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The Canadian Engineer

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CONTENTS OF THIS NUMBER:

EFFICIENCY OF COAL CONSUMPTION IN RAILWAY PRACTICE.*

BY HERBERT WALLIS, PRESIDENT CAN. SOC. C.E., 1896.

There are many subjects commonplace in themselves, whose very commonplaceness makes them interesting. Coal, for example, entering as it does so largely into our domestic economy, is a subject upon which few people are not willing, in some way, to express an opinion, and about this season of the year, when the mercury in our thermometers is ranging in the neighborhood of zero, it becomes a matter of deep interest to most of us, whether that supply which was so carefully cellared during the summer is going to outlive our necessities before inexorable laws require that it shall be again replenished. It has occurred to me that you might not be unwilling, in lieu of a general retrospect, to hear something about fuel in its various forms, of which coal is one, and especially in its relation to locomotive steam practice in Canada, where, owing to the extremes of atmospheric temperature, and to climatic disturbance, the conditions under which it is used are perhaps dissimilar to those existing in most other countries. Assuming, then, that this should be the case, I shall have to ask you to go with me while I retrace my steps, in reviewing the practice and past operations of the Grand Trunk Railway, that great Canadian artery with which, as is known to many of you, I have been identified for a quarter of a century, and from which I have collected such data as I propose to bring before you to-day. I do not claim that my conclusions have been reached as the invariable result of exhaustive experiment, or that my figures are beyond criticism. They are suggested rather as a contribution to practical literature upon a subject which has occupied in the past, and which will unavoidably continue to occupy, the minds of those engaged in solving the great problems arising from the frequent calls for cheaper and more rapid transportation, in connection with which this question of fuel through the energy derivable therefrom stands out as the prominent feature. The fact that the coal bill alone in the accounts of our great railways absorbs some 14 per cent. of the total expenditure, is sufficient to constitute it, as it literally is, a burning question.

Years ago, when fire-boxes were made of copper and tubes of brass, when their repairs caused no anxiety in the minds of those engaged in their daily work of operating railways, and when their renewals did not constitute an important feature in the general expenditure, the forests of Canada supplied the staple fuel for locomotive consumption. It is true that trains had to be stopped every forty miles or so, to have the tender loaded with a fresh supply, an operation which occupied ten or fifteen minutes; but these were halcyon days, when time was not so valuable, because competition was not so keen as it is to day, and no inconvenience apparently resulted from the not infrequent arrival of passenger trains long after their schedule time. It was only when the possibility of sharing in the distribution of the great produce of the West suggested an assimilation of the gauge of the Grand Trunk with that of the American lines, that it was seen how totally inadequate was cordwood to meet the requirements of a first-class railway service. Even then the substitution of coal had to be very gradually effected, on account of the expense attending the conversion of the locomotives. A wood-burning engine was *hors de combat* after a very short tussle with coal, and the renewals of fire-boxes and tubes were of such a costly nature as to suggest, oftener than not, the substitution of an entirely new engine and the relegation of the old one to the "scrap" heap. It is not, therefore, to be wondered at that cordwood outlived for many years the introduction and even the extensive use of coal, particularly upon branch lines, from the neighborhood of which it could for many subsequent years be obtained cheaply, and also in other districts where competition was the least active, to the extent necessary to wear out those locomotives, which, while being still equal to the service, were not worth the expense of conversion. Fuel wood was purchased by the measure, in cords of 128 cubic feet, and was delivered under various contracts upon the railway "right of way" at the nearest points to the sources of supply. The piles were measured and removed by specially appointed and equipped trains to the wood sheds upon the line of railway, where the process of drying was supposed to be undergone. For a variety of reasons, however, this process was rarely completed, and, as may be imagined, the fuel differed very widely in its calorific value. The

* Extracted from the President's address at the annual meeting of the Canadian Society of Civil Engineers.

system of acceptance by measurement took no account of the density of fibre or the amount of moisture it contained, and although hard and seasoned wood commanded a higher price than the soft or greener article, there was no practical means of establishing an accurate or reasonably accurate standard of value as a check upon extravagance on the part of users. For general statistical purposes, 3,712 lbs. was held to be the average weight of one cord of mixed and seasoned wood, and probably the figure was sufficiently reliable. In the year 1878 careful tests were made to determine the values relatively of the hard and soft woods which were delivered on the line of the Grand Trunk Railway in Eastern Canada. The former comprised chiefly hard maple and birch, and the latter covered those non-deciduous trees of which pine, spruce and helmlock are representative. The weight per cord of seasoned wood was about 4,000 lbs. for hard, and 2,700 lbs. for soft. The result of the tests showed that one cord of the hard wood was fully equal in calorific value to one and a half cords of soft.

So far back as the year 1868, the Grand Trunk Company, with the object of checking the advancing price of cordwood, introduced peat as a competitor. This peat was cut from the bogs at Lapigeonniere and at St. Hubert, in this province, and after being partially cured and otherwise prepared, was hauled, as in the case of wood, to the way station delivery sheds. The difficulties in its use, anticipated at its outset, were such as applied to cordwood. The crude peat was not uniform in quality, it was liable to imperfect manufacture and to absorb an undue amount of moisture. It was, moreover, very unpopular, owing to the pain its use inflicted upon the eyes of the firemen, and its death knell was rung about the year 1875. The last year's record, based upon issues of about 80,000 cords of mixed wood at 3,712 lbs. per cord, and of 8,000 tons of peat at 2,000 lbs. per ton, showed a consumption per engine mile of 95 lbs. of the former, and 118½ lbs. of the latter, the actual cost of peat per car mile being about 50 per cent. more than that of wood. These figures were, however, the result of the daily working of the railway, and the conditions were not perhaps in all respects the same. In 1876, I made very careful experiments to determine the relative values of the two fuels, upon representations having been made that a superior quality of compressed peat was in the market, which would eclipse anything that had been previously introduced, both as to its calorific value and its price. The cost of the wood was $3.33 per cord of 4,031 lbs. delivered upon the tender, and that of the peat $1.71½ per ton of 2,240 lbs., similarly delivered, and the evaporative efficiency proved to be 3.09 lbs. and 2.33 lbs. respectively of water per lb. of fuel, while the quantity used per ton of train hauled one mile, excluding the engine and tender, was .263 lb in the case of wood, and .362 lb. in that of peat, or an excess as against the latter of over 37 per cent.

It was during the autumn of 1873, when, after the gauge of the railway had been changed from Montreal westward to conform to that of American lines, that the Grand Trunk Company contracted largely for bituminous coal. During that year upwards of 150 engines, constructed for the purpose, replaced others of the wood-burning type, which were subsequently rebuilt or otherwise disposed of, and the number of coal-burning engines was largely augmented the following year, on the completion of the change which made the Grand Trunk a 4 feet 8½ inch, or standard gauge railway throughout its entire length. As a result, the influx of American traffic from the Western States to the seaboard, coupled with the increased capacity and fitness of the new engines, so greatly increased the mileage and added to the weight of the trains, that the superiority of coal and the insufficiency of cordwood as a steam generator could not be ignored, and the absolute retirement of the latter became merely a question of time. During experiments made in 1876, a locomotive hauling a freight train of 340 tons consumed .263 lb. of hard dry maple, weighing something over 4,000 lbs. per cord per unit of work (one ton one mile), as against .105 lb. of good Welsh steam coal, and the efficiency of the boiler under similar conditions was 3.09 lbs. and 7.94 lbs. of water evaporated per lb. of fuel respectively. Similar experiments made at the same time with stationary boilers of locomotive type produced similar results, so that it may be broadly stated that one pound of good steam coal effectually burned will in practice yield an equal result with two and one-half pounds of hard dry maple, or that a ton of coal is equal to a cord and a quarter of seasoned hard wood by measure. The best of soft woods did not yield by measure more than one-half the duty of coal, one ton or 2,000 lbs. by weight producing equal results with two cords. Meantime the gradual clearing of the country contiguous to the railways was making cordwood difficult to obtain, while competition and improved facilities in transportation were cheapening the price of coal. While therefore the issue of coal during the year 1871 amounted in all but to 200 tons, it had risen in 1875 to 140,000 tons, and in 1895 the quantity used exceeded 700,000 tons, and from the year 1884 cordwood ceased to be used except for lighting fires, or to a limited extent for stationary purposes.

In the early history of the use of coal upon the Grand Trunk Railway, the supply was, for the most part, obtained by water delivery, either at Montreal from Cape Breton and Nova Scotia, with occasional cargoes from Great Britain, or at Toronto, Belleville or Brockville, by way of the lakes from the coal fields of Ohio and Pennsylvania. Thus a large stock had to be provided during the season of navigation to meet winter requirements, which, by exposure to the atmosphere (for the quantity was too large to admit of it being piled under cover), lost much of its calorific value by decomposition and the gradual volatilization of the hydrocarbons. This loss was accelerated, in coals which contained sulphur, in a more than ordinary degree, to the extent that active combustion not infrequently followed upon or resulted from the heat generated on account of its presence. The loss by breakage in loading and unloading the vessels, as well as the loss of interest on invested capital, furnished additional reasons for inducing the opening of all-rail routes, and for making recent contracts on the basis of continuous daily delivery. Coal from some seams, owing to a soft and friable nature, is specially liable to damage in the process of mining and subsequent handling, and quantities varying from 75 to 25 per cent., according to the nature of the coal, pass through the screens, in the form of dust and slack, which, if used in the fire-boxes, would escape through the tubes in a condition wholly or partially unconsumed, thus helping to swell the volume of smoke, which imperfect combustion, the result of forced fires, too often produces.

It has often become a question as to whether it is desirable to forego the expense of screening, and to be sat-

isfied with what is known as the "run of mines" supply. The result of experiments made in 1887 with coal from three widely separated mines indicated a higher evaporative efficiency in favor of the screened coal by as much as 7½ per cent. In these trials one car load from each mine was used as delivered under a "run of mine" contract, as against other cars from which the coal was handpicked. The comparative freedom from smoke and dust seems to point to the desirability of screened coal for passenger train service, and in countries like Canada, whose importations are large, and where the import duty is alike for screened and unscreened coal, it is a question if the balance of advantage is not in favor of the former. Pennsylvania anthracite, or what is usually known as hard coal, has not found favor in Canada as a locomotive coal, owing to its relatively higher first cost. For passenger train service, it cannot be excelled, on account of its freedom from smoke and dirt, but it requires from 12 to 15 per cent. more by weight to equal the duty obtained from bituminous coal, and the greater wear and tear consequent upon its use shortens fire-box life from one to two-fifths. A very careful record made under the supervision of T. N. Ely, chief of motive power of the Pennsylvania Railroad Company, showed that during one month the amount by weight of anthracite required to work the local trains leaving Broad street station, Philadelphia, exceeded by 11 per cent. that of bituminous coal required to perform the same work. On the Reading Railroad, where the use of the Wooten boilers permits of a very large fire grate area, the evaporative efficiency of soft coal was superior by 15 per cent.

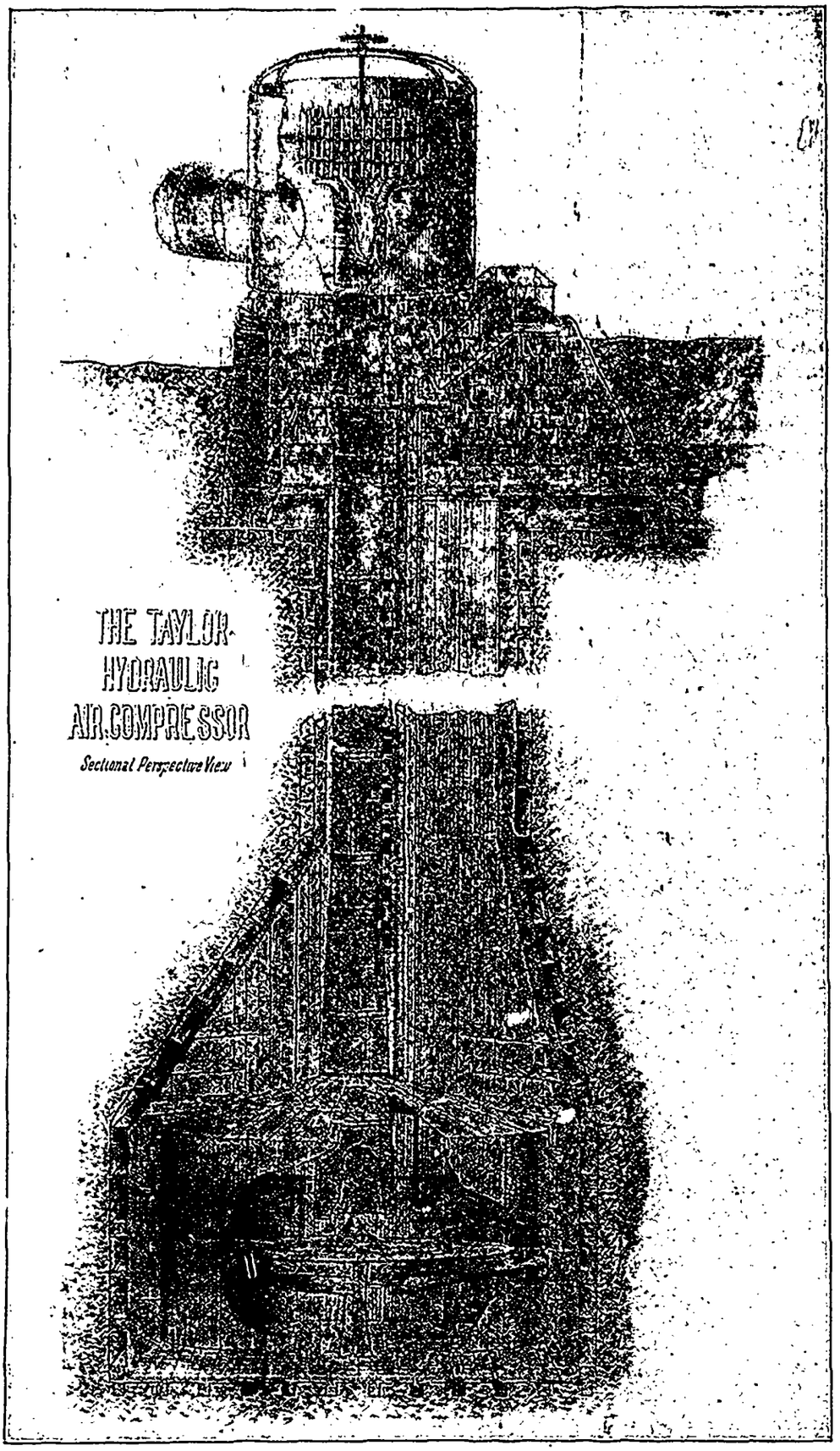
(To be continued.)

HYDRAULIC AIR-COMPRESSOR PLANT AT MAGOG.

A description of the Taylor system of hydraulic air-compression was given in THE CANADIAN ENGINEER, vol. 2, pages 343-346. A 150 h.p. compression plant was erected for the Dominion Cotton Mills Co., at Magog, last year, as a test of the system, by the Taylor Hydraulic Air-Compressing Co. of Montreal, and the following account of this plant, which has excited a good deal of interest, was given by the inventor, C. H. Taylor, at the Mining Engineers' Convention in Montreal last month. The construction of the plant consists in sinking a shaft to the necessary depth and erecting the separating tank, compressing pipe, head piece with air inlets, and penstock. The shaft of the Magog plant has been sunk to a depth of 128 feet. The dimensions inside the timbering and rock are 6 feet by 10 feet from the top of the shaft to within 16 feet of the bottom, where it is enlarged to 20 feet in diameter. The timber used in the shaft is 8 x 8-inch hemlock, the sets being placed 4 feet apart, centre to centre. The timbering extends from a point 3 feet below low-water level in the tail-race down a depth of 72 feet, of which the last 20 feet is in the rock. All the timber above the rock is backed with 2-inch hemlock. As each set was put in, each plank was wedged separately, and the space filled up solidly with fine gravel. After timbering was completed, a lining of 2-inch hemlock plank was put in. The space between this lining and the rock was filled with concrete, thus forming a solid base upon which the upper timbers were supported. This careful timbering was necessary because of the nature of the ground, which is composed of layers of running sand. The rock below the timbering consists of a very firm slate. A mud seam, an inch and a half thick, cuts the shaft at the bottom of the timbering, separating the solid rock from rock of a loose nature above. On three sides of the mouth of the shaft a stone wall has been laid in Portland cement. This wall is 3 feet thick at its base, and batters upwards to 2 feet at the top. Its height is 14 feet. It has for its foundation two layers of 10 x 12-inch timbers laid crosswise, bedded in cement, with 10-inch spaces between timbers filled with concrete. The space between the walls forming the tail-race, is 13 feet. The timber in the structure will always remain below water level; consequently, it will be of as permanent a character as the remainder of the plant.

The material of the compressor is ¼-inch steel plate. A penstock of 5 feet 6 inches diameter and 160 feet long conveys the water from the canal, or forebay, to the receiving tank at the head of the compressor. This tank is 12 feet in diameter and 12 feet high, open at the top, and rests upon four 12-inch I-beams spanning the foundation walls. The compressing pipe, 44½ inches in diameter, passes through the centre of the bottom of this tank and projects 3 feet up into it. A 10-foot telescoping pipe is inserted into the upper end of the compressing pipe. On the upper end of this is rivetted a cast iron bell-mouth piece 4 feet 8 inches in diameter, which is part of the head piece. Three lugs are on this casting by which the upper part of the head piece is attached to the telescoping pipe. The upper part of the head piece is a casting in the form of a cylinder 4 feet 8 inches diameter, terminated below by a conoid, of which the surface is concave. Three 1¼-inch bolts attach the lugs on the bell-mouth piece and telescoping pipe to three corresponding lugs on the cylindrical piece above. Two flanges 6 feet 2 inches diameter encircle the cylindrical part of the casting above and below, which served to hold vertically in place thirty 4-feet lengths of 2-inch wrought iron pipe equally distributed around the cylindrical casting. The lower ends of these pipes are flatly welded together. Near the lower extremity of each pipe, five rows of holes are bored to receive thirty-three ⅜-inch pipes, all within 15 inches of the closed end. In each of these holes a pipe 6 inches long is screwed and bent so that they are all directed towards the centre of the compressing pipe. These pipes serve to admit the air and direct it into the water. The combined head piece and telescoping pipe are supported by a 2½-inch square threaded screw, which passes through a timber spanning the top of the tank. A hand wheel, with nut attached, supports the screw and enables the head piece to be raised or lowered as desired. As before mentioned, the compressing pipe starts from a point 3 feet above the bottom of the upper tank and extends down the shaft. Its total length is 136 feet. Its diameter is uniform for 116 feet, but enlarges in the last twenty feet from 44½ inches to 56 inches diameter.

This compressing pipe is constructed with butt joints held together by 4-inch straps rivetted to the sections. All the rivet holes are counter sunk, thus making a perfectly smooth interior. The lower or separating tank is 17 feet in diameter and 12 feet high. The bottom of this tank is open and rests upon eight cast-iron legs which raise it 16 inches above the bottom of the shaft. The top or cover is conical, rising two feet to where it is connected with the compressing pipe. The compressing pipe extends down into the tank 9 feet below the cover, its lower extremity being 8 feet from the bottom of the shaft. Directly under the compressing pipe is placed a circular casting, the upper surface

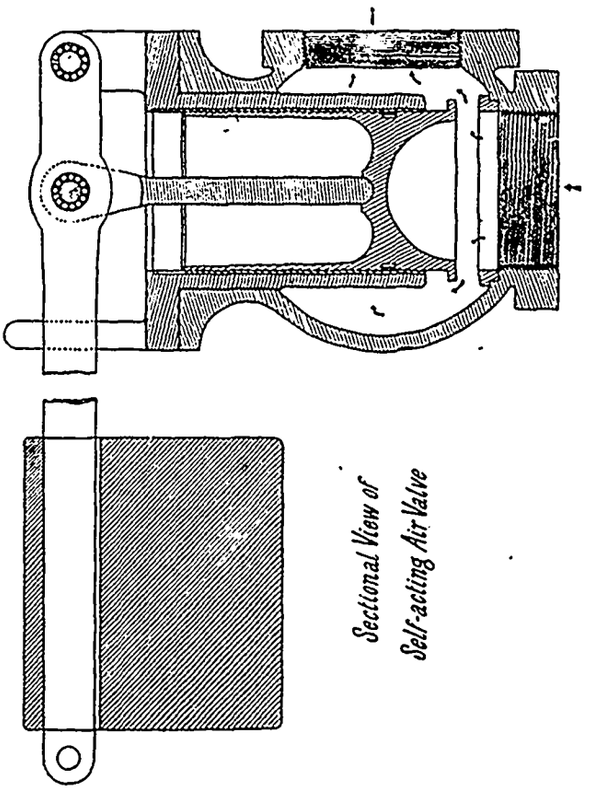


of which is a conoid similar to the one already mentioned in the head piece. Its diameter is enlarged by steel plates to 12 feet. The opening between this disperser and the lower end of the compressing pipe is 14 inches. The disperser is supported on a pedestal and also strengthened by stays from the compressing pipe; 14 inches below the outer edge of the disperser is a conical apron, 5 feet wide, extending around, and rivetted to, the interior of the separating tank. Both this apron and the disperser have two 5-inch pipes 5 feet long extending upwards to allow the escape of air, which collects underneath them, to the main body of air in the upper part of the tank. A 4-inch waste pipe, or "blow-off," begins on a level end of the compressing pipe, and close to it. On this end is an elbow and short piece of pipe, the latter having its upper half removed. On each side of this elbow and pipe a plate 18 x 20 inches is bolted to the pipe, leaving the top and one end open. The waste pipe passes through the top of the separating tank, extends up the shaft to a point 10 feet above water level, and is terminated by a return bend for the purpose of directing the spray and water into

the tail race. Opening out of the top of the separating tank is a 7-inch pipe to conduct away compressed air. This main extends up the shaft, and is carried into the mill. After it enters the mill a self-acting regulating valve (of which a sketch is shown) is placed for the purpose of preventing the water from entering the air pipe, should the supply in the separating tank fall short at any time of the demand. As the air fills the separating tank, the pressure increases by a few pounds. When the pressure lessens to a certain degree by the rise of the water, the valve closes automatically before the water can reach to within 15 inches of the top of the separating tank, and thus adjusts itself to the supply of air from the compressor. From this valve a 6-inch pipe is carried to seven pairs of 8 x 12 inch engines, also to two singeing machines, a 9 x 12 inch single engine, and two Worthington pumps. A 1-inch steam radiating pipe passes through a portion of the air pipe and raises the temperature of the air to about 150° Fah.

In the working of the compressor the water is carried through the penstock to the upper tank, which it fills to about the same level as the forebay. From thence it enters the opening between the two castings of the head piece, passing among and in the same direction as the small air pipes. The water creates a partial vacuum at the ends of these small pipes, so that the atmospheric pressure drives the air into the water in innumerable small bubbles, which are carried with the water down the compressing pipe. In their downward course the bubbles are compressed according to the depth and weight of return water sustained. When they reach the disperser their direction of motion is changed from the vertical to the horizontal. The disperser directs the mixed water and air to the circumference of the tank. Its direction is again changed towards the centre by the apron, from whence it is again returned towards the circumference of the tank. During this process of travel the air has been separating by rising in the tank and also under the disperser and apron. The water (almost free of air in this plant) escapes under the lower edge of the separating tank, and returning up the shaft surrounding the compressing pipe, is carried off in the tail race. The air rising through the water to the top of the separating tank, displaces the water, and is kept under nearly uniform pressure by the weight of the return water. The variation in pressure does not exceed three pounds per square inch.

