Engineer Beaudry of Sherbrooke, Que., is preparing plans for a new system of waterworks

The Northern Elevator Company is building a thirty thousand bushel elevator at Regina, N.W T.

The Rathbun Company, Deseronto, Ont., is erecting a large lumber shed on its dock at Picton, Ont.

W. H. Kelly, Buckingham, Que., is building a new steam saw mill of a capacity of 50,000 feet per day.

A large pulp mill will be, it is said, built at once at Escuminac, Que., on the Baie des Chaleurs Railway.

A new Catholic church is to be erected in Barford, Que. The contract has been let to Paquette & Godbout for $14,800.

Extensive additions and improvements will be made to the Russell House, Ottawa, this summer, at a cost of about $12,000.

Jas A. Simpson, formerly engineer at the Berlin, Ont., Water Works pumping station, has been succeeded by Wm Collard.

The Arrow Milling Co, Birtle, Man., has made a contract with Stuart & Harper, Winnipeg, to overhaul and improve their mill

A large number of grain elevators are being erected in Manitoba this year, and the aggregate capacity of the province will be increased over 25 per cent.

The Granby Rubber Co's box factory is now turning out 500 cases a day The Robb Engineering Co equipped the power. The factory is 36 x 84 feet

C J. Robertson, printers' machinery and supplies, 12 Phillips square, Montreal, will make an interesting display at the approaching exhibition in Montreal.

John M Moore, civil engineer, of the London, Ont., waterworks staff, has made a report to the town council of Ailsa Craig, Ont, on their proposed waterworks scheme

At the last regular meeting of the Brockville, Ont., branch of the C.A.S E., it was decided to hold the annual convention in Brockville, Thursday and Friday, the 19th and 20th August.

J. R. Booth and G. A. Mountain, C.E., engineer of the C.A.R. system, have been in Parry Sound superintending the erection of a one million bushel grain elevator in that town.

The Hamilton Smelting Works is sub-letting work, such as unloading and loading cars, and so forth P C Peterson, ex foreman at the works, has been awarded three contracts.

Peuchen & Co., acetic acid manufacturers of Toronto, Ont., will establish a branch at North Tonawanda, N Y. The firm has leased the old buildings of the Spang Manufacturing Company

The town of St. Mary's, Ont., through the medium of W. K. McLeod, secretary of the Board of Trade, is investigating the question of putting in a system of waterworks for the town.

Rudolph Hering, the New York engineer, has returned to Winnipeg to complete his investigations as to the best source of the city's water supply. He is said to favor artesian wells.

The sum of $1,800 was allowed the Gartshore-Thompson Pipe and Foundry Company for its loss by fire a few weeks ago. The loss was much greater, but the foundry was not fully insured.

The Jenckes Machine Company, Sherbrooke, Que, has just completed the balance of the sawmill machinery for the Montague Paper Company, Lake Megantic, which expects to start its new mills at once.

Harrison Bros. have let the contract for the erection of a 75-barrel flour mill at Holmfield, Man. Stuart & Harper, of Winnipeg, who represent the Stratford Mill Building Company, have the contract.

The Three Rivers Iron Works Company has been awarded the contract for the laying of mains for the waterworks and sewerage system of Renfrew, Ont., for $51,874. The stand pipe, pumps and plant will be awarded as a separate contract.

The Cooper Machine Company, Limited 92 Adelaide st. east, Toronto, report a good demand for their "Imperial" gasoline engine, and have recently made shipments to Bracebridge, Ont., Goderich, Ont., and Pawtucket, Rhode Island. They are increasing their facilities by the addition of larger machinery of the latest design. The firm will make an exhibit at the Toronto Industrial Fair.

A new industry for Guelph, Ont., is the Guelph Linseed Oil Company, Limited. This business will be carried on in a portion of the building occupied by the Guelph Flax Mill Company, and will be run in connection with the present business under the management of S. J. Taylor. The company will manufacture linseed oil, oil cake, flax meal and green tow, and will give steady employment to about 20 men

Three new bridges have recently been completed at the Record Foundry and Machine Co.'s works in Moncton, N.B They are for College Bridge, Blackville, N.B., and Campbell's, near Nauwigewauk, N.B The Campbell bridge consists of a single span of 240 feet in length. The College bridge consists of two spans, each of about 200 feet The Blackville bridge is smaller, being a single span of about 200 feet.

It is understood that the Minister of Railways and Canals has authorized the construction of a new bridge to take the place of the present bridge over the Lachine canal at Seigneurs street, Montreal. The new bridge will be large enough for street car tracks as well as vehicle and foot passenger traffic. A new bridge may also be built over the canal at the foot of Atwater Avenue, which divides the city from St. Henri.

The three sets of plans for the water and sewage systems of Nelson, B.C., prepared by Messrs. Cummings, Coyle and McCulloch, have been accepted by the council, and each competitor was awarded $200. The reports favor Anderson creek as a source of water supply, and also agree as to the site for the reservoir. The estimated cost is between $1,900 and half that sum. A. L McCulloch has been appointed engineer in charge with a salary of $200 per month.

The work of restoring the malleable works is now in full swing, says the Whitby *Chronicle*, and will be pushed to completion as rapidly as possible. Jas. Gall has the contract for the stone and brick work. Don Valley pressed brick will be used for the front wall, and Whitby brick for the balance of the work. John Sykes & Son have the contract for woodwork. Goldie & McCulloch, of Galt, will supply the engines. It is expected that the works will be restored by September 1st.

Marsh & Henthorn have succeeded to the foundry business of the Geo. T. Brown Manufacturing Co., Ltd., Belleville, Ont L. W. Marsh has been accountant with the Geo. J. Brown Co. for about four years, and W. H. Henthorn has been mechanical superintendent for that company for about nine years. The new firm has already supplied three steam hoists to Wm. Gibson, M.P., for use on the Victoria bridge at Montreal, and in his quarries, and has several large orders on hand.