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CONTENTS OF THIS NUMBER:

For THE CANADIAN ENGINEER.

RAILWAY ENGINEERING.*

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

INTRODUCTION.

These papers are the outcome of an endeavor on the writer's part to epitomize a vast subject into such a compass that the student or layman whose experience is pre-supposed to be "nil" may grasp it in an intelligent way. It is intended to be a foundation course only, and as such, has been largely selected from the various works bearing on each department of the subject; but the proper balancing of the parts, if such there be, giving each its due importance, the combination of the whole subject, technically considered, as a ground work for future study, and the exclusion of much confusing detail which obscures the mental vision, the writer may claim as his own.

During the present period of depression, which always so seriously affects railway construction, it might be thought that the vocation of the railway engineer was being largely obliterated; but this is not at all a consequence. Our railways must be maintained, and while more engineers, per mile, are employed during construction than afterwards on maintenance, yet, although there are, no doubt, pleasant and remunerative positions to be had during the former period, there is no condition of permanence that makes them desirable. On the other hand, railway companies recognize more, every day, the value of a technical engineering training for those young men who fill junior positions in the operating and maintenance departments, not strictly engineering in their nature.

And those companies (*e.g.*, Pennsylvania, or Norfolk and Western) that have persistently filled such positions with young engineering graduates, that have had them do routine work and given them a business training, have seen their highest offices filled by men whose engineering knowledge has brought them to the front, when aided by a good business training, a knowledge of ways and means, and of traffic and operation.

In the future, such positions, and those on the maintenance staff proper, would seem to be the paths more likely to lead to success than the more strictly technical work of location and construction, particularly as the construction in future will be chiefly in the shape of short extensions of large systems having permanent staffs.

These papers, however, will deal chiefly with location, construction and maintenance, not because these cover the whole ground, but because a knowledge of traffic, rates, operation and management can be gained only by experience, whereas a good grasp of the former may be had previous to employment of such an extent, at least, as will be valuable in obtaining and filling junior railway positions, and also form a basis for future study. And even though very little of what is here given may be used at once by the young engineer, yet it will enable him to take a more intelligent interest in all that his superior officer does, which he could not otherwise do unless he had a proper understanding of the general principles on which railways are surveyed, constructed and operated He is warned against having his faith in these principles shaken by the adverse criticism of men who do not appreciate or understand them. Care is taken to give here only what is fairly well tried and established.

On the other hand, he is advised to keep his opinions, largely, to himself, and to carry out faithfully the instructions of his superiors in office. These instructions, though perhaps sometimes faulty, should be studied and respected, so that when the time arrives that he, in turn, gives orders which must be obeyed, he may put into practice what he then considers, after several years' experience, to be best, not only theoretically, but from the standpoint of being feasible and advantageous, capable of being put into execution by his assistants—the best, all things considered.

It must not be forgotten that these papers are not exhaustive, but merely introductory. Years of reading, conversation, experience, observation, and above all, honest hard thinking, are necessary to complete a man's knowledge on any subject, and even then it is not complete. So that we must never desist, but always persevere, if we wish to keep up with the progress of this most progressive subject. C. B. S.

Montreal, Que., Canada, May, 1897.

CHAPTER I.—FUNDAMENTAL CONSIDERATIONS.

ARTICLE 1.—TRANSPORTATION.

The inhabitants of the civilized world have, since the year 1825, been enabled to remodel their ideas of

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

how and where to live. There has been developed within this period a new potentiality, which had through all the previous history of the world been practically dormant. The impulse given by it to the material and industrial progress of the world is such as to stamp it as one of the grandest events of our world's history, and it will be so spoken of in future ages. It is the development of transportation.

In its broadest sense, transportation may be said to include all means of communication; but of its various phases the transportation of material objects by means of the railway train will be the one treated of in this book.

The railway had its birth in England, and a fierce struggle took place between it and the canal for supremacy, while in North America the canal systems not being far advanced, and the extent of territory to be traversed rugged and vast, the result was never in doubt; to-day, the canal is a useful regulator of rates, and a means of transportation of heavy bulk freights in which time is not a factor, but it cannot be said to be a competitor of the railway to any serious extent.

By 1850 the people of North America had grasped the fact that the rapid extension of our railways to the remote and unsettled regions westward, was the key to that marvellous growth that has peopled a continent in so short a time. The capital available was small, and the country fairly rough, so that different methods of construction and operation from those in vogue in England, and a consequent different class of equipment, were imperative.

At the present day, in Canada, our railways are developed along the same general lines as those of the United States, and in it we have done our fair share, but it must be recognized that to the civil engineers of the United States is due the credit of those essential departures from early forms which have defined our continental types so distinctly, and are the glory and the boast of North Americans. These departures took place gradually, the gap becoming wider every year, until now it has passed its maximum, and the slow conservatism of English engineers is yielding. Bogie trucks, equalizing levers, Westinghouse brakes, and American cars are becoming familiar in England, while on the other hand increased wealth and traffic are enabling American railways to introduce block-signalling and interlocking systems, to abolish many grade crossings, and make their road-beds more solid and permanent.

The distinctive features of the railway system of North America that have enabled it to extend to a length of over 200,000 miles (including Mexico and Central America), that have given Canada a system of over 16,000 miles, moving 22,000,000 tons of freight, 14,000,000 passengers, 60,000,000 newspapers, 100,000,000 letters, besides much express, etc., each year, having a capitalization of $900,000,000, and employing an army of perhaps 55,000 men, are as follows:

(1) A frank recognition of the fact that curvature is not a great drawback, and can be introduced freely to economize construction.

(2) The introduction of bogie and swivelling trucks and equalizing levers, enabling lines of poor surface and sharp curvature to be operated safely and economically.

(3) The use of long wheel-bases on engines for freight work, enabling greater weight to be put on the drivers of engines operating over quite inferior track.

(4) The consequent hauling of increasingly heavier loads of freight per engine and per train crew.

(5) The lowering of freight rates to a point that enabled coarse freights to be worth moving, thereby increasing the volume of freight enormously.

(6) The acceptance of a timber-construction period, enabling roads with meagre early traffic to pay their small fixed charges and survive until their finances and credit are such as to enable them from their earnings or by increased bonding to replace such structures with permanent ones. The Canadian Pacific Railway is a striking example of this.

(7) The use of increasingly heavier freight cars, in which paying freight is a larger percentage of the gross load—and also giving a less co-efficient of rolling friction—which the following table illustrates:

1875	..20,000 lbs.	car,	20,000 lbs.	freight,	50 per cent. dead load
1880	....24,000 "		40,000 "		37 " "
1890	....28,000 "		60,000 "		31 " "
1896	.. 36,000 "		80,000 "		31 " "

From which it appears that the limit has been reached.

ARTICLE 2—PROJECTS.

A company of limited liability, but whose capital is inelastic and non-circulating, must do business or break down; it cannot contract its business in hard times except at a sacrifice; business at starvation wages is better than none, and this is the exact condition of a railway company which is a manufacturer and seller of transportation. In this it is different from a store, or more particularly a banking house, therefore all the more carefully should the project be studied before money is embarked in it.

No considerations of a general character will cover all cases, and therefore it will be necessary to exclude roads which have been or may be built (*a*) for purposes of blackmail, to force rival companies to buy them out; (*b*) for speculation of the builders, not owners. These are not legitimate enterprises, but ones which projectors start by the expenditure of a small sum for charter, issue of bonds, etc., expecting to charge a margin for selling the bonds, to form construction companies, and let the contracts of construction to themselves at high prices, getting all the money out of the bondholders, running no risk themselves, but controlling all management by means of valueless stock. This gives them all the voting power, and any extra profit remaining after the bond coupons have been paid. Even such roads as these, however, will profit in the same way, as legitimate enterprises, by the application of true economy in location and construction.

Cost is the basis of all business, and most particularly in the case of railways must this always be so. An engineer may insist on technical accuracy and massive work, to such an extent as to bankrupt his company before the road is on a paying basis or even built, or he may, in an ill-directed effort toward economy, give it such a miserable constitution of grades and position, relatively, to its customers, that it will never secure traffic, and could not handle it economically if it did. Between these two extremes, the intelligent engineer should strike a happy balance, so that the project may be where it can obtain most traffic, at least first cost consistent with moderate working expenses, so that it will be profitable to the present owners or promoters, who usually build the road on borrowed money up to a certain safe mortgagable amount.

The promoters of roads are always sanguine, and probably the most common error into which such men

usually fall, is to overrate the funds on hand or in view, and on the other hand, to underrate the cost of the completed enterprise. Roads are seldom built within their first estimated cost, and therefore, this is a danger against which the chief engineer must guard; he must be sure and firm in his figures, because it is difficult to foresee all contingencies, and still more so to impress the directors with the reality or necessity of each item.

The finances at the command of the company should always be fully known to the chief engineer; he has the right to know it, and should have the courage to insist on the fullest confidence of the directors. These means should be carefully studied, allowances made for changes in the money market affecting the value of bonds, the amount of money which can be raised easily, and the difficulty in getting the *last* part of the required amount should also be considered. Usually the bonds of new roads, just being built, sell below par, and, as the amount issued increases, the selling price may get less and less, until they may become unsaleable.

Many roads become bankrupt before or just after construction is finished, and a promising project ends in a receivership, the wiping out of past debts, or issue of prior-lien bonds on the part of the bondholders themselves. Receiverships, instituted originally to protect bondholders, are often made the instruments of defrauding them. The history of the railways of the United States, particularly, is full of examples of unnecessary roads built on faith and hope, and ending in disaster or fraud. Over 25 per cent. of United States railways are now in receivers' hands, and nearly all have passed through that stage in some period of their history.

The most casual observation teaches that in a country like Canada, where traffic is still unfortunately very light, we must build roads with the utmost economy. This has been practised in several justifiable directions.

(*a*) The introduction of curves where necessary, with a sharpness of as high as 4° to 6° on main lines, and 8° to 10° on branches, with a frequency only limited by a piece of tangent of 200 to 400 feet long between curves; in this way, by a slight addition to the cost of hauling trains and length of line, the cost of road-beds has been kept at a minimum.

(*b*) The use of fluctuating grades, by which the local "sags" or depressions do not increase the cost of hauling trains, but cheapen the cost of construction materially, and which have no objectionable feature except a change in train speeds, as they store up or yield a part of their "velocity head."

(*c*) Timber structures over all important streams, and even timber box culverts under light banks; in this way a railway company is enabled to get its road in operation quickly at a minimum cost, is able often to tide over the first few years of meagre traffic, replacing them, gradually, as means will permit, with permanent structures. On the other hand, there are certain directions in which economy cannot be practiced.

(*a*) Narrow gauge roads, except in isolated cases, have now been abandoned, because the demands for interchange of traffic put them at a disadvantage; because the cost of construction is higher in proportion to carrying capacity of cars, etc., and chiefly because it is found that American engines of standard gauge can pass around any ordinary curve quite freely.

(*b*) Light rails. This will be dealt with more fully in future chapters, but it may be well to say here that with rails quoted at $20 to $25 per ton, there is no greater blunder than to buy light rails. In stiffness, strength and wear the increase varies nearly as the square of the weight per yard, thereby decreasing maintenance charges enormously as the weight increases. The present weights are roughly 60 lbs. per yard for branches and 80 lbs. for our main lines, with a strong tendency upwards.

(*c*) Excessive ruling gradients. Almost any other mistake can be corrected in time, curves can be flattened, short grades lifted, temporary structures replaced, but the ruling grade is the life or death of a road that has or expects to have any traffic beyond a meagre minimum. This question will be fully dealt with in Chapter II.

(*d*) Locating roads adjacent to but not through towns. Many instances might be given of this fact, where railway companies, in order to save money on right of way, to shorten the line slightly, or out of pique at not receiving bonuses, have built the road a mile or more away from the centre of population. Experience proves, however, that it is usually profitable to pass as near as possible through the *very heart* of all towns or cities, even at considerable extra expense.

The engineer must, therefore, when entrusted with a study of proposed routes, have several leading ideas constantly in his mind:

(1) How to obtain the most traffic, including the idea of shutting out, avoiding or fighting competitors.

(2) How to get a road built with as small fixed charges as possible consistent with small operating expenses, and clause (1).

(3) How to build a road that will be operated and maintained at as small a charge as is consistent with clauses (1) and (2). *These three things are intimately intertwined*, but may be affected by such considerations as obtaining heavy local aid, having heavier grades in direction of lesser traffic, and a complete change of train loads at the end of each engine division (100 to 130 miles), excepting always that the whole road will allow the passage of moderately heavy passenger trains intact.

Unfortunately these matters are often, erroneously enough, may be, settled quite apart from engineering ideas, politics and local aid being the controlling factors; but facts remain, and while politicians perish and local aid, once given, looks for a *quid pro quo*, the railway burdened with too heavy grades, too much debt, or distant from its customers, will gradually, but surely, fail in the race. The problem which has to be solved, in each case, is to create a paying property without satisfying, often, the dangerous desire on the part of the engineer to build solidly and erect monuments to himself, or satisfy his innate desire for excellence of construction considered from too narrow a standpoint. This is a difficult matter in a thinly settled country like Canada, as statistics to be given will show, but our roads are being more economically constructed and operated day by day and traffic is slowly increasing, so that we may confidently look forward to a time when there will be a change and some small returns for the stockholders and promoters.

(*To be continued.*)

BRITISH RAILWAY ENTERPRISE.

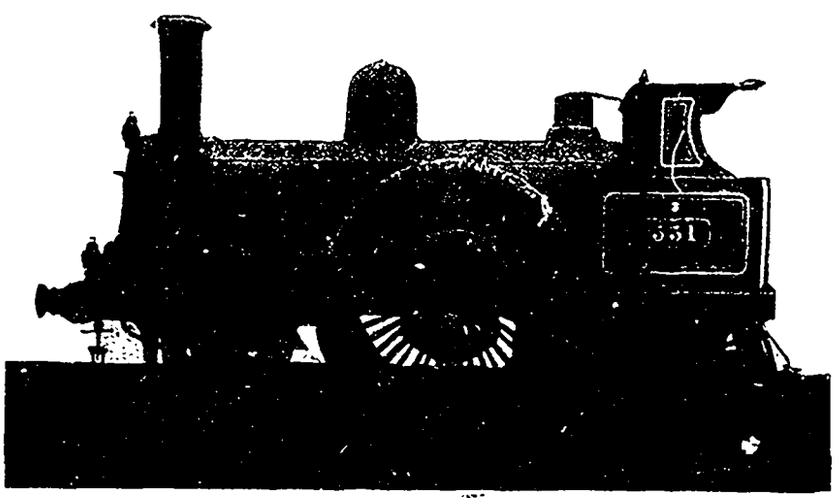
(Correspondence of THE CANADIAN ENGINEER*)*

Before the writer set foot in England he was inflated with the idea common to Americans (using this word in a continental sense) that we were ahead of the world in railway enterprise and railway management. A few journeys over Great Britain and a short study of the two systems will dispel that idea as an illusion.

ENTRANCE TO EUSTON STATION, LONDON AND N.-W RAILWAY.

It is true that the American tourist will, generally speaking, miss his convenient system of baggage checking, and will see the faults of the compartment system of passenger cars; but if he travels by the London and North-Western Railway, he may have the American system applied to his baggage, with the American feature of "baggage smashing" omitted, and if he is travelling on a through train he will find dining cars, sleeping cars and parlor cars on a modified American plan, quite as luxurious, quite as convenient and affording easier riding than any in the United States. But assuming that this splendid Americanized special service on the London and North-Western did not exist, the unprejudiced American will find on investigation that the system in use in the United States and Canada could not be wholly applied to Great Britain without depriving it of some of those distinctive points which make it on the whole the most efficient and best managed railway system in the world—for in the three great essentials, solidity of construction, average speed of trains, and safety of passengers, the railways of Great Britain stand unequalled. On a previous visit to England the writer remembers reading the annual report of the London and North-Western. Out of over 25,000,000 passengers carried that year by this company, not a single passenger's life was lost! Think of the efficiency, the care, the regularity and intelligence this means. No such record has been known in any corporation of like dimensions in the history of American railways. Then as to speed, it is true that the "Empire State" express on the New York Central now holds the record for the fastest train in the world, but that is an exceptional performance, and the average speed of the New York Central expresses is below that of the leading English railways. Taking a late time table of the London and North-Western, I find that the six expresses running daily from London to Carlisle make an average of 45.4 miles per hour, and on the return to London the eight expresses make an average of 44.5 miles per hour, while the New York Central's four expresses from New York to Buffalo make an average of 43.6 miles per hour, and returning from Buffalo to New York the average is 42.9. The difference is nearly two miles per hour in favor of the London and North-Western, though the grades on the English road between Crewe and Carlisle are much more severe than those on the New York Central.