The air bubbles are comparatively small; they are surrounded by a cold body of water, and compression takes place through the whole length of the compressing pipe. From this it will be readily inferred that this mode of compression is isothermal, a process which is not accomplished by any other compressor. More energy is consumed in compressing a body of air adiabatically than in compressing it isothermally. The rise in temperature acquired by air compressed adiabatically is generally lost in transmission. Hence by this system of compression a considerable saving of energy is effected. It is a well known fact that a given space will hold a weight of water vapor greater or less according as the temperature is high or low. If at any given temperature a space is saturated with vapor, when the vapor is compressed isothermally into smaller space a portion of it will be condensed. Where air is compressed mechanically it is heated, and the water vapor contained is not condensed because of the rise in temperature. When, however, the air passes through the cool transmission pipe, condensation takes place. Should condensation not occur in the transmission pipe on account of insufficient cooling, it takes place at the exhaust of the motor because of the great fall in temperature due to the work done by the expanding air, thereby filling the exhaust with ice. Where compression of air is effected by water as in the system considered in this paper, condensation takes place on the walls of the bubble, and so can neither take place in the transmission pipe, nor at the exhaust, even when the temperature is very low. The compressed air delivered is of the same temperature as the water compressing it, and in the Magog plant its volume is about two-ninths of that at atmospheric pressure. Hence the air after its expansion in the motor will not contain sufficient vapor to saturate it at even the greatly reduced temperature. By a test made on 50 cubic feet of air delivered by the compressor while in full operation, it was ascertained that the air when expanded to atmospheric pressure contained one-fifth of the amount of



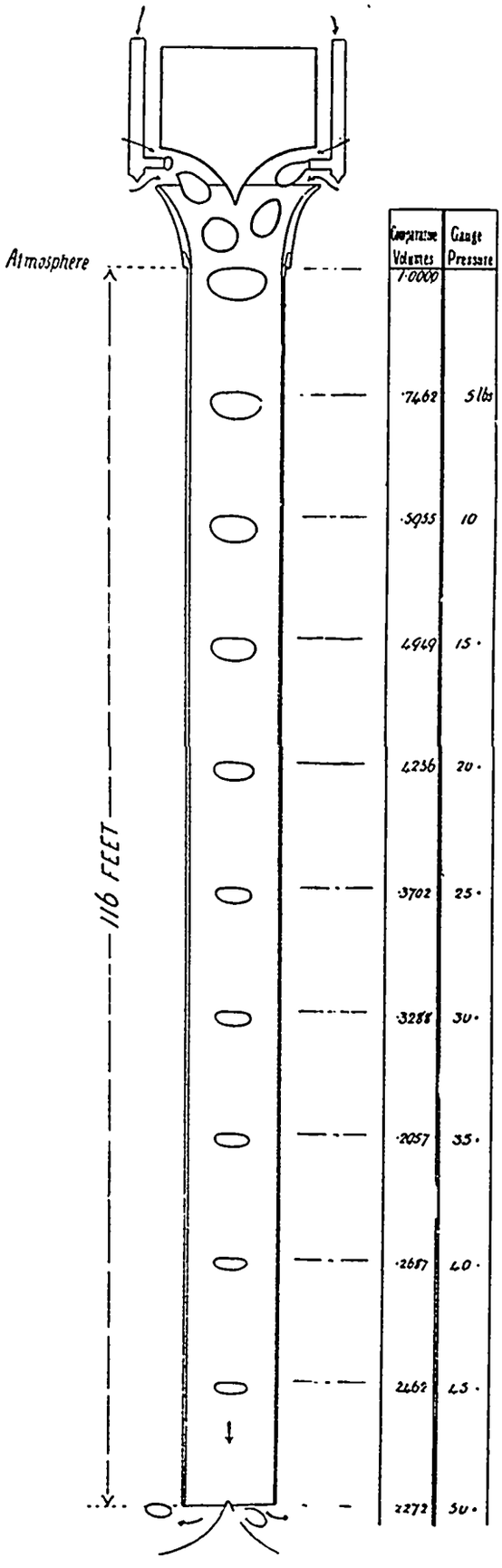
Sectional View of Self-acting Air Valve

vapor usually found in the atmosphere during fine weather, or about 14 per cent. of saturation.

On the proposal of this method many engineers and others raised the objection that the air bubbles after being carried down 34 feet (the height giving a pressure equal to that of the atmosphere), would separate out by their buoyancy and fall no further. They thus predicted as a limit of pressure attainable about 30 pounds absolute. Others predicted that the cold air entering and being diffused throughout the water, would congeal the same. Others again promised us an efficiency of not more than ten per cent. from experience obtained about 200 years ago with the trompe used in the south of Spain. I am pleased to say, however, that none of these predictions have been fulfilled. In the maiden plant at Magog, we have actually obtained an efficiency of over 62 per cent., and this was obtained in spite of the fact that we are wasting, owing to the insufficient size of the air chamber, about 20 per cent. of the air compressed. This defect, which can be easily remedied in future plants, is accountable for a loss of about 15 per

cent. in efficiency. So that it is safe to guarantee an efficiency of 75 per cent. as easily attainable in future installations.

The annexed table takes the results of a series of tests made on the Magog Compressor by Prof. C. H.



McLeod of McGill University. The first three tests were made on the 7th August and the last three were made on the 13th of August, 1896. Column (2) gives the quantity of water in cubic feet per minute flowing through the compressor; column (3) the available head in feet during the trial. Column (4) gives the gross horse power in the fall under these conditions of flow. The fifth column gives the measured quantity of air discharged at atmospheric pressure, the actual pressure being given in the sixth column. The horse power required to compress this quantity of air to the pressure in column (6) is given in the seventh column. The ratio of the horse power in column (7) to that of column (4) is called the efficiency and is given in column (8). Columns (9), (10) and (11) give the temperatures of the air, water and compressed air.

RESULTS OF TRIALS OF THE TAYLOR HYDRAULIC AIR COMPRESSOR AT MAGOG, P.Q., ON AUGUST 7TH AND 13TH, 1896.

No of trial.	Quantity of water discharged in cubic feet per minute.	Available head in feet.	Available horse power.	Quantity of air delivered in cubic feet per minute at atmospheric pressure.	Pressure of air in compressor.	Actual horse power of compressor.	Efficiency of compressor.	Temperatures. External Air.	Water.	Compressed Air.
I	II	III	IV	V	VI	VII	VIII	'X	X	XI
1	6,122	21.4	247.7	1,377	52	132.5	53.5	79	75.2	75.2
2	5.504	21 9	228.0	1,363	52	131.0	57.5	83	75.5	75.5
3	4,005	22 3	168.9	1,095	52	105.3	62.4	80	75.6	75.6
4	7,662	21.1	305.9	1,616	52	155.4	50.8	75	80.0	80.0
5	6,312	21.7	260.0	1,506	52	144.8	55.7	77	80.0	80.0
6	7,494	21.2	299.8	1,560	52	150.2	50.1	75	80.0	80.0

From observation made in glass tubes the rate of rise of the air bubbles due to their buoyancy is from five to seven inches per second. To illustrate the effect of this slip, take a 75 lb. pressure installation, requiring a depth of 173 feet from tail water to separating chamber. The velocity of the water in the compressing pipe would be about 12 feet per second, so that the compression would be effected in 14.4 seconds. During this time the bubbles would have risen but seven feet two inches, a comparatively unimportant loss, which is still more lessened when we bear in mind the fact that the volume of air is on the average one-fifth of that of the water descending with it. Regarding the freezing of the water by the entering air, it is only necessary to point out that the lowering of the temperature of one cubic foot of water from 34 degrees to 33 degrees would raise the temperature of 277 cubic feet of air at atmospheric pressure from 30 degrees below zero to 33 degrees Fah. above. As the proportion of air to water by volume is only one to five, it is manifest how small the actual cooling effect must be. This takes no account of the heat given off by the air while it is being compressed.

I have prepared a sketch, which may be of interest to those members who wish to look more closely into the matter of the air compression. The relative size of the bubbles as the air they contain is compressed, during their descent of 116 feet from atmospheric pressure to a pressure of 50 lbs. per square inch, is shown diagrammatically in this. The diminution in the size of the air bubbles is seen to be quite appreciable, and their diminished size produces less retardation of the flowing water. A large proportion of the whole power is spent in effecting the earlier part of the compression. It is well known that as much work must be done to compress the air to about 25 lbs. as is required to complete the compression up to 75 lbs. Hence the advantage of using high pressures.

THE MECHANICS OF MINING.*

BY D. W. ROBB, MEMBER CAN. SOC. C E., A.S M.E.

The general public seem to regard mining much in the same light as a search for Captain Kidd's treasure, mysterious, difficult and uncertain, but having discovered the mine, the fortune has only to be picked up. This belief is, perhaps, unfortunate, since it leads to the loss of money and faith, and tends to produce distrust of all mining ventures. Yet this gambling spirit, which seems inherent in humanity—the desire to acquire wealth with little labor, is perhaps not an unmixed evil, because, if all enterprise was limited to absolutely safe investment, very few mines would be discovered. The mining engineer knows only too well that, notwithstanding the comparatively strong light that may be thrown upon, and even into, the bowels of the earth by geological science and prospecting experience, aided by the diamond drill, nature's secrets are so various and intricate that there is still much chance work. The present paper will not deal with the problem of finding a mine, but with the successful operation of it after it has been found.

While a few mining properties have been, and will be, developed which pay handsomely, in spite of bad management and crude mechanical appliances, by far the greater number of mines of all kinds depend for success or failure upon the method of operation, and even in those which will stand a certain amount of waste, there is no reason why they should not be made to pay better by good engineering. While the mining engineer should be qualified to lay out and conduct purely mining operations, such as location and arrangement of pits, shafts, drainage, ventilation, etc., he is not usually an expert mechanic. He may understand the general principles of steam engines, pumps, air compressors, and electric machines, but his calling does not require him to study the details of each of the numerous forms of these machines, and he has not the constant opportunity to become familiar with the peculiar advantages and disadvantages of each, so that he can readily choose the details of his plant, with a clear perception of how they may be combined, to give the best results, with the highest economy in fuel, labor and repairs.

The mechanical part of mining consists in providing the best and cheapest methods of drilling and removing rock or ore, transporting, screening, crushing, milling, or otherwise preparing the mineral for further use; pumping, ventilating and other operations, which may be accomplished by the use of machinery. First of all comes the power necessary to drive this machinery; this must, in the present state of the mechanic's art, be obtained either by means of steam or water power. Whether steam or water will be used must be determined by circumstances; where water power is not available, steam must be used, but in other cases there may be a choice. Where both water power and steam are available, care should be exercised in making the choice. To the superficial observer water power may be attractive, because the water is free of cost, whereas fuel costs money, but it should be kept in view that the cost of building and maintaining dams and other incidental expenditures is frequently so large that the interest on capital and cost of maintenance is equal to, or even greater in some cases, than the cost of fuel, and if the stream of water is insufficient or irregular, steam may have to be used to supplement it, or the interruption of work would entail heavy loss. Having decided upon the kind of power to be employed, the next question is the selection of apparatus. If water-wheels, whether they shall be of the turbine or re-action type; if steam is to be used, whether the boilers are to be water tube or some other type, engines simple or compound? These are questions which should be decided by a competent and experienced mechanical engineer for each individual case, as they are governed by the conditions, *e.g.*, whether the head of water is to be high or low, whether one large engine or a number of smaller ones must be employed, whether the steam is to be carried a long distance, or used near the boilers, and other circumstances too numerous to mention. In small and medium-size mining operations, a mistake is often made in using several separate engines for hoisting, pumping, milling, etc., involving five or six cylinders to be cooled and re-heated, causing a great waste of fuel, when, by a proper arrangement of gearing, one large engine, of the best and most economical type, could be made to do all the work. There is frequently an enormous waste of fuel from this cause alone.

The next point to be decided is one which is so closely allied to the previous one that it must be considered with it, viz., that of transmission of power, one of the most important subjects in mining, because power must in every case be used for many purposes, and at many places, both above and underground. I find a tendency among mining men, and even mechanics, to advocate some one form of transmission as superior to others, while the truth is that each form (direct steam pressure, compressed air, electricity, rope driving, belt driving, shafting, etc.) has some special advantage, and is better suited to some particular case than any other. For instance, if a mine were so situated that only hoisting, pumping and perhaps a small amount of drilling, had to be done a short distance from the boilers, it would be more economical to use steam direct than compressed air or electricity, each of which consumes power in the transformation by compressor or dynamo; if so situated that a Cornish pump may be driven direct from the main engine, or even by a separate engine with early cut off, and reasonable expansion, it would be much more economical than a steam pump, to which steam must be carried a long distance, and used without expansion, as is common with underground pumps.

Compressed air is admirably suited to underground working. It may be transmitted in ordinary pipes having only the average capacity required, and the pressure maintained by means of receivers at almost any distance from the supply. It may be used in ordinary pumps, drills, or other simple apparatus which are easily managed by miners, and in use does not cause any inconvenience from discharge; on the contrary, aiding in ventilating to a small extent. On the other hand, it is attended by considerable loss from the accumulation of heat in compressor, and decrease of pressure by cooling. These losses may be overcome to some extent by compound cylinders, re-heating, &c., all of which adds to the complication of the machinery, and consequent additiona expense and care. Electricity is perhaps the most flexible and convenient of all forms of transmission, because by a simple copper wire it may be conveyed long distances and furnish power for pumping, drilling, haulage, &c., or may be converted into light or heat. Since its use for these purposes is comparatively new, there is much room for improvement in the apparatus, and in

*A paper read before the Canadian Mining Association at Montreal.

the presence of gas in coal mines it may be dangerous from sparking or defective connections, but time will no doubt overcome these objections to a very great extent, and render its use as successful and popular for underground operations as it has become for street car propulsion and other uses above ground.

Although it may be necessary or expedient in some cases to use several forms of transmission for the surface and underground working of the same mine, there would be a great advantage in point of economy of fuel, attendance and repairs in using one source of power, and one form of transmission for all purposes. For instance, if one or more large steam engines of the most economical type could be used to compress air, or generate electricity for distant or underground work, and hoist directly, there would be a great saving of fuel over a number of small engines, pumps, compressors or dynamos. A large mine, to a greater extent than almost any other operation, presents constant opportunities for the mechanic's skill and invention, and since there is always a large amount of material to be moved and operated upon, economy is only to be obtained by performing every possible function by mechanical means. The conditions are so varied that the best mechanical knowledge and original invention is required, and the mechanic, equally with the mining engineer, has the power to make success or failure.

The moral to the investor in mining properties is, make sure of a good mine, under the management of a capable and experienced mining engineer; and to the mining engineer, get good mechanical advice and assistance. I have nothing to say against the advice given gratis by manufacturing concerns, which is frequently honest and valuable, if it is not entirely disinterested, but an independent mechanical engineer, who has had experience in mining operations, and who is employed directly by and for the mine, should be of great assistance, both in selecting and arranging the plant and in operating it.

THREE-PHASE TRANSMISSION.

DESCRIPTION OF THREE-PHASE TRANSMISSION PLANT IN THE MONTREAL COTTON COMPANY'S MILLS, VALLEYFIELD, QUE.

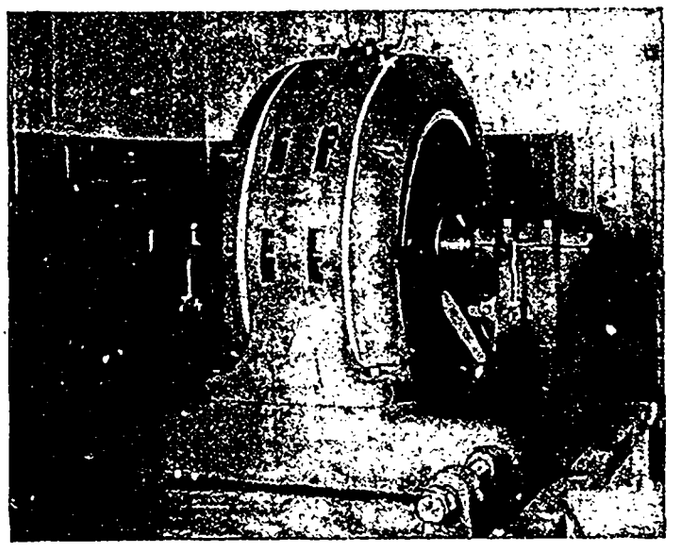
BY F. C. ARMSTRONG.

Amongst the most important of the great textile manufacturing establishments of the Dominion, both in respect to the amount of capital invested and the value of the annual output, are the mills of the Montreal Cotton Company, at Valleyfield, Que.

At this point, a dam erected by the Dominion Government to increase the depth of water in Lake St. Francis, connects Grande Isle de Beauharnois with the south shore of the St. Lawrence River, creating incidentally an excellent water-power. Upon this island, 23 years ago, the first mill of the company was built, containing 600 looms, the necessary carding and spinning equipment, and a bleachery. About 16 years ago the mill was extended to contain 1,300 looms, and a dye-house and finishing department were added to the bleachery. Three years ago the bleachery and dye-house departments were re-arranged and greatly enlarged, and the mills have been enlarged each year since, until now they contain 80,000 spindles and 2,330 looms, and a bleachery and dye-house large enough to handle 120 tons of cloth per week. The large increase in the size of the plant during the past three or four years, combined with the lowness of water in the St. Lawrence, has rendered necessary an increase in the power plant of the company. This up to last year consisted of seven 60 inch and four 54-inch Hercules turbines, and two 84-inch Risdon turbines.

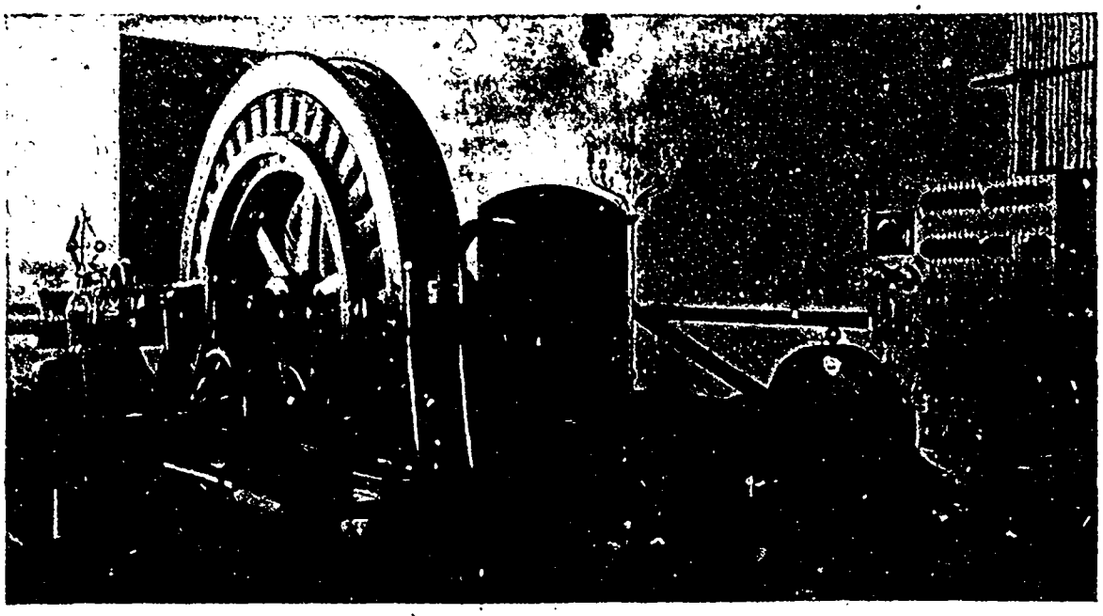
The selection of electricity as the transmitting and distributing medium for the additional power plant was arrived at after a careful consideration of the first cost, and losses involved in the various alternatives offered, of which the most feasible, considering the comparatively short distance to which the power had to be carried (to the farthest point not more than 1000 feet), was rope transmission. The choice of electricity and of the three-phase system with induction motors was made after an investigation by the general manager of the company, Louis Simpson, of the principal plants operating under similar conditions in the United States, including the three-phase plants installed by the General Electric Company at the Pelzer and Columbia Mills.

For the hydraulic portion of the new plant a new flume was excavated, which was arranged to contain eight 60-inch McCormick turbines, each calculated to develop about 300 horse-power, making a total of 2,400 horse-power. The turbines are erected in pairs, each pair driving a 400-kilowatt generator. The lower part of the power house is all built in solid concrete, the power house proper, above water, being built of stone lined with terra cotta lumber. The roof is composed of 5-inch solid timber laid upon girders and covered with

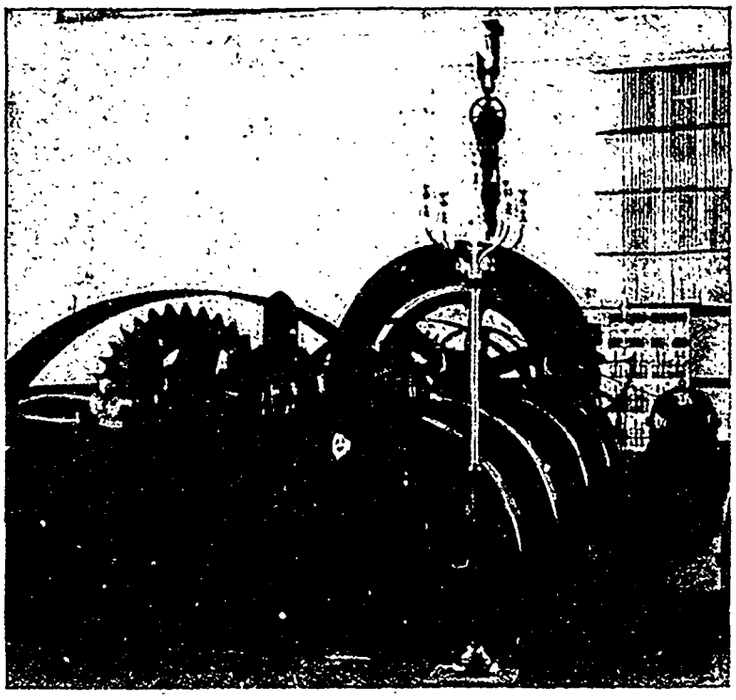


resin cement, and on the inside it is sheathed in steel, which is stamped out in panels and painted. Altogether the power house in solidity of construction and excellence of detail and finish is not excelled, if indeed it is equalled in America. The wheels are governed by Replogle's New Relay governors, the turbines being supplied by S. Morgan Smith, of York, Pa. The saddles and shafting were furnished by Wm. Kennedy & Sons, of Owen Sound, and by John McDougall, of Montreal. The gearing wheels were supplied by S. Morgan Smith.

For the electrical plant, as has been stated, the three-phase system of the Canadian General Electric Company was adopted, and a contract given to that company for two 400 kilowatt generators, the first of which has been installed and in satisfactory operation for about two months. The second machine will be in operation in the course of a few weeks. These generators, which are designated as A.P. 36-400-200, have 36 poles circumposed within a steel yoke about the periphery of the revolving iron-clad armature, and represent



the latest development in design and construction for machines of this type. A point to be noted is the very slow armature speed, 200 revolutions per minute, which admits of direct coupling to the jack-shaft and of a consequent saving in power and floor space, and a generally increased simplicity in the entire installation. The armature, which is of what is known as the A. P. type, is of the multi-tooth style of construction, with distributed winding, and has in consequence a very low armature reaction, with a correspondingly close inherent regulation. The generator voltage, on account of the short distance over which the power is to be transmitted, has been fixed at 550 volts, thus admitting of the current's being used directly on the motors at that pressure without the use of step-down transformers. The motors are of the C.G.E. Co.'s standard induction type, varying in size from 50 to 100 h.p., and are, where a saving in floor-space is desirable, of the inverted type, bolted to the ceiling. They are, of course, self-starting under full load, and as they are without collector rings or brushes, are especially suited for operation under the conditions favorable to combustion which exist in a cotton mill.



Altogether the plant is a model one, in every respect, and as the successful outcome of the first attempt on a large scale in Canada to secure increased economy by the use of electric power in the operation of a large industrial establishment, reflects the highest credit on Louis Simpson, the able and energetic general manager of the cotton company, and his foreman machinist, Jas. Sparrow.

It might be added that the Montreal Cotton Company have now, as a result of the extension of their plant, a surplus of about 1,500 horse power, which they would be prepared to dispose of for manufacturing purposes on a most liberal basis. The excellent situation and shipping facilities of Valleyfield should under these circumstances make it a particularly desirable manufacturing site.

SEWAGE DISPOSAL.

BY W. M. WATSON, TORONTO.

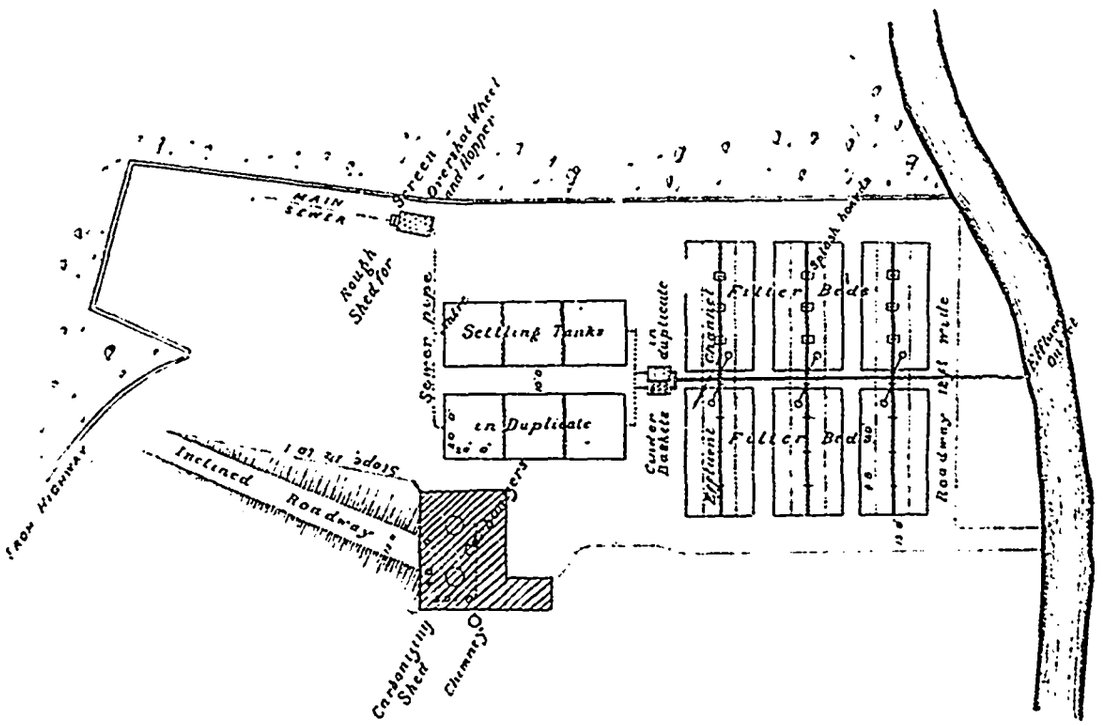
In the January number of THE CANADIAN ENGINEER there is a description, with illustrations, of the new sewage works at Hamilton, which are intended to clarify part of that city's sewage by using as chemical precipitants lime and alumina. This system is like the former sewage works, at Bradford, England, but with inferior arrangements and with the additions of pumps and a sludge press. If Hamilton's sewage contains the usual percentage of solids and floating material, the sand pit and receiving well will be inadequate to cope with the rough dirt of the sewage. It appears, on examination of the plans, that it is intended to have a continuous flow of sewage into the settling tanks, and to rely on the skimmer-pipes to reject any sewage not properly clarified. It is necessary that the sewage be motionless during the process of settling. This is impossible where there is a constant delivery into the tanks. To discharge clarified sewage unfiltered is to nullify the work done. Those who have been treating sewage and testing effluents for the past twenty years, have proved that no chemical process, without some secondary treatment, is capable of producing a sufficiently pure effluent. The fluid may appear clean, but some of the chemicals

introduced as precipitants, together with others that the sewage may itself contain, will still be embodied in the effluent, and after joining clean water will putrefy.

About 1879 I was foreman of the sewage works at Bradford. They were considered at that time to be the best appointed works in England. We were supposed to purify the sewage of a population of 240,000, together with the waste water from several hundred dye-works and manufactories. We had forty-four large settling tanks and forty filters. Forty of the settling tanks had a 10-inch float valve (or skimmer-pipe) which enabled us to draw off each tank every forty minutes. The sewage entered the tanks and filters by gravitation. The sludge was pumped back and discharged into a porous reservoir, where it dried and was carted away. We clarified with milk of lime, mixing it with the sewage at a point where it passed over some rough stones, before entering the distributing culvert. After passing through the settling tanks the appearance of the sewage changed from an opaque black to a moderately clear water. This clarified fluid was then passed slowly through filters containing fine coke breeze, which extracted most of the chemicals, and made the affluent nearly harmless, though not pure. After a filter had been used for a week, about four inches of the coke on top would have changed color and formed into a hard cake. This way of treating sewage was superior to that now at Hamilton. Our sewage was more difficult to clean on account of the dye-water; our effluent was considerably purer than theirs can be, as they do not use filters; our expenses would be considerably less proportionately, because we conveyed our sewage to the tanks by gravitation. Still the works were practically a failure on account of the slowness of the process and the heavy expenses of management. It was impossible for us to treat all the sewage, though we had the best machinery and labor-saving appliances. The corporation urged us to find a simpler and cheaper method, and we tested the ideas of several inventors, but found nothing at that time of such a saving character as to justify the erection of a new plant. But while in England, last August, I found that they are about to erect an entirely new works on improved principles.

The Hamilton corporation showed good judgment when they rejected the suggestions of E. Kuichling, of Rochester, also by discarding the irrigation system; the sanitary value of irrigation land for sewage purposes being small, even when well under-drained. The efficiency of land as a filter depends on the weather. In summer, when vegetation is active, good results may be obtained for a few years; but in rainy weather, or in the winter, it is quite the reverse, as there is no plant life to extract the manurial constituents from the sewage. The land thus becomes heavily charged with impurities that cannot be thrown off, altogether destroying the filtering qualities, and making it necessary to turn over and ærate the soil to the depth of the drains.

With the object of assisting the land, some corporations clarify the sewage before running it on, by using chemicals as precipitants and passing it through settling tanks, but the advantages of this addition are not equal to the expense, because the land cannot fully extract the obnoxious chemicals. This was proved several years ago at the village of Ilkley, Eng., where the sewage was first clarified and then purified by passing it through carefully drained land, but it was found that when the effluent mixed with river water it putrified and poisoned the fish.



There are about thirty different systems of cleansing sewage, but there is space here to mention but a few.

The Porous Carbon process was partially described and illustrated on page 159 of the October number of THE CANADIAN ENGINEER. In this system the sewage is clarified by a precipitant named Ferozone, then passed through a filter containing Polarite. This method has been severely criticized in England. In the proceedings of the Institute of Civil Engineers, volume 88, page 279, in referring to this system of filtration, it is stated that the Porous Carbon Company was offered every facility to prove the efficiency of its system at the town of Leicester, England, but they had utterly failed to produce a telling effect.

The Electrolytic System was invented by W. Webster. This is in working order in a small way near London, England. It has one advantage over other clarifying systems: it separates the dirt from the water by the electric current, instead of using chemical precipitants, which invariably set up putrefaction after the effluent has been discharged. Mr. Webster tells us that to clear one million gallons of sewage per day will require a twenty-seven horse-power engine to drive the dynamos. So far as I know, this system has not yet been adopted by any large town, and is in the experimental stage.

The Amines System consists of mixing milk of lime with herring brine. The mixture is incorporated with the sewage, which is allowed to settle, the effluent being then discharged. This is said to have considerable merit.

The Iron Process was invented by the late Mr. Conder. This is at present working at Grange Over Sands, a village on the shores of Morecombe Bay, Lancashire, England. The system consists in dribbling a solution of iron into the sewers at various points in the drainage system. The sewage, mixed with the iron solution, is discharged into Morecombe Bay when the tide is at the flood. It is claimed for this process that after the solution of iron becomes properly mixed with the sewage, by running along with it for about one thousand feet, the injurious effect of the sewage is nullified. The system may answer at Grange Over Sands, where the effluent is discharged into the sea and carried off by the tides, but I am very doubtful whether it could be tolerated where the effluent is discharged into a clear water stream.

The Native Guano Company's process makes a good but very expensive purifier, and the powdered charcoal manufactured by the carbonizing of street refuse (as mentioned below) is as good and probably a better cleanser than guano.

The Carbonized Refuse System (patented) is very well spoken of in Great Britain because of its efficiency, simplicity and cheapness. This system is also partially explained on page 159 of the October number and on page 218 of the November number of THE CANADIAN ENGINEER. In this system the sweepings from the streets and other vegetable refuse are carbonized, and the product is used to filter the sewage. This removes two public nuisances at considerably less cost than is necessary by other systems to simply clarify the sewage, while the effluent reaches the highest standard of purity. Pumps and other expensive machinery are very seldom needed, as the sewage is treated on the continuous flow principle, needing attention only when the filters are to be cleaned or renewed. The sludge extracted from the sewage can be shovelled up and carted away direct from the filter with only one handling and without either drying or pressing. The first plant erected to carry out this system is at Horsforth, near Leeds, England. (See illustrations.)

FIG. 1

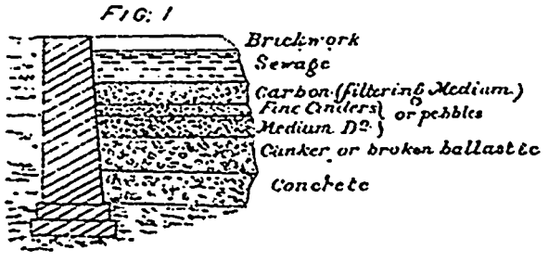
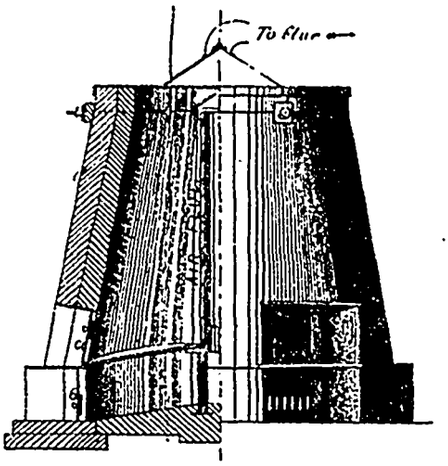


Fig. 2.



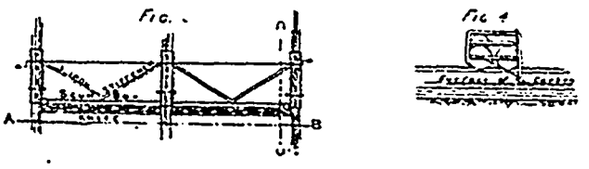


Fig. 5.

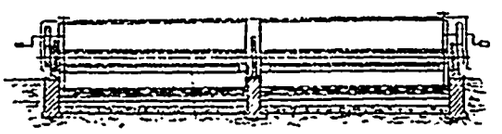


Fig. 1—Detail of filter beds, showing formation of beds. Fig. 2—Sectional elevation of carbonizer. Fig. 3—Plan of Scum plow. Fig. 4—Sectional elevation at C, D. Fig 5—Sectional elevation at A, B.

Works constructed for the purification of sewage are some of them erected with little forethought and often poorly arranged. For the purpose of illustrating my meaning I will give as an example what came under my notice in an English manufacturing town. The town was surrounded on three sides by gently sloping hills, on the fourth by a river. An engineer was engaged to construct irrigation sewage disposal works, and commenced by laying a forty-inch cast iron pipe down the bed of the river from the old outfall to a tank at the irrigation works, over a mile distant, at a very heavy cost, as the river had to be coffer-dammed. At the works large pumps were placed to lift the sewage about twenty feet, so that it could be run over the land. Had he made a high level trunk sewer, which could have collected about 75 per cent. of the sewage, and had so run the sewage to the land by gravitation, running the other 25 per cent. of the sewage to the works in the existing drain along the riverside road, which was large enough, then have pumped that small quantity to the tanks, the original cost would have been immensely less, and the annual costs of management, added to the interest on debentures, would not have been more than about half the present expense.

The cost of purifying sewage in the various towns of Great Britain ranges from twelve to fifty cents per head of contributory population, and it is remarkable that those works that cost the least discharge the purest effluent. Below is a table showing particulars that may be interesting. They are a few condensed answers to questions asked by J. H. Cox, Esq., Borough Surveyor of Bradford, Eng., August, 1892.

Names of towns in Britain.	Population.	Average flow c/dry weather sewage per day in gal-lons.	Is manufacturers' sewage allowed?	How is the sewage purified.	What kind of a precipitant is used?	Do you filter the clarified sewage?	How is the sludge disposed of?	Is the flow of sewage into the tanks continuous or intermittent?	How many tanks?	Total capacity of tanks in gallons.	Cost of plant, not including the land	Men employed.	Total area of land in acres.	Commenced about.	Annual cost of management.
											£				
Birmingham	600,000	20,000,000	Yes	Clarified and filtered	Lime	Yes	Into land	Both ways			75,000	114	1,300	1860	£36,800
Manchester	505,000	17,000,000	A few	do.	Alumina and lime	Yes	Pressed	Intermittent					130		
Sheffield	324,243	12,500,000	Yes	do.	Lime	Yes	Wasted	Intermittent	30	1,500,000	32,000	58	23	1886	8,100
Belfast	265,000	9,000,000	Yes	Pumped into the sea											
Salford	198,000	10,000,000	A few	Lime precipitation	Lime	No	Wasted	Both ways	12	5,000,000	104,000	40	34	1884	4,370
Leicester	180,000	7,000,000	Yes	Clarified	Ferrozone and lime	No	Wasted					160	1,700	New	
Blackburn	120,000	4,500,000	Yes	do.	Lime	No	Wasted	Continued	5	500,000			510	1874	
Bolton	115,000	3,250,000	Yes	do.	Lime	No	Wasted	Intermittent	13	5,200,000	30,000	7	25	1886	1,700
Huddersfield	96,000	5,000,000	Yes	By filters.	Polarite and Sand	Yes		do.	24	Area 4,460 sq. yds.			40	New	
Burnley	90,000	1,825,000	A few	Clarified and filtered	Lime	Yes	Pressed	Continuous	12	1,150,000	35,000	7	70	1878	1,800
Leyton	70,000	1,750,000	A few	Clarified	Hanson's sulphurous powder and lime	No	Pressed	Intermittent	7	1,750,000	19,500	7	12	1885	1,800
Rochdale	72,000	1,250,000	A few	Clarified and filtered	Spence's alumio ferric	Yes	Used	Continuous	3	300,000	12,500	11	80	1890	
Northampton	64,000	1,500,000	Yes	do.		Yes	Sold	do.		500,000	75,000		280	1854	1,100
Hanley	55,000	1,750,000	Yes	do.	Lime	Yes	Wasted	Intermittent	5	1,500,000	10,000	13	22	1883	1,300
Coventry	53,000	2,250,000	Yes	do.	Sulphate of alumina	Yes	Wasted	Continuous	3	1,600,000	13,000	16	10	1876	3,500
Lincoln	42,000	1,200,000	Yes	do.	Sulphate of iron	Yes	Pressed	Intermittent	6	1,000,000	20,800	29	66	1880	1,296
Darlington	38,000	1,250,000	Yes	Broad irrigation	Only Farms let to tenants						22,400	1	320	1879	
Chester	37,000	2,500,000	No	Clarified	Lime	No		Continuous	2		10,000	7	4	1875	
Leamington	27,000	750,000	No	Land irrigation	By Farm lands			do.	1	1,250,000			375	1874	
Swinton	16,000	300,000	Yes	Clarified and filtered	Ferrozone	Yes	Given away	Intermittent	4	240,000	6,000	4	32	1893	600

Less than a century ago most of the water courses in England were bright and clean, and well stocked with fish. Since the beginning of the present century manufactories and dyeworks have largely increased and each discharges a large quantity of dirty fluid, which combined with the sewerage from a dense population, has fouled the streams. About thirty years ago the Government very properly made a determined effort to stop the wholesale pollution of water courses by compelling each municipality to purify its own sewage.

Last fall I visited England after an absence of fourteen years and saw that several rivers were quite as foul as when I left, though every town in the watershed was supposed to be cleaning all its sewage. This shows that to leave the purification of sewage to local effort is a mistake.

Wild schemes and showy expensive plants can easily be talked into inexperienced representatives of the people by trained drummers, and some of the most costly works built and guaranteed to do all the necessary purification of the township's sewage, are little more than monuments of wasted resources. Many plants are too small, and cannot handle all the sewage requiring treatment, and some managers are very careless, and let the untreated fluid go forward uncleaned when an opportunity serves, such as during a heavy rain storm, or during darkness. As a result the country gets a very poor return for the large sums of money expended on sewage disposal works, and those persons who have actual experience in the treatment of sewage know enough to place very little faith in the many glowing reports made and circulated.

Before reasonable efficiency can possibly be secured each township must have a separate set of drains for sewage and storm water, and no sewage plant should be allowed to have a by-pass channel or an overflow weir in the main drain of the sewage works, but to enable the works to be closed down for necessary cleaning and repairs, also to obviate Sunday work, all works should have a screening reservoir sufficiently large to hold at least an average day's sewage.

WM. M. WATSON.

Wm. M. Watson was born in Bradford, England, 1845. At the age of fourteen, he was bound apprentice for seven years to John Schofield, plumber, gas and steamfitter. Before terminating the apprenticeship, he was put in charge of the plumbing and pipe-fitting required in the erection of almshouses, hospital schools and other principal buildings in the model town of Saltair. For six years he was in business at Bradford, afterwards in the general building trade at Cleethorpes, Lincolnshire. He then accepted the position of fore-

man of the Bradford sewage works, until he was appointed superintendent of waterworks and inspector of plumbing department, under the corporation of the manufacturing town of Dewsbury, receiving high class testimonials for the ability displayed in raising the waterworks department to efficiency. In 1882 he came to Canada and put in a system of waterworks for the C. P. Ry. Co. at Montreal. During the past eleven years he has been in business in Toronto.

TORONTO HARBOR AND THE PROPOSED ISLAND RAILWAY.

In a discussion last month on the subject of the proposed Toronto Island Railway, this journal cautioned those interested in the future commercial and shipping interests of Toronto against plunging into an ill-considered scheme of bridging the western gap of the harbor at a time and in a way which would work a most serious damage to Toronto as a shipping centre. At the request of the publishers, A. B. Ross, C.E., who has had an extensive experience in railway and bridge work, made an independent estimate of the cost of bridging the gap, and Mr. Ross' report is as follows:

TORONTO, Feb. 22nd, 1897.

DEAR SIR,—In compliance with your request for an estimate of cost of the proposed Island Railway, I herewith submit approximate estimate on four different schemes. Two of these estimates are based on the same conditions as proposed by the City Engineer, and the other two on similar conditions, excepting that they provide for an overhead crossing of all railway tracks near the proposed site of the swing bridge at the Queen's Wharf.

Scheme number one is for a double track street railway, commencing at the corner of King and Bathurst streets, thence down Bathurst street, crossing the railway tracks at its foot by a steel bridge with a ten-foot roadway, and a seven-foot sidewalk on each side of the tracks, thence following down the present public road to the entrance of the Queen's Wharf property, and crossing the railway tracks at that point at grade, thence by a timber trestle approach to a swing bridge across the western channel, and thence around the island to Ward's, as proposed by the City Engineer. This scheme is for a double track street railway only; the trestle approaches to the swing bridge and embankments on the island being only 22 feet wide on top. The estimate for the swing bridge, which is 354 feet in length, provides for a ten-foot roadway and a seven-foot sidewalk on each side of the car tracks, this provision being advisable in case it should be desired at some future time to widen the embankment for a driveway. The estimate for the swing bridge also includes the cost of a crib protection and rest pier, this pier being necessary for the proper protection of the bridge when open, as well as of vessels passing through. For the right of way across the Queen's Wharf property I have allowed $100,000. This is a capitalization of $5,000 (the rent paid by the C. P. Railway to the Harbor Commissioners) at 5 per cent.

This may seem excessive, but it must be taken into consideration that a swing bridge at the point proposed, virtually ruins the south face of the Queen's Wharf for dockage purposes, as it will be necessary to keep the channel between the rest pier and the wharf clear for the safe passage of vessels.

ESTIMATE OF COST OF SCHEME NO. 1.

Permanent pavement on track allowance	$ 9,200 00
Bridge across track foot of Bathurst St	20,000 00
Timber trestle approach, 22 feet wide, Queen's Wharf	2,800 00
Swing bridge, including rest pier and turning machinery	75,000 00
Embankment on island 22 feet wide	16,000 00
Sheet piling and rip-rap protection	12,000 00
Right of way and damages across Queen's Wharf	100,000 00
Engineering and contingencies	15,000 00
Total	$250,000 00

SCHEME NO. 2.

The route for this scheme is the same as that of No. 1, but the bridge approaches are 50 feet in width, and the embankment on the island 80 feet. The embankment on the island provides for a 20-foot roadway on each side of the car tracks, and paved with macadam on a cedar log foundation. It also provides for a 12-foot plank sidewalk on each side, concrete foundations for the car rails, and the space between the rails being sodded.

ESTIMATE OF COST, SCHEME NO. 2.

Permanent pavement on track allowance.....$	9,200 00
Bridge over tracks, foot of Bathurst St	20,000 00
Timber trestle approach on Queen's wharf....	5,200 00
Swing bridge, including rest pier	75,000 00
Embankment 80 ft. wide, paving, side-tracks, etc	158,500 00
Sheet piling protection.....	12,000 00
Right of way and damages.....	100,000 00
Engineering and contingencies	30,000 00
Total .....$	409,900 00

Say $410,000.

SCHEME NO. 3.

Provides for street car tracks only, as in scheme No. 1, but includes an overhead timber trestle from the swing bridge to the end of the Canadian Pacific Railway freight shed, and embankment to the foot of Bathurst Street. By adopting this arrangement it will leave the present public road from the foot of Bathurst St. to the entrance of Queen's wharf, free for wagon traffic to and from the freight sheds and docks, and will give easy grades with good alignment for the street railway. Part of the present public road is quite narrow, and a double car line would leave very little room for wagon traffic.

ESTIMATE OF COST, SCHEME NO. 3.

Permanent pavement on track allowance .....$	6,000 00
Bridge over tracks foot of Bathurst street....	20,000 00
Embankment 22 feet wide	1,500 00
Overhead timber trestle	8,000 00
Swing bridge, including rest pier.....	75,000 00
Embankment on island 22 feet wide.....	16,000 00
Sheet piling protection	12,000 00
Right of way and damages.....	125,000 00
Engineering and contingencies	14,000 00
Total ... .$	277,500 00

Say, $278,000.

SCHEME NO. 4.

No. 4 is for the same route as Scheme No. 3, but provides for 50-foot overhead timber trestle from the end of the bridge to the end of the Canadian Pacific freight shed and then embankment to the foot of Bathurst street, and an 80-foot embankment on the island part.

ESTIMATE OF SCHEME NO. 4.

Permanent pavement on track allowance ....$	6,000 00
Bridge over tracks foot of Bathurst street	20,000 00
Embankment and paving	3,700 00
Overhead timber and trestle 50 feet wide.....	13,000 00
Swing bridge, including rest pier	75,000 00
Embankment on island, pavement, etc.....	158,500 00
Sheet piling protection.....	12,000 00
Right of way and damages.....	150,000 00
Engineering and contingencies	30,000 00
Total .....$	468,200 00

Say, $468,000.

The foregoing estimates do not include the cost of rails or track laying. This part is to be done by the Toronto Street Railway Company.

I notice by the sketch of the proposed swing bridge at the city engineer's office, and given in a late number of THE CANADIAN ENGINEER, that the timber approach at the north end of the bridge provides for only 15 or 16 feet head-room above the railway track running along the south face of the Queen's Wharf. This clearance is barely room enough for the high freight cars now in use, and much less than the law allows. The Railway Act requires that the lowest part of all overhead structures crossing railway tracks shall be at least seven feet above the highest car in use on such railway. There are cases, of course, where the Government has permitted a less clearance to be used; but for a clearance as proposed for this approach, Government permission would have to be obtained, and, if refused, it will necessitate a material increase in height of both approaches and bridge piers, which will mean a considerable increase in cost of these structures.