Although the area of Great Britain is so small compared with the United States and Canada, and although it has been for years covered with a net work of rails, while vast regions of America are still unserved, the mileage of new roads was relatively greater during the last year under review (1895) in Great Britain than the United States, and what is still more remarkable, the British roads return better dividends. In 1895 there was added to the United States railways 1,628 miles, while in Great Britain the mileage added was 270. In the same year the railways of the United States earned a dividend of 2.94 per cent., while those of Great Britain earned 3.95 per cent. In both cases the dividends are less than in former years; partly due, no doubt, to the increasing use of the bicycle, and in the case of the United States to the growing competition of the electric railways in some States. In addition to this the widespread depression in the United States has no doubt put a check on new enterprises, and new roads are not built for the benefit of contractors so much as they used to be. Anyone travelling over Great Britain is struck with the solidity of the permanent way, the substantial character of the stations,



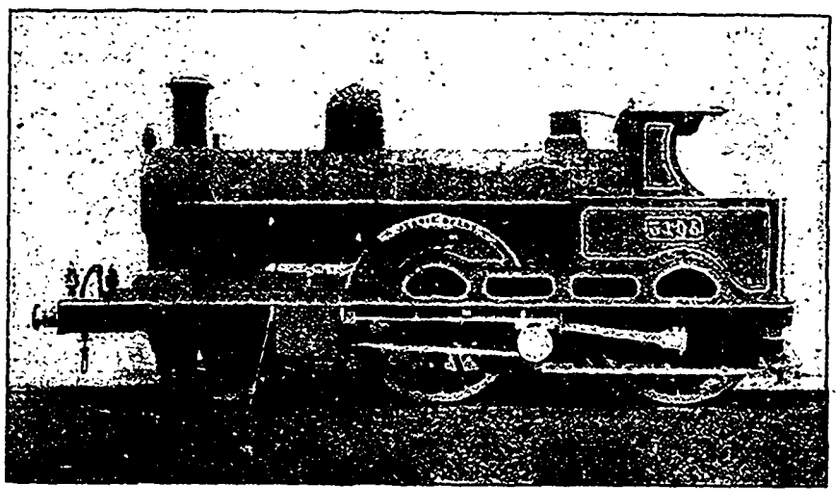
"LADY OF THE LAKE" PASSENGER ENGINE, WITH 7 FT. 6 IN. DRIVE WHEELS—L. & N.-W. RY.

the numbers of solid bridges, viaducts, culverts, archways and tunnels—all built to last for ages. The English railway builder goes through a mountain, the American goes over it. The cost of construction of British railways is about double those of America, but the receipts of British railways in 1895 were over three times those of the United States, being $19,220,

against $6,170 per mile. British railways are operated more economically than American, for of the gross receipts of the United States railways 70.30 per cent. were absorbed in expenses, while in Great Britain the expenses are 56 per cent. of the receipts. About a quarter of the revenue of the United States railways is derived from passenger traffic, while the passenger traffic of Great Britain is 46 per cent. of the whole. The total freight handled in the United States, in 1895, was 763,750,000 tons, while Great Britain, with one-ninth of the mileage, handled 334,000,000 tons. In the last ten years $72,500,000 were spent on new railways and improvements in Britain, there being 1,842 miles built in that time; and the total capital now invested in the railways of these islands is £5,005,000,000. The average annual increase in the passenger traffic is 23,000,000 passengers, though the increase in 1895 was only 19,750,000. The enormous amount of passenger traffic handled in England, and the admirable order with which the vast crowds are carried on special occasions, such as holidays, is one of the marvels of British railway traffic. In Yorkshire and Lancashire, the factory population hold what are called "wakes," the annual summer holidays, when thousands upon thousands swarm to the seaside or mountains, having saved up by means of "going away clubs," sufficient for the festive occasion. Last summer, in the town of Oldham alone, a total of $750,000 was drawn from the funds of the "going away" clubs, and half of this big total was spent at Blackpool, the popular seaside resort of Lancashire. This attractively situated seaside town is reached by the London and N.-W., and on the occasion of the last Oldham "wakes," no less than twenty special trains were required to convey the holiday-seekers of that town to Blackpool. On the last bank holiday, twenty-seven special trains had to be provided to take holiday seekers from Liverpool to Southport—another seaside resort of Lancashire fed by the L. & N.-W. Though this was nearly double the number that had been calculated on, the extra traffic was provided for without hitch or accident. Altogether, on that single day, the L. & N.-W. ran 150 special trains into Blackpool alone, yet not a mishap was reported, and the regular service went on with nearly its usual regularity. Within a comparatively short time, on that day, the booking clerks (ticket agents) of the L. & N.-W., at Liverpool, made change for 9,219 passengers and took in £2,449; while at Birmingham, the same day, they sold 24,978 tickets, and took in £6,608. On the day before this, at Euston Station, London, the sum of £8,414—say, $42,070—was received for passengers' tickets. To supply all these tickets, give the correct change instantly, as they must do, to keep account of the cash, and answer enquiries, implies a combination of alertness and coolness which seems almost supernatural to the lay mind. Yet the same trained intelligence is required in the engineer, the signalman, and the other employees who have to cope with work requiring such lightning-like activity, and who have so many thousand lives dependent on them.

INTERIOR OF SALOON CAR, LONDON AND NORTH-WESTERN RAILWAY.

Two samples of London and North-Western express engines are given in this letter, these being of the class that will carry the tourist from Liverpool to London—a distance of 100¾ miles, in less than four hours and a-half; and they can easily run over a mile a minute. The L. & N. W. have over 3,000 engines, all built at their workshops at Crewe (which will be referred to in another letter), and the value of these engines is over $25,000,000. One of them, the old *Cornwall*, having a drive-wheel 8 feet 6 inches in diameter, has just been laid off after 50 years of service. Every five days a new engine is turned out from these shops, and 2,000 come in each year for overhauling, there being an average of 330 in hand at a time. The "Jeanie Deans" compound express engine, which hauls the Scotch express from Euston, frequently takes 18 to 20 cars, including the heavy dining-cars. The "Greater Britain," another recent engine built at Crewe,



"THE JEANIE DEANS."

is perhaps the most powerful locomotive in existence. Though heavier than any other on the line, it does not put any more steam on the permanent ways or bridges, owing to having an extra pair of small wheels underneath the foot plate, these wheels having half an inch of side play. The front wheels have a patent radial axle-box—designed by F. W. Webb, the company's

mechanical engineer—so that the engine, though of great length, can travel safely over curves. The engines on the L. & N.-W. consume over 3,000 tons of coal per day. In my next letter I shall speak further of this company's great shops at Crewe

For THE CANADIAN ENGINEER

FORMATION AND AGGLOMERATION OF FRAZIL AND ANCHOR ICE.

BY HOWARD T. BARNES, M.A. SC., DEMONSTRATOR IN PHYSICS, M'GILL UNIVERSITY, MONTREAL.

In northern countries there is no subject which presents so many practical difficulties to the hydraulic engineer as the formation of frazil and anchor ice, and their subsequent agglomeration into masses. The relations of these phenomena to the temperature of the river water have been repeatedly under investigation, but while much valuable work has been done already, the observations have been of such a contradictory nature, especially as regards the temperature of the water, that very few practical suggestions have resulted. The purpose of the present paper is to endeavor to present to the readers of THE CANADIAN ENGINEER a simple and intelligible explanation of the appearance of frazil, based on a long series of experiments undertaken on the St. Lawrence River, to show the dependence of its formation on the temperature of the water.

Among those, in later years, who have taken the keenest interest in investigating the question of frazil is John Kennedy, who is the chief engineer of the Harbor Commissioners' Works, at Montreal, and it was through him that the writer's attention was first directed to the importance of the work. Mr. Kennedy had long felt that some connection existed between the agglomeration of frazil ice and the temperature of the river water, but could not with the apparatus at his command satisfactorily demonstrate that such a relationship existed. Under his direction, as a member of the Montreal Flood Commission, temperatures of the river water during the winter were taken by W. J. Sproule, the assistant engineer, both under the surface ice and at Lachine in open water. Although great care was taken with the measurements, no definite variation from 32° F. could be detected even in the most severe weather. The measurements were taken with an instrument designed by Mr. Sproule, and consisted of a mercurial thermometer reading to tenths of a degree, enclosed in a tin case so that a quantity of the water to be measured was brought up and served as a protection against the colder air. By this means it was clearly shown that if any deviations from the freezing point took place, they must be less than can be measured on a thermometer reading only to tenths of a degree.

Mr. Kennedy, with the object of testing the matter more accurately by means of more delicate thermometers, consulted Prof. Callendar, of McGill University, in regard to carrying on the work by means of an electrical resistance thermometer. Prof. Callendar accordingly designed, and had constructed in the McDonald Physics Building, a thermometer capable of reading differences in temperature to the thousandth part of a degree centigrade. As the employment of this thermometer entailed considerable practice in the use of electrical measuring instruments, and Prof. Callendar was wholly occupied with the work of the session and had no spare time to devote to the observations, the writer undertook the measurements at Prof. Callendar's request.

An electrical resistance thermometer is really the only form of instrument suitable for measurements of this kind, not only because it measures with a far greater degree of refinement than can be looked for in a mercurial thermometer, but because it may be read from a sheltered place without withdrawing the stem from the water. Very little reliance can be placed on observations made on any temperature measuring instrument which has to be taken out of the water and read in an atmosphere cooled down far below freezing.

The thermometer used was of the differential type and consisted of two stems, each made of a similar coil of platinum wire. The coils were balanced against each other by the well-known Wheatstone's bridge method. The coils of wire were protected by small lead composition tubing, about eight inches long, which was soldered to longer and thicker compo-tubing containing the connecting leads. One end was made 100 feet long, to pass into the river, while the other end was made 10 feet long, for retention at a uniform temperature in a sheltered place.*

The temperature of the water was determined, not directly, but more accurately, as a small difference from a carefully prepared mixture of snow and water. Every possible error, due to changing temperature conditions, in the connecting leads and on the rest of the apparatus, was compensated for. The thermometer was so made as to have a scale of 8 inches to the degree and a vernier with lens reading to $\frac{1}{2000}$ of an inch. Under suitable laboratory conditions it was possible to measure to $\frac{1}{10000}$ part of a degree centigrade. In the present case, in spite of obvious difficulties in making refined electrical measurements in a light shanty unprotected from the wind, readings were accurate to $\frac{1}{1000}$ of a degree.

The method of making an observation consisted in immersing the two ends of the thermometer in a mixture of snow and water in the shanty, and obtaining a zero reading when both the ends were at 0° C. The shorter end was left in the mixture and the longer end passed out of the shanty into the river. Any difference in the temperature of the river from the mixture of snow and water in the shanty was immediately obtained. During the winter of 1895-96 the writer carried on the experiments for a considerable time on the river water, under the surface ice, opposite Montreal, and, during the winter of 1896-97, made a similar series of observations in open water at the Lachine Rapids. A shanty was provided at both places by the Harbor Commissioners, through the kindness of Mr. Kennedy, and served for the reception of the instruments and for making the measurements. A watchman was also procured to protect the instruments.

The results of the first series of experiments have been recently published in the "Transactions of the Royal Society of Canada," vol. ii., sec. iii., page 37, and those of the second series will, it is hoped, be published in the course of the year. In the first paper will be found, besides the results of the observations, a description of the instruments used in the investigation, and a brief discussion of some of the principal points brought out by previous observers.

The general results of the writer's experiments have

* The writer desires here to express his thanks to H. T. Pye, Instrument maker in the McDonald Physics Building, for willing aid in renewing, at short notice, delicate portions of the apparatus which were broken through want of proper laboratory conditions.

been to show that the temperature of the river water under the surface ice does not vary throughout its depth by more than a few thousandths of a degree from the freezing point during the entire winter. During the time in which the measurements were made the air temperature varied from −28° F. to + 40° F. Small differences from the freezing point are recorded, and these are found to accompany atmospheric changes. A sudden drop in temperature of the air below 0° F., after a warm spell of weather, would invariably send the temperature of the water slightly below freezing. On February 25th, 1896, an observation after a sudden cold dip gave a difference from the freezing point of −.005° C. On March 4th a similar cold dip gave −.006 to −.0004°, and on March 11th, −.004° C. It was found that these small differences below freezing never continued, although the air temperature remained cold. The river soon came to the freezing point with the apparent accumulation of frazil under the surface ice. During mild weather the temperature of the river never rose more than one or two thousandths of a degree above freezing. From the experiments in open water it was found that the variations were of the same order below freezing as those under the surface ice, but the extent to which the river could become warmed through the influence of sun and rain was much larger than could be expected under the ice.

Differences of opinion have existed to a great extent among observers in regard to the temperature of the river water in winter. Mr. Kennedy has charts of air and river temperatures for three years, taken for the Grand Trunk Railway by the late T. D. King, at Victoria Bridge, under the surface ice. There are recorded variations of temperature of the water amounting to several degrees below freezing to several degrees above. It is not known to the writer how the measurements were taken, but as these variations are very large and are not found to correspond with the atmospheric changes, they suggest possible errors of observation. Since then a number of observers have expressed the confident opinion that the river water in winter is cooled considerably below freezing. In one case an observer had noticed on very cold days the water in the river above the Lachine Rapids at the mouth of the waterworks to be in general 32° F., and sometimes 31° F., down to a depth of 20 feet. Here again no details have been given as to how the measurements were taken, or what methods were adopted for reading the thermometer in a cold atmosphere. It is important for observers, who have actually found large differences from the freezing point, to state clearly how the readings were obtained, since from Mr. Sproule's measurements and those of the writer's no considerable variations could be detected.

With special laboratory precautions it is undoubtedly possible to cool water, free from ice and dissolved air, to several degrees below freezing, without the formation of ice. On the slightest agitation, however, or on the introduction of the smallest crystals of ice, there will be formed all through its mass long needle crystals of ice in sufficient quantity to bring the mass of water to the freezing point. It will then be found impossible to further cool the mixture of ice and water so long as any water remains.

Ice and water can exist together only at the freezing point. If heat is abstracted from the mixture there is apparently an isothermal change of water into ice, and if heat is supplied to the mixture there is apparently an isothermal change of ice into water. From theoretical reasoning a large temperature difference between ice and water in the same solution could not possibly exist. It seems impossible then to imagine a flowing river, either with surface ice or mixed with frazil, to be cooled appreciably below the freezing point. The small differences observed by the writer would, however, appear to indicate that the process, although apparently isothermal, is in reality dependent on small temperature changes. This has already been claimed by some authorities, and the results of investigation have been to indicate that the temperature of a mixture of ice and water to a certain minute extent depends on the relative amounts of ice and water present and whether the mixture is rapidly freezing or thawing. The fact that under surface ice, on a sudden drop in air temperature, the water commenced by being in a slightly undercooled state, and then as the ice grew and the proportion of water became less, the temperature came nearer and nearer to the freezing point, would tend to support this view. Of course these variations are exceedingly small, and could only be detected with very delicate apparatus. They would not be noticed on a thermometer reading only $\frac{1}{100}$ of a degree.

The idea will immediately suggest itself to the reader, whether or not these small differences observed by the writer could have originated in the artificially prepared mixture of snow and water containing the steady end of the thermometer. It would be out of place here to go into details over the many precautions necessary to avoid errors of this kind, but it may be said that it is possible, within the limits of these measurements, to prepare mixtures which will be sufficiently uniform.

Larger temperature differences may very probably exist in quiet water where there is little or no ice, but the more water is being churned up and mixed with air and ice, the less can its temperature be cooled below the freezing point. It was, therefore, almost certain, *a priori*, that the temperature of the river water in the rapids could not differ materially from the freezing point. Nevertheless it is satisfactory to have been able to demonstrate the fact by direct observation, and at the same time to detect such small variations as should theoretically be due to the rate of formation or dissolution of the frazil.

Previous observers have differed a good deal in regard to the way in which they have explained the appearance of river ice. The terms "Frazil" and "Anchor Ice" have been used synonymously, and are apparently often understood as the French and English for the same thing. From the report of the Montreal Flood Commission, published in 1890, which is undoubtedly the highest authority on river ice formation which we have, it is seen that "Frazil, as distinguished from anchor ice, is formed over the whole unfrozen surface above and below Lachine Rapids, between Prescott and tide water, and wherever there is sufficient current or wind agitation to prevent the formation of bordage ice. . . ." The term anchor ice includes of course only such ice as is found attached to the bottom, but frazil is apparently frequently used to include ice formed on the bottom as well as throughout the mass and surface of a river. In the present paper the distinction indicated by the Flood Commission has been adopted, and frazil is not used so as to include ground ice.

To the writer, the formation of ice in a river cooled to the freezing point, appears to be due to two causes:

(*a*) Loss of heat by contact with a cold air; (*b*) Loss of heat by radiation. The first cause is probably responsible for the greater amount of the fine floating ice seen in our rivers whenever the current is too rapid to permit of the formation of a surface sheet. The churning up of the water in shallow rapids is simply a special case of this, in that a greater area of surface is exposed to the influence of the colder air, causing a more rapid abstraction of heat. In quiet waters subjected to a cold atmosphere, every one has noticed how long needle crystals of ice shoot out horizontally in all directions over the surface. These crystals by increasing and compacting form the first layer of surface ice. In agitated water, time is not given for surface crystals to grow to any size. On the contrary, small needle crystals are formed, the degree of fineness depending on the rate of agitation.

An experiment was carried out at McGill University, by Prof. Nicolson, which will illustrate this point. A quantity of water in a tub was kept in rapid motion under the influence of a cold atmosphere in winter. The result was that fine needle crystals of ice, in every respect similar to frazil, were formed throughout its mass, until the whole became somewhat like a thin paste. During the progress of the experiment no deviation in the temperature of the water from freezing could be detected with a thermometer reading to hundredths of a degree. In smooth, gently flowing water it is possible to have thin, flat plates of ice formed which become mixed with the finer crystals. Previous observers have noticed these plates mixed up with frazil and have endeavored to draw a distinction between the two. It does not seem necessary to draw a distinction, as these will be formed in a river ice of every degree of fineness.