To the question whether a right of way has been reserved to the public across the Queen's Wharf property, I quote the following paragraph, contained in lease to the Canadian Pacific Railway by the Harbor Commissioners :—

"Provided 1st. The said wharf premises shall be open to the public to be used as heretofore, and the charges of all and every kind for the use thereof shall in no case, without the consent of the lessors, or their successors, or assignees, exceed the tariff rates established by the lessors, and heretofore collected thereat; and that the charges on vessels wintering at the said wharf shall be regulated by the harbor master appointed by the lessors." The next paragraph provides among other things, "that the approach to the light-house shall be at all times kept clear and unobstructed." From this it will be seen that entrance to the Queen's Wharf has been reserved to the public only as heretofore. That is, as I understand it, for foot passengers and teams to the docks and lighthouse required in connection with a shipping traffic, and not to be construed as giving the public a right for a street railway, either surface or overhead.

To the question whether a swing bridge across the western channel would be a hindrance to navigation or not, I would say it would be a serious one to sailing vessels, but not much to steam craft. It would necessitate sailing vessels being towed through the swing bridge, which means extra expense to shipowners. I see it has been stated in the press that the city engineers of Chicago and Cleveland are quoted as saying that swing bridges at those places are no hindrance to navigation, but the conditions at Toronto are totally different. At both Chicago and Cleveland the bridges are across a narrow river bounded by high buildings, where sailing vessels are compelled to tow, bridges or no bridges. I think a different opinion would be given if swing bridges were to be placed across the openings in the breakwater which encloses the main Chicago harbor. The Chicago harbor is enclosed by a breakwater with openings for navigation, and is very similar to the Toronto harbor, if we imagine the island here replaced by a crib breakwater. I doubt very much if Chicago would permit of swing bridges being constructed across the main entrances to their main harbor. The same conditions exist in Cleveland, that is, the bridges are across a narrow river, where vessels are bound to tow, there being no room to use sail even if the bridges did not exist.

Respectfully submitted,

A. B. Ross, C.E.

It will be seen that in most of the items Mr. Ross' estimates agree pretty well with those of the City Engineer. But though the question of the right of way over the property of the Canadian Pacific Railway at the Queen's Wharf was alluded to by the City Engineer, no estimate of the cost of obtaining it was given. In the first place, we have it from the officials of the Canadian Pacific Railway that they would not suffer any interference with their property at this wharf, and there is no authority possessed by the city council to compel them to do so. That authority could only be obtained by special act of Parliament. The quotations from the perpetual lease held by the Canadian Pacific Railway make this point clear. Then again, a stretch of 2,500 feet of the sand bar, extending from the Queen's Wharf towards the island, is now vested in the Harbor Commissioners by a patent from the Crown, and another question of right of way comes in here also. The Harbor Commissioners are as little likely to grant this right of way as the Canadian Pacific Railway. The Island residents whose property will be damaged by such a railway are also to be heard from.

Over and above these questions comes the greater one of the navigability of the harbor for large vessels. As pointed out last month, the present western channel —where it is proposed to make the railway crossing— has a depth of only nine feet, and last summer vessels bumped on the rock. The deepening of the Canadian canal system to fourteen feet is a necessity, and the Deep Waterways Commission may recommend a further deepening to 22 feet or more. Is Toronto to be left inaccessible to the large vessels that will navigate the great lakes when this general deepening of canals and harbors takes place? We assume not. We assume that the citizens, if not the city council, will want to take their share of the larger lake traffic in this coming new era of navigation. That being the case, will they spend half a million dollars on a scheme which will have to be undone when the deepening takes place. It must not be overlooked that the bottom of the present 9-foot channel is bed rock. To get a depth of 14 feet, it has to be carried 7 feet deeper than it is now, taking into account that the recent low water (which will recur periodically) was 16 inches below zero, and 8 inches more must be allowed to clear the keelsons of vessels. The channel being 354 feet (say 350 feet) wide, and 2,500 feet long, this means a cost of $453,700 at $2 per cubic yard. Now, the channel proposed by Capt. Eads, 1,400 feet farther out, would afford the shortest and cheapest cut from the lake to the line of deepest water in the bay, and the cost of this channel can be figured out as follows: 400,000 yards of excavation at 12 cents, $48,000; 3,000 lineal feet of cribwork at $30 per foot, $90,000; 5,300 feet of close piling at $10 per foot, $53,000. Making the liberal allowance of $47,000 for engineering, contingencies, etc., we have a total of only $238,000, as the cost of putting a 14-foot channel where it should have been put before. In the case of either deepening the present channel, or making the Eads cut, a bridge such as proposed would have to be taken up and replaced even if the city had the power to place the structure there in the first instance.

Again, as to the alternative scheme proposed by Kivas Tully, to run a tunnel under the western gap, that gentleman's estimate of cost completely ignores, or at least overlooks, the necessity of deepening the present western gap—an oversight fatal to the plan. But it may be observed that even if the channel were to remain forever a nine-foot one, Mr. Tully's tunnel, on his present plan, would prove a most expensive affair, from the constant percolation of water through a dangerously narrow shell of shaly rock overlying the roof of the tunnel.

Apart from these objections, is it to be supposed that the Government engineers are going to advise the Dominion Government to have the chief entrance to Toronto harbor blockaded by this needless obstacle at a time when important developments in the transportation system of the lakes are to be carried out? Supposing that a majority of the citizens persisted in the accomplishment of a mere pleasure scheme at the sacrifice of the important shipping interests of the city, it is not likely that the Government will allow the harbor to be spoiled to gratify a passing popular whim.

As we have already said, the chief glory of the island is that it brings people in contact with the water, and one of the chief delights to young and old is in being able to reach it by water and not by land. It is a question whether, if half a dozen railways were built to it, the majority would not prefer to go by ferry or by row boat or sail. For our own part, we think the marine instincts of the Canadian people should be sustained and cultivated by all means in our power, and every agency which attracts us to the water and keeps us familiar with it, should be strengthened and new agencies created. It is because Britons are at home on the water that Britannia still rules the waves. Let Canadians keep to the tradition. Let us therefore keep to the steamer, the sail boat and the row boat. Our pleasures, as well as our business, should draw us to the river, lake and sea. Let the island railway rest.

A WORD IN SEASON.

The time for letting contracts and ordering supplies is now upon us, and every firm who wishes to maintain old business and create new, requires to keep in touch with the trade.

There is no better way to accomplish both these ends than to be represented in *The Canadian Engineer.* It has been enlarged four times since it started—being now double its original size—and its circulation record is unparalleled in the history of trade journalism in Canada. The best of it is that the increase shown below is in *bona fide* paid subscriptions, and not free copies. *The Canadian Engineer* has now more than double the paid circulation of any paper touching the engineering and kindred trades. Our mail sheets are open for proof of this. But even if we had one-half, instead of double, the issue of any contemporary, *The Canadian Engineer* would still be a better medium, because it is more closely associated with, and is of more practical interest to, the trades which the advertiser wishes to reach.

Now is the time to begin. Cuts can be made from photos or drawings to suit advertisers. One or two specially favored positions are still open. For rates, etc., address our Montreal or Toronto office.

THE RECORD.

To whom it may concern:

Toronto, Feb. 15th, 1897.

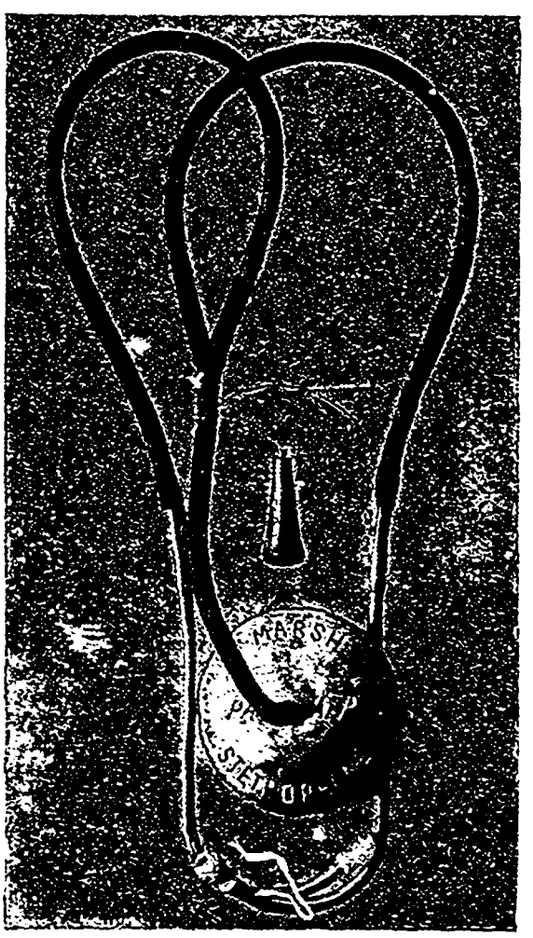
This is to certify that the statement given below is a true account of the copies of THE CANADIAN ENGINEER we have printed and mailed for Biggar, Samuel & Co., beginning with May, 1895, issue, and ending with Feb., 1897, issue.

THE MONETARY TIMES PRINTING CO. OF CANADA, LTD.
Per A. W. LAW, Sec'y-Treas.

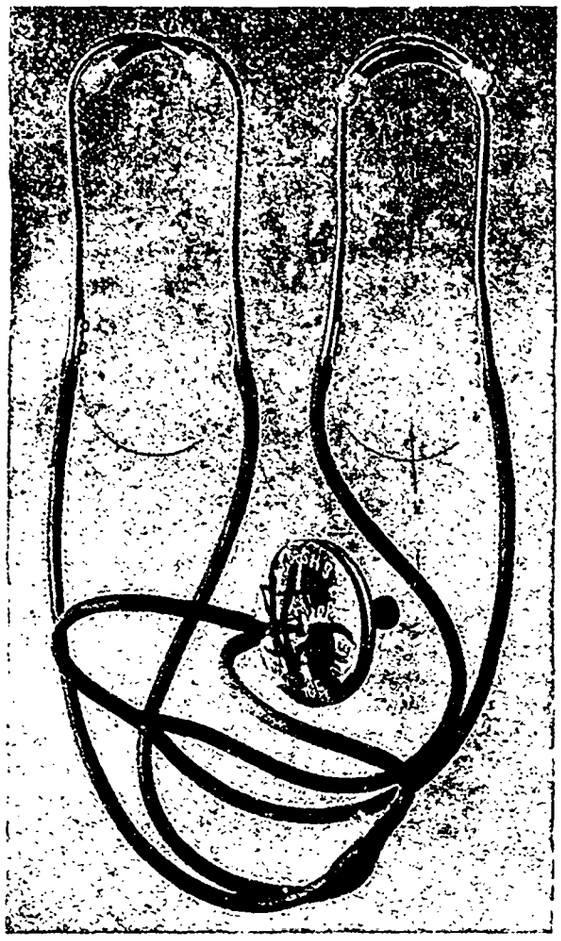
Date of Issue.	Copies Printed and Mailed.
Volume III., No. 1, May, 1895	2,000
" " 2, June, "	2,000
" " 3, July, "	2,100
" " 4, Aug., "	2,200
" " 5, Sept., "	2,400
" " 6, Oct., "	2,400
" " 7, Nov., "	2,500
" " 8, Dec., "	2,600
" " 9, Jan., 1896	3,500
" " 10, Feb., "	3,000
" " 11, March, "	3,100
" " 12,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

MARSH'S STETHOPHONE.

An important departure in the construction of medical appliances is made by the invention of the Stethophone by Rev. D. B. Marsh, Blackheath, Ont. The medical uses of the stethophone are very important. By its means the sounds in the chest can be heard



in a most accurate manner. The normal and abnormal sounds of the lungs are conveyed to the ear, and very full information can be obtained as to their condition. In the examination of the heart the clearest expression possible of what is taking place in that organ is conveyed to the listener's ears By means of the flexible tubes the lungs and heart can be examined while the patient is in any position, and the instrument can be passed under the patient's clothing, and a most accurate examination made. The whole instrument is small and light, and can be conveniently carried in an ordinary pocket It is of the utmost value to physicians whose hearing has become impaired The inventor claims that there are no buzzing or metallic sounds, what is conveyed to the ear is the exact reproduction of what is taking place in the organ to which it is applied.



By means of a special arrangement, two physicians may examine the same organ, at the same time, with the same instrument, thus lessening to a very considerable extent the possibility of a difference of opinion There is also an adjustment by which the sound heard may be modified or intensified. This is not shown in the illustration, as it is a recent modification, but its value in determining sounds of varying intensity is at once apparent. The modifying appliance consists of a small perforation in the disk, through which the cushion of air inside the instrument communicates a portion of the vibrations to the outside air, instead of to the diaphragm, thus lessening the vibration of the diaphragm, and consequently the volume of sound conveyed to the ear. A small revolving disk containing perforations of different size covers the outlet, and is used to entirely or partially close it, as may be desired.

Each case contains a localizer that can be instantly attached, by which the separate regions of the heart may be differentiated with the utmost ease and accuracy. Instruments are adjusted with the greatest care to suit physicians who have impaired hearing. The facility with which this class can hear with these instruments is remarkable. The invention is thus described:

It is an apparatus for examining the condition of the heart, lungs, etc., consisting of Fig 1, a circular metallic disk A, concave on its inner surface, provided with a central opening *b*, a pendant also concaved at its inner mouth to correspond to the concavity of the disk, a flange formed on the upper edge of the disk having an outwardly bevelled edge *a*, a diaphragm made to rest on said flange B, and slightly convexed and held in that position by a bezel ring screwed down over the edge of the diaphragm and flange, the pendant being connected to the ear tips by rubber tubes. In combination with the disk A, Fig. 2, there is the vibrating plate B, Fig. 3, attached to the inner surface of the disk, and to its outer end secured a convex-shaped plate *j*, Fig. 1, to transmit and focus vibrations from the diaphragm B to the pendant and ear tips. In combination with the disk A and its accessories, the projection F on the diaphragm B In combination with the disk A and diaphragm B there is the pendant *i*, Fig. 1, constructed concave at its large end, conforming to the concavity of the interior surface of the disk A and made to fit in the opening *b* of the said disk. In combination with the disk and diaphragm there is the localizer *g*, Fig. 6, made secure to the centre of the diaphragm.

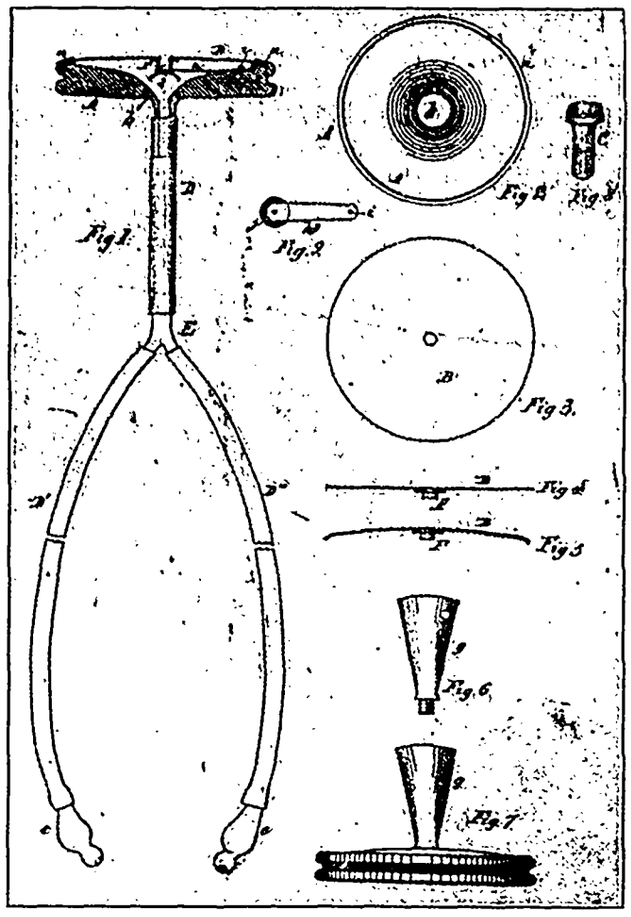


Fig 7 shows the localizer in position. By this means a sound may be located more exactly than is possible when so large a surface is exposed, as is afforded by the instrument without this attachment.

The Marsh stethophone has met with a very hearty reception from the medical profession and the trade generally. Orders are in hand much in advance of the company's present capacity for production. The company is now making preparations for a very much enlarged production.

THE REV. D. B. MARSH.

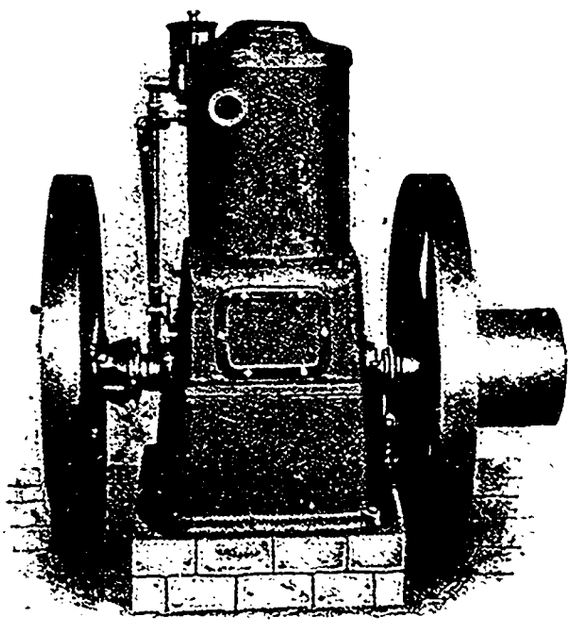
The Rev. Daniel Brand Marsh was born in the county of Grey, Ont., in 1859, and was educated at Knox College and Toronto University. After his ordination he took charge of the First Presbyterian Church at Eramosa, Ont., and after two years in that charge

he was called to Blackheath, near Hamilton, Ont., where he is now in charge of the Presbyterian church. In the quiet life of his village home Mr. Marsh found time to pursue his favorite studies in the theories of light, heat and sound, and before his stethophone was invented he constructed a "talking machine" which is capable of repeating sounds with many times the force of the machines used at entertainments. The stethophone described in the preceding article was suggested to Mr. Marsh one day by his calling to his little girl through a window, and conceiving of the window-pane as a diaphragm, he immediately set to work on experiments that resulted in the invention, which must completely supersede the stethoscope in medical examinations In putting his invention before the world, Mr. Marsh has begun in the right way by applying to his invention a name which really describes the apparatus. The Greek words which form the term stethoscope mean to "see the breast," whereas the instrument only enables one to hear the sounds of the human chest. Mr. Marsh's term, stethophone, which, by the way, is registered under the Trade Marks Act, is truly descriptive of his invention, and deserves to come into use, if it were only to do away with the old misnomer. But the new stethophone is as much superior to the stethoscope in efficiency as it is in name.

IMPERIAL GAS AND GASOLINE ENGINES.

The "Imperial" gas and gasoline engine, while containing nothing that may be termed radical in good gas engine practice, embodies several improvements in details and design that will prove interesting to our readers. The vertical design has been adopted as being more compact and pleasing in appearance than the usual horizontal type. Fig. 1 shows the general appearance of the engine in all sizes. The pump used to supply the gasoline to the sight feed cup is shown in its position, bolted to the side of the engine frame, and also the shaft governor, which is simple in design, and acts positively on the governor valve. The governor embodies some new features from the fact that it does away entirely with the "hit and miss" plan on which many gas engine governors work. The "Imperial" works on the "Otto" cycle, and the governor supplies the cylinder with a charge every other stroke, which is graduated to the work being done, and the piston receives an impulse of greater or less effect accordingly This feature makes it especially adapted for electric lighting purposes.

The gasoline pump and the governor are the only parts working outside the engine frame. By referring to Fig. 2 it will be seen that the gearing, valve cams, and shaft for imparting motion to the igniter are all enclosed and dust proof, though readily got at by removing the side plates on the frame, the crank dips into an oil chamber at each stroke and throws the oil in a fine spray into the cylinder and over all the working parts, from which it drips back into the chamber to be used again. After four months' usage an



IMPERIAL GAS ENGINE, FIG. I.

engine was taken apart for examination, which showed that every part had been well lubricated. The engine is built with either the tube or electric igniter, but the electric igniter is preferred. Motion is received from a shaft connected to the gearing and imparted to the electrode of the igniter, by a crank and arm motion which gives a wiping spark above and below a small wire electrode, which has a long life and can be readily renewed. The vaporizer for the gasoline is situated inside the frame, and does away altogether with the use of

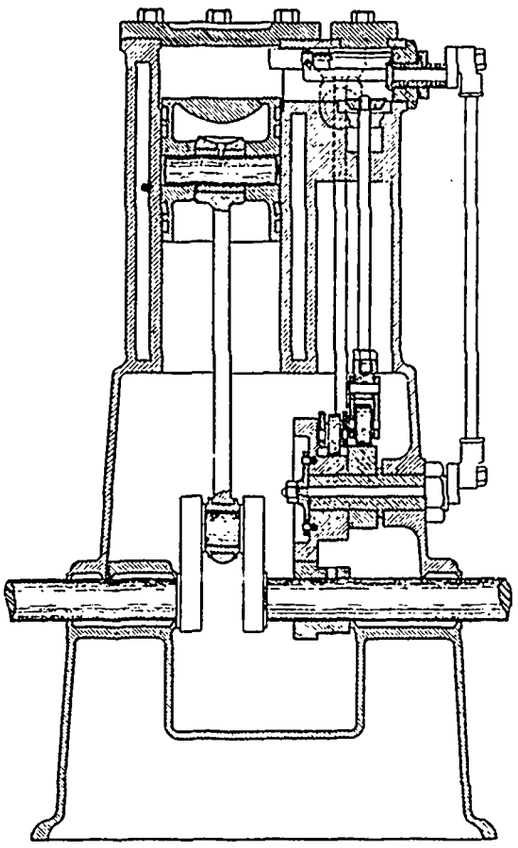


FIG. II.

a carburetter. No explosive mixture is made until the downward motion of the piston draws a supply of air through the inlet valve, and as the air must pass through the vaporizer to enter the valve, it converts the gasoline on its way, and leaves no mixture within the engine frame. This system does away altogether with any semblance of danger in the use of gasoline, and is a great improvement in that respect. With the use of the electric igniter there is no delay in the starting of the engine, and in regular practice the time needed is less than one minute. A novice can start them quite easily, and the simplicity of the entire outfit makes it a desirable outfit for any purpose where power is required. Villages and towns, summer resorts and large factories, public buildings, etc., find it an efficient means of producing power for a combined electric lighting and pumping plant. For a pumping plant, a plant of this kind can be used during the day for supplying water for domestic purposes, and at night can be started full power at a minute's notice for fire protection. Where city gas, natural gas, or producer gas of any kind can be had, the engine can as readily be operated as with the gasoline.

The Cooper Machine Works, 128 Adelaide Street East, Toronto, are the builders of the "Imperial" engine, and will build it in all sizes, and intend devoting their entire time to the manufacture of gas, gasoline and oil engines for all purposes, stationary, marine and portable. They will also build suitable motors for horseless vehicles.

THE CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

On Feb. 3rd, Toronto Branch No. 1 held their second annual At Home in their hall, 61 Victoria street, which consisted of a concert, followed by a dance and refreshments

On Feb. 8th there was a meeting of Kingston No. 10. F. Simmonds occupied the chair. A paper, which was read in the Montreal association, was read by J. Turnbull. It was entitled, "Heat and the Action of Steam during a Boiler Explosion." This paper was discussed by those present, after which C. Asselstine, read a paper entitled, "The Engineer of the Past and Present." It was decided to hold an open meeting Feb. 22nd.

Hamilton No. 2 held an open meeting of instruction, Feb. 19th, in the K.O.T.M. Hall. Lectures were delivered by Mr. Norris and Mr. Ballard, inspector of public schools, who kindly consented to be present.

NOTES ON THE MINING OF LOW GRADE GOLD ORE IN NOVA SCOTIA.*

BY C. F. ANDREWS.

In view of the interest which at present is being awakened in the low grade gold ores of Nova Scotia, some personal observations in this line may not come amiss; the purpose of this paper is, therefore, to give an outline of some personal experience while manager of the Richardson mine, at Isaac's Harbor, N S. The writer does not claim that all the methods adopted during this experience have been as satisfactory as he could have wished. Circumstances often compel us to accept that which of things obtainable comes nearest to meeting our wishes.

The Richardson belt is composed of slate and quartz, between regular walls of which. It is located on what is known in Stormont gold district as the Gold Brook Anti-clinal (also called the Upper Seal Harbor Anti-clinal), the course of which is N. 62° W. and S. 62° E.; and along which auriferous belts, lodes and drift have been discovered for a distance of three miles. The Richardson belt was first discovered and worked on its south dip, where the average width was 11½ feet. In working west the belt narrowed down considerably. Eastward, the belt turned in a northerly direction, increased in width to 18 feet and lay very flat, the dip changing from south to east; continuing, it swung around and ran westwardly, assuming a north dip and growing smaller again than on the turn.

The mill for crushing this ore is located about three hundred yards from the mine on the shore of a lake, from which the water supply is obtained. The ore is conveyed from the mine in cars running over steel rails, laid the greater part of the distance on trestle work. These cars are hauled by means of a steel cable, the power being taken from the mill. The total expense for haulage averages about three cents per ton, including renewals of cars, ropes, wheels, axles, etc. When first started the mill was furnished with but 15 stamps; a few months later the number was increased to twenty, and later to forty.

The following extracts from a report to the directors in June, 1894, may be of interest, it being remembered that the mill then consisted of twenty stamps with hand breaking and feeding. "At the mine three shafts have been sunk. The west shaft is not more than 30 feet deep and was put down mainly to test the length of the belt, which is here about seven feet wide. The middle shaft is down 100 feet; width of belt here from 8 to 14 feet. Tunnels and stopes are driven west from it 72 feet, or to a point within eighteen feet of the west shaft." The labor expenses here for drilling and blasting amounted to 26 cents per ton. The cost of dynamite per ton of ore sent to mill was 3½ cents. "Tunnels and stopes are also driven east from here to connect with the east shaft, which is 108 feet deep. The southerly dip of the middle shaft is about 52° from horizontal, that of the east shaft about 42°. East of the east shaft a tunnel has been driven on the belt 89 feet, the belt at this point having a width of 17½ feet. Here a bend of 70 per cent. to the northward takes place in the course of the belt. A tunnel has been driven here on the belt for a distance of 85 feet, the dip being 23° in an easterly direction, the width 18 feet."

The total cost for mining, transporting to mill, and milling at this time, was $2.90 per ton, including an allowance for total depreciation in value of plant in five years, and for taxes, insurance and all charges.

"The belt for the most part is composed of one large lode on the back-wall side, varying in width from 1 to 4 feet, and a varying number of smaller lodes intermixed with slate. At places, nearly the entire belt is quartz, and gold is sometimes found in the soft slate between the lodes. Enough black or waste rock cannot be obtained below to load the scaffolds; and the walls have to be supported by leaving in blocks or pillars of ore."

The underhand method of stoping was employed. In an attempt to use the overhand method it was found that the slate between the veins of quartz was not firm and solid enough to hold the quartz in place overhead, and, consequently, large masses of rock were falling, making it dangerous to the miners beneath. I am of opinion that at greater depths the slate becomes more firm and solid, and overhand stoping may be resorted to. At this time hoisting was done from the east and middle shafts by a single cylinder engine, geared to a single friction-drum The gear was so located that the rope could be shifted from one shaft to the other as occasion required. Wheelbarrows were used below ground as a means of transporting the ore to the shaft, and the ore was then hoisted in tubs to the surface, where it was washed, the waste rock thrown out, and the good ore shovelled into cars to be hauled to the mill. Since then the belt has been followed farther west on the south dip; the east shaft, now the pump shaft, sunk to a depth of 200 feet, and the belt driven and stoped, carried around the turn and continued west on the north dip. At the time of writing the belt produces more waste slate than in 1894.

The present plant consists of a hoisting, pumping and breaking gear, located on the apex of the semi-cone formed by the turn of the belt. Two shafts are worked from here, one on the south dip and one on the north. The bottoms of these shafts are about 250 feet apart, as measured on the belt around the turn; and as they are sunk this distance is, of course, increasing. At the surface they are 48 feet apart and converging towards each other. At a height of twenty-six feet above the surface, the skip-tracks from each meet above the same deck head; and self dumping skips empty their loads beside the same rock-breaker. The "sump" at the deck-head into which the skips dump their loads is lined on the bottom with open-sand cast iron plates seven-eighths inch thick laid in five-eighths of an inch of cement. The ore is here thoroughly washed, the waste rock thrown into trolleys and run out on the dumps, and the good ore shoveled into a hopper which drops it between the jaws of a 9x15 Blake Breaker, from which it falls into a bin. Cars are run under the bin, where the ore is allowed to fall into them; they are then run out on the main track and hauled by the wire cable to the mill, where the ore is dumped into a bin of 500 tons capacity. Thence it runs through shoots into the automatic feeders supplying the mortars. Copper plates are used inside these mortars. The surface dimensions of the outside plates are 12 feet 6 inches by 4 feet. After passing over the outside plates and through mercury traps, the sand is discarded, no attempt being made at concentration.

(To be Continued.)

* A paper read before the Federated Canadian Mining Institute.

THE DOMINION GOLD MINING AND REDUCTION COMPANY.

The following letter, which has we believe been refused publication by the *Mining Review*, has been forwarded us by Alan Sullivan, C.E.:—

The Editor of the Mining Review, Ottawa, Ont.:

DEAR SIR,—As one familiar with the Dominion Gold Mining and Reduction Company, Limited, of London, England, and as one also intimately associated with R. H. Ahn in business in Rat Portage, I beg to take exception to certain editorial remarks in your last issue, assuming that your publication, like all others, is equally available for the exposition of both sides of a question. The gist of the exception you take to the report is contained in the following paragraph:—

"What do our constructing mill engineers think of the sum of over $27,000 being spent to remodel a ten-stamp mill? And what do our Rat Portage friends think of the equity of paying over $800,000 for the purchase of the reduction works and the few prospects that went with that sale?"

It is due to those whom your criticism may have affected to state that the expenditure of $27,000 includes the following items: Rebuilding of the reduction works, including the purchase of four batteries of 20 stamps, each battery with its own ore bin; purchase of one Frue vanner, two Krupp vanners, two Colorado Perfection concentrators, Cornish rolls, sample grinders, all connections, belting, pulleys, shafting, etc., including all costs of construction. Estimate, $12,000; actual cost, $11,500. Will the average qualified constructing mill engineer do much better? The balance of the $27,000 was spent as follows: Equipment of two mines, viz., Black Jack and Gold Hill. Full equipment, including pumps, two hoists in place, one not set up; two boilers, cables and running gear, buckets, ore cars, rails, etc., and also the remodelling of the ten-stamp mill on the Gold Hill property.

I think the impartial observer of the above expenditure will consider it was economical for the value received, and this, coupled with the fact that competent engineers have invariably expressed themselves favorably impressed by the Reduction Works, and their standard of workmanship, will rob the quoted paragraph of some of its apparent point. As to the purchase of the Reduction Works, the two mines and the other properties amounting to 2,500 acres, that went with them, this was a matter arranged in London to the satisfaction of the company, and altogether outside of the Canadian office; the latter had no say whatever in the matter. The directors made their own arrangements to suit themselves, without consulting the *Mining Review* in the matter, and those who are directly interested in the outcome are those who will make the necessary criticisms.

I regret that the remarks in the *Mining Review* should be so prompted by personal animosity, as they evidently are, judging

from their initial paragraphs. Personalities answer themselves and in the end the old chicken comes home to roost. No end is gained by such a course; and mud is an awkward thing to throw, and it does not carry far. If the *Mining Review* will devote itself to the interests of the country in accordance with its self-stated purpose, and avoid petty and misleading vituperation, it would make a step forward towards the position it so ardently longs to attain.

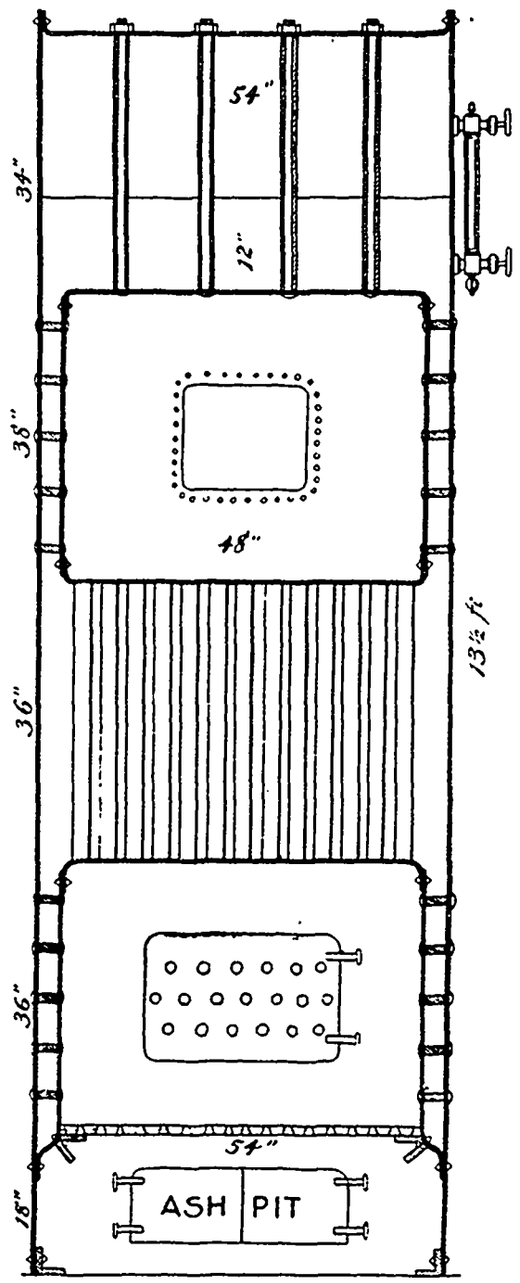
Yours truly,

ALAN SULLIVAN.

Rat Portage, Ont., Feb. 5th, 1897.

GOLDING'S VERTICAL BOILER.

The accompanying sketch illustrates a type of vertical boiler, the design of Wm. Golding, of New Orleans, La., and described by him in a letter as follows: As will be observed, the features of this



boiler consists in the facility with which the tubes may be taken out through the combustion chamber, which is purposely made longer than the tubes. There are two doors to this chamber, one of which will serve as out-take to chimney, and the other to admit access for cleaning and repair, and also to check excessive draft. Since experience has shown that 50 per cent. of the evaporative power of tubes lies in the first foot of length, it is plain that a 2-inch tube need not exceed three feet in length to effect perfect transmission of heat, especially when aided by the combustion chamber.

GOLD has been discovered at Sheep Creek, on the eastern slope of the Rocky Mountains, about 60 miles from Calgary, Alberta.

ONTARIO ESTIMATES.

The following are some of the items in the estimates for 1897 submitted in the Ontario Legislature at the current session:

PUBLIC BUILDINGS.

Asylum for Insane, Toronto—	
General repairs, drains, interior alterations, outside repairs, fire protection, hose, etc.	$ 4,000
Asylum for Insane, Mimico—	
To complete chapel, assembly hall, store rooms, etc.	6,000
Repairs to iron work and slating of roofs of cottages and centre building	1,000
Engineer's supplies, fittings, etc.	500
Asylum for Insane, London—	
Repairs and renewals to north building	2,500
Interior renewals	1,500
Fire protection, building and hose	625
Asylum for Insane, Hamilton—	
New boiler in west boiler house, main building	700
Plumbing	1,000
To complete infirmary building	10,000
Asylum for Insane, Kingston—	
Addition to east wing, heating, plumbing and lighting	4 500
Boiler and connection for pumps, carpenter shop, etc.	750
Fire protection, hose, etc.	300
Asylum for Insane, Brockville—	
Storm sashes	1,200
Main building and cottages for balance of contracts and completing medical superintendent's residence	6,500
Telephone system and time detector (re-vote)	1,000
Material for carpenter, engineer, lumber, tools, etc.	1,000
Asylum for Idiots, Orillia—	
Renewing and re-arranging steam and water pipes and covering steam pipes	2,500
Construction of drains and of ducts for steam and water pipes from boiler house	1,000
Completion of improvements to furnace of boilers and installation of the Frue system of heating and ventilating	9,500
Central Prison, Toronto—	
Conversion of old hospital into two dwellings	2,500
Completion of furnishing for new cells and for Warden's residence	1,500
Additions to north shop with enameling ovens	1,000
Reformatory for Boys, Penetanguishene—	
Independent steam heating in the Superintendent's residence	300
Deaf and Dumb Institute, Belleville—	
Installing electric light (400 lights)	1,200
Repairs to boilers	250
Blind Institute, Brantford—	
Installing electric light	1,000
Upright piano	375
New metal washer	200
Agricultural College, Guelph—	
Water supply—engine, fire pump, shafting, pipes, fittings, etc.	2,800
Water supply—storage, reservoir and pipe connections for fire protection	1,200
Hose, reels, ladders, etc.	500
Rope drive from dairy buildings to dairy barn, shafting, pulleys, ropes, etc.	250
Fencing	175
Normal and Model Schools, Toronto—	
For balance of contract, cleaning and painting old building, heating, electric wiring and lighting (part re-vote)	6,000
Altering heating old portion of Education Department Building	2 000
Algoma Districts, East and West—	
House for lock-up keeper, Little Current (re-vote)	1,200
Thunder Bay District—	
Additional vault accommodation to court house (re-vote)	600
Nipissing District—	
Heating gaol and court house	1,200
Vaults	500
Enlarging court house, Rat Portage	2,000

PUBLIC WORKS.

Peninsula Creek Improvements—	
To complete dredging, and to sheet pile sides of channel..	$4,805
Gull and Burnt River Works—	
To construct dams at the outlet of Percy Lake	1,884
Mary's and Fairy Lakes' Works—	
To reconstruct dams at outlets of Mary's and Fairy Lakes	5,147
Madawaska River—	
Re-vote to construct swing bridge at Combermere.....	1,100

ADVANTAGES OF COMPRESSED AIR.*

BY JAS. F LEWIS, CHICAGO.

The first recorded experiments in compressing air were made by Hero, of Alexandria, who flourished 150 years before Christ Papin in the seventeenth century, investigated the subject to some extent, and according to Ganot's Physics, the air pump was invented in 1650 by Otto Guericke.

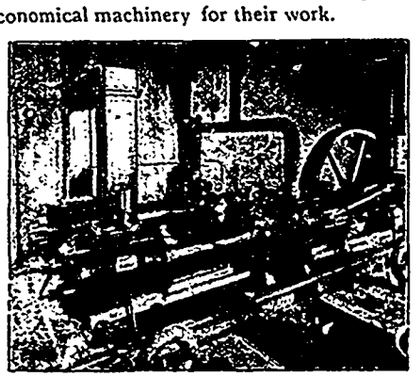
In 1726, 1753 and 1757, patents were taken out for different methods in compressing air. From 1810 to 1860, quite a number of patents were issued along this line, but the first work of any moment done by compressed air was in 1861, driving the Mt. Cenis Tunnel. The honor of first applying successfully to any great extent compressed air for the purpose of driving rock drills in America, belongs to one of your prominent and highly respected citizens, Walter Shanly, when he was driving the Hoosac Tunnel from Dec., 1868, to Dec., 1874 This tunnel is 24,100 feet long, 361,500 cubic yards of rock excavated, 544,735 lbs. nitro-glycerine and mica powder burned Mr. Shanly in that early day found great saving in cost over hand labor, as well as time in completing his work.

It was in this tunnel, also, that nitro-glycerine was first introduced in this country Therefore, Mr Shanly has the honor of being the first to make a success of the three great powers that have been instrumental not only in developing the great mining industries of this country- sinking to great depth for the precious metals—but making it possible to carry out wonderful engineering projects, driving tunnels and excavating canals from one to thirty-four miles long. These powers are air compressors, rock drills and high explosives.

The largest compressed air plant in the United States is at Quinnsec Falls, on the Menomonee River, the falls being forty-seven feet in height and furnishing unlimited power, which has been harnessed by modern skill to do economic duty.

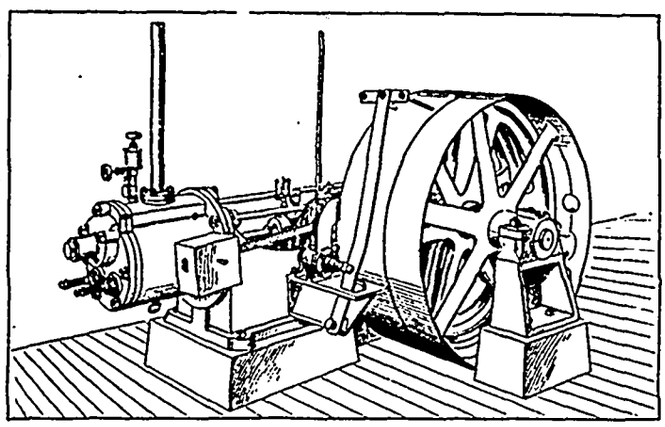
This plant consists of three pairs of air compressors, 23 inches in diameter by 60 inches stroke, and one pair 36 inches in diameter, by 60 inches stroke, delivering 3,000 h p. through 3½ miles of pipe to the Chapin and Ludington Iron Mines, at Iron Mountain, for pumping, hoisting and motive power engines above ground, and direct acting pumps and rock drills below ground. This power is carried through a twenty-four inch pipe, with a loss of only one pound in pressure, and the superintendent figures that he gets an efficiency of seventy-five per cent

Until quite recently the mine owner has taken no thought as to the economy or the efficiency in compressed air, feeling that it was a necessity and caring little about the cost, so long as it enabled him to prosecute his work, but during the last three or four years there has been a great change in this respect. The mining engineer has been looking carefully into the question of economy, and the manufacturers find with pleasure that they are willing to pay for the highest type of air compressors The same may be said also of contractors They are fast becoming educated by experience to the fact that there can be a great saving made by using the most economical machinery for their work.



HIGH-CLASS ECONOMICAL STEAM DRIVEN COMPRESSOR.

The Chicago Drainage Canal has been a great educator in this respect. It was a long time before the contractors on that work could be convinced that it was economy to use compressed air as a power on open work as against steam. Finally, however, Mason, Hoge, King & Co., and E. D. Smith & Co., were persuaded to purchase compressed air plants, but before they could be installed, the work had been prosecuted for six months by the use of a number of small steam plants scattered over the mile sections. The air plants were installed in the centre of the section, and the air carried in pipes along the banks of the excavation, and after working six months with compressed air, they were fully convinced that it was at least twenty per cent. cheaper than the use of steam for the same work. Therefore, ten rock sections out of fourteen were worked with compressed air. The other four with steam, and from data thus obtained, it shows conclusively that air was the most economical. The cost of drilling with steam was 8.64 cents per cubic yard of rock, with air 6.30 cents per cubic yard of rock. Two of the contractors had the courage to purchase a high type of air compressor, and the saving in the coal pile was greatly to their advantage and very soon paid for the extra cost of the compressors.



E. D. Smith & Co., who excavated two miles of the Chicago Drainage Canal, are now driving a two-mile tunnel near Boston. From the experience they had on the canal, they equipped the two miles of tunnel with two first-class Corliss engine air compressors, both of them duplex machines, 20-inch diameter cylinders by 36-inch stroke. The plant is installed at one end of the tunnel, the air carried the two miles through pipes, and the entire work of pumping, hoisting, and drilling is done by compressed air. This same company is also doing a large piece of work at Niagara Falls, excavating for the new wheel pits, which are to be 185 feet deep, 20 feet wide and 180 feet long. The entire work of drilling and channeling is being done with compressed air.

Great progress has been made during the past four or five years with compressed air as a power in mechanics. In fact, it is fast becoming universal for use in machine shops, boiler shops, foundries, railway shops, bicycle shops, and also for deep well pumping. There is yet much skepticism as to its economy or efficiency for mechanical purposes, but a great change of opinion has and is taking place among many of our most thoughtful mechanical engineers. They are becoming converted rapidly in favor of compressed air. They find no end to its uses, after it is once introduced into the shop or foundry. The advantages of it as a motive power in shops are numerous. It is easy to handle, it is clean and neat, it is always ready to do its work the moment the throttle is opened, it can be carried from one end of the shop or yard without loss, if properly piped.

It has been considered until quite recently rather of an expensive power, because railway shops have labored under the same impression as mining men—that any old cylinder or machine was good enough to make compressed air. For instance—you will find railway shops using five or six locomotive pumps that produce from fifty or sixty cubic feet of free air per minute. This means an investment of $600 or $700 tied up on the wall. With an air compressor, that would not cost over $500, they can produce double this quantity of air with one-fifth the amount of steam. Many railway shops are being fitted up with the most economical air compressors, and mechanics are becoming ready to testify to its efficiency and great saving over other powers.

Four or five years ago, the Cramps installed a large economical air compressor in their shipyard, piping the air throughout their works They say to-day that it has been one of the greatest money saving machines they ever purchased.

About a year and a half ago, the Atchison, Topeka & Santa Fe Railway installed a duplex 20x48 air compressor in their shops at

* From a paper read at the Federated Canadian Mining Institute, Montreal.

Topeka. They have now about five miles of air pipe running through their shops and yards Since then they have purchased six compressors for their different line shops.

It may be interesting to know what their master mechanic says regarding the saving over the old way, by using the Baird Portable Machine Co 's tools, run by compressed air Of course, this saving is figured on the basis of the tools working steadily through the day.

With the ten-foot reach stationary riveting machine you can drive 2,000 rivets per day of ten hours with three laborers, at a total cost of $4.75 per day. With hand labor it required three men, total $7 per day, to drive 200 rivets.

The six-foot riveter, combination flange punch and riveting machine, and the bridge and girder riveter, will each average about the same as the ten-foot reach riveter.

The truck riveters, one machine operated by two laborers, total $3 per day, drive 3,000 rivets in a day of ten hours, as compared with hand labor, three men at $6 of a total, in the same class of work will only drive 175 rivets.

The frame riveter will average about the same as the truck riveter.

The stay-bolt breaker will make an average saving of $8 a day.

The tank riveter will make an average saving of $10 a day.

The mud ring riveter will drive as many rivets as can be handed to it, and will make a saving of from $12 to $15 a day for that class of work. Not only does it make a great saving, but it insures every rivet hole being entirely filled and insures tight work, while with hand-driven rivets in mud rings a large per cent. of them invariably leak, and have to be caulked or fullered up.

The stay-bolt cutter will do the work of fifteen men. This machine will very easily cut off 1,500 bolts an hour, while when cutting off by the old method of hand hammer and chisel, you must agree it goes very slow, and it is hard work.

The rotary tapping and drilling machine will do the work of four men.

The rotary grinder saves the work of six men.

Rotary saw for sawing car roofs saves the work of four men.

Pneumatic hammer will save the work of three men.

Crown bar bolt machine saves the work of three lathes.

Rail saw saves the work of two men.

Rail drill saves the work of two men.

Device for operating transfer table saves $6 per day.

Device for revolving driving wheels for setting valves saves the labor of two men.

Device for shearing bolts saves the labor of two men.

Thirty hoists in shops save the labor of ten men at $1.50 per day.

Device for loading and unloading oil at storehouse saves $6 per day over the old method.

Jack for pulling down car draft sills saves $10 per day.

Device for fitting up hose couplings over the old method saves $15 per day.

Pneumatic painting machine, one man does the work of ten using a hand brush.