Loss of heat from the water under the surface ice will take place by slow conduction through the ice, the upper layers of which must be nearly at the temperature of the air. In the experiments conducted by the writer under the surface ice, it was noticed that when the air temperature was very cold, long needle crystals would grow out which could be seen through the hole cut for the thermometer. This fact has already been noted by previous observers, and shows the tendency for surface ice to grow on the underside. The writer has seen the opinion stated that surface ice never grows in thickness beneath, but always on top The explanation given for this is that ice is always somewhat porous and water is drawn up through pores and frozen on the surface. It is difficult to conceive how this could take place through two or three feet, how water could be drawn through a mass of ice cooled below freezing, as surface ice must be, without its becoming transformed into ice on the way. In this case the pores, if they ever existed, would soon become choked up. It has been urged as a further proof that the surface level of ice formed on a river rises, even though the water does not. This would naturally occur as the ice would be continually buoyed up as it grew deeper into the water. This force would of course act so slowly that the surface ice would move without cracking, continually adjusting itself in response to the pressure underneath.

In regard to the second cause of the loss of heat in a river, there has been a good deal of dispute. Some claim that as all the phenomena of ice formation in a river may be satisfactorily explained without the aid of radiation, it is unnecessary to introduce it at all. But as radiation exists, as is shown by Dr. Wells' beautiful experiments on the formation of dew, described by Prof. Tyndall, it becomes important to see how far it influences the formation of ice in a river. On clear days, irrespective of the temperature of the atmosphere, immense quantities of heat are radiated from the earth off through the atmosphere into space. This has the effect, as is well known, of cooling the surface of the earth, which in its turn cools the atmosphere. During cloudy weather the heat radiated from the earth is reflected back again by the clouds, so that under these conditions the earth does not become cooled. From Tyndall's experiments on radiant heat, it is seen that heat rays may be passed to a certain extent through clear water or clear ice. He beautifully illustrates this by heating platinum red hot in the sun's rays, concentrated by a lens of ice. There is no reason then why the bottom of a river should not radiate heat straight through the water and atmosphere into space. Then the bottom will become cooled below the temperature of the water, which in winter is at the freezing point, and ice will be formed *in situ* by the abstraction of the latent heat of the water in immediate contact. The process of thickening will take place by radiation from the surface of the ice itself. Radiation from the bottom will be, of course, greatly hindered by the granular texture of the ground ice, and when it becomes so thick as to prevent any further radiation, or on a cloudy day, not sufficiently cold to produce undercooling in the water, heat slowly conducted through from beneath will melt off the hold which the anchor ice has on the stones and rocks.

Engineers have held that heat conducted through from beneath must help to keep up the temperature of the river, and that stones could not become cooled below the freezing point on account of this. One observer says: "How then could a stone, whose upper surface is at, or almost at, 32° F., and whose lower surface is at a somewhat higher temperature, radiate cold into a body of water from which it is itself receiving cold?" From the results of the observations on soil temperatures which have been carried on now for several seasons at the McDonald Physics Building by Prof. Callendar, in conjunction with Prof. McLeod, with delicate electrical thermometers placed at different depths in the ground, it has been shown that the conduction of heat through the earth from beneath is exceedingly slow. It may be easily calculated from the results of their work that the amount of heat which would be conducted through the earth to the bottom of a river in one hour, would not be sufficient to melt a layer of ice more than 1-500 of an inch in thickness.

It is very improbable that ground ice could be denser than normal, and therefore prevented from rising, as some observers have thought. There are certainly no experimental data to support such a supposition. On the contrary, the growth of the crystals in a mass of anchor ice is as far as possible in a vertical direction, showing that the ice must possess buoyancy even as it forms. This no doubt gives rise to the beautiful tree-like forms of masses of ice on the bottom, resembling the weeds in summer. Where a river is flowing very gently and smoothly a surface layer of ice forms, which becomes covered very soon with a layer of snow. This layer of snow will act as a check to radiation, hence the well-known fact that anchor ice does not form under a layer of surface ice. There is another possible reason why in deep, gently flowing rivers, ground ice is not readily formed. Below 39° F. it is well known that warmer layers of water sink to the

bottom and colder layers rise, so that the bottom of a deep river may be above 32° F. As a matter of fact the writer found the water under the surface ice slightly warmer at a depth; otherwise there seems to be very little reason why ground ice should not be formed under a layer of clear surface ice.

There is very little doubt that the immense thickness of several feet which anchor ice attains must be due, partly, to the sticking of surface formed ice carried down by currents which are continually shifting in a rapidly flowing river. The branching form, in which anchor ice grows, would tend to entangle and collect the floating ice. This sticking together of the ice was only noticed by the writer when the water was in a very slight undercooled state, caused by excessive abstraction of heat. The two principal atmospheric conditions for producing this effect the writer considers to be a dull, cold stormy day with wind, or a clear cold night. When measurements were being made of the temperature of the water in this state, in a shallow part of the rapids near the shanty, the stem of the thermometer was placed on the surface of some ground ice, which could be distinctly seen through the water. In a very short time the stem was frozen down, and could only be removed with great difficulty without injuring it. It is interesting to state that the writer was actually observing a small difference below freezing during the time the lower portion of the stem was becoming attached to the bottom. During this time immense islands of ice appeared in the shallower parts of the rapids, apparently growing by the attachment of frazil carried down by the currents. The river was of a dull, sandy color, as though full of ice. The whole tone of the river seemed different to that on a similar dull mild day.

Mr. Keefer, former president of the Canadian Society of Civil Engineers, in the discussion following G. H. Henshaw's paper on "Frazil," published in the transactions of that society, for March, 1887, gives an observation made by himself, which accords well with the one made by the writer. He has noticed that while crossing the St. Lawrence, opposite Montreal, in a canoe, when the thermometer was below zero, and when there was no floating ice, the water, instead of being clear as usual, was lead-colored, thick and "sandy" with ice. He further goes on to say that "spicules of ice, about the size of darning needles, attached themselves to the paddle by their points, and when it was withdrawn from the water stood out at right angles to the wood." He goes on to express the opinion that in this condition the river was loaded with ice spicules to the bottom, densely and uniformly distributed throughout the whole mass, and would supply the raw material for the formation of anchor ice at the bottom, when the latter was prepared to receive it. In this condition the writer thinks that had any ice been already formed on the bottom by radiation, then the lower layers of these ice spicules would have become entangled and subsequently attached.

Regelation has been proposed as an explanation of the way in which ice sticks to the bottom. This is very improbable, for there is quite a difference between the coalescence of ice particles by continued pressure, which cannot take place between ice and any other body, and the freezing together of ice crystals due to a natural growth on their surface. Even during very cold weather the sun has an enormous influence in determining the temperature of the river water. Its rays undoubtedly penetrate to the bottom and melt off the anchor ice. The writer has frequently noticed in the morning that, after a cold, clear night, beyond the amount of frazil floating down in the currents, there was no other ice visible, while as soon as the sun became brighter and more powerful, large masses of anchor ice were brought up from the bottom and floated down. Mr. Keefer states that mill-owners never find any trouble from the formation of anchor ice, no matter how cold the air is, if the sun is shining, and also if there is a cloudy sky at night. This again points to the formation of anchor ice by radiation.

In order to test the effect of radiation in the water, the writer arranged some experiments by which it was made apparent on the stem of the thermometer. During the day, when the sun was shining, it had always been noticed that the water was a little warmer than freezing, even though the air temperature was considerably below freezing. The writer found that by placing the thermometer at different depths in some comparatively quiet back water near the shanty, the upper layers of the water were always warmer than lower layers, and if the thermometer stem were sheltered from the direct rays of the sun, it showed a still lower temperature. The water within eight inches of the surface was apparently considerably warmer than freezing, although the air was very cold. No other explanation of this could be given, except that the sun's rays were radiated through the water and were warming up the stem of the thermometer itself.

Experiments were also tried to test the effect of having the thermometer actually cooled by radiation. These observations had to be taken during a very cold clear night. The result accorded closely with the expectation. The details of these observations would perhaps be somewhat beyond the scope of the present paper, but the writer hopes elsewhere to be able to give the actually observed differences of temperature in support of these assertions.

It will be of interest here to give two examples which have come under the writer's notice, the first one by direct observation and the second one through Mr. Kennedy, which will serve to illustrate the tremendous power exhibited by frazil during the time when it is agglomerating. Engineers have found this to be the most destructive state for the frazil to be in. It has been already shown that this is probably due to the temperature of the river being very slightly below freezing. During the course of the winter quantities of frazil are being manufactured in the Lachine Rapids and swept under the barrier ice by the swift currents. This frazil on reaching quieter waters soon rises and becomes attached to the underside of the surface ice. If reference is made to the report of the Montreal Flood Commission, it will be seen on the charts made of the cross sections of the river at different distances below the rapids how, the nearer the section is to the rapids, the greater the area of ice and the less the free waterways, while the further away, the less the total area of ice and the greater the channels. During a severe cold spell it would not be difficult to imagine the free waterways becoming completely choked up. This apparently occurred during the past winter, for during a severe storm about the end of January, the level of the water rose, and by increasing the head produced a shove.

It is well known how the Ottawa and St. Lawrence Rivers meet at the head of Ile Perrot and flow around the island into Lake St. Louis, the Ottawa on the north side and the St. Lawrence on the south side.

For a long way the waters do not mingle, but flow side by side. The Ottawa River has also another course around the Island of Montreal. During a continued cold spell so much frazil is made in the open water of the St. Lawrence, just before it enters the lake under the surface ice, that the channels become almost completely blocked. The water is consequently forced around the head of the island into the Ottawa River channel. This in turn forces the Ottawa entirely into the back river course. The Montreal waterworks obtain water on the north side of the river above Lachine rapids, and under normal conditions receive almost entirely Ottawa River water. When the Ottawa is forced out of its channel and its place taken by the St. Lawrence, the fact is made apparent by the difference in color of the tap-water in the city.

In conclusion, a great deal might be said about frazil, with reference to the construction of hydraulic works, but as the present paper is simply an explanation of the appearance of river ice in its many forms, from the point of view of a physicist, the rest will be left to those more competent to deal with that side of the question.

As in northern countries it will be impossible to prevent the formation of frazil ice, it becomes the duty of the engineer to make a careful study of the facts attendant on its manufacture and agglomeration, and to apply such knowledge intelligently. As we continue to grasp more and more the true scientific nature of river-ice formation, we may hope, not without reason, to find possible methods for tempering its effects. The practical advantages to the industries of the country derived from such a result would be incalculable.

For THE CANADIAN ENGINEER.

ANYONE CAN ASSAY.*

BY ALEX. ROY, TORONTO.

[The following easy method of making a test for gold is the cheapest and most convenient of which we know. The instructions must be followed with precision, and to attain good results, a certain dexterity in handling the materials is necessary; but this may be attained by practice.—ED.]

MATERIALS.

The actual requirements for finding out if an ore carries gold, are:—

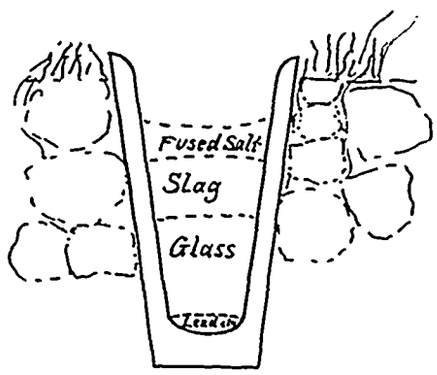
A good hammer.
A few crucibles.
A few cupels.
5 cents worth of litharge.
5 " " washing soda.
5 " " cream of tartar.
5 " " nitric acid.
A small quantity of salt.

This amount will make half-a-dozen assays, and the materials can all be carried in a small grip. Cupels are made of bone ash powdered up as fine as flour. This can be bought for about twenty cents a pound, and one pound will make about forty, and can be carried in a small pepper-box, packed inside with paper to prevent their being broken. Litharge can be got at any village drug store. Cream of tartar or washing soda can both be found in any farmhouse, as also salt.

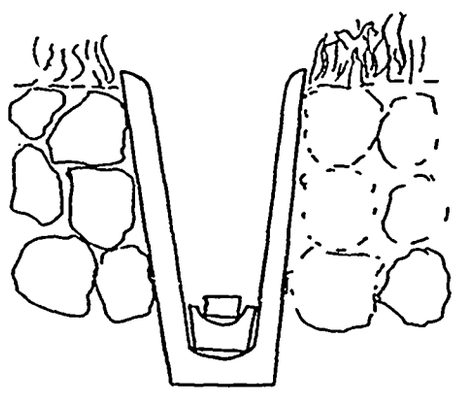
The usual method of prospecting is to arrange board for a week at a farm house, except in uninhabited districts where camping is necessary, and prospect around a day's walk in different directions, then go on to the next place. Gold can be looked for to advantage in the neighborhood of any reported discoveries. The writer has made assays of gold ore from almost every county in Ontario north and east of Lake Simcoe and Peterborough, all of which showed more or less gold.

PROCESS.

Pound up the ore to powder and mix it up well, then shake it so as to make any heavy gold fall to the bottom, then take one tablespoonful (= one ounce), or for accurate work 1 ounce, and lay it on a piece of paper, then take a tablespoonful of washing soda (= one ounce) and mix it with the ore, then a teaspoonful of cream of tartar (½ or ¾ ounce) and mix it in with the other two, and add a tablespoonful of litharge (two ounces) and mix it with the rest. Then pour the whole



of it into the crucible, cover it with salt ½ inch in depth, and place the crucible in a good fire so that it can get white hot. Let the contents melt into a liquid and then take the crucible out and gently tap it on something to shake the lead, etc., down to the bottom. Then let it cool and break the crucible. At the bottom will be found a piece of lead about the size of a coat button and of the same shape. Take this out and pound it up into a cube or little square block, so as to get all the sand and other stuff out of it. Then take a clean crucible and place it in the hole in the fire that the other one was taken out of. Place the cube of lead in a cupel, and lower it into the crucible with a thin strip of paper. Let it get quite hot or until it begins to fume or give off a little white smoke, and let it keep doing this for about an hour. It will gradually all grow smaller, until there is only a very small bead of it left which won't pass off. Take a small piece of silver (a shaving off a five-cent piece will do), and drop this on this bead and let them melt together; take out the crucible, and let it get cold. Then take out the bead very carefully and lay it on a piece of flat iron, and press a hammer down on it till it



is flat. Place it in a small vial, or bottle, or a tea cup, and pour a little nitric acid on it and heat it a very little. If there is only silver present it will all melt up in the acid, but if there is gold, there will remain a small black flake, which will reveal its true character by rubbing it with a knife.

This is all that a prospector requires to know, as if

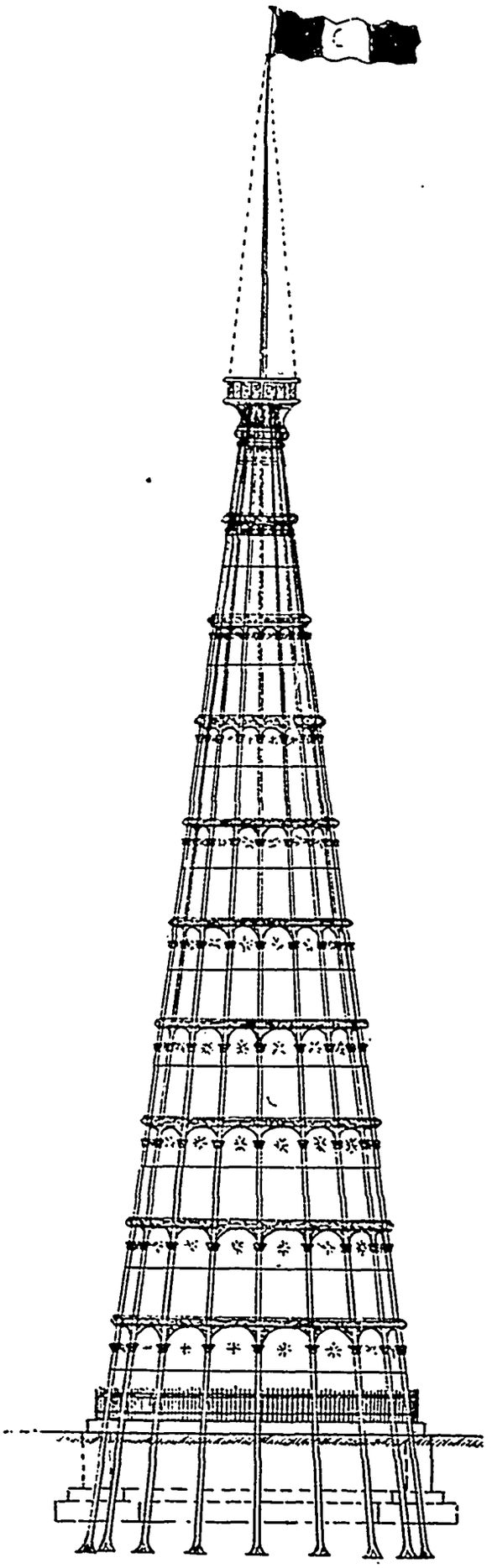
a mine shows gold at all it is worth something to the man who finds it. Any mine that shows gold under this test will run over four dollars a ton, and any mine showing this amount will pay to work it. Assays running over $15 per ton are not average assays, and not to be depended on. The prospector need not expect to find the gold sticking on in lumps; it does not occur in that form very often. Liquid tests, as a rule, can only be made by expert chemists.

If the ore contains a small amount of arsenic, it cannot be tested by this method, as the arsenic would carry all the gold off with it in the form of vapor. The arsenic can be detected by heating the ore, when the arsenic is given off, and can be recognized by its smell, which resembles garlic. All ores containing a large amount of pyrites will have to be roasted before assaying. Ores containing arsenic can only be tested by an expert analyst, as I have myself seen ores which went as high as fifteen dollars in gold show nothing when tested by assay, so when an arsenical ore is met with, if it does not show gold by this process it should be analyzed. Gold when found in a free state is only in very small white-yellow grains, hardly visible under a magnifying glass. If the capping rock of a mine shows a large amount of iron or rust, it must have a little sand mixed with it to form a good slag. Other little points the assayer will find out as he goes along.

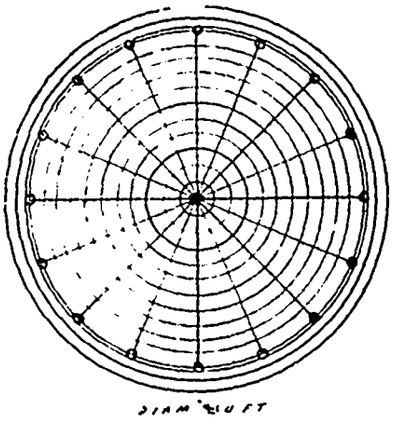
PROPOSED VICTORIA JUBILEE TOWER FOR QUEBEC.

Charles Baillairge, city engineer of Quebec, has recommended to the city council the construction of an iron tower 150 feet high on the Place d'Armes, as a memorial of the Queen's reign. This would be 50 feet higher than the loftiest point of the Frontenac Hotel, the top having a "crow's nest" 10 feet in diameter, surmounted by a flagstaff, having a flag with the word "Victoria" worked into it. The structure, of which a plan is here presented, could be built very cheaply. and the effect of the fireworks and illuminations from such a tower are vividly and dramatically pictured by Mr. Baillairge, as follows:

"The crow's nest on the now proposed pyramid would afford a commanding view of the whole surrounding country, and in the case of an illumination with fireworks, a hundred rockets or more set around its periphery or two or three hundred of them in double or treble tiers, all slightly inclined outwards at an equal angle to the vertical, if simultaneously or together fired by electricity, and soaring skyward another hundred and fifty feet or more, would thus form a sheaf, a monster parachute, opening at some 600 feet above the St. Lawrence, and their component vari-colored stars lighting up the heavens and descending in a fiery shower upon the city, not this time out of God's wrath, as on Sodom and Gomorrah of old, but as a shower of blessings for a munificent reign of 60 years of good and noble deeds. Such a structure would be used on all festive occasions, each of its 160 arches lit by an incandescent light at night with a 10,000 candle power arc light at its summit, or a 100,000 c.p. one, if the city could afford it. Creeper roses might be made to grow around it, and in time to almost cover it, or at any rate it could be festooned with artificial flowers and a bouquet hanging from each of its component arches, diminishing in size as they ascended. On a gala occasion, its usually white drapery could be supplemented to form the 'red, white and blue' of the British, the



PROPOSED
VICTORIA TOWER
QUEENS JUBILEE
SCALE 16 FT. 8 INCH
150 FT. HIGH



'tricolor' of the French; while on a day of national mourning, as when we lose our beloved Sovereign, it may be painted and draped in black or white and black, or all in white, as on the birth of another heir to the throne."

THE MOTOR VEHICLE—IDEAL AND REAL.

Regular readers of THE CANADIAN ENGINEER need not be told that this journal is interested in the new development of inventive industry in connection with the autocar or horseless vehicle, and that we have faith in the outcome of inventive efforts along this line. Since the editor returned from England last autumn, and wrote his impressions, we have published nothing special as to motocycles, for the very good reason that no radical improvement has since been made. We think our readers may be interested in a review of the situation as it is at present, gathered from the various journals of the motocycle industry, from the published data as to tests, and from interviews with practical mechanics and electricians who are wrestling with the knotty problems involved.

Let us first say that the essentials for motocycle work are: (1) power, (2) control, (3) speed. These essentials are given in the order of their relative importance. *Power* must be sufficient for overcoming hills and holes, sand and snow, rain and ruts. The power required on a good level road for 2½ tons of vehicle and load would be about 2.5 horse-power for a speed of eight miles an hour, or about 3.75 horse-power for a speed of twelve miles. To mount a hill, some parts of which may be on a gradient of 1 in 20, the 2.5 horse-power rises to 10.5 horse-power; but if a speed of three miles per hour were deemed sufficient for climbing the gradient of 1 in 20, only about 4 horse-power would be required. But for bad roads these quantities ought to be doubled, so that to take 2½ tons of vehicle and load up a gradient of 1 in 20, at eight miles an hour, would require about 20 horse-power, or at low speed about 8 horse-power. These conservative figures, taken from an English engineer, should be kept constantly in sight by inventors; and it might be added that even on ordinary level roads there are occasional short grades much steeper than 1 in 20, whereas sidewalk crossings run 1 in 10. *Control* is important both as to speed and as to steering. In the Chicago contest one motorman became unconscious because of the great strain of manipulating the steering apparatus. *Speed* is the third element, but has no value except in conjunction with power and control. The more speed we get, the more urgently must we insist on control. High rates of speed may be permissible, even advisable, with an extremely perfect control; and it is possible that a method of control may be yet secured that is even more tractable than a horse; but it is not here yet. The control of electric vehicles, not being limited to fixed speeds, is preferable to that secured by differential and frictional gearings, both of which are antiquated, though the latter is advertised as a novelty. The practical difficulty with frictional gearing on an autocar is that there is insufficient grip when it is most needed, viz., when special demand is made for power.

The motive powers which have been tested on autocars may be named in order of merit: (1) *Explosives*, including petroleum, acetylene and gunpowder. (2) *Electricity*, primary and storage. (3) *Steam*. (4) *Compressed Air*.

It is next to impossible to get reliable data on autocars. Readers must winnow a bushel of chaff to get one kernel of wheat. The only really reliable mechanical data we have is that furnished by the judges in the *Times-Herald* contest in Chicago last November. The Duryea gasolene motor made the highest record on practically all points, and we may, therefore, take this as high-water mark up to date. What do we find? The vehicle (seating two persons) weighed 1,208 lbs.—and this, by the way, was the lightest of all the vehicles entered. Two runs were made with her on the testing machine, giving draw-bar strains of 83 and 88 lbs. respectively—these being the records of the motor while running under its best conditions. At these draw-bar strains, 1.10 and 1.16 horse-power was exerted at the rim of the driving wheels, at a speed of less than five miles per hour; a mechanical efficiency of 65 per cent.; a consumption of 3.64 and 3.24 lbs. of gasolene per h.p. per hour, giving a cost per h.p. hour at rim of wheel of 7.28 cents and 6.48 cents. As the Chicago judges remarked: "It is apparent that the heaviest pull exerted, namely, that with the Duryea vehicle, amounted to only 187 lbs., as compared to 400 lbs. which a single horse could exert. . . . For the purpose of determining roughly a probable value, an express horse of average type was tested by your committee, and without resorting to violent methods of persuasion, the maximum pull obtainable was found to be about 250 lbs. It is probable that 400 lbs. is about the maximum of a good horse. On the other hand, when the pull is light a considerable range of speed may be obtained, and the measure of the power exerted by the horse at all times may be obtained by multiplying the pounds pull by speed in feet per minute; dividing this by 33,000 gives the ordinary unit known as a horse-power." Taking this method of calculation with the Duryea motor, the best result is about half the draw-bar strain that a good horse could exert.

It is quite evident from the above figures that although the price of motor carriages ranges from $1,000 to $1,500, their actual efficiency for work on roads other than asphalt is less than that of a horse which could be bought for about $25. The only hope of popularizing the horseless vehicle, at least for the present, is by producing something infinitely better than an ordinary horse.

As to acetylene and gunpowder, these are two very desirable fuels if they can only be kept reasonably cheap, but thus far the indications are against this.

As to electricity from storage batteries, there are many advantages such as cleanliness, simplicity of manipulation and control, absolute safety, and absence from vibration; but as shown by the Morris & Salom

vehicle at the Chicago test, the difficulty is the low margin of power-supply, and the uncertainty of being able to accomplish your journey unless charging stations are established along the route.

It seems absolutely cruel that in an up-to-date article on the latest development in autocars we should have to mention steam; but many enthusiastic and intelligent autocarists, particularly in England, are proclaiming its superior merits, the Serpollet system being the prime favorite with the cult led by Sir David Salomons. The advantages of steam are, first, no trouble with igniter: secondly, a well-fitted steam engine is one of the most reliable machines made by man. The disadvantages relate to the boiler—danger from explosion, size, difficulty of keeping clean, the large amount of water to be carried, and the visible nature of the exhaust.

Compressed air has largely the advantages of the storage battery, with its most serious defect—lack of sufficient storage capacity. It has, however, all the advantages of the steam engine in its ease of control and certainty of operation, while it is absolutely free from all odors, and vibration can be reduced to a minimum. But the great difficulty and cost of supply, large bulk of reservoirs, and danger from explosion, put this power out of the race, at least in the meantime, except for very short services.

To sum up: there is not to-day, so far as we can learn, a single vehicle motor anywhere working under any of the systems above named, which can show an efficiency equal to that of good horseflesh for every-day work on all classes of roads. There need be no trouble from slipping when pneumatic tires are used; but we would impress on inventors that they should pay less attention to speed and more to the development of power so as to suit actual roads, and not ideal ones, under the impression that the roads will be made to suit the vehicles. The motocycle will be an important factor in bringing better roads, if it can be made to do effective work on present ones.

The difficulty of securing reliable data sufficient for this article has been so great that we can readily understand why the motor vehicle industry is now practically at a stand-still, the public having been disheartened by the great disparity between claims made by inventors and actual performance; but the best proof that motor vehicles are not yet on a commercial working basis is the fact that they are not doing work on our streets, and that first class opportunities, such as that offered by Elder, Dempster & Co., for the carriage of goods from Liverpool to Manchester, go a-begging.

For THE CANADIAN ENGINEER.

CARE AND ERECTION OF SHAFTING.

BY G. P. CLAPP, MONTREAL.

A few simple rules for the erection and maintenance of line shafting may be interesting to manufacturers who are looking for strict economy and the best results obtainable in this department. In erecting new shafting, adjustable hangers should be selected, and strong enough to do the work required without springing. The width of bearings should be three times the diameter of the shafting. Where a number of pulleys and belts are used, bearings should ordinarily be ten, eleven and twelve feet between centres, for 2, 2½ or 3 inch shafting.

When large driving belts, from six to twelve inches wide, are to be used, a strong bearing should be placed on each side of the pulley. A neglect to provide for this important item will result in springing the shaft, and causing it to heat in the bearings, besides the liability of breaking from the constant vibration and eccentric motion, which always occurs when shafting is sprung out of line by stress of tight and heavy belting. Shafting should not be fully lined up until all machinery on upper floors is in position. When hangers are attached to floor timbers or ceiling, and the floors are then loaded down with machinery or material, the shafting will always be found badly out of line from the effects of springy floor and timbers. By all means avoid making a storehouse of buildings where line shafting is extensively used.

When convenient, shafting should be hung on posts having a good foundation in the ground cellar and running directly through the various floors; by this plan the floors may be sprung by varying loads and still the shafting will not be effected. Tallow or grease of any kind should never be used on bearings unless it comes in direct contact with the shafting. Piling grease on the box of a vertical shaft, stuffing it in the oil holes, or in the recess around the oil holes, in the caps of horizontal shafting, is a delusion and a snare. Only the grease that comes in direct contact with the shaft will melt until shaft and bearings become so hot that damage is done. The person whose duty it is to look after the shafting, will usually depend upon the grease doing the work that he should do with his oil can. Where the writer is employed, no one is allowed to use grease as cited above, without risking his position. More damage has been done to shafting and bearings by this practice than by any other known.

The size of shafting in its relation to its liability of heating and springing is one of great importance. Shafting too small for the work required leads to bad results, not simply from the width of bearings and size of shaft. Insufficient bearings, with a heavy tension on belting, causes the shaft to spring, and this brings the greater part of the strain on the edge of the bearings nearest the tight belt, consequently heating and cutting is the result. Writers on this subject often overlook the fact that there are other causes for hot bearings besides narrow boxes and small shafting. The fact is, bearings are not likely to heat providing oil can be kept between the two metals composing the shafting and bearings. With small shafting and tight belts, so much strain in proportion to the size of the shaft is brought to bear upon the bearings that the pressure makes an oil-tight joint, and the oil failing to penetrate between the two metals, heating is the result. If any good lubricant could be kept between the metals, heating would be almost an impossibility, but when the pressure becomes so great that the lubricant is excluded by an oil-tight joint then the trouble begins. The best and most economical results are obtained by running the main, or driving shaft, at as high a rate of speed as is consistent with safety. Experience teaches the fact that the source of power, such as engines and water-wheels, should be driven at the highest convenient speed. The following memo. for the proper size of shafting to transmit a given h.p. at varying speeds, may be interesting to some of your numerous readers. Size of shaft $1\frac{15}{16}$ in.:

Speed of shafting	100	125	150	175	200	225	250
H.P. developed.. ..	10½	13	16	19	21	24	26

We are glad to be able to announce that the Ontario Government has refused the extension of time asked by the Canadian Niagara Power Co. to complete their power works on the Canadian side of the Niagara River, and work was commenced on the 30th April. The question of the status of the company in relation to other companies requiring power from the Niagara has been referred by the Government to the Court of Appeal, as also the question of the bearing of the Dominion charter granted to the Canadian Power Co. (the Welland River) on the American syndicate.

THE OTTAWA WATERWAY TO THE GREAT LAKES.

BY A. J. FORWARD, OTTAWA.

For THE CANADIAN ENGINEER.

In *Scribner's Magazine* for January, 1896, a New York writer quotes approvingly the proposition of L. E. Cooley that "the line of export must follow the line of domestic transportation," and infers that "whatever merit Canadian routes may have from an engineering standpoint is entirely overbalanced by the fact that they run through a district which can furnish but very little freight in either direction." The fallacy of this statement, so far as regards the Ottawa route, may be readily shown.

During the season of 1895 the traffic of the Erie Canal, both eastward and westward, originating in New York State, was in the neighborhood of 600,000 tons, of which the following were the principal items: Pot and pearl ashes, 11,495 tons; barley malt, 24,698 tons; salt, 66,460 tons, stone, lime and clay, 240,859 tons. The quantity of coal distributed was 469,595 tons. Wheat from Buffalo and Tonawanda to points along the line of the canal amounted to 71,850 tons. From 1890 to 1894, inclusive, the movement of freight was as follows, according to New York Chamber of Commerce reports:—

	From Tide-Water Tons.	From Western States. Tons.	From New York State. Tons.
1890.....	1,304,274	1,194,017	470,549
1891.....	1,175,536	1,186,521	502,589
1892.....	1,120,704	1,329,706	478,380
1893.....	567,659	1,586,238	675,380
1894	960,320	1,437,293	259,059

The average annual traffic of the Erie Canal originating in New York State, or in other words, "derived from the district through which it passes, was therefore, during that period, only 473,191 tons.

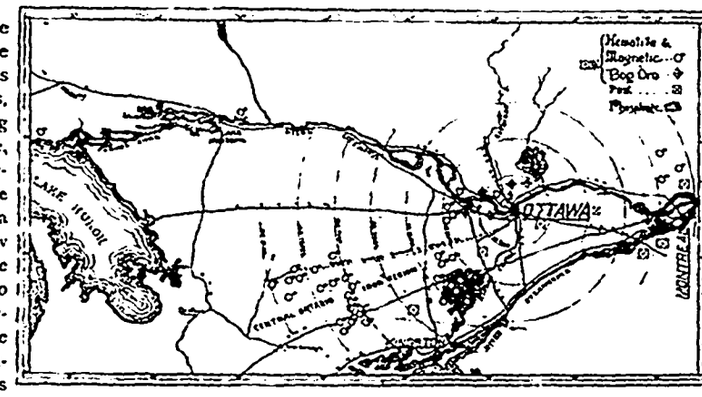
For the period 1883-'93 inclusive, the average traffic of the Ottawa canals amounted to 692,173 tons.* Practically the whole of this originated along the Ottawa River, and the bulk of it was lumber. In 1894, out of a total traffic in that year of 562,010 tons, no fewer than 548,747 tons were the produce of the forest.† During the same year, out of 886,778 tons moved on the St. Lawrence, exclusive of the Welland, 537,982 tons were through freight, leaving only 348,796 tons as the traffic of local origin. From these figures it appears that the lumber traffic alone of the present Ottawa canals exceeds the entire traffic of the Erie canal derived from New York State, and is double the local traffic of the St. Lawrence canals. Such being the case when the canals extend westward no further than Ottawa city, it is reasonable to expect that the locally-derived traffic of the completed waterway, passing through the heart of the lumber country, and giving an additional outlet westward to Chicago and other lake markets, as well as better facilities to the east bound trade, will be at least twice or three times as great as that of the Erie Canal, without reckoning on anything else but lumber and other products of the forest.