Machine for tearing down old car roofs saves $8 per day.

Jack for raising and lowering freight and passenger cars makes an average saving of three men.

Drop pit makes an average saving of three men.

Device for sanding engines saves one man.

Shifter for switching cars in shop yard saves $50 per week.

Device for cleaning coaches saves ten men.

Device for rolling flues makes a saving of two men over the old method.

The whitewasher will do the work of ten men with a brush.

(Concluded in next issue.)

FEDERATED CANADIAN MINING INSTITUTE.

The conference of the Federated Canadian Mining Institute was opened Wednesday, Feb. 3rd, at the Windsor Hotel, Montreal. There were present not only mine owners and experts, but men who had also toiled as laboring miners, and this resulted in substantial benefit.

Wednesday morning was devoted to the business of the Institute and presided over by Major R. G. Leckie, of Toronto. The Secretary, B. T. T. Bell, gave an encouraging account of the past year. Letters had been received from Mining Institutes in America and Great Britain, expressing willingness to attend the proposed international convention. It was proposed that this convention should be postponed for a year in order that the members of the Iron and Steel Institute might be able to attend, which they intimated that they could not do if it were held this year. A discussion took place on the proposed Mining Bureau, during which it appeared that the Quebec Mining Association had received promise of a grant of $2,500 from the Quebec Government, being $1,500 for rent and $1,000 for equipment for the first year. The title of Mining Bureau was commented upon. It was found that this would conflict with that of the local association, and it was ultimately decided to change the title to that of Mining Museum. A resolution was proposed and adopted that the council appoint a deputation to interview the Dominion Government and ask for assistance in the scheme.

The first business in the afternoon was the able address of the President, Major Leckie, which we have been obliged to hold over. J. Bawden, of Kingston, read a paper on "The Economics of Joint Stock Mining Companies and the Laws Relating to their Incorporation," in which he suggested many restrictions to fraudulent enterprises.

In touching cursorily on some of the amendments required in joint stock company law, he recommended that notice of application for incorporation should be abolished, because it was unnecessary; notice of incorporation only should be required. Incorporation had as its main purpose the acquisition of capital, and the fullest information should be given above ground to the public. When stock was divided into proprietary and treasury stock there should be some provision that the shareholders, whose money was risked for development, should not be sacrificed if the company was wound up or new stock called for. The law should interfere to protect those whose cash had been risked for development, on the representation of the promoter, who controlled the management and controlled the expenditure. In the majority of cases in which mines did not realize what the prospectuses would lead investors to expect, he believed that the directors had been deceived by so-called experts. The attention of the Minister of Justice might be directed to the necessity for criminal legislation as the means of preventing the operations of fraudulent experts. Evolution has not yet brought us to that level that as a nation we are able without calling on private means to work our mines as national property, and with their treasures build up railroads, endow colleges and libraries, promote scientific investigation, erect beneficent institutions, reward inventors and artists.

W. R. White, Q.C., of Pembroke, Ont., said that, speaking as a lawyer, he thought it almost impossible to carry out the suggestions contained in this paper, and differed from Mr. Bawden as to the course to be pursued. But there is a law which prevents stealing and punishes those who make false statements, only people either did not know of it or would not take the trouble to put it in operation. Even this would not go far enough, and the association would do well to try and induce the Minister of Justice to consider some addition suitable to the existing circumstances. He did not see the practicability of incorporating the mining engineers. They may differ in opinion as much as lawyers do about law, or judges about the interpretation of it. Still there ought to be some sort of organization, and a mining engineer ought to be placed in a position which guaranteed his competence. Too many so-called engineers knew hardly enough to push a barrow. Mining is improperly treated as a mere money-making scheme. There comes a time in the history of a mine when it ceases to be an uncertainty, but every mining scheme ought at least to have a mine behind it.

A. Dick, of Rossland, thought that speakers seemed to consider that British Columbia had the monopoly of wild-cat schemes, while they were really as anxious as other people for proper safeguards.

A paper on "Initial Payments on Bonds and Options," by Howard West, New Denver, B.C., was read by the secretary, and the sitting closed with the presentation and adoption of the report of the committee on constitution and by-laws.

In the evening W. Hamilton Merritt, of Toronto, exhibited and explained a compact and easily portable explorer's outfit for determining free gold and the concentrates. This was followed by a paper on the "Responsibilities of the Mining Engineer," by Dr. John Bonsall Porter, of McGill University, who pointed out the necessity of the engineer exercising the utmost care in all his works, so as to avoid misleading his employers or the public in view of the magnitude of the interests involved. "At first sight," Dr. Porter said, "the returns of the U.S. census of 1890 seem to show that the mining engineers of that country are a most unimportant body of men. I can't say how many engineers there are—civil, mechanical, electrical—to each man who even poses on the returns as one of our craft. As we get deeper into the thing, however, we take heart. Although so few in number, we find that the enterprises which we control play no small part in the financial affairs of the country, and when the figures are finally cast up, it becomes evident that for

each mining engineer in service there are added not less than 100,000 dollars yearly to the wealth of the country."

In his remarks on this paper Dr. W. L. Goodwin, of the Kingston school of mining, said that after what they had just heard it was incumbent on the institute to take some action in regard to fraudulent properties, and believed the best course to pursue would be to appoint a committee to interview the Government on the matter He moved that the following gentlemen be a committee to confer with the Minister of Justice on the subject of such amendments to the criminal code as may be necessary in the public interest: J. Bawden, Kingston; W. R. White, Q.C., Pembroke; Dr. Porter, McGill University, and Prof. Jno. E. Hardman, Montreal This was seconded by the secretary and carried. B. T A. Bell read a letter from R W De Marest calling attention to a deficiency in the Ontario Mining Act, viz., that there was nothing in it which provided for the working of mineral properties, when the minority prospector or other interest would not accept any reasonable proposition for the sale or working of the property.

The next paper was that of James F. Lewis, president of the Canadian Rand Drill Co., on "The Advantage of Compressed Air" followed by C. H. Taylor, M E., inventor of the Taylor Hydraulic System of Air Compression, who gave an account of the 150 h.p. air compressor erected for the Dominion Cotton Mills Co at Magog, Que. We publish extracts from both of these papers in this number. The business of the day was agreeably terminated by a calcium light display of photographs of the Sudbury mining district, etc., given by G. R. Mickle, M.E., of Sudbury. His Excellency the Governor-General entered the room very late in the proceedings, and retired with a promise to preside the next day.

On Thursday the meetings were attended by Drs. A. R. C. Selwyn, C.M.G., and G. M. Dawson, present director of the Geological Survey.

Dr. A. P. Coleman, of Toronto, who was the first speaker, gave an interesting chat about the western Ontario gold field, dealing especially with the geology of the Rainy River and Lake of the Woods districts. He described the nature of the deposits there and said they should prove very valuable. But as yet they were only prospects. Assays were in many instances not satisfactory as to the paying nature of the ores. Credit was due to Dr. Lawson, formerly of the Canadian Geological Survey, but now of the University of California, for his excellent work in these districts. From present results it was believed that the veins went down thousands of feet, though the greatest depth yet obtained in mining is 200 feet. A group of mines, including the Foley, the Ferguson and the Lucky Coon, had been developed with considerable success Incidentally be dealt with the Sultana mine, in Lake Superior, the Little America mine, in Minnesota, and the Empress mine and their successful workings. Dr. Coleman's general conclusion was that there was every probability that wherever there was contact between the Laurentian and Huronian rocks there was a possibility of gold deposits, and he saw no reason why this should not be the case in Manitoba and Quebec as well as in Ontario. It was at any rate worth looking into.

W. H. Merritt said he had spent two summers in that district, and spoke of the Sultana and Regina as instances of mines showing good results.

Dr Selwyn said it was impossible to speak generally of the veins in these districts, as their character was so variable. He had been quoted for an opinion on the Sultana mine. The present Sultana mine he had never seen; but upon the old one, which was in quite a different place, he had expressed the opinion that it would soon give out, which was actually the case.

Dr Dawson referred to the presence of gold in granite in the district alluded to as being a peculiar feature. Such instances are not general There are a few places in Australia where granite is worked for gold.

"Gold-quartz Mining in Canada, and Victoria, Australia," was the subject of the next paper, by Dr. Selwyn, which we have held over It was Dr. Selwyn's misfortune to be much misunderstood by some enthusiastic members of the convention. Wide knowledge is more likely to produce temperance of speech than a limited and fortunate experience.

Dr. Gilpin, of Nova Scotia, admitted that his province deserved a good deal of Dr. Selwyn's censure, and believed that alluvial mining in the province would repay the labor bestowed upon it. As regards the depth of gold mining in Nova Scotia, one mine was worked down to 600 feet and was profitable to that depth. Gold mining had been confined to the working of small, rich veins. He thought that much would depend on the attention paid to low grade ores. The Government had considered the sinking of a deep shaft, but several difficulties had presented themselves. He saw no reason why gold mining should not increase in Nova Scotia.

Prof. Miller, of the Kingston Mining Institute, referred to the gold deposits of Hastings county, Ont These fields had not received fair play. At present the district was being well exploited, and the company engaged was spending a great deal of money. They were paying out $1,200 in wages per week, and were so satisfied with the prospect that they were not issuing any shares or attempting to impress the public.

The President took exception to Dr. Selwyn's censure of Nova Scotia. The fault, if any, lay with the miners, not with the mines. He laid stress upon the fact that the legitin ate miner was no more responsible for the exaggerations spread abroad by unscrupulous persons seeking to trade upon the public than was the farmer for the speculation in pork and wheat in Chicago. He added that Nova Scotia mines were now being worked at good profit by local men, all the speculative ones having weeded out. Dr. Porter remarked that the limited production was due largely to the number of small mines, each with its own plant. If these litttle concerns were united, the general work might be carried on to much greater advantage W H. Merritt, as a young Canadian, could not sit still under Dr. Selwyn's supposed opinion that Canada could never become a great mining country, and expressed his own firm belief that Canada was destined to become one of the greatest mining countries of the world. He asked for the opinion of Dr. Dawson.

Dr. Dawson had the greatest possible confidence in the country as a whole, though, of course, there were distinctions. Manitoba and the North-West, for instance, could not be considered rich in mining. British Columbia was the greatest hope of the country. There was no reason to doubt that it was as rich in minerals as the great belt to the south, which was producing nine-tenths of all the mineral wealth of the United States. After having seen the country, he was confident that there was a magnificent mining future before British Columbia. As for the Lake of the Woods country, that was unique, and had got to make its own history. The mineral production of Canada last year was $22,000,000, and was mounting up year by year; that of British Columbia was likely to double in a very few years.

J Bawden, of Kingston, presented the following resolution: "That the Federated Mining Institute desires that the amendment of the law relating to the incorporation of mining companies throughout the Dominion receive the early attention of the Dominion and Provincial Legislatures for the purpose of securing as much information as may be practically attainable, for affording increased protection of the rights of shareholders, and for promoting the financial enterprises operated by joint stock companies; that the following gentlemen be a committee on legislation to submit to the Dominion and Provincial Legislatures such amendments of the law as may appear suitable to promote these objects: Dr. Porter, Dr. Goodwin, W. R. White, Q.C., B. T. A. Bell, Prof. Hardman, F. A. Heinze, and the mover." The following resolution was moved by B. T. A. Bell: "That all papers hereafter proposed to be read at the meetings of the Institute shall be transmitted to the secretary at least ten days before such meeting, and that the secretary cause such papers to be printed and distributed among the members of the Institute on the opening of the meeting." Both resolutions were carried after short discussion.

An invitation from McGill University and W. H. Browne, general manager of the Royal Electric Works, was presented to the members to visit the respective institutions.

Thursday Afternoon.—"Notes on Some Mining Districts in British Columbia" was the title of the first paper read by John E. Hardman, S.B.M.E., of Montreal. Mr. Hardman said that a large number of the properties in the district under discussion did not contain gold in paying quantities by the present method of treatment, though the ore might improve as the shafts are deepened. He dealt in detail with the deposits, and described the main features of the best known mines Owing to various circumstances, it was difficult to estimate the cost of production at Rossland at the present time The LeRoi and the War Eagle were the principal producing mines. Though principally devoted to Rossland, the paper also treated of the Nelson, Slocan and Fort Steele districts. The writer considered that paying mines will be the exception rather than the rule, owing to the geological formation of the country, and that it is extremely improbable that one-tenth of the mines now located would ever be developed, but on the other hand it was extremely probable there would be ten or a dozen permanent mines.

J. D. Sword, of Rossland, admitted that some people had decried British Columbia on account of a few irresponsible stock jobbers advertising inferior properties and trying to sell them. Referring to what Prof Hardman had mentioned, he said that if they ultimately had six gold mines in Rossland, they would be

thoroughly satisfied. They had four now, two of which were paying dividends, and it was expected that the other two would do so shortly. From the Slocan country great things were hoped, and in the Lardeau district there were some wonderful deposits of silver, lead and gray copper rock.

Dr. Dawson said that Mr. Hardman's confidence in the country was justified. It contained not only one great mineral field, but many The whole mountain ranges from the international boundary up through the Big Bend country to the Yukon was full of wealth. It only required a certain amount of time for the prospector to find it, and a large amount of ingenuity in discovering new names for the mines for British Columbia, to prove the greatest mineral section on the American continent. Dr. Selwyn expressed his pleasure in hearing how splendidly British Columbia was turning out.

S. F Andrews then read his paper on "Notes on Low Grade Ores of Nova Scotia," which we reproduce.

The next paper was by Ernest A. Sjostedt, M.E., of Bridgeville, N.S., on the "Utilization of the Mill Refuse and Peat Mosses of the Ottawa." He described the methods in which such material had been utilized in Europe and urged that they be adopted in Canada, thus effecting a saving of money for fuel as well as developing a latent natural resource. At its conclusion, His Excellency the Governor-General paid the author a compliment upon the research evident in his paper.

THE DINNER.

Owing to press of other matter, we regret to have to withhold a detailed report of the dinner at the Windsor. The occasion was graced by His Excellency and several other distinguished guests, and was the most successful held for a long time at that celebrated hotel. Major Leckie made an admirable chairman, and the dinner committee and Mr Bell received much praise for the manner in which the capital programme was carried out.

On Friday morning the members of the conference met again, and a useful conversation took place on the subject of surveys. Col Roy, of Port Arthur, said that the reports of the Geological Survey at Ottawa were issued too late in the season and thus robbed of half their value. Great changes were going on in the mining centres, and it was essential that explorers should have the reports as early as possible. Dr Dawson said he was always pleased to receive thoughtful suggestions, and, as chief of the Geological Survey, he was accustomed to criticism. With regard to the reports, they are of two kinds The statistical report is a little late, not through indifference, but on account of circumstances that could not be altered at the time. He hoped, however, they would not recur. The reports that form the annual volume are issued as soon as finished and at no fixed time. These are presumed to have a permanent value and require a great amount of care in preparation. He thought that an expression of opinion by the convention might be of great use. There are no proper maps of most of the older provinces. The Geological Survey has to make a topographical map before it can proceed to the map proper to its own department. For the sake of effectiveness and speed the Geological Survey ought to have more assistance from the Government. Dr. Gilpin pointed out the great advantage of topographical maps and the tentative efforts made by his local Government. The president, Major Leckie, said he remembered the time when mining men were in closer touch with the Survey Department than appeared to be the case now. Mining men could be of great use to the Survey. Dr. Coleman said there was really great need for a proper survey of the older provinces It need not be expensive, but for the laying out of railroads, &c., it would be invaluable, and in the more thickly settled portions it is highly essential The Geological Survey might combine with the provinces in the matter Ontario is perhaps the least progressive in this respect. Mr Shorey said that nothing would supply the deficiency but a trigonometrical map.

The secretary then read a paper by Robert Chalmers, of the Geological Survey, on "The Gold-bearing Deposits of the Eastern Townships." In this paper the geological outlines of the district were dealt with and the history of gold mining therein in the past recalled. Mr. Chalmers does not consider the prospects discouraging, but recommends careful and continuous exploitation before much development work is attempted. At the conclusion of the paper, W. P. Lockwook detailed his experiences in gold mining in the Chaudiere (Beauce) district thirty years ago, especially in the Gilbert River district, which he considered as one of the most fruitful gold fields in the world.

During these proceedings the secretary had objected to a report in a daily paper that Nova Scotia gold mining was not a success. Speaking to this, A. A. Hayward, N.S., said that his province had not received fair play. He had been in it for 15 years and found that its resources were at least equal to those of any State in the American Union. He was now working at 900 feet. He began at the grass roots and penetrated vertically to 650 feet. The advantages which N.S. offered to the miner were equal to those offered by any other part of the Dominion. The pay of labourers ranged from $1.25 to $1.50 per day, transportation is easy, and the means nearly always adjacent, titles are easily obtained (there is very little litigation), and every one has access to the books of the public department. In his own experience for six years the deterioration has been only 1½ ounce.

Votes of thanks were passed to the Intercolonial Railway (coupled with the name of Mr. Price), to Major Leckie, and Mr. H. A. Budden for presiding, and to B. T. A. Bell for his services as secretary. G. E. Drummond, of Montreal, president of the Quebec Mining Association, was elected president of the Institute for the coming year, while B. T. A. Bell was re-elected secretary. In returning thanks for the honor done him, the president-elect promised to do all in his power to secure the establishment of the proposed mining museum in Montreal. Mr. Shirley then rose, and remarking that a mining bureau would be a great bond of union between mining engineers and the public, placed his own collection of minerals at the disposal of the bureau.

The convention has, however, fairly established the facts that the mineral wealth of Canada is localized. That while some districts have, in the language of Dr. Dawson, a magnificent future before them, there are others which are very uncertain, and would not, under existing conditions, pay for working.

An important exhibit of gold ores from Nova Scotia was to be seen in the rotunda of the Windsor Hotel during the convention. This was collected on behalf of the Provincial Legislature by Dr. E. Gilpin, Deputy-Commissioner of Mines. The exhibit included ore from Caribou (Elk Mining Co.); ingots ranging from 1 dwt. to 5 ozs. from the Golden Group, Montague; two lumps of the vein and eight pieces of ore from the Oxford Mine, which has produced about $250,000 worth of gold; a fine display of auriferous quartz from the Dufferin Mine, which in eight years has produced 99,000 tons of ore and $800,000 worth of gold; ore from the Golden Lode Mine, South Uinacke, which has been worked for three years and for nearly two years has paid a dividend of 5 per cent. per month; ore from the Molega mine, Queen's Co.; ingots and quartz from the Eastern Development Co., Renfrew, and ore from the Barrel Lode, East Waverly, Central Rawdon, North Brookfield and Thompson mines.

Among those who attended the convention were: Col. Ray, Port Arthur; Milton L. Hersey, Montreal; John J. Penhale, Black Lake; Hector McKae, Ottawa; C. E. Willis, Halifax; George R. Smith, Thetford Mines; J. Obalski, Inspector of Mines, Quebec; J. S. Mitchell, Sherbrooke; John F. Stairs, Halifax; John Blue, Capelton; W. E. C. Eustis, Boston; W. A. Brown, Boston; S. P. Franchot, Buckingham; W. R. White, Pembroke; Prof. John E. Hardman, Montreal; C. McDonald, Glensdale; W. H. Nicholls, New York; J. H. Chewitt, Toronto; J. S. Lewis, Chicago; F. H. Hopkins, Montreal; H. W. de Courtenay, Montreal; S. J. Simpson, Montreal; James King, Quebec; Dr. A. R. C. Selwyn, C.M.G., Ottawa; Daniel Smith, Brownsburg; R. G. L. Leckie, St. John, N.B.; Major R. G. Leckie, Torbrook; H. A. Drury, St. John's; C. H. Carriere, Levis; Duncan McDonald, Truro, N.S.; C. H. Dimock, Windsor, N.S.; T. R. Gue, Halifax; C. H. Baker, Templeton; E. W. Ingall, Ottawa; L. B. Brophy, Ottawa; Harry Graham, New Glasgow; Graham Fraser, New Glasgow; J. T. Burchell, New Campbellton; Dr. Reed, Reedsville; Capt. Donnolly, Kingston; H. A. Budden, Montreal; A. Dick, Rossland; Dr. Goodwin, Kingston; H. M. Wylde, Halifax; Capt. A. L. Howard, Brownsburg; Dwight Brainerd, Montreal; Dr. J. Bonsall Porter, Montreal; John B. Hobson, Onemille Forks; Hon. C. C. Colby, Stanstead; R. W. Leonard, Beauharnois; S. A. Klein, Black Lake; Charles Ramos, Barkerville; C. E. Rothwell, Kingston; W. G. Miller, Kingston, J. D. Sword, Rossland, D. A. McDonald, Renfrew, N.S., W. Price, Halifax, Charles Archibald, Halifax; J. Bawden, Kingston, Dr. E. Gilpin, Halifax, and R. T. Hopper, Montreal.

At the annual meeting of the Kingston & Montreal Forwarding Company, Limited, the following officers were elected, Frank Ross, president; Geo. Hall, vice-president; J. B. Carruthers, Kingston, Ont., William Stewart, managing director, and John Torrance, jr., Montreal,

A Toronto firm is building a steel steamer for service on the Lake of the Woods, between Rat Portage and Fort Frances. It is to be 125 feet long, beam 30 feet, twin screws, and to run 14 miles an hour. It will have 35 cabins and to carry 100 passengers, besides freight. It will cost $40,000, and be lit with electricity.

THE ROYAL ELECTRIC COMPANY.

During the convention of the Federated Canadian Mining Institute in Montreal last month, the new factory and generating station of the Royal Electric Company were inspected by some hundreds of visitors on the invitation of the company. The president, the Hon. J. R. Thibaudeau, introduced the general manager, Wm. H. Browne, who made a speech giving the following interesting history of the company :—

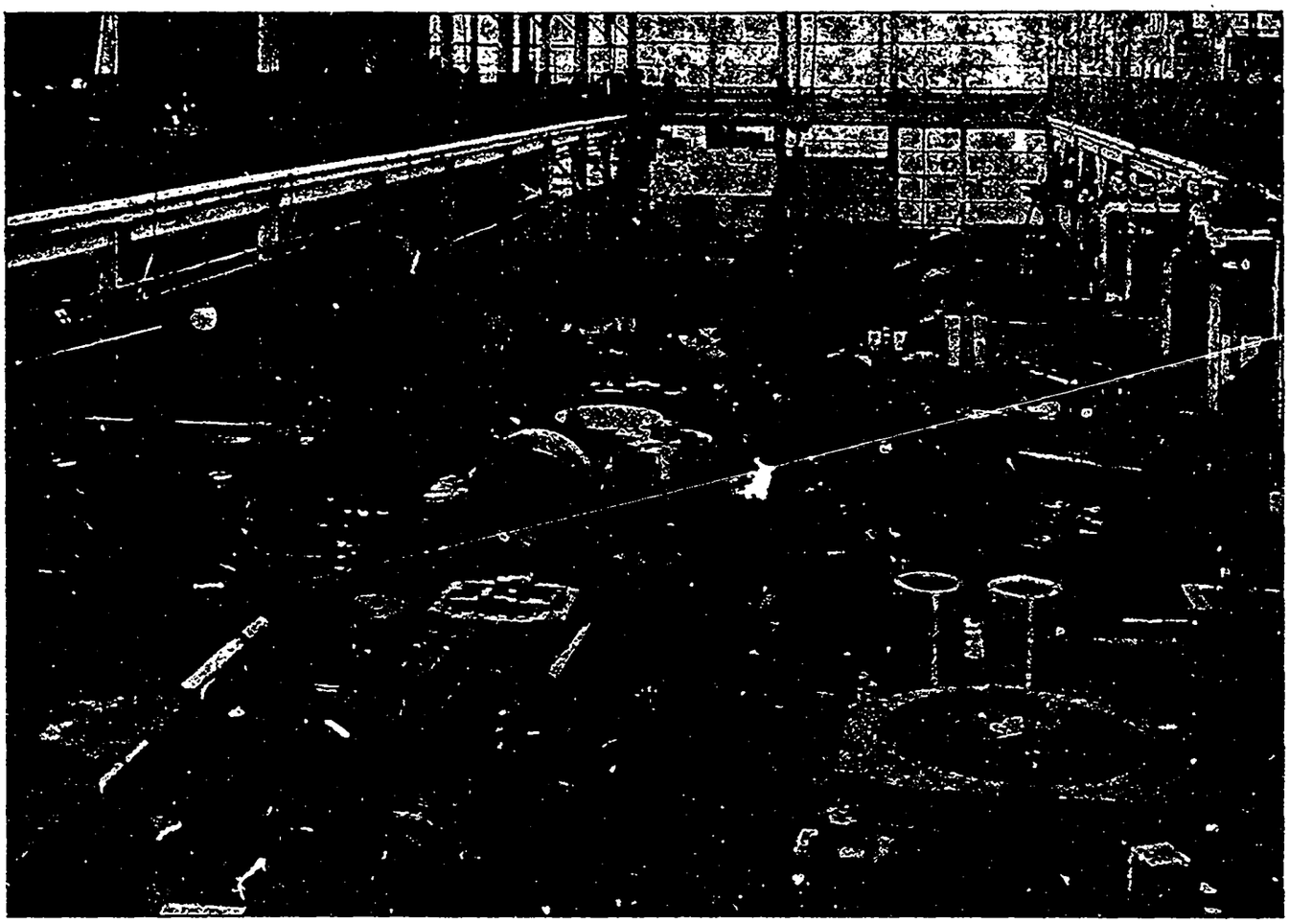
GENTLEMEN,—To the citizens of Montreal, the Royal Electric Company is well and chiefly known by the brilliant illumination which provides the security of daylight to the streets and parks of the city. It is also known by the cheerful radiance of the numerous incandescent glow lamps, which make pleasant and decorate so many residences and places of business. As a manufacturer of electrical machinery and apparatus, it is, however, better known throughout the Dominion of Canada, than in the city of Montreal.