The output of sawn lumber from the Ottawa district for 1895 was estimated at 627,000,000 feet. This at 600 feet B.M. to the ton, would amount to 1,045,000 tons. In 1892 the Georgian Bay region exported 184,500,000 feet of sawlogs, or 307,500 tons. Last year 307,000,000 feet (estimated), or 511,666 tons, went to the United States from that quarter. An open waterway from the lakes to the foot of Lake Tamiscamingue would result in the establishment of mills on the route to saw lumber for export to lake markets. A largely increased cut of timber would result, and the provincial revenues be correspondingly augmented without any injurious drain on our forest resources. Henry O'Sullivan, Inspector of Surveys for the Province of Quebec, in his report of surveys on the Upper Ottawa in 1895, says: "If there were mills on the spot, or if easy access could be had to this region, a great deal of good timber that is now left to rot could be utilized; but when we consider the distance, some seven hundred miles, that this timber has to be driven to Quebec market, second quality stuff cannot pay." Hardwoods, which cannot be floated for long distances, and inferior sorts of timber, would at once become merchantable, and go to swell the annual output, which it may be safely asserted might be doubled without trenching to any greater degree on the stock of pine of the better class. Where there is cheap transportation, such as the waterways would afford, the by-products of the forest are in the aggregate of greater value than the lumber and timber annually cut. Pulp and pulp-wood alone will furnish a large carrying trade. The market is extensive, and rapidly growing. European countries import over 500,000 tons of pulp annually. The report of the New York Forest Commission, 1891, states: "In the last eight years the amount of timber used for this purpose has increased 500 per cent. In 1891 the timber cut for wood-pulp in the great forests of Northern New York was equal to one-third the amount cut by the lumbermen. Already the cry of scarcity of pulp-wood is being raised in the United States, and they must soon come to Canada for almost their entire supply. On the head waters of the Ottawa, and northward over the height of land, are inexhaustible stores of spruce and poplar of the best quality. The conditions for its local manufacture are also of the best. Three things are necessary to success, suitable wood, extensive water-power, and cheap labor. All these, as well as cheap transportation, will be found along the Ottawa River. Firewood to the extent of 1,064,812 tons was carried on Canadian railroads in 1893, and would furnish considerable traffic on the Ottawa. Tan bark, hop poles, telegraph poles, railway sleepers and ties, stave bolts, posts, pot and pearl ashes, manufactures of wood, etc., along with various minor products of the forest, would each afford a material addition to the traffic.

Without counting, however, on any increased output from any of these sources, there would be an annual traffic of 1,800,000 to 2,000,000 tons of products of the forest alone to draw from, and all "furnished by the district through which the canals run."

The opening of this waterway will aid to revive phosphate mining, and will eventually, by giving access to the markets, and reducing the cost of transportation, swell it to an industry of very large proportions.

There are two principal districts in Canada where apatite or phosphate of lime occurs. Both these are in the Ottawa Valley. The first, on the north shore of the river, consists of a belt from 12 to 25 miles wide, stretching northward through Ottawa county. Though of limited area, extending about 30 miles, so far as explored, it is notable for the richness of its deposits, both as to quantity and quality of product. The second district is in Ontario, having been developed principally in the counties of Leeds and Lanark, in the vicinity of the Rideau Canal, and covers a larger area than that on the north side of the Ottawa. Hitherto the impression has prevailed that the deposits are smaller and of poorer quality than those in Quebec. However, the report of the Royal Commission on the Mineral Resources of Ontario states: "Larger deposits have been opened up, particularly in one district, on the Quebec side thus far, but as regards similarity of occurrence and variation in quality (dependent largely upon intelligent dressing of the rock) identical conditions appear to prevail on both sides of the Ottawa. The quality of the higher grades of phosphate shipped from some of the mines along the Kingston and Pembroke Railway is as high as any produced in Canada." The depth to which the apatite extends is probably for all practical purposes unlimited. Shafts to a depth of over 600 feet still continue in good phosphate, and the vein matter, though irregular, is continuous.



*Canadian Stat. Year Book, 1894.

†Report Department Railways and Canals.

Mr. H J. Wigglesworth, of New York, in addressing the Canadian Mining Engineers in 1895, said. "These phosphates are practically unlimited Those who have studied their occurrence most carefully see no possibility of exhausting them. If all the population of Canada were employed there mining for ten years, the extent of the deposits would not be laid bare"

Here is evidently the basis of an extensive future industry. It is estimated that every year 1,500,000 tons of phosphate are taken out of the soil of the United States by its food crops. This must be returned to the soil in some form. For want of it many farms in the Eastern States have been abandoned as worthless, and whole States that could grow 30 bushels of wheat to the acre do not now average 15. Large areas in the older portions of Quebec and Ontario have been exhausted by continuous cropping. A judicious use of fertilizers would restore vitality to the soil. The worn-out cotton lands of Georgia, by the use of artificial manures, were raised in 20 years from a value of $3 per acre to $30. The same transformation might take place in Quebec. An almost unlimited home market for this valuable product will be developed in time. If the Ottawa waterway is to carry eastward the grain of the West, there must be return cargoes for the vessels employed in the traffic. What more beneficial occupation than to convey back to the soil the fertilizing elements of which it has just been depleted by the crops exported? Chicago, Cleveland, and other lake ports will afford markets every year more extensive. The only competition in those markets would be with the South Carolina product, which is handicapped by the long and expensive railway haul across the Alleghanies and westward. Vessels by the Ottawa waterway looking for return cargoes would carry very cheaply. Buckingham, Que., would be about the same distance from Chicago by water as Buffalo.

The adverse influences affecting Canadian phosphates are chiefly.—1. Low prices in the European markets, owing to cheapness of production in South Carolina and Florida; 2. General depression of the agricultural interests and low prices for farm produce; 3. High cost of apatite mining owing to the uncertainty of its occurrence, and the expense of selection or "cobbing"; 4. Frequent rejection of shipments that fail to analyze up to required quality; 5. Excessive cost of transportation; 6. Lack of home market.

The demands of the European market have been confined to the highest obtainable grades. These are used for mixing with low grade cheap material from South Carolina and elsewhere. The necessity for obtaining an 80 per cent. grade immensely increases the cost of production, and leaves a very large part of the product at the mines as waste material. If the United States and Canadian markets were available to the fullest extent, so that at 60 per cent. grade could be shipped, the output of each mine could be nearly doubled with the same labor, and the cost of mining and handling materially reduced. The present cost per ton laid down in the English market, ranges from $7 to $14, while it is probable that if markets on this continent were to take the low grade product, it could be loaded on vessels at Buckingham, at from $2.50 to $5 per ton It may be shipped either after simply grinding the rock, or after manufacture into superphosphates. Magnificent water-power for grinding is available at the mouth of the Du Lievre. Iron pyrites for the manufacture of sulphuric acid can be conveniently obtained. To estimate the prospective tonnage to be afforded is, of course, out of the question, but there is every reason to believe it would be large eventually. About 6,000,000 tons have been shipped from the South Carolina deposits to date. European markets import 500,000 tons a year.

Another feature to be taken into account is that mica and other minerals occur very frequently associated with phosphate, where neither alone will repay working. So that whatever helps the phosphate industry will stimulate their production as well. Mica, graphite, asbestos, serpentine, pyrites, iron, and other mineral products of economic importance occur throughout the phosphate region, and would be extensively developed by the opening of this waterway.

The principal ores of the Ottawa region are magnetic. Hematite occurs very generally associated with magnetite, but usually in small quantities comparatively. From the well-known South Crosby deposits on the Rideau Lake northward to Arnprior, and extending across the river into Pontiac county, is a region described by mining experts as a hematite and magnetic belt whence valuable ores may be obtained in large quantities. Five miles from Ottawa, four miles from excellent water power on the Gatineau River, and only two miles from a shipping wharf, is the Baldwin mine. Ore from this has been pronounced "the best car-wheel iron ever used." The vein has been traced upwards of one and a half miles on the surface, there being at one place a solid hill of ore 100 feet in height. The amount of exposed or easily accessible mineral has been estimated at 100,000,000 tons. Ten miles north-east of Ottawa is the Haycock mine, from which very large quantities of ore may be obtained. Thirty-five miles west of Ottawa, and about four miles from the Ottawa River, are the Bristol mines, where there is an available supply of ore calculated by their mining superintendent, Mr. Symons, at over 30,000,000 tons. A report made for the owners in 1889 by John Birkenbine, a mining engineer of Philadelphia, among other things states:

"The extent of the ore body would appear ample to encourage the installation of a plant for smelting the ore, and personal investigations impress me with the belief that the Bristol mines should become as large a producer of iron ore as any of the ore bodies which I have examined either in the Province of Quebec or Ontario. Should mining operations be carried on upon an extensive scale, the location offers some peculiar advantages, owing to the fact that four miles south-east of the mines the Ottawa River encounters a limestone ledge over which it falls in picturesque rapids and cascades about forty feet. This water power, known as the Chats Rapids, could be utilized to advantage for producing power and compressing air, which might be carried, as at Quinisee Falls and Michigammee River, Michigan, to operate machines at the mines, or by converting it into electric force, it may be conveyed so as to produce power. Inspection and analysis would indicate an ore obtainable for smelting purposes approximating 60 per cent. iron, 2 per cent. sulphur, with phosphorus very much below the Bessemer limit; and when roasted this ore should exceed 60 per cent. of iron, with sulphur below one per cent. Taking into consideration the facilities now existing in the city of Ottawa, it appears to be the most advantageous location for utilizing the ores from the Bristol mines. An examination of the vicinity of Ottawa developed four very satisfactory points where blast furnaces could be located to advantage, and where facilities are offered for adding other manufacturing industries in the future. Some of these points possess special merit as to certain features, but all are convenient to transportation, and have ample cinder room, water, etc."

On the line of the Rideau Canal is the celebrated South Crosby ore deposit. Conveniently located along this waterway are also numerous deposits throughout the county of Lanark, as yet altogether undeveloped.

The numerous and rich mines of the Renfrew district and Central Ontario, and along the lines of the Kingston & Pembroke, Ottawa, Arnprior & Parry Sound, and Irondale, Bancroft & Ottawa railways, would also be very accessible from this point. Bog iron ores for mixing might be obtained from Vaudreuil, the present source of supply of the Drummondville forges. They also occur (in unknown quantities, the deposits being undeveloped) in Templeton township, in Hull township, only a few miles north of the city of Ottawa; near the river in Eardly township, 20 miles to the west; at various places along the Rideau, and throughout Lanark and Renfrew counties. Iron deposits are known to exist also in the vicinity of Lake Nipissing, on Lake Temiscaming, and elsewhere in the county of Pontiac. By means of the opening of the waterway the distance from the iron regions of Lake Superior and north of Lake Huron to Ottawa would be the same as to Cleveland.

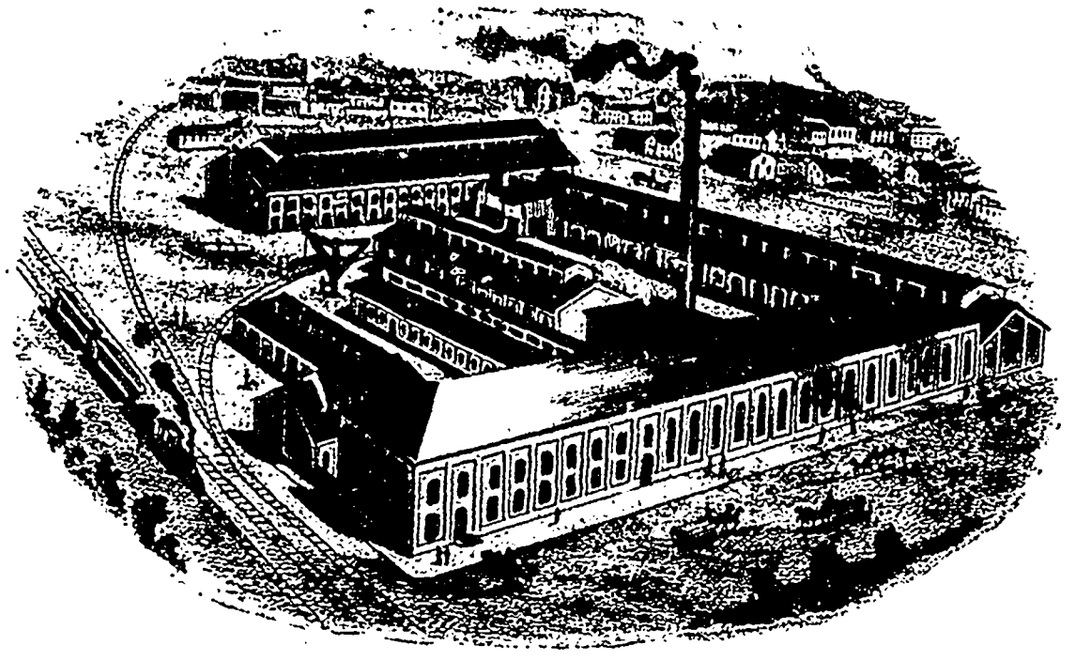
The supply of ore which may be cheaply centred at Ottawa by the various waterways and railways is practically unlimited. A writer in the *Field Naturalist* several years ago asserted that—

"We have in the Hull, South Crosby, South Sherbrooke, McNab and Marmora deposits alone, in round numbers, 1,000,000,000 of tons, a quantity sufficient to yield 1,000 tons of ore a day for 3,000 years."

A statement so purely speculative must be taken for what it is worth. What is certain is, that deposits undeniably very large are already known, that the occurrence of iron is very general over a large part of the Laurentian area in the Ottawa Valley, and that the development work and exploration thus far done amount to very little more than scratching the surface here and there.

Continued.

THE city council of Vancouver, B.C., has accepted an offer from J. A. Evans & Co., London, England, to erect a 6,500-ton smelter, as also a 250-ton refining plant. The firm is within a year to spend $600,000 on a building and plant capable of treating both lead and copper ores, and agree to employ no Chinese or Japanese. In return the city gives tax exemption for ten years, and a sufficient free public water supply. The smelter is to be of 500 tons capacity, and the refinery to be gradually, as required, brought up to 250 tons capacity. A vote will be taken on the proposal by the ratepayers.



WORKS OF S. MORGAN SMITH CO., YORK, PA.

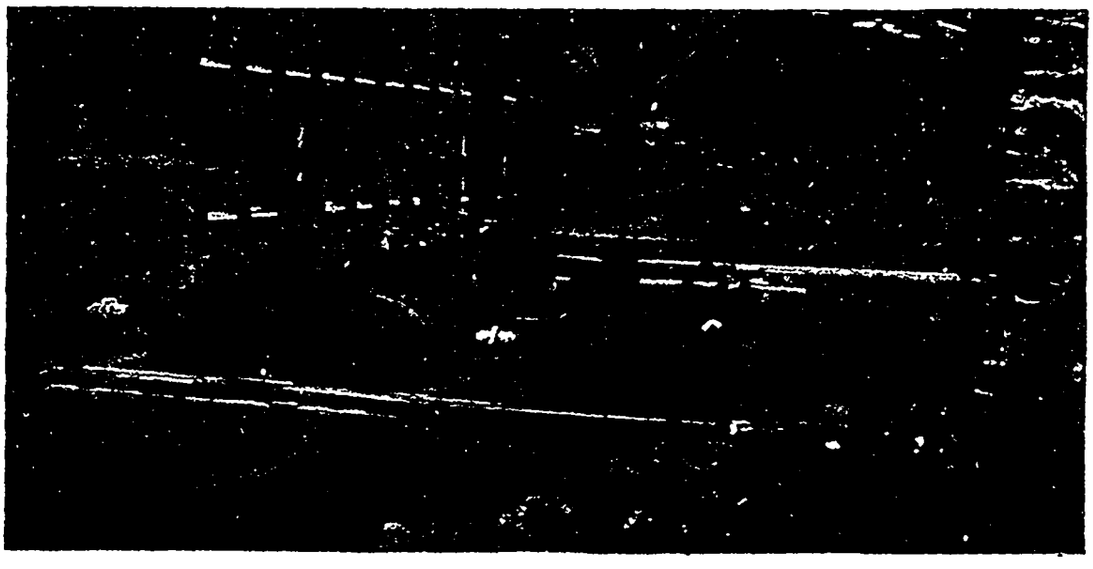
M'CORMICK TURBINES.

York is one of the many noted manufacturing centres in Pennsylvania, and prominent among the manufacturing plants found in that city is that of the S Morgan Smith Company. The buildings are chiefly of stone and brick, and are more than 1,100 feet long and cover several acres of ground This plant has been built within the past six years, and equipped with new and modern machinery The old shops, in another part of the city, formerly used by S Morgan Smith in the manufacturing of water wheels and mill machinery, are used by other parties for the manufacturing of different lines of oods.

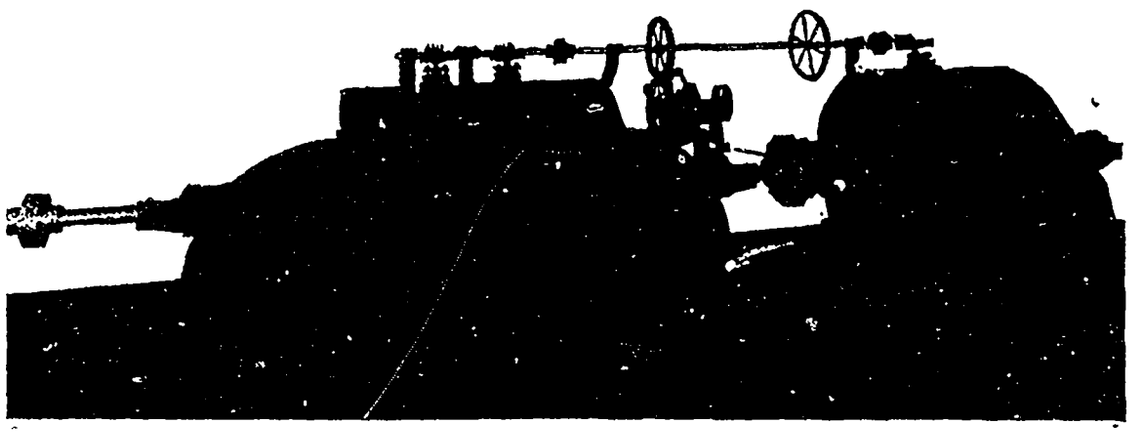
The many railroad tracks travelling cranes and elevators in use upon the premises and within the buildings are so well placed that all articles of machinery manufactured, whether in their crude or finished condition, up to 60,000 pounds weight, are handled as readily as a farmer handles his ploughs upon the farm, or the merchant his goods in the store The plant is supplied with the latest and most improved machine tools, such as boring mills, pit lathes, shafting lathes, planers, and whatever else is needed in the construction of turbine water wheels, iron flumes, shafting, pulleys, gearing, steam boilers, etc.—some of the boring mills and pit lathes being large enough to allow of pulleys, rope sheaves and fly wheels being turned off and bored out, as great as 25 feet in diameter and six feet wide upon their face. There are also some remarkably large and fine machine tools for cutting and dressing gear wheels up to 20 feet in diameter and as much as 30 inches on the face.

On looking through this shop and noting the many massive and modern tools it contains and the conveniences for handling every article manufactured, one readily understands why it is that the McCormick and New Success Water Wheels and other machinery for cotton, paper, pulp, flour and saw mills, so extensively built and sold by the S. Morgan Smith Co., give such excellent satisfaction.

The company is composed of father and three sons, who own nine-tenths of the plant. All of them are hydraulic and mechanical engineers, as well as practical business men. These facts explain why it is that the buildings composing the shops are so well constructed and arranged, why all the railroad tracks, travelling cranes, trolley lines, elevators, boilers, engines, cupolas for iron and brass foundries and great lathes and boring mills, are each and all seemingly located just in the right place. An important feature of the plant is the many windows in the ceilings and walls, flooding every department through the day with light, and at night the whole is illuminated with arc and incandescent lights, supplied by the company's dynamos. Large sums have been spent in improving and testing these water wheels, and in this way they know the speed and power of each size of their water wheels so perfectly



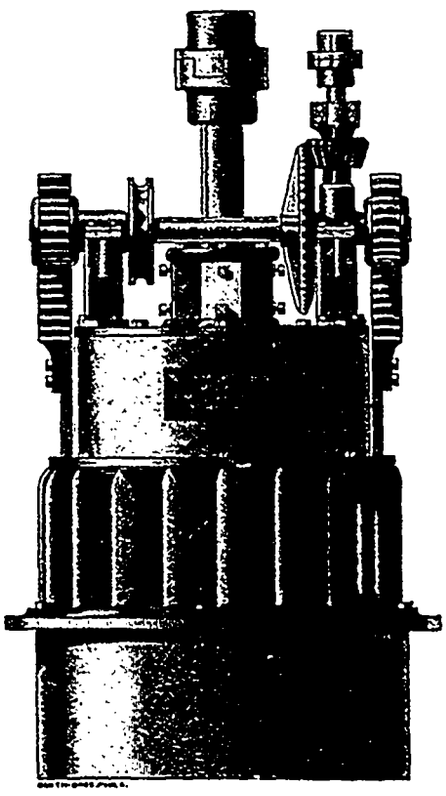
This engraving represents two pairs of horizontal 42-inch McCormick turbines, mounted in iron cases on horizontal shafts. They are coupled together, and the power is taken off at one end of the water wheel shaft, which extends into the mill, by three rope sheaves 10 feet in diameter, having 45 grooves for 1¾-in. ropes. There is also a 27-in. McCormick turbine on horizontal shaft, direct connected to a 1,000 gallon fire pump. This turbine also drives the dynamo. The combined power of these turbines is 2,355 horse. The water is supplied to the turbines by two pipes 10 feet in diameter, which are attached to the sides of the wheel cases. The entire outfit was built and erected by the company at the new No 3 mill of the Clifton Manufacturing Co., Clifton, S.C.



This engraving represents one pair and one single 21-inch McCormick turbines, mounted on horizontal shafts in iron cases, operating under 64-ft. head, the ice manufacturing plant of Chas. T Westcott, Baltimore, Md By means of the Worrall friction clutch between the pairs and the single wheels, the latter can be disconnected from the former, when it becomes necessary, owing to lack of water, to operate but two wheels. A shaft about 60 feet long is connected with the shaft of the turbines and on the extreme end of it is a rope sheave, from which the power is transmitted to another rope sheave, located in the mill, about 200 feet distant. The water is supplied through a pipe about 125 feet long. The entire outfit was built and placed in position by this company.

that when informed as to what power is needed, and head of water available, they claim never to make a mistake in the size and number of water wheels required to operate the plant to the best advantage.

The McCormick wheel is the invention of John B. McCormick, who also invented the Hercules wheel and did much toward the designing of the Victor wheel. The McCormick is his latest invention, and embodies new points of merit in its construction. It is very heavy, strong, well-built and nicely finished. It is a cylinder gate wheel. The gate consists of a ring or cylinder, which is raised or lowered by means of the gate operating device, thus regulating the flow of water to the runner. The guides through which the water passes to the runner are stationary. The gate is balanced, thus making it operate very easily. Hundreds of these wheels are in operation throughout the world, driving all kinds of machinery. A great many have been sold in Canada. The following is a list of some people in Canada who are using McCormick wheels furnished by this company:—Sault Ste. Marie Pulp and



Paper Co., Sault Ste. Marie, Ont., 18 vertical 51-inch; E. B. Eddy Co., Hull, Canada, 2 pairs of horizontal 42-inch; Riordon Paper Mills, several different sizes; the Montreal Cotton Co., Valleyfield, Quebec, 2 60-inch, together with gears and shafting, and a duplicate of this order now being built for the same company; Municipality of Valleyfield, Que., a 60-inch, together with gears, shafting, friction clutches, etc.; Milton Pulp Co., Milton, Nova Scotia, 4 33-inch; Morgan Falls Pulp Co., New Germany, N.S., 3 33-inch; Sissiboo Falls Pulp Co., Weymouth Bridge, N.S., 1 45-inch, 1 27-inch, and 2 33-inch; Farnham Electric Light Co., Farnham, Quebec, 42-inch; G. K. Nesbit, Cowansville, Que., a 27-inch, etc

A NEW USE FOR SCRAP MICA.*

BY C. H. MITCHELL, TORONTO.

Mica is found in irregular crystals in almost endless varieties of size and color. It is one of the most perfectly foliated of all materials, the laminæ being so delicate in many specimens as to require the almost incredible number of 300,000 of them to form a thickness of one inch. Mica crystals are more or less seamed or cracked, so that often an apparently perfect crystal when split open parts and subdivides into a number of small fragments. This unfortunate characteristic has really been the cause of much of the disaster which seems so often to have dogged the steps of mica mining in this and other countries. It is bad enough to have to deal with any material which occurs in pockets which pinch out without warning, and which leave no particular indication or lead as to where it may be found again. If all the deposits of mica which have been found in Canada had produced crystals more or less free from cracks and flaws, most miners would have been content with their finds, and would not have been so much concerned as to whether or not it was a pocket or a true fissure vein. Then again many deposits of mica disclose a large portion of crystals twisted and destroyed to such a degree as to render their cleavage almost impossible. These together with the fragments already referred to, find their way to the dump, having thus far served no other purpose than to add very largely, and in some cases prohibitively, to the cost of mining the merchantable article We shall, however, resurrect them presently, and I trust be able to demonstrate that instead of a loss, this hitherto costly waste may become a valuable by-product of mica mines. The proportion of waste or unmerchantable mica in every ton mined is very considerable. I do not know that the percentage of it to the ton has ever been approximated, but the evidence of a large number of miners would seem to indicate that it would average not far short of 70 per cent. of the total product. There are many instances I am aware where the average waste per ton is considerably less, but there are also as many cases where the percentage is as much higher, so that I think I am justified in venturing that estimate.

So far I have referred to mica in general, but now we must notice the particular groups of it in Canada. These we may determine chiefly by the variety and color of the material. There are, as I have said, almost innumerable variations of color and shade, from the nearly pure white to jet black, but for general purposes we may divide them into three groups—white, amber, and black. White mica appears to be very scarce in this country, as compared to the quantities of amber and black, and as it is almost perfectly transparent, it has always commanded a much higher price than the other varieties. I may say, too, in speaking of white mica, that there is a value for the waste or scrap of it, as when pulverized it has a beautiful lustrous appearance, which leads to its being utilized for wall-paper silvering and other decorative purposes. As, however, it does not appear to have been discovered in anything like the same quantity as amber and black in Canada, it has not as much interest to us as the commoner varieties. The great bulk of Canadian mica is included in all these shades of amber, silver, red and brown, which range from

* A paper read before the Ontario Mining Institute.

cloudy or milk white to dense black, which latter, as far as I know, has had no value whatever I now come to this new use for waste mica, although we can use the refuse of nearly all these varieties, excepting badly twisted crystals, it is the soft amber and light brown micas which we prefer for our purpose. This is fortunate for all concerned, as it appears to be the most abundant. We find that by taking these scraps or waste pieces and subdividing them as finely as possible, and then quilting them between galvanized wire netting, that we produce a fireproof mat, flexible and clean, and a non-conductor of heat. It will be noticed that all these flakes are ribbed or corrugated, the object being to increase the number of dead air spaces in the mat, and also to add to its bulk without increasing its weight. The finer we are able to divide these flakes the more effective they become, as each one in itself is an effective non-conductor, so that the greater number we are able to get into a given space the higher the results are in checking the escape of the heat waves.

It will be seen that these mats, or quilts, are not only fireproof, but are flexible and elastic, which is a most valuable feature, as they will expand or contract with the iron they cover without cracking or flaking off No doubt many of you have seen boilers covered with some of the old-fashioned cements, which being put on wet and allowed to set on the material, often crack and split to make room for the expansion of the material beneath. In time it will loosen and fall off, and requires constant patching to keep in order The real value, however, in making these mats in sections, is that they can be removed whenever it is desirable to examine the shell of the boiler, and can be replaced easily and quickly without injury As you will notice, they are secured to the boiler by means of hooks attached to iron bands, which are passed round the boiler under the mats Besides this covering for boilers, the waste mica is made into sectional covering for all sizes of steam and hot water pipes, the only difference being that the mica is stitched between a wire core which fits the pipe, and an outer covering of canvas. The sections are secured to the pipe by lacing round the boot hooks, which are riveted up the seam at convenient distances. Covering for all sizes and shapes of fittings, including elbows, tees, crosses and globe valves, are also made and secured to the iron in the same way. These have been difficult to make, owing to the intractable character of the mica flakes themselves, as being very elastic, it was found hard to bend them to the various shapes. We found the same difficulty in making the flakes bend round the smaller sizes of pipe, but finally succeeded by separating them into different sizes in the same way as coal is graded, the larger flakes being used on the larger sizes, and so on down to the small half inch pipe. Perhaps I may be allowed to refer here to the not unnatural idea that using the mica in this loose dry form it would be liable to shift or sag in the wire netting or canvas case. This, however, is not the case, for the reason that the flakes being of irregular shape, with the rough edges and ribbed surfaces, they catch and bind one another, matting together as hair does. As a proof of this, we may say that after nearly two years in constant service on locomotives, where there is probably heavier and more constant vibration than is found anywhere else, the mats have been found in perfect condition, and in the opinion of railway engineers are likely to last an indefinite number of years.

How vast the market for this material is may be imagined, when I remind you that every locomotive in use the world over has to be protected with some substance, that every steamer that puts to sea has boilers which require hundreds of tons of coal to feed them (in one of the great battleships of Great Britain lately launched, there were no less than 48 boilers), and that every stationary steam plant has a boiler or a battery of boilers, which require covering to minimize the loss of steam and power by radiation. How great this loss is few manufacturers, or indeed engineers, seem to realize As you of course know, it is occasioned by the condensation of steam, that is, you allow the steam which you have generated often at great cost of fuel to cool off and condense by allowing the surface of the boiler and pipes to remain exposed to an atmosphere many degrees colder than they. With steam at 75 lbs. gauge pressure, it has been estimated that the loss of horse-power on different sized pipes uncovered is about as follows:—

2-inch	pipe	1	horse-power	lost	for every 132	feet long.
4	"	1	"	"	75	"
6	"	1	"	"	46	"
8	"	1	"	"	40	"
12	"	1	"	"	26	"

So that when you complain that you cannot get power out of your engines, or that the boiler seems too small for the job, you may solace yourselves with the thought that it is very often because you don't know enough to keep your steam dry. An argument often heard among mining men is that as many of them use wood for firing their boilers, it is not so much consequence if it does take a little more of it to keep up steam. Suppose that is true, it is difficult to believe that it is wiser to tie down the safety valve and pile in wood to carry steam through long runs of pipes than to remove the necessity of doing so.

Another use for this waste mica is for fire-proofing. Mica, like everything else, will fuse if there is heat enough, even "the elements will melt with fervent heat"; but it will stand an almost incandescent heat without injury, and for that reason it is a very valuable substance for fire-proofing. Considerable quantities of it have been already used for protecting smoke flues, kilns, etc., and in some factories the underwriters have reduced the premiums after the flues have been insulated with mica. In this connection, it is not without interest to refer to the fire risk in some mines from unprotected steam pipes. I have heard that a serious fire occurred in a mine lately in Canada, which was directly attributable to a live steam pipe which ran in close contact to a wooden sheeting or boxing, and which subsequently took fire. It is very questionable whether a fire could be started from steam heat alone, but it is perfectly certain that wood may become so charred and calcined from contact with a live steam pipe, that a drop of oil or grease falling on it would quickly cause combustion. So that here again we find a use for mica. I cannot refer in detail to all the other actual and possible fields and usefulness for this hitherto despised waste product of our mica mines, but I must not leave the subject without touching on its qualities for resisting the other extreme of heat, namely, frost. It is said extremes meet. They do in this instance, for the identical covering made for fire-proofing gives splendid results in frost-proofing, and I have no doubt at all that mica will shortly be used for insulating cold storage chambers. Being free from organic matter to mold or smell, it will not taint even such susceptible commodities as butter or milk, not the least valuable of its advantages.

As those interested in mines and mining, you will doubtless enquire what effect this discovery is likely to have on the mica industry in Canada? This altogether depends on the demand. If it increases as it is doing now (the sale of it advanced 98 per cent. last year), very large quantities indeed will be required. I believe that while this new industry may not justify mining solely for its requirements, yet every ton of waste or refuse used in it means so much less cost of mining, and so much more profit in the year's business. It should make a considerable difference to the expense of mining, if in the future it is known that by simply laying aside in some protected place the waste and scrap which has hitherto been consigned to the dump, a certain amount of revenue may be earned which will lessen the general expense of mining.

The building up of industries in Canada which use as their base raw material produced entirely in this country, must be of ultimate benefit to the general community, and I think we must all deplore the conditions which appear to result in so much of the raw material of this country being shipped out of it, to benefit the towns and villages in the countries in which it is manufactured. We must recognize the enterprise and pluck of foreigners who come to this country and develop our latent wealth, but we must also deplore the fact that it often results in the large profits of the enterprise being carried away and spent amongst other peoples. The profits of much of our Nova Scotia coal mining is not unappreciated in Boston; the great lumber mills of Michigan know something of the value of Canadian logs. The paper pulp mills of the United States are not indifferent to the wood-pulp of British America, and even distant Spokane has associated the gold mines of British Columbia with many a new brown stone front in that city.

GOLD QUARTZ MINING IN CANADA AND VICTORIA, AUSTRALIA.

BY P. HILLE, M.E., PORT ARTHUR, ONT.

Dr. A. R. C. Selwyn, in a paper read before the Canadian Mining Institute, published in full in the *Canadian Mining Review*, and in a synopsis of the same paper in THE CANADIAN ENGINEER, entitled "Gold Quartz Mining in Canada and Victoria, Australia," tries to give us a picture and comparison of the gold mining industry of both these countries, and comes after lengthy argument at last to the conclusion that they could not be compared with each other. "For the reason," he says, "Canada is essentially an agricultural and pastoral country, and it is very unlikely that it can vie in gold produce with the smallest province of Australia." Well, then, if this is the case, in the Doctor's opinion, why then make comparisons? He tells us he did it because "it is only by knowing and comparing with results elsewhere that we can gain a true and accurate knowledge of our own results and possibilities." This is cor-

rect when the fundamental conditions are equal, and we have a true and accurate knowledge of both subjects here—our resources and those of Victoria. But let us see if these conditions are equal:

Victoria's geology has long been known in detail; ours very far from being so as yet.

Victoria's economical geology is looked after by the different Government departments very attentively; ours was not till lately.

Victoria's climatic condition for all year outdoor work is better than ours.