It has been manifest on several occasions that many, even of those who are intimately acquainted with the company, have little actual knowledge of the extent and character of the source of the illumination they enjoy, and have a very inadequate conception of the enterprise represented by or of the establishment constituting the Royal Electric Company. To those throughout the Dominion, who are users of electrical appliances, the company is well known as manufacturers of the best and most advanced types of such appliances, and in a general way as conducting the largest operating electric light and power plant in Canada, but the full extent of this feature of its business is not thoroughly comprehended even by those who purchase and use its manufactures.

The factory and station you have seen to-day represent the utmost development attained to the present moment in the electrical art as applied to light and power purposes, and also represent the development and growth of the Royal Electric Company, which has kept pace with the progress of electrical science.

From a beginning in 1884, with a dynamo of 12-light capacity, a work room containing a few ordinary machine shop tools, a dozen employees, and a capital of less than $50,000, it has steadily and continuously progressed until to-day its generating plants provide electric current for street lights, house lights and motive power to the equivalent of 100,000 of 16-candle power incandescent lamps, with capacity for 50,000 more; its factory is equipped with the latest and most modern machinery capable of building the largest electrical machinery used in the world, and it is now at work manufacturing generators, each of nearly 3,000 horse-power capacity.

The completion of recent improvements made in the generating station and of the new factory in full working order, and at work in the manufacture of large apparatus, has, therefore, been deemed an appropriate occasion to bring to the personal knowledge of the citizens of Montreal and to those throughout Canada who are interested in electrical enterprises, the fact that in the Royal Electric Company the city of Montreal and the Dominion of Canada possess an industrial institution of the highest rank. We have believed that it would be an especial pleasure to you to become acquainted, by actual inspection, with the details of an electric manufacturing establishment within your city and country, which in character of machinery and equipment employed, in adaptability to its purpose, and in quality and finish of product, is the equal of any on the continent, second to none. We have also believed that it would be to you an equal pleasure to see in operation a generating station, unique in many particulars, far in advance of stations even in the largest cities, and containing features which are models and standards to which others will conform. This is the object and purpose which actuated the president and directors of the Royal Electric Company to extend the invitation, which your presence indicates was agreeably acceptable.



VIEWING THE ROYAL ELECTRIC COMPANY'S WORKS.

It introduced in 1884 a new business into Canada, beginning with the manufacture and use of what was then the best and most improved electrical apparatus, and it has continued to be the leader in its line. To-day it is manufacturing and using generators and other electrical apparatus, which are so far superior to those hitherto or elsewhere made in Canada, as to be considered, even in the electrical world, a new departure, the improvement is so radical and far-reaching. The company began business in 1884, having both its factory and generating station in a small building in Dowd street. In September, 1885, the building on the corner of Queen and Wellington streets was leased and became the factory, lighting station, stores and offices of the company. In July, 1886, the streets of Montreal were first illuminated, 113 lights being placed.

To-day nearly 1,500 lights in the streets render your city one of the best lighted on the continent. In 1888, the first incandescent lights were supplied, and a dynamo having the capacity to provide 500 lights was installed. The station which you have just inspected is connected with it, and serves at present about 65,000 incandescent lights, besides electric motors and arc lights, and is capable of supplying 50,000 more. In 1889, the generating station known as the East End station, on Water and Commissioner streets, was established solely for arc lighting. In 1891, the building in which you are at present was built and equipped as a generating station, to meet the rapidly increasing demand for incandescent lights.

(To be continued.)

ONTARIO LAND SURVEYORS.

The annual meeting of the Association of Ontario Land Surveyors was opened in the association's repository, Parliament buildings, Toronto, on the 23rd February, and was continued on the 24th and 25th, the president, Willis Chipman, in the chair. Among those present were the following: Willis Chipman, Toronto; F. L. Foster, Toronto; H. D. Q. Sewell, Port Arthur; P. S. Gibson, Willowdale; E. Stewart, Collingwood; R. Gamble, Toronto; H. L. Estin, Toronto, T. H. Jones, Brantford, W. A. Browne, Toronto, L. B. Stewart, Toronto, R. H. Squire, Brantford; A. J. Van Nostrand, Toronto, C. Unwin, Toronto, W. Beatty, Delta, A. Niven, Haliburton, L. C. Charlesworth, Collingwood, J. F. Whitson, Toronto; G. B. Kirkpatrick, Toronto; C. E. Filton, Orillia, Geo. Ross, Welland, Villiers Sankey, Toronto, J. W. Tyrrell, Hamilton, A. W. Campbell, St. Thomas, A. P. Walker, Toronto, W. F. VanBuskirk, Stratford, A. R. Davis, Napanee, T. H. Wiggins, Cornwall, E. J. Boswell, Peterboro', O. McKay, Windsor, R. T. Johnson, Toronto, Wm. Spry, Toronto; C. J. Murphy, Toronto, G. B. Abrey, Toronto Junction; R. P. Fairbairn, Toronto.

The president opened the convention by a brief address in which he extended a hearty welcome to members and visitors. The attendance, he explained, would have been much larger than it was had it not been for the fact that so many members were now absent in distant parts of the country engaged in surveying operations, necessitated by the extraordinary mining developments now going on in Canada. Since the last meeting of the association, death had removed three valued members, Messrs. Haskins, Howell and Peddar, and the association had lost another member by the removal of Mr. Thompson to Chicago. Among the most important committee work of the year was that done by the Committee on Legislation, and prompt action was necessary in the interests of the association. The Committee on Polar Research had not accomplished as much as they could have wished, but it must be remembered that this was a very gigantic subject, and too much could not be expected at once. The address was received with applause.

In the report of the Council of Management, which was presented by Mr. Villiers Sankey, it was stated that there had been some cases of irregular practice during the year, but that the parties had been written to, with the result that they had ceased operations. Mr. Sankey also reported that in one or two cases the members had neglected to pay their fees, and that in another the member had emphatically refused to pay at all. In this case he said an action at law would be taken at an early date.

The Committee on Publication reported the number of copies of last year's report that had been issued, and gave a list of exchanges received. The Committee on Repository and Biography reported that a number of volumes had been added to the library, and several biographical sketches and photographs of members received; the collection of an album of photos was recommended. The Committee on Standard Measures of Length reported that they had conferred with a representative of the Inland Revenue Department, and had been assured that the provisions of the Act governing the work of the department would be interpreted so as not to conflict with the Ontario Act. The Committee on Legislation reported progress on the revision of the statutes of Ontario now in process at the present session of the legislature. There will now be two Acts, one known as an "Act respecting Land Surveyors," and another as an "Act respecting the Survey of Lands." In the revision of the latter Act some important defects will be remedied in the interests of the public and the profession. One of the changes which has been incorporated into the Act is a clause requiring surveyors from elsewhere in Canada than Ontario, or from other parts of the British Empire, to spend at least twelve months in their profession in this province before taking the qualifying examination. Heretofore surveyors from Quebec were let off with six months, notwithstanding that that province did not reciprocate to the O.L.S. The Committees on "Civil Engineers' Bill" and on "Drainage" had no reports to make.

E. Stewart presented the report of the Committee on "Explanatory Surveys," which urged the desirability of a thorough system of exploration of our unoccupied domain. This report will be referred to in next issue.

The Committee on Land Surveying reported through A. Niven. One object sought, that of having a fixed fee for making use of plans in registry offices, has been provided for in the Consolidated Act. Some discussion arose over a clause suggesting that the expense of locating side lines be distributed over those interested, in proportion to acreage, and in the event of any not paying the charges, to levy the same on the municipality, as is done under the Ditches and Watercourses Act. This, it was pointed out, could not be done, as the locating of the line was in no way a public work. It was generally agreed, however, that some method ought to be put in practice to compel each person benefited to pay his fair share.

The report of the Committee on Topographical Survey was presented by Otto J. Klotz. The committee urged, as in former reports, that the primary triangulation should be undertaken by the Federal Government, and called attention to the geodetic survey of South Africa. This triangulation survey extends from latitude 27° 30' south, through Natal, Guiqualand East, and Cape Colony, besides a chain of triangles to Trimbulay, and one through Bechuanaland. Surely this was an object lesson to Canada. The advantages of this survey in South Africa are now acknowledged on all hands, and it is expected that the triangulation will be extended northward to the mouth of the Nile, a distance of 4,500 miles. To the frame work of the triangular formation should be attached the topographical survey, the benefits of which are the more readily discernible by the people. During the past year, in connection with the survey of the north shore of Lake Erie, an observatory was erected at Port Stanley, and observations for latitude and longitude were made. This point is suitable as a triangulation station in formation, and data on the location of primary triangulation stations in Western Ontario have been obtained. The Ohio Academy of Science expect to secure legislation for a topographical survey of that State, which already has primary geodetic station. The committee conclude by urging further representations to the Commissioner of Crown Lands on this subject.

The report of the Engineering Committee was presented by A W Campbell, and stated that there was an improved outlook fo engineering work, especially in the growing towns, which are now beginning to appreciate the value of substantial public works. The installation of municipal electric systems is a feature which promises to develop The demand for improved streets and pavements will give opportunities for the municipal engineer, and it is beginning to be felt in many towns that a permanent officer is necessary to look after maintenance, as well as construction of works. In view of the mining developments, there will be a greater demand for experts, and if these developments continue, a number of railway extensions and spurs will be required. Referring to development of electric railways, the chairman quoted items from a recent number of THE CANADIAN ENGINEER showing severa enterprises in prospect. He also referred to the drainage works in the townships of Raleigh, Harwich and Tilbury, described in recent numbers of THE CANADIAN ENGINEER, and to the various railway enterprises projected, such as the James Bay Railway, etc. The report concluded by recommending the extension of the aims of the association as laid down in the report of the previous year.

The report of the Committee on Polar Research, a summary of which will appear in our next issue, was presented by J. W. Tyrrell, and on motion of A. W. Campbell, seconded by T. H. Wiggins, it was decided that a deputation be sent to Ottawa to urge on the Minister of the Interior the advantage of a further exploration of our "northern heritage."

The financial statement showed a balance to the good of $1,322.09.

"Reminiscences of an Old Surveyor" was the title of a very entertaining and amusing paper by Charles Unwin, read for the writer by Charles J. Agar.

"Irrigation in the Canadian North-West Territories" was the title of a paper by Wm. Pearce, of Calgary, Alta., read in his absence by a member of the association. This will be alluded to in another issue.

T. O. Bolger, city engineer of Kingston, read an instructive paper on electric street railways, giving hints on construction and equipments on street railway, with an explanation of the terms used in electricity.

"The Mines of Ontario" was the subject of a paper by J. F. Whitson, dealing chiefly with the mines of Rainy River. The paper will be quoted in our next number.

A paper by H. DeQ. Sewell, on "Hints to Prospectors," contained many valuable hints on the testing of ores. First of all, any serious addition to the kit, amounting to say even ten pounds, would be out of the question, as the prospector has generally to carry everything he takes with him on his back. Therefore the length of the time he can spend on a trip is closely governed by the weight of provisions that he can conveniently take with him, after deducting the weight of his blankets, tent, etc. Such being the case, the Ontario explorer, when he has found a good-looking vein, simply wishes to determine whether it contains gold or not, and he will also naturally wish to find out whether the gold is present in free state, or whether it is mixed with any mineral that will materially affect the cost of extracting the gold. By taking with him a small box containing a few reagents and a blowpipe kit, which will hardly weigh more than a pound, and can be purchased for $2.50—to which may be added a small text book—the prospector can readily determine with absolute certainty any mineral he may come across. What he requires is a blowpipe with a spirit or grease lamp, a small hammer, a prospector's anvil (weight about half a pound), forceps, magnet, and a clay pipe for cupelling a little soda carb., bone ash, litharge and charcoal, and with them he is in a position to make a test for gold with its associated minerals. By heating with the blowpipe on charcoal (commonly called roasting), a small quantity of the powdered ore, the presence of sulphur, arsenic, antimony and tellurium can be readily detected, the first two by their smell, sulphur being that of a match, whilst arsenic smells like garlic or onions, besides giving off white fumes. Antimony also gives off white fumes, which form a white coating on the charcoal, but they have no smell. Tellurium also gives off white fumes, which form a dense white deposit, slightly yellowish when hot and tingeing the flame point a light green. Having made the test for associated minerals it only remains to determine the presence of gold or silver by cupellation. This can either be done from a small portion of the ore direct, if sufficiently rich, or the process can be simplified by concentrating from a somewhat larger quantity, and a serviceable pan can be extemporized for this purpose by burning the grease off the frying pan. After having determined the presence of gold in the vein to his satisfaction, the prospector is then advised to make a careful examination of the vein, noting its size and direction, whether it goes with or across the formation, and what it consists of. The topography surrounding the vein should also be noted, and if he is not an adept at free-hand sketching he is advised to take with him a small photographic camera, with which he can take all the views he may require. The camera recommended is one carrying film cartridges, which weighs about five ounces and costs $5. By this means the prospector would be able to convey to others a fair idea of his discovery, and would also perhaps be a means of substantiating his right of claim.

"The Proposed Sault Ste. Marie and Hudson Bay Railway" was the subject of a valuable paper by Joseph Cozens, of Sault Ste. Marie. A summary of it is unavoidably held over.

A useful paper was read by Henry Carre, of Belleville, on "Undisputed Limits, Posts or Monuments." Sherman Malcolm, of Blenheim, read a paper on "Hints on Surveying and Instruments." T H. Wiggins, of Cornwall, gave a paper on "Waterworks," and J. L. Morris, of Pembroke, gave a good summary of the principles of "Evidence," and among other papers was one by Capt. W. F. Van Buskirk, on "Sewage Disposal," and one by A. W. Campbell, on "Macadam Streets in Towns."

Among the resolutions passed was one by A. Niven, seconded by P. S. Gibson, dealing with surveys in the newer districts of Ontario. The resolution urged a change, whereby new lines should be run on the course of the governing line as stated in the original plan and field notes, instead of as at present, on the course of the governing line as defined on the ground.

The election of officers took place with the following results:

President, T. Harry Jones, Brantford; vice-president, Peter S. Gibson, North Toronto; secretary-treasurer, A. J. Van Nostrand, Toronto; council, Villiers Sankey, Toronto; H. J. Bowman, Berlin; A. P. Walker, Toronto; T. H. Wiggins, Cornwall; J. W. Tyrrell, Hamilton; A. W. Campbell, Toronto; W. F. Van Buskirk, Stratford, and J. L. Morris, Pembroke.

Auditors, H. L. Esten and A. R. Davis.

T. H. Browne and J. F. Whitson were appointed scrutineers for the election of the two new members of the council.

A vote of thanks was passed to the retiring president, and a bonus of $175 was unanimously voted to Mr. Van Nostrand, whose ability and courtesy as secretary was spoken of in the most complimentary terms.

WHAT MAKES BOILERS EXPLODE?

Editor CANADIAN ENGINEER:

SIR,—In reading over your December issue I notice a letter from G. W Sproule, under the heading, "What Makes Boilers Explode?" and I was rather struck with the incongruity of some of his remarks Mr. Sproule claims that it is wrong to speak of a boiler exploding. He also says that a boiler, like a horse, vehicle, or man, can carry only a certain load in proportion to its strength, anything over that will cause it to give way in its weakest points, or collapse altogether. He also claims that when a safety valve is overloaded until the boiler is destroyed, that even then there is no explosion. Now the word explode means "to burst or tear asunder with noise." The word collapse means to fall together. Any person who has been in the vicinity of a boiler carrying steam pressure, when the pressure within it has exceeded the strength of the material of which the boiler was made, and was torn asunder, liberating a considerable mass of water at a temperature due to 100 lbs. per square inch, or about 338° F., will bear me out in saying that the result was "a bursting with a great noise;" consequently, there was an explosion in the true sense of the word, or otherwise Mr. Sproule must dispute the authority of the dictionary. It is impossible for the ordinary horizontal tubular boiler to collapse from the pressure within. A tube in such a boiler, or a furnace flue, or crown sheet in any internally fired boiler, may collapse or fall in through the pressure on its external surface being greater than it can stand, or through overheating from low water; and such accidents are well known in steam engineering as a collapse. There is no need to attribute the cause of steam boiler explosions to the presence of electricity, gas, or any other ignitable matter within the boiler, as such theories have long ago proved groundless. Boilers explode when their tensile strength has been diminished until they are no longer able to withstand the strain, and this gradual deterioration may be accelerated by the following factors, viz., faulty construction, in the first place; corrosion, both external and internal, ignorance of persons in charge in allowing safety valves to become inoperative, and neglect of proper attention to cleaning of boiler. I quite agree with Mr. Sproule regarding the folly of blowing off boilers under steam pressure when about to clean them out, as it is a very bad practice, indeed, and no engineer who knows his business should be guilty of doing such a thing.

If Mr. Sproule is not satisfied that his theory of boiler explosions is wrong, and he will write to your paper and say so, I will try and find time to prove to him that there is sufficient explosive energy in the ordinary horizontal tubular boiler, when under steam, to make a very decent explosion, without seeking the aid of any mysterious ignitable gas or other unknown quantity.

ALBERT E. EDKINS,
Boiler Inspector.

P. S.—Regarding the experience of Engineers Quinlan and McCormack on the U.S. dredge "Comstock," at Galveston, Texas, there is no doubt in my mind but that the explosive which burned them was from kerosene oil, which had been used to prevent scale, and when they opened the boilers and brought a light near it the explosion took place. I have had one or two narrow escapes myself with boilers, where they have used kerosene oil. A. E. E.

METAL IMPORTS FROM GREAT BRITAIN

The following are the values in sterling money of the metal imports from Great Britain to Canada, for January, 1896 and 1897.

	January, 1896.	January, 1897.
Hardware and cutlery	5,772	4,765
Pig iron	1,773	380
Bar, etc.	1,631	1,236
Railroad	..	..
Hoops, sheets, etc.	1,741	1,840
Galvanized sheets	1,079	654
Tin plates	11,109	22,508
Cast, wrought, etc., iron	3,323	1,684
Steel	6,308	2,586
Lead	1,046	519
Tin, unwrought	1,151	3,046
Cement	302	468

THE tender of the Quebec and Montmorency Electric Light and Power Company to light the Quebec streets has been again accepted for five years by the city authorities at the price of eighty dollars per year for each arc lamp of two thousand candle power, and of twenty-five dollars a year for each incandescent lamp of sixty-five candle power.

LITERARY NOTES.

For the student of Canadian history, undoubtedly the book of 1896 is "In the Days of the Canada Company," by Robina and Kathleen M Lizars It is a record of the early settlement of the tract between Toronto and Lake Huron, and gives our first insight into the characters of the courageous pioneers who founded the settlements of the "Huron tract," such as the Galts, Dunlops, Stricklands, Dons, Hyndmans, Haldanes, Luards, Lizars and others. When one gets into the heart of the book the stories are so naturally told, the record of events is so stirring and so frequently touched with humor and pathos, that it is hard to lay down the book till it is finished. To those inclined to hero worship, perhaps the most satisfying portions are those that portray John Galt, the soul of the old Canada Company, who stands before us in a clearer light than we have yet seen him in any biographical sketch. This is a work the authors have done with love and enthusiasm, and this feature alone would entitle the work to a high place in the literature of Ontario, for Galt is the industrial hero of Upper Canada, as Sir Isaac Brock is the military hero. What he suffered, and how he labored to lay the foundations of settlement in so wide a region of Western Canada, few Canadians of this generation have any conception of; and what we learn in this book makes us long to know more, not only as to the inner workings of the company, but as to the personal and domestic life of this remarkable man. Galt's literary career alone is not eclipsed by that of any author whose life is associated with this country, and yet the average Canadian of to-day reads little of him in the parrot sketches of Canadian literary men to be found in our magazines. How many young Canadians knew that John Galt is the author of over sixty books. How many knew that he was the pioneer, not only of settlement in the Lake Huron region of Ontario, but of that style of Scottish story-telling which is making Ian Maclaren and S. R Crockett famous? The present day novel reader is just learning it in the announcement that a prominent London firm has brought out a new edition of some of Galt's Scottish novels, and judges of Scotch character at home will yet have to pronounce whether Galt or his modern imitators are truer to the life The present editors of *Blackwood's* are now proud to boast that their magazine discovered Galt. Fashion runs in novels as in clothes, and so it is that the story reader of to-day knows so little of Galt. No story of the early half of this century had a wider popularity than Galt's "Lawrie Todd." The writer has a copy printed in New York in 1847, and it had already run through sixteen editions! But in the short space of a newspaper review one cannot do justice, either to the career of Galt or to these admirable pictures of early settlement in the Huron tract. This much we can guarantee, that no one interested in the history of Western Ontario can be disappointed in the possession of this book, which runs to nearly 500 pages, has 42 illustrations, and is beautifully printed and bound Wm. Briggs, publisher, Wesley Buildings, Toronto.

CATALOGUES.

The Packard Electric Co., St. Catharines, Ont., have sent us a neat catalogue of the Scheeffer Watt-Meters, which contains many valid arguments for their use. We are also indebted to the Packard Electric Co. for a most convenient monthly diary, "Daily Notes," and an office blotter.

The Cooper Machine Co., 128 Adelaide St. East, Toronto, has placed before the public an illustrated catalogue of the gas and gasoline engines which are now being manufactured by them. Much interest is now being taken in the use of gas, gasoline and oil engines.

The S. Morgan Smith Co., of York, Pa., have issued a very handsome catalogue of the well known "McCormick" turbines. It not only describes these special turbines, but gives in a convenient form a great variety of valuable data and tables relating to water wheels and water powers.

A very interesting catalogue of special hydraulic machinery has been published by Henry Berry & Co., Croydon Works, Leeds, Eng. This firm are among the largest manufacturers in Great Britain of hydraulic machinery and other special tools, some of which will be illustrated in this journal from time to time. The book, which is bound in cloth and copyrighted, is illustrated with over 150 engravings, and also contains tables of useful information.

THE Hamilton, Ont., Electric Light and Power Company has elected the following directors and officers:—Robert Thomson, president; John Knox, vice-president; J. V. Teetzel, Q.C., secretary-treasurer; Robert Evans, A. Turner, J. J. Wright, S. F. McKinnon, H. M. Pellatt, Toronto.

FIRES OF THE MONTH.

Feb. 6th—John Roddick's saw and grist mill, Lyndhurst, Ont. No insurance.——Sanderson, Pearcy & Co.'s paint and varnish warehouse, Adelaide street west, Toronto. Loss about $40,000.——Patterson & Jolly's wagon works, London, Ont. Loss on machinery, stock and buildings, $8,000.——Feb. 19th—J. C. Cooper's wood-working shop, Park street, Hamilton, Ont., was damaged about $500.——Feb. 20th—Glass Bros. & Co., pottery works, Pottersburg, Ont. Loss $35,000.——Feb. 25th—The carpenter shops, blacksmith shop and engine room of the Industrial Deaf and Dumb Institution, conducted by the Brothers of St. Viateur, St. Louis du Mile End, Montreal. Loss $25,000; insurance $6,000. — Feb. 27th—John Allgoe's foundry, Simcoe, Ont. Loss $5,000, no insurance.——Feb. 28th—The Newfoundland Northern Railway shops at Whitbourne. Two locomotives, valued at $12,000 each, and a number of cars, together with the plant, were destroyed.

Personal.

W. H. FROST, owner of the electric light plant, Waterloo, Ont., died of pneumonia recently.

M. DUNBAR, C. E. and M.E., has gone into partnership with T. R. Deacon, O.L.S., at Rat Portage.

ALAN MACDOUGALL, member Canadian Soc. C.E., is visiting the south of France in search of health.

H. ALDRICH, son of the late engineer of the Berlin Gas Co., has been appointed to succeed his father.

H C MOORE, formerly of St. John, N.B., has been appointed representative of Carnegie, Phipps & Co., in London, Eng.

W. H. BREITHAUPT has been elected president of the Berlin and Waterloo Street Railway Co., to succeed the late E. Carl Breithaupt.

THE employees of the John Gillies, Son & Co. Machine Works recently presented Geo. Ruth, their late foreman, with an address and a gold watch.

WALTER VAUGHAN, of the law department of the Canadian Pacific Railway Company, has been appointed bursar of McGill University, Montreal.

MRS. MARGARET JENNINGS, widow of the late Rev. Dr. John Jennings, Toronto, and mother of W. T. Jennings, C.E., died recently at her home in Toronto.

J J BELL, who has been head machinist in the Montreal Rolling Mills for eight years, was presented on leaving by the employees with an oak secretary.

T B. BROWN, of the well-known shipping firm of Kingman, Brown & Co., Montreal, is about to retire from the partnership and will make a European tour.

W. TRAVIS, engineer at J. Simpson & Co.'s carriage works, Brantford, Ont., died Feb. 21st while having a hand dressed which had been mangled by a circular saw.

CHIEF ARCHITECT FULLER of the Dominion Government has been superannuated. Mr. Fuller prepared the plans for the Parliament Buildings at Ottawa, and also the State Capitol, Albany, New York.

W. G. BLACKGROVE, for seven years and a half in charge of the steam plant at the works of the Jas. Morrison Brass Manufacturing Co., Toronto, is now travelling for the William C. Wilson & Co., steamboat, railroad and mill supplies, 24 Front St., Toronto.

W. A. AIRD, for many years foreman of the machine shop in the Grand Trunk works at Point St. Charles, has been appointed to the position of master mechanic, to succeed F. L. Wanklyn, who resigned last week. Joseph Farrar, Mr. Aird's assistant, succeeds the latter as foreman of the machine shop.

T. L. WALKER, M.A., PH.D., of Brampton, Ont., has been appointed to the position of assistant superintendent on the Geological Survey of India. Dr. Walker is at present at Leipzig, where he obtained the degree of Ph.D. in August last. He graduated from Queen's College, Kingston, in 1890, after which he spent some time as chief analyst at the Vivian nickel mine near Sudbury. He was also for two seasons connected with the Geological Survey of Canada.

A DOMINION charter will be applied for to build a railway from Galena or Thumb Bay, on the upper Arrow Lake, to the Forks of Landeau Creek, and to build a number of branch lines.

Mining Matters.

KAOLIN has been discovered at Battersea, Frontenac county, Ont.

HOLE RIVER, near Selkirk, Man., has some promising finds of gold.

THE new natural gas wells at Attercliffe, Ont., are yielding a good flow.

PETEWAWA, ONT., near Pembroke, is the scene of another reported coal discovery.

BELLEVILLE, ONT, is agitating for the establishment of a Government assay office.

THE Wheatley, Ont, Gas and Oil Co. struck oil recently while putting down a well for gas.

AN exchange reports twenty-seven mines in the Rossland district as owning steam plants.

THE strike among the coal miners at Springhill, N.S., has ended after lasting five weeks.

IT is reported from Fort William, Ont., that gold has been discovered in MacGregor township.

LOUIS GENDREAU reports a valuable find of gold ore in the parish of St. George, Beauce Co., Que.

THE oil-bearing area of Bothwell, Ont., seems to be confined to a strip about half a mile wide and three miles long.

SAMPLES of valuable gold ore have been brought into Campbellford, Ont., from points in Northumberland county.

THE Boston & Maine Railway Company ordered 250,000 tons of coal from the Dominion Coal Company, recently.

THE Crystal Mining Co., Wahnapitae, Ont., has installed a stamp mill; about 500 tons of ore have been taken out.

A NEW find of gold quartz has been made at Killag, Sheet Harbor, N.S; 60 areas have been taken up by J. Chisholm and others.

A HEMATITE vein 8 feet wide and assaying 43 per cent. on the surface, has been located in May township in the Manitou district.

THE rapid increase in the demand for copper should be a material influence in the development of the extensive Canadian deposits.

THE diamond drill worked by Burley Smith, in Bald Indian Bay, outside Sultana Island, has struck the Sultana lead in forty feet of water.

W. A. SIMPSON, who has been drilling for gas at Kingsville, has stopped work, the Essex Gas Co. having served an injunction to restrain him.

IT is reported that John McCaw has struck a deposit of chromatic iron at the Brompton Lake, Que., asbestos mine, which assayed 53 per cent.

MINING operations are being extended up the Chilcotin River, B.C. Placer mining has been carried on in this district for some time, chiefly by Chinese.

CAPT GRAHAM, of the Nova Scotia Steel Company, New Glasgow, N.S., has opened up some of the iron veins at Indian River, near Whycocomagh, C.B.

THE Ontario Government diamond drill is at work on the coaly deposits at Sudbury, Ont. Definite information as to their character and extent may shortly be expected.

MINING operations at Belle Isle, Newfoundland, will be carried on this spring more vigorously than ever. Besides the Nova Scotia Steel and Iron Co.'s mine, two others will be worked.

RENEWED attention is being given to the oil deposits at Lake Ainslee, Cape Breton. Twenty years ago about $100,000 was spent in this district in boring, but the work was abandoned.

AN assay of mispickel ore taken from lots 2 and 3 in the 4th concession of Elzevir township, Hastings county, Ont., showed arsenious acid 25.09 per cent.; gold value, $21.07 per ton.

THE Elk mine at Cariboo, Halifax Co., N.S., is now showing exceedingly rich quartz. The lode was lost twenty years ago, after ore yielding $70,000 had been taken out.

THE Act of the British Columbia Legislature prohibiting the employment of Chinese labor in underground workings has been declared constitutional. This is an important matter for the coal companies.

THE Hawk Bay Gold Mining Company has elected the following officers for the year: President, F. C. Bruce; vice-president, H. C. Beckett; managing director, H. A. Wiley; secretary-treasurer, H. N. Kittson.

GOLD has been discovered near Danville, Que., which is famous as the location of the Danville Slate and Asbestos Co. The auriferous vein has been located in Shipton and Cleveland townships, Richmond county.

LEAD pencils made from the Renfrew, Ont., graphite are found to be of the best quality by Johann Faber, the famous manufacturer of lead pencils in Bavaria, and M. Schneider, of Nuremberg, another larger manufacturer.

THE natural gas supply of Ruthven, Ont., which supplies Windsor, Ont., and Detroit, shows no signs of diminution. After being drawn upon steadily for two years, the pressure, which was originally 475, has only decreased to 470 pounds.

A DELEGATION consisting of A. F. Wood, ex-M.P., Thomas Cross and Arthur Cole, of Madoc, Ont., as the appointees of a public meeting, came up to Toronto recently to ask the Ontario Government to erect in their town a reduction furnace.

PELLEW HARVEY, Victoria, B.C., visited a short time ago the gold mining districts of Nova Scotia. Mr. Harvey represents in Canada the Cassel Gold Extracting Company, of Glasgow, Scotland, which controls the cyanide patents of McArthur & Forrest.

ATTENTION continues to be turned towards the Forty Mile Creek in the Yukon, where placer mining has been successfully carried on for some time. The district is now known to be in Canadian territory. The difficulty of transportation is so great that the miners are paid as much as $10 per day.

A QUEBEC charter has been issued to E. A. King, St. Pacome; C. King, Lyster; J. King, Levis; W. S. Thomas, Quebec; W. McNaughton, Pabos Mills, to do business as lumbermen and storekeepers, and to carry on asbestos and other mining within the Province of Quebec, as "King Brothers," with a capital stock of $300,000.

THE headquarters of the Mining Association of the Province of Quebec are situated in the McDonald Building, on Victoria square, Montreal; the rent will be paid by the Quebec Government. The association's architect, Eric Mann, is making alterations in the premises. A very complete museum, club room, etc., will be arranged for.

FROM the official report on the efficiency of various coals used by United States warships from 1893 to 1895, inclusive, prepared by the Bureau of Equipment, Washington, it appears that our Canadian bituminous coal, the product of the Canmore mines, in the North-West, led all others in point of percentage of fixed carbon, 86.367, and also in the small quantity of ashes left after combustion.

A. J. G. SWINNEY, the general manager of the Deloro mines, of the Canadian Gold Fields Co., in Hastings Co., recently stated that his company has not the slightest doubt that by means of its new bromo-cyanogen process the mispickel ores of Hastings county can be successfully treated. Already $350,000 has been spent on the mines and plant, and that investment is to be increased at once to $2,000,000.

THE pressure on our columns caused by the report of the meeting of the Federated Canadian Mining Institute has obliged us to hold over the statistics of the mineral productions of Canada for 1896, prepared by the Geological Survey; the report of the Nova Scotia Department of Mines; the report of W. A. Carlyle, provincial mineralogist of British Columbia, on the minerals of the Slocan, Nelson and Ainsworth districts in West Kootenay, B.C., and a number of other interesting articles on mining subjects.

THE William Hamilton Manufacturing Company, Peterboro', Ont., recently shipped to the Lillooet, Fraser River and Cariboo Gold Field Co., Ltd., of Illecillewaet, two pairs of "Boss" turbine waterwheels. Each pair, set in steel cases, is to work together on a horizontal shaft. Along with this shipment was sent the necessary steel piping, one pair for electric lighting purposes, and the other for driving an electric power generator, which will be employed on a concentrating mill, which the above company has erected on their valuable property at Illecillewaet.

THE curriculum of the prospectors' course at the Kingston, Ont. School of Mining will be read with special interest at a time when so much attention is being devoted to the development of our mineral wealth. The course embraces every section necessary to the study, including chemistry, mineralogy, geology, lithology, discovery and winning of ores, milling, blowpiping, assaying and drawing, and there is also provision made for a series of lectures in advanced work. The work is made thoroughly practical, and those who wish to enter upon it can do so with advantage, even though they may have had no previous scientific education.

Electric Flashes.

THE Peterboro' street railway will probably be extended this spring.

KNOWLTON, QUE., will be without electric light till spring, on account of the lowness of the water.

THERE is a movement on foot in Berlin, Ont., to make the street railway the property of the municipality.

BUFFALO capitalists are interesting themselves in the peg-leg railway at Ridgeway, Ont , and Crystal Beach.

THE Hamilton city council will not grant the bonus of $65,000 applied for by the International Radial Railway Co.

THE New Brunswick Telephone Company is extending its line from Fredericton to Woodstock, along the St. John river.

SOUTHAMPTON, ONT., has carried a by-law voting $11,000 for the purchase of the Saugeen water power and electric light plant.

THE Montreal Park and Island Railway has equipped its cars with motor head lights made by Noah L. Piper & Son, of Toronto.

A NUMBER of water-service pipes on James street, Hamilton, Ont., were recently discovered to have been destroyed by electrolysis.

FOSS & DAVIS, proprietors of the Eastern Townships Electric and Machine Works, Sherbrooke, Que., have dissolved partnership. Geo. F. Foss will continue the business.

THE Bell Telephone Company of Canada, under date of January 30, has presented a petition to the Governor-General in Council asking for permission to increase its rates.

THE Chatham City and Suburban Ry. will apply for an Ontario charter to extend its line to Rondeau, thence to Blenheim and Charing Cross, also to Wallaceburg and Petrolea.

CHICAGO money will build the Chatham city and suburban line if the city will guarantee $200,000 of the company's 4 per cent. bonds for 20 years, in return for a lighting service of 100 lamps.

RECENTLY the Brockville, Ont., subscribers of the Bell Telephone Co. were connected with the Queen's theatre, Montreal, and were treated to the performance over the long-distance wire.

THE Auburn Power Co., Peterboro', Ont., has elected the following officers: President, John Carnegie; vice-president, Jas. Kendry, M.P.; managing director and secretary, W. H. Meldrum.

THE officers of the H., G. and B. Ry. for the year are: C. J. Myles, president; Wm. Harris, vice-president; R. S. Martin, treasurer; A. J. Nelles, manager and secretary, and H. J. Brown, electrician.

THE G.T.R. is experimenting with a system of electric alarm bells for railway crossings. One has been placed at Shoebolton crossing, near St. Mary's, Ont. If satisfactory, they will be used on the whole line.

THERE is an electric railway scheme on foot to connect Richmond and Bell's Corners, and to connect near the latter point with the proposed line of the Ottawa Electric Railway to Britannia. Power will also be supplied.

A TROLLEY line is to be built from Bridgeburg, the Canadian terminus of the International bridge, to the gate of the new Fort Erie Jockey Club grounds, and thence on to Crystal Beach. It is expected to be in operation before July.

THE Mineral and Timber Electric Ry. applies for an Ontario charter to build a line from a point between Chelmsford and Sturgeon Falls to Lake Wahnapitae and to James Bay on the north, and Lake Huron, near Killarney, on the south.

THE Toronto Railway is using the Piper signal system for distinguishing the route of cars at night. This is a great convenience to the citizens, as by this system the route of an approaching car is known when it is several blocks away.

WM. MCKENZIE, E. B. Osler, and other Toronto capitalists are said to have options on the stock of the electric roads running into Hamilton, Ont., with the aim of uniting them, and eventually connecting the Toronto and Hamilton systems.

THE Halifax Tramway Co. realized a profit of $27,000 in the last six months; a dividend was not declared. H. M. Whitney, president, and John Y. Payzant and David McKeen, vice-presidents, were re-elected. The extension of the road was left over till the spring.

THE H., G. & B. directors, who went to St. Catharines recently to meet Dr. Oille and other railway projectors to talk over a proposed electric railway between St. Catharines and Beamsville to connect with the H., G. & B. Railway, are reported not to be in favor of the H., G & B. Company building the line. President Myles, of the H., G. & B., promised to have an engineer go over the line at an early date.

C. D. MCPHIE, Arnprior, Ont., has invented an electric alarm clock which will light any required number of electric lights at any fixed time, and also turn them out as may be required. Connected with it are alarm bells which may be rung when the lights are turned on.

THE Sherbrooke Electric Street Railway has let a contract for five hundred poles, two hundred of which the contractors will begin to deliver at once. The road to the exhibition grounds is expected to be finished for traffic by July 1, and the entire system in running order for August.

A CONTRACT has been closed between the Quebec Cold Storage Company and the Linde British Refrigeration Company, of Montreal, for the installation of a refrigeration plant, which is to be operated by electricity, supplied by the Montmorency Electric Power Company.

PRESIDENT SALISBURY of the Burrard Inlet, B.C., Telephone Company, says that his company will begin in the early spring and build a line through from Ashcroft to Clinton, 150-Mile House, Soda Creek, Quesnelle, Stanley and Bakerville, with a branch line to Quesnelle Forks.

THE annual report for 1896 of the Ottawa Electric Railway Co. shows Ottawa's progress. The total number of passengers carried in the Ottawa electric cars in 1892 was 1,520,405, with receipts of $71,698. In 1896 the number of passengers carried was 4,583,235, with receipts of $212,105.

AT a meeting of the executive committee of the Canadian Electrical Association, held on the 25th ult., it was decided to hold the next convention of the association at Niagara Falls, Ont., on the 2nd, 3rd and 4th of June next. Committees were appointed to make the necessary arrangements.

THE seventeenth annual meeting of the shareholders of the Bell Telephone Company was held in Montreal last month. The annual report showed that the total number of sets of instruments now earning rental was 29,462. The company owns and operates 341 exchanges and 275 agencies. During 1896, 176 miles of poles and 1,013 miles of wire were added to the long distance system, of these 11 pole miles and 236 wire miles are in the Ontario department, and 165 pole miles and 777 wire miles are in the Eastern department. The long-distance lines now owned and operated by the company comprise 15,864 miles of wire on 6,060 miles of poles. The report was adopted and the old directors re-elected.

THE report read at the annual meeting of the Lachine Rapids Hydraulic and Land Company showed that the electrical machinery is all completed and ready to be shipped from Schenectady, N.Y., while the power house and dams are practically finished. The pole line is also completed, the conduits all in and the contract has been given out for the lead cables. The wire contract was let some time since, and a portion has been already made and tested. The water wheel machinery is likewise all on the spot, and everything indicates a most successful inaugural early in May. The report says that the sale of the lots alone will more than pay for the hydraulic development. The following officers were elected: G. B. Burland, president; Alex. Fraser, vice-president; Peter Lyall, E. K. Greene, R. Wilson-Smith, S. Carsley, and W. McLea Walbank, managing director.

Railway Matters.

THE G.T.R. is placing heavy steel trestles on five bridges between Chatham and Windsor, Ont.

CORNWALL, ONT., is asking for an extension of the time limit in the charter of the Ontario and Pacific Railway, which is planned to cross the St. Lawrence by bridge at that town.

THE statement of the earnings of the Canadian Pacific Railway, for the twelve months, January 1 to December 31, 1896, shows the net profits to have been $8,107,581.74, against $7,480,950.99 for the year 1895.

A JOINT deputation representing the Toronto city council and the Board of Trade waited on the Ontario Government recently to urge aid for the James Bay Ry., which is proposed to bring the trade of the new mining regions to Toronto. Geo. H. Bertram spoke on the wealth of the district.

THE Winnipeg, Duluth and Hudson Bay Railway applies for a Dominion charter to build a line, to be operated either by steam or electricity, from the southern boundary of Manitoba to Winnipeg, and thence to Hudson Bay.

THE Desbarats and Northern Railway Company applies for an Ontario charter to construct a line, to be operated by steam or electricity, from St Joseph's Island to Algoma, to the C P R near Desbarats station, thence to Moose Factory on James Bay.

W B. MACKENZIE, assistant chief engineer of the Intercolonial Ry., inspected the Canada Eastern shops at Gibson, N.B., and the road recently. This is thought to confirm the report that the Canada Eastern is to be purchased and run by the Government.

THE difficulties among the Niagara Central board of directors have been settled by the retirement of President Dr. Oille and directors W W Greenwood, John Shields, J. S. Campbell and J. N. King The new directors are Capt. P. Larkin, G. M. Neelon, president, Dr. Elliott, vice president, A Woodruff, F. E. Coy and H. M. Helliwell.

THE half yearly statement of the Grand Trunk Railway shows that the gross receipts were £2,079,700 during the six months, and the net receipts £616,000. A deficiency of £67,500 is charged to the Chicago and Grand Trunk section, while the Detroit and Grand Haven part of the system is behind £24,000. A surplus of £39,000 is shown for the half year, as against a deficiency of £33,100 for the same period of 1895.

Marine News.

THE Beaver steamship line has been bought by Peterson, Tait & Co.

THE famous Cramp shipyards are to establish a branch at Sault Ste. Marie, Mich.

A STOP lock will be built in the Cornwall Canal below the lagoon at Sheik's Island.

N. TESSIER, Hull, Que., is building a steam ferry boat to ply between Ottawa and Hull this spring.

CAPT. CRAWFORD will sail the "Modjeska," of the Hamilton Steamboat Company's Line, this season.

THE C P.R. is to build docks at Rat Portage, Ont., to handle the heavy freight for the mining districts.

THOMPSON & Co., St. John, have contracted for another steamer to be named the "Platea," and to be the same size as the "Cheronea" now building.

ALAN SULLIVAN, C.E., M.E., has prepared an estimate for the proposed lock at Ash Rapids, Lake of the Woods, which the Government is asked to construct.

DIFFICULTY is still being experienced in dredging for the new wharves at St. John, N.B.; about thirty feet of the bank fell in recently, sinking a portion of the old Mayes wharf out of sight.

GEO. LEPROHON, of Three Rivers, Que., is organizing a company to run in opposition to the Sincennes McNaughton Line on the Richelieu and St. Lawrence Rivers, from Chambly to Montreal, Three Rivers and Quebec.

THE Richelieu and Ontario Navigation Company has decided to place the steamer "Columbian" on a western route, and to conduct excursions from Colborne, Cobourg, Port Hope, Toronto and Hamilton to various United States and Canadian ports.

AT the annual meeting of the Ottawa River Navigation Company, the old board of directors was unanimously re-elected, namely: J. J. Gibb, president; H. W. Sheppard, vice-president; G. W. Simpson, R. Bolton and R. W. Sheppard, managing director.

C. MEIKLE, Gravenhurst, Ont., is having a $4,000 steam yacht built at Kingston, Ont., for service in the Muskoka Lakes. The same Kingston firm is also building a 40-foot yacht to cost $1,750 for W. J. Thomas, Toronto, which will also ply on the Muskoka Lakes.

THOMAS RUBIDGE, chief engineer for the Public Works Department on the St. Lawrence canals, says that the water in the St. Lawrence is very low, and he does not think it will ever be higher. It has been falling steadily since 1871, and has never been so high since then as it was before that date. Mr Rubidge has an experience of over half a century in observing the St. Lawrence River.

AT the annual meeting of the Richelieu & Ontario Navigation Company, it was stated that the net profits of the year's business was $104,186.67. The gross receipts were $669,091.35, showing a decrease against last year of $20,077.11. The expenditure showed a decrease of $17,825.92, but the actual decrease in expenditure was $51,972.11, as the sum of $34,146 had been expended in improvements. The president, the Hon. L. J. Forget, said that in order to keep up with the business, it was intended to build two new steamers to run between Toronto and Prescott to connect with the steamers at these points, and that these new boats would be ready for the season of 1898. C. F. Gildersleeve, the general manager, said the decrease in the annual expenditure was due to the improved condition of the machinery. The different portions of the steamers, including the working parts of the machinery, were being continually removed and improved. The steamers are now in a much better condition than when he joined the company in 1894. The following officers were elected. The Hon. L. J. Forget, president, W. W. Wainwright, vice-president. Executive committee—W. Wainwright, Col. Henshaw, Joseph Louis, C. O. Paradis, and R. Forget.

THE above is one of two car-loads of 50,000 feet of tramway cable, weighing 48 tons, shipped to the Hall mines, Nelson, B.C., by the Dominion Wire Rope Co.

Industrial Notes.

DR. LARRATT W. SMITH has been elected president of the Consumers' Gas Co. in place of the late Jas. Austin.

THE Metallic Roofing Co. has closed a contract for the I.O.F. Temple building, Bay street, Toronto, for embossed metal doors, copper-plated metal dado and Hayes' patent fire-proof lathing. The estimate for the work calls for $32,000.

THE Weeks-Eldred Co., Toronto, has contracts to supply the Improved Jones Under Feed Mechanical Stoker to the boilers in the High Level Pumping Station of the Toronto Waterworks; the new Court House, the I.O.F. Temple building, Bay street, Toronto, the Bowmanville, Ont., Rubber Co., and John Labatt's Brewery, London.