And when we add to these considerations the Doctor s belief in the great difference in the geology and occurrence of economic minerals in both these countries, then surely any person must be at a loss to see the reason and utility of the Doctor's comparisons. But we learn further from his exposition that he wants to give us in these days of booms cold facts about our mineral resources, "to warn us of that most pernicious and meanest of lies—half the truth." This is undoubtedly very good to guard our material interest, but I question very much if he is able to give us cold facts, if he is possessed of a true and accurate knowledge of our possibilities. Why? Because he visited only a very small part of our districts, and his former staff had no orders from him "to waste time in economic geology." What do we know through the Geological Department, and especially under the guidance of Dr. Selwyn, about Western Algoma in regard to ore deposits, or their genetic relation to our rocks? Nothing! Yes, even the report on that part east of Rainy Lake to Sudbury is not yet published. And the Doctor tells us that he can give us true but cold facts! It is indeed to be lamented that he, although for many years director of the Geological Survey, has kept back this country through an inexcusable prejudice, which originated in his belief in his infallible gift of prognostication. Instead of concentrating the forces of the geological staff, and surveying those districts which were more populated and of easier access, and laying more weight on economic geology, he sent the gentlemen of his staff to the inaccessible, uninhabited and uninhabitable regions to the north. Of course to whose benefit could it be to know and learn the names of those barren rocks in the western part of Ontario, and barren they are, so he believes. And he must be correct, because he informs us he had also foretold the great possibilities of the Victorian gold fields, and further also those of the Nova Scotian, because the rock formations were identical with the Victorian. This prognostication reminds me of the effort of Sir R Murchison, who predicted in 1844 the gold occurrence in Australia, because certain rocks from that country showed similarity with some in the Ural Mountains.

Everyone who has an idea of the formation of veins knows that gold, or other deposits, are of "local" occurrence. We find similar or even identical geological conditions in many parts of the world, but do we find now in every instance ore deposits of the same character in these rocks? No, not by any means. This brings to my memory a similar incident which I observed last year. I had a gentleman of our fraternity from one of the south-western States with me in one of our western districts for the examination of some gold properties His first question was whether we had porphyries in this country. The reason of his asking was very easily discovered, when I considered the occurrence of gold in his country being in the porphyry. But now let us see if the Doctor had not been equally justified in comparing the geology and ore deposits of our Western Ontario districts with the Victorian, as he did with the Nova Scotian. If he had examined our rocks somewhat more closely he would have found them to be very similar to the Victorian, if not in many instances identical with them. The latter deposits occur, as it is in most instances here, in the metamorphic rocks in the neighborhood of intrusive granites. Now, why not be consistent, and give us the same benefit of his prognostication as Nova Scotia, if he is so well versed with our geology? The Doctor said among other things: "It seems unlikely that the history of gold mining in Canada will differ from what it has been in other countries and under corresponding geological conditions." Well then Canada must have a good future, and could be well compared with Victoria, according to Dr. Selwyn's theory, because the geological conditions correspond very well. Again he says: "What the effect of the opening of new ground, better mechanical and chemical methods and appliances may be, we have yet to learn, but it is not likely that in the next thirty years an equal amount of gold produce will ever be recorded." There we have again the prognosticator. How does he know that there will not be more and more extensive gold placer and quartz mining ground found? Already we hear of new placer regions, and extensive trials are going on to win the fine gold in the Saskatchewan and other rivers From season to season we extend by prospecting the gold bearing areas. Those in Victoria cannot be compared in extent with ours in Ontario, not to speak of the Western Provinces, and I have no doubt that by sufficient influx of money and a little more enterprise on the part of our people, we shall succeed in the same way as Victoria. Yes, we would be so far now if the former director of the Geological Survey had shown the same interest for our mineral industry as the Victorian authorities have done and still do, by sending qualified mining engineers into the different mining camps for exhaustive information in regard to the genetic relation of the ore deposits to the various rocks. These informations and reports contain valuable advices in mining and milling operations. If we had imitated this wise practice, our industrial conditions would look quite different to-day.

Not even the reports are published, with the exclusion of the Seine River and Shebandowan sheet, for whose early issue we have to thank Dr. Dawson, and neither are the maps of West Algoma published yet. Now can anybody tell me what good they will do to the development of our districts and provinces, when they are published two and even three years after the surveys are made? And when they are available to the public, of what benefit are they to the prospector? Do they tell or point out to him where and in what formation he can find the different economic minerals and metals, and in what relations they stand to the different rocks? Economic geology should go hand in hand with stratigraphical or structural geology; only then is the latter of practical value. If Dr. Selwyn had done more in this regard in our western districts he would have now a better knowledge of them, and would have perhaps reconsidered the passage in his paper that Canada "was essentially an agricultural and pastoral country." The Doctor forgets that the times of the old miners are past; as dynamite has superseded black powder and the fire setting methods, so has the air drill taken the place of the tedious hand-drill. Mankind is too busy, and time is too valuable—we want to see results as quickly as money can bring them about. We cannot wait for the old miner any longer, "till he is done with his tunnel in a hill-side." For this the "new miner" needs money, and to procure it he has to follow the custom of the times, to show what he has to sell, and the more truly and openly he does it the better for him and his customers.

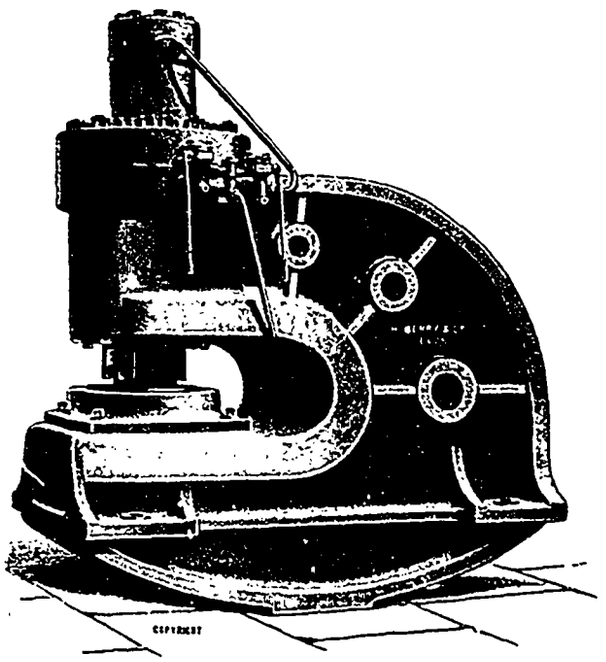
Dr. Selwyn compares the production of gold in Canada, and especially of British Columbia, with that of Victoria. How far he is justified in doing so we shall see. The earliest production of gold in British Columbia came principally from placer workings, very little from quartz mining, as in the case of Victoria. In the year 1858 it produced 40,275 ounces, and increased rapidly to 1863 up to 223,632 ounces, but fell then the more the Fraser River and other diggings were worked out, very gradually down to the year 1894 to 21,275 ounces. But since quartz mining operations commenced there more systematically and energetically the production increased in the year 1895 nearly 300 per cent., that is to 62 436 ounces. Now I have not the slightest doubt that we shall see in the next few years the production climb up to that of 1863, if we consider that there are daily more mines opened up, and as I mentioned above, new and more extensive placer ground to be discovered, and we may yet see the production of gold in our North-West reach that of Victoria. Now, if we look at the Doctor's list of Victoria's gold production, we observe here exactly the same falling off as we have seen in the British Columbian. The largest amount was mined in the second quinquennial period; so it was in our Province, and decreased then to the year 1891, when most of the placer mines were worked out, and would have kept on decreasing if the cyanide process had not enabled them to work their old dumps over. Victoria has undoubtedly reached the height of its gold production, while British Columbia is only beginning now with gold quartz mining, and also with new placer ground. The same can be said of Ontario. Very little is known of its vast areas of gold-bearing rocks; but what is known justifies us in saying that it has as good a future as Victoria had 40 years ago as a gold-producing country. Dr. Selwyn exemplifies a few old prospects worked in the beginning of the seventies, in the Lake of the Woods district, and belittles these mining ventures; at the same time he tells us that they were examined by a gentleman of the geological staff, and creates the impression as if Mr. Coste's report had been unfavorable. Exactly the contrary is true. He commented unfavorably on the different companies' method of working, but had no fault to find with the veins. A number of the latter are undoubtedly good true veins. The principal reason for discontinuing the work on these mines was the same that has characterized also the later mining periods of the Lake of the Woods: Insufficient capital, lack of knowledge of mining and of geology, complete ignorance of metallurgy, and employing of inefficient milling machines, and this latter is up to date

the case. Since more capital has flown into that country, and more systematic mining practiced, the Lake of the Woods is showing up very well indeed. On superficial examination, the geology of that country seems complex, but by repeated visits and closer study a person can read more intelligently those ancient hieroglyphics of nature. The same can be said of many other places in our Western Ontario districts that are rich in different minerals, which should have been known long since, if the former director of the Geological Survey had sent his staff there ten or twenty years earlier.

In summing up what I have said about the part that Dr. Selwyn has played in the development of our Western country, and the information he has gathered in regard to our ore deposits, I must deny him the right to speak publicly and authoritatively on the possibilities of this country.

HYDRAULIC MANHOLE PUNCH.

The accompanying engraving shows a powerful hydraulic manhole punching machine, capable of punching at a single operation a manhole 27 x 22 inches, out of a piece of metal three-quarters of an inch thick. This machine is one of the numerous special tools



HYDRAULIC MANHOLE PUNCH

made by Henry Berry & Co., the well known manufacturers of hydraulic machine tools, of the Croydon Works, Hunslet, Leeds, England This machine is invaluable in ship yards, boiler shops and similar establishments, and is made in several sizes.

THE NEW CROCKER TURBINE.

It is manifest that the evolution of the turbine is keeping pace with advance in other lines of mechanical art. A decade ago, iron wheels were frail in construction, of small capac y and uncertain in results. A glance at any old water-wheel catalogue will reveal the progress. A 30-inch runner was tabled to develop say, 50-h.p. under 20 foot head; the modern turbine gives nearly three times this power, and the efficiency has been raised from 15 to 20 per cent. also. These important results have been realized by men of natural talent, aided by practical experience gained by close observance of the results attained by the various types of wheels in use. It is a curious feature that no turbine of purely mathematical or scientific origin has held a place on the market. The horizontal system of installing turbine plants is highly successful. Under more than moderate falls, this is said to be the most desirable plan. The removable step-socket now used with vertical wheels has, however, greatly lessened the difficulties experienced heretofore with that mode of setting. The turbine style furnished the most economical power and the greatest percentage of the force expended. With it, electrical energy can be generated at the lowest possible cost. Thus, every water privilege having reasonable constancy, is destined to become valuable and available for the development of local or distant enterprise.

The subject of this article, the Crocker Turbine, is claimed to embody all the desirable characteristics required in the diversified industries of to-day. The runner, or wheel proper, is a model of design and scientific construction. It unites ample strength in a union capacity, and the highest efficiency obtainable. The gates and chutes are so formed and secured to the casing as to be easily operated, even under high heads, which admits of perfect regulation by ordinary governor. The surface formed by gates and chutes introduce the water to the wheel in solid streams, the full height of bucket, thus producing high part gate results and uniform speeds under variable conditions. Every particle of water is directed on to the buckets, there is no leakage through the crown plate to the wheel vents, which is always said to occur when cylinder gates are used. These turbines are manufactured by the Jenckes Machine Co., Sherbrooke, Que.

ESTIMATES BROUGHT DOWN BY THE DOMINION GOVERNMENT.

RAILWAYS.		
Intercolonial Railway—		
Increased accommodation at Halifax	$135,000	
Extension to Halifax cotton factory	40,000	
Other equipment	173,000	
		$348,000
Prince Edward Island Railway—		
Improvements		19,000
CANALS		
Soulanges—Construction		1,250,000
Cornwall—Enlargement		185,000
do Converting basin into dry dock		15,000
Farran's Point—Enlargement		375,000
Rapide Flat do		115,000
Galops do		1,635,000
North Channel—Straightening and deepening		375,000
Galops Channel do do		50,000
River reaches		50,000
Lake St. Francis—Removal of boulders, etc.		75,000
Trent—Construction		650,000
Sault Ste. Marie—Construction and equipment		75,000
Lachine—Enlargement		216,000
do Deepening river at St. Pierre		40,000
Lake St. Louis Channel—Straightening and deepening		86,000
Grenville—Enlargement		90,000
To pay George Goodwin final estimate and award of Walter Shanly		45,696
Chambly—		
To complete drainage works and culverts at St. John's, Que		25,000
Rideau—		
New Swing Bridge, Ottawa		10,500
Welland—		
Pier at Port Dalhousie		20,000.
Fender works for new bridges		18,500
St. Lawrence Ship Canal—		
Improvements		200,000
River Kaministiquia, Ont.—		
Improvements		18,000
HARBORS.		
Nova Scotia—		
Various wharves and breakwaters		55,100
Prince Edward Island—		
Piers, wharves, etc.		73 800
New Brunswick—		
Wharves, dredging		33,500
Quebec—		
Piers, breakwaters, wharves, dredging		73,800
Ontario—		
Wharves, dredging, piers		306,000
Manitoba—		
Wharves, etc.		11,500
North-West Territories—		
River and bridge works		5,000
British Columbia—		
Dredging, wharves		49,250
PUBLIC BUILDINGS.		
Nova Scotia—		
Halifax drill hall		110,000
Ontario—		
Arnprior post office		15,000
Manitoba—		
Portage la Prairie post office		20,000
British Columbia—		
Victoria post office		53,000

THE MINES OF ONTARIO.*

BY J. F. WHITSON, O.L.S.

I will endeavor to give some of the information I gathered during the two years I was an active explorer in the Rainy River, 1890-91, and from what I have gathered during the last few years, when I have been somewhat closely connected with the mining interests of that district, so that you may have some idea of the great mineral wealth of Ontario's most westerly possession. I am fully alive to the responsibility resting on anyone writing about a new mining country, and shall hew closely to the line, so that no one going to the new field shall be disappointed in not finding things fully as good as stated in this paper, but rather be able to say the half has not been told.

Indeed, it would be very difficult to overestimate the possibilities regarding the mineral wealth of New Ontario. Up to the year 1856, when Napier made his first exploration trip through the district, but little was known of the new region, and, in fact, that statement would almost hold good at the present time with reference to a great portion of the country lying even south of the C.P.R., between it and the northern boundary of Minnesota, while the country to the north of the railway is as yet a closed book. The building of the great railway, the C.P.R., has done much to open up the western country, and no portion of Ontario has been more benefited than has this new district. It occupies that great stretch of country lying between Thunder Bay district and the Province of Manitoba, 192 miles in width, and extending from the northern boundary of Minnesota, north to Lake Seul, 175 miles in length, on its eastern boundary, and averaging not less than 125 miles, and comprising an area of nearly 20,000 square miles, or about 12,000,000 acres, including within its limits the Lake of the Woods, with its 1,400 or more islands; Rainy Lake, with its 600 miles of coast line, or more than that of Lake Ontario, Manitou, Wabigoon, Eagle, Lonely, and more than a thousand other lakes, in fact, one might call it "the land of a thousand lakes."

The general physical characteristics of the country are very similar to those found in other glacier-swept Archean tracts, such as the north shore of Lake Huron, Muskoka, or Parry Sound. In few places is the country as mountainous as the north shore of Lake Superior, or as difficult to explore as the region north of Lake Huron. Within the district are to be found many large and magnificent streams—Rainy River, 80 miles in length, with an average width of not less than 500 feet; Winnipeg, English, Seine, Manitou, Eagle, and many more streams are quite navigable for large boats in places. The geological formation of the district is either Laurentian, Huronian or Keewatin, and post glacier, the Laurentian rocks predominating. The most recent, the clays and sands, form the agricultural section of the region along the Rainy River and around Wabigoon.

Of the total area of the district, nearly 5,000 square miles is covered with the Huronian, or gold-bearing, rocks. It will, therefore, be seen what a vast field there is for prospectors in this new district. I believe that this new Ontario will yet be one of the richest gold districts in the Dominion within the next ten years; yes, on the continent. The success which has attended mining in that thinly-populated and undeveloped condition of the country in the past two years is but an evidence of the great success which awaits the future exploration, not only for gold, but for other minerals.

The history of the district since attention was first drawn to it by the discovery of gold, about fourteen years ago, shows that nearly all the exploration to which the country has been subjected, up to within the last 18 months, has been confined to the shores of the Lake of the Woods, Rainy Lake and a few of the larger streams tributary thereto. Few prospectors have ever penetrated into the interior; in fact, this will apply even up to the present time, they having contented themselves in prospecting the main waterways, which are easy of access, going back but a short distance inland, so that at the present time but a very small portion of the country, even convenient to the C.P.R., or the larger lakes, has as yet been even partially explored.

Long after the first discovery of gold on the Lake of the Woods, very little development work was done, except on the Pine Portage and Sultana mines; this was partly owing to the want of capital, but more particularly to the belief that there was little gold to be found in the district. The good results attending the development of the Sultana mine have done much to encourage others to prospect and develop discoveries, and in nearly every instance where development work has been done the results have been highly satisfactory, so much so that during the last two years prospecting has been very active, and has resulted in the discovery of a great many veins of gold-bearing quartz, many of them undoubtedly rich, and will yield large profits when mined.

Mining, properly speaking, can scarcely be said to have more than begun, except in a few cases. Prospecting, however, has been very active, and many of the leads are well stripped and opened into. No less than 100 different mines are being developed or partly so, so that with the increased shipping facilities, the building of new roads by the Government, the investment of English and foreign capital in the district of late, it is confidently anticipated that this year will see extensive mining operations and good returns therefrom; in fact, there are no less than half a dozen stamp mills, either being shipped into the district or being erected, at the present time.

The good results of the last six months' mining have given to those interested in the future of the Lake of the Woods unqualified satisfaction. Everything, with few exceptions, has gone to show that their confidence has been well grounded. Those who were at first most skeptical as to the permanency in depth and richness of the deposits have candidly yielded in the face of the unquestionable evidence offered them in the splendid showing of such mines as the Sultana, at a depth of 400 feet, with an enormons body of rich ore at that depth, and every appearance of an unlimited quantity, which can be mined and stamped with even a 10-stamp mill at less than $4 per ton. The Regina mine, at a depth of 286 feet, with a similar mill, is producing gold at nearly the same cost per ton; other mines in the district, such as the Mikado, Yum-Yum, Cornucopia, Gold-coin on Shoal Lake, Gold Hill, Black Jack, Princess, Scramble, Trojan, Triumph, Bath Island, and many others on the Lake of the Woods, are producing large quantities of rich ore, and there is scarcely the shadow of a doubt but that most of them will be pay mines. The Mikado yielded 136 tons of ore at first clean up, while the Saw Bill, Lake Harold, Hawk Bay, Folger and Hammond are all producing large quantities of ore, and are undoubtedly splendid mines. On Seine River the Foley mine has a 20-stamp mill at work, and can work the ore at $3 per ton. They are down several hundred feet in the shaft, and there is every appearance of it being a permanent mine. The Porcupine, the Weigand, Proudfoot, and many other mines on the Seine River, are turning out very successfully.

Rainy River, as a gold district, can be conveniently divided into five sections—first, and probably the most important, is the Lake of the Woods section, including all the country northwest of Rainy Lake and around Shoal Lake; west of the Lake of the Woods, comprising an area of not less than 2,000 square miles, in which there has been over 1,500 claims surveyed, and the Rainy Lake section. Gold was first discovered on a small island in Rainy Lake on the Minnesota side of the line, in the fall of 1893. In the spring of 1891 was found a small nugget of free gold on Hunter's Island. Since that time the prospecting has been very active and several good mines located, on which stamp mills are now working. The Manitou section, comprising the country round Manitou, and Wabigoon and Eagle Lakes, in which there are over 300 locations surveyed and several good veins, well developed, and from all appearance this has every likelihood of being a very good gold district. One of my Indians, in 1890, found a sample, showing free gold, at the head of this lake, and I arranged with him to take me to the place, but a few hours before starting the Indian got drunk, and I have never been able to get him sober enough to go out.

The Saw Bill Lake section, including the country around Saw Bill and Harold Lakes, in which about 125 claims have been surveyed; this is one of the most promising sections in the district and contains the great Folger and Hammond dyke from 10 to 300 feet in width and nearly a mile in length, and which appears to assay from a few dollars per ton up to $100 or more; this is probably one of the largest quartz ledges ever discovered in the province, and is probably one of the most enticing properties on the market

The year 1883 marks the beginning of surveys of mining locations on the Lake-of-the-Woods. No less than 4,000 claims have since been surveyed, during the last two years 2,500, and over 1,500 during the last 12 months. Within the district 1,500 patents and mining leases have been issued, covering over 2,000 claims. From fifteen to twenty Ontario land surveyors and their assistants are in the field at the present time, hard at work. Of the 4,000 claims already staked out there are, of course, an unusually large number of worthless and comparatively worthless properties, but at the same time there appear to be an unusually large number of promising veins. If one claim in every 100 proves a paying mine, forty gold mines in the district mean a great deal. If 2 per cent. prove successful properties, it will make one of the best gold regions in the Dominion, if 5 per cent. it will surpass that of California. A

* A paper read before the Association of Ontario Land Surveyors.

purchase, carefully and judiciously made, may be safely calculated upon as likely to yield, under proper and economical management, profits that will compare very favorably with some of the best known gold districts. It is not improbable that even a few very rich claims will be found, but the legitimate claims of the region are based upon the free-milling character of the ore, the large quantities of ore in sight, the true fissure veins, the economy with which the ore can be worked, owing to the abundance of fuel, the splendid shipping facilities afforded by the navigable streams and lakes, and the abundance of good water-power.

One great drawback, however, to the mining development of Western Ontario is the fact that so many of Ontario's investors are land speculators, rather than mining developers. They are willing to lease or purchase large tracts of mining land at $1 or $2 per acre, with the hope of selling it at a fabulous price, without spending one single dollar in development work, and thus the barter and sale of mining lands go on. Many of the small investors in the poorer claims will never reap a dollar in return, and there are hundreds of worthless claims in this district. I fear that in the course of only a few years, at the mouth of the shaft of many of these partly developed claims could be erected a slab, and on it the inscription written, "Died for want of sufficient capital to develop."

This new district is a province within itself with a future, possessed as it is of great natural advantages as a mining country, and peopled with an industrious race, her progress cannot be checked, as her resources are becoming better known, her towns and villages are becoming more populous, while sturdy farmers from the East are filling her agricultural areas, and on every hand can be seen abundant evidence of prosperity and advancement.

THE VALEDICTORIAN AT McGILL.

G. R. McLEOD.

G. R. McLeod, the valedictorian, said among other good things that they should be pleased that in their day a common interest actuated all the faculties, and made the success of class day and such like university undertakings a great success. One and all were coming to understand the unity of learning, a principle so ably upheld by the Principal and professors. Mr. McLeod then turned to his own faculty, that of Applied Science. During the four years the number of professors had been doubled, and the laboratories enlarged and filled with costly instruments. This was due to McGill's great benefactor, who will ever live in the memories of the Science men. With reference to the appointment of professors, Mr. McLeod continued, while not disregarding for a moment the ability of professors from other lands, yet he thought McGill graduates should be given a chance. Already those who had been appointed had filled their positions with distinction and success, and there ought to be more of them. At a time such as this there was a feeling of regret at saying farewell to University life. While a student was enriching his mind at the shrine of knowledge, he was not lessening the store, but adding to it. In this it differs from other pursuits, and in this lies its great chance. Mr. McLeod closed with a few well chosen words of farewell to the Dean and professors, speaking also of the regrets felt by all the class in breaking, for the time, at least, friendship which had sprung up during the year, and which had been of so much help in the student life.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the metal imports from Great Britain to Canada for March, 1896 and 1897, and the three months ending March, 1896 and 1897:

	Month of March,		Three months ending March,	
	1896.	1897.	1896.	1897.
Hardware and cutlery	£6,228	£4,955	£16,322	£12,018
Iron, etc.—				
Pig iron.....	748	20	3,781	455
Bar, etc.....	645	830	3,067	3,031
Railroad	1,111	3,295	1,963	3,847
Hoops, sheets, etc.....	877	2,700	3,249	6,311
Galvanized sheets	1,312	2,615	5,333	5,841
Tin plates	8,165	23,141	31,134	61,542
Cast, wrought, etc., iron ..	3,642	2,252	9,566	7,004
Old (for re-manufacture) ..	....	96	. ..	572
Steel	5,469	5,302	17,554	10,235
Lead	702	791	2,870	2,070
Tin, unwrought	1,584	947	3,671	5,444

NEW ACETYLENE GAS LAMP.

A representative of THE CANADIAN ENGINEER has had an opportunity of inspecting a portable acetylene gas lamp, manufactured by the R. Mitchell Co., of Montreal, and invented by Dr. Casgrain, Quebec. It is now generally known that acetylene gas is produced by bringing calcium carbide in contact with water, and that this gas yields a light far more brilliant than that from coal gas and so pure that it is now used for photographic purposes. The upper part of the lamp contains a receptacle for water which is filled in the same way as an ordinary oil lamp. This is inserted into the cylinder containing the carbide, and the whole apparatus into a metal case, which may be plain or highly artistic, according to purse and taste. The water is allowed to run slowly from its receptacle on to the carbide, and the gas, which is instantly generated, begins to rise through an ordinary gas nipple. The quantity of gas generated is regulated by the stream of water and the water by a cock exactly as in a gas burner. The lamp is constructed on a plan which renders anything like explosion impossible, and produces an unmistakable warning when the gas is generated too fast. Water is easily enough obtainable and the carbide can be obtained at the rate of $80 per ton. One pound of the carbide is enough to produce an exceedingly brilliant light for 6 or 8 hours, at a cost of 1 cent per hour.

MINERAL PRODUCTION OF BRITISH COLUMBIA.*

AMOUNT AND VALUE OF MATERIALS PRODUCED 1895 AND 1896.

Customary Measures.	1895 Quantity.	1895 Value.	1896 Quantity.	1896 Value.
Gold, Placer....Oz.	24,084	$481,683	27,201	$544,026
" Quartz ...Oz.	39,264	785,271	62,259	1,244,180
Silver.....Oz.	1,496,522	977,229	3,135,343	2,100,689
Copper .....Lbs.	952,840	47,642	3,818,556	190,926
Lead ... .Lbs.	16,475,464	532,255	24,199,977	721,384
Coal .....Tons	939,654	2,818,962	846,235	2,327,145
Coke .....Tons	452	2,260	615	3,075
Other materials.....	.....	10,000	.....	15,000
		$5,655,302		$7,146,425

CANADIAN SOCIETY OF CIVIL ENGINEERS.

At the meeting held on the 8th ult., Henry Irwin read a paper on the "Fraser Valley Reclamation," by R. E Palmer, A.M., Can. Soc. C.E., the discussion upon which was postponed to next meeting. At the meeting held on the 22nd, under the presidency of P. A. Peterson, some members wished to discuss the paper read at the previous meeting on the "Fraser Valley Reclamation," but it was thought advisable to defer this until word could be received from the author. The discussion on Mr. Atkinson's paper on "A New Method for Dressing Car Wheels, Axles," etc., was then opened. A letter on the subject from Herbert Wallis was read by Secretary McLeod. He had tested wheels, both old and new, by the process referred to, and the experiments did not seem to warrant a change of methods. He expressed himself as quite in accord with the opinions of the author. Prof. Nicholson said he had seen a similar device at the Dominion Bridge Company's works, and wished to ask Mr. Atkinson how does the co-efficient of friction vary with speed? The co-efficient of friction diminishes so much at high speed that it pays to increase heat by electricity. What makes the grinding of chilled wheels harder than the chilling does? What is Mr. Atkinson's theory of what happens? Mr Atkinson, in reply both to the letter previously read and to Prof. Nicholson, said that Mr. Wallace had taken for his experiments what are considered as condemned wheels. No wheel remains perfect long after being put into use. The cost of hauling a train is largely increased by the imperfections of wheels Wheels could be dressed by the new process at a cost of 25 cents each. With regard to the question of abrasion, it is due to the friction of surfaces. The working disc will be more abraded at a lower speed than at a high one. He did not see how temperature could enter into the question. The particles from steel wheels are red hot. Not so with cast iron. The temperature in the latter case cannot be more than 70° to 80°, and that of steel-tired wheels is so little more that they can be handled, and, therefore, cannot be much higher than blood-heat. Heat is applied only to soften the surface of steel wheels and so reduce the horse-power required to turn them.

The President, P. A. Peterson, said that when the machine was first brought to Canada he took great interest in its working. It was at first badly put up, but its merits were even then evident.

* From the official report of the B.C. Minister of Mines.

It often happens that a day and a half is consumed in dressing a wheel by present methods, while this process would take about three quarters of an hour At the Erith works in England, they could dress twenty wheels at day, at a cost of 5½d each. At the close of this very interesting discussion it was announced that the American Society of Civil Engineers intended to hold a three days' convention at Quebec, beginning on June 30th, and Messrs. Hunt and Owen, members of the committee, who have recently passed through the city, intimated their intention of formally inviting the Canadian Society to join them.

THE CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

The tenth annual banquet of the Hamilton C.A.S E. was held in the Commercial Hotel, April 22nd The chairman, R Mackie, filled the chair in his usual happy manner The following were visitors Aldermen Findlay, Donald, McLeod, George Black, G N W Telegraph Co, W H Ballard, Inspector of Public Schools, and others The toast list was as follows. "The Queen", chorus, "God save the Queen" "Governor General", the "Maple Leaf in chorus W S Hyslop singing the solo. "Dominion Parliament and Local Legislature", song, M Wilson, response, James McLauchlin, song, W. S Hyslop. "Our Army and Navy", duet, W S Hyslop and M Wilson, response, Thomas Carter. "The Mayor and Corporation", song, W. Woods, response Ald Findlay, Donald and McLeod "The Executive Head", response, A. M Wickens, Toronto; W. Blackgrove Toronto, R. C. Pettigrew. "Our Manufacturers," response by A. Rodgers, song, Rod. Harris "Our Sister Associations", response by Walter Fox, Toronto, and J. Geary, Guelph "The Learned Professions"; responses by George Black, Mr. Ball and Mr. Gill; song, M. Wilson. "The Press"; response by J. H. Mattice, of the *Globe*. "The Ladies", response by J N Morris, song, by W. S. Hyslop. "Host and Hostess"; response by Mr. Maxey. The committee in charge of the affair was composed of R. Mackie, chairman; J. Ironside, secretary; W. Norris, W. Stevens, J. Johnson, W. Cornish. Mr. T. Bain had charge of the music and played the accompaniments.

Associatio Canadienne de Secours Mutuels des Ingenieurs-Mecaniciens P. Q. have taken possession of their new hall, 392 Lagauchetiere St., Montreal. A report of the annual meeting will be given in next issue.

CANADIAN ELECTRICAL ASSOCIATION.

The following is the programme for the convention which opens at Niagara Falls, June 2nd:

LIST OF PAPERS.

"The Best Method of Increasing the Day Load in Central Stations"—J. A. Kammerer, Toronto. "Submarine Cables—Dealing more especially with the Actual Experience in Cable-Laying and Maintenance in this Country"—D. H. Keeley, Ottawa. "Determination of the Heating Power and Steam Producing Value of Coal from a Preliminary Examination"—Wm. Thompson, Montreal "Water-Driven Plants"—John Murphy, Ottawa. "The Commercial Aspect of Electric Railways"—C. E. A. Carr, London, Ont. "Accumulators. Their Application to Central Station Lighting and Power"—W A Johnson, Toronto. "Why Some Lighting Plants do not Pay"—F. C. Armstrong, Toronto. "Steam End of an Electric Plant"—A. M. Wickens, Toronto.

It is proposed to introduce at this convention a question drawer, and members are invited to forward questions to the secretary prior to May 22nd, and an effort will be made to furnish satisfactory answers at the convention.

SOCIAL FEATURES.

Wednesday, June 2nd.—7.00 p.m.—By special invitation of the management of the Buffalo and Niagara Falls Electric R'y Co., an excursion by special electric cars from Niagara Falls, N.Y, to Buffalo. Visit of inspection to Buffalo Railway Power House. Returning, reach Niagara Falls about 11 p.m. By courtesy of the Suspension Bridge Co., members taking part in this excursion will be permitted to cross the Suspension Bridge in both directions without charge.

Thursday, June 3rd.—8.00 p.m.—Annual banquet at Dufferin Cafe.

Friday, June 4th.—By courtesy of the undermentioned companies, the following programme has been arranged:—9.00 a.m.—Special car will leave Hotel Lafayette for a trip over the Niagara Falls Park and River Railway to Queenston. 9.45 a.m.—Cross Niagara River by Niagara Navigation Company's steamer to Lewiston, N.Y. 10.00 a.m.—Leave Lewiston by special cars on the celebrated Gorge Electric Railway, reaching Niagara Falls at 10.45. 11.00 a.m.—Visit of inspection to Hydraulic Power House. 11.30 a.m.—Descend by Incline Railway and take steamer "Maid of the Mist" for a trip to the foot of the Cataract, landing on Canadian side. 1 30 p.m.—Cross Suspension Bridge. 2.00 p m.—Inspection of the Power House and Works of the Cataract Construction Co. 3 00 p m.—Visits to various Electro-Chemical Works.

THE TARIFF.

The tariff presents many difficulties, even at a cursory glance, both as to the immediate effect of its various clauses and as to the ultimate incidence of the taxation which it imposes. The whole subject is further complicated by the preferential clause, whose effects are as uncertain as at the moment its enforcement seems problematical. Whatever may be thought of freer trade with England, and most Canadians heartily endorse it, there can be little doubt of the wisdom of Protection against the United States. The Canadian tariff has been low, that of the United States high; when United States producers suffered from over-production they sacrificed their products in Canada, when the Canadian market was glutted our manufacturers had no such resource, but were compelled to dispose of their goods in competition with each other.

The abolition of the duty on machinery to be used in mining will, if not reconsidered, be a most serious injustice to a considerable number of manufacturers, many of whom have recently embarked additional capital in this department of industry. The admission of such machinery duty free means that virtually the whole trade will be done by United States manufacturers, and the prices current in the United States will rule in Canada. If a moderate duty be imposed, the Canadian maker would be enabled to remain in business, but in order to enter our market the United States manufacturer would have to reduce his price by the amount of that duty, and the prices to Canadian consumers would be practically the same as if they were supplied from the other side of the line, while all the advantages attending the development of this industry would be ours.

ROPE DRIVING.*

The subjoined table will be found of great value to those interested in the subject of rope transmission:

Diam. rope inches.	SPEED OF THE ROPE IN FEET PER MINUTE.									Smallest diam. pulleys inches.
	1,500	2,000	2,500	3,000	3 500	4,000	4,500	5,000	6,000	7,000	
¾	3.3	4.3	5.2	5.6	6.7	7.2	7.7	7.7	7.1	4.9	30
⅞	4.5	5.9	7.0	8.2	9 1	9.8	10.8	10.8	9.3	6.9	36
1.	5 8	7.7	9.2	10.7	11.9	12.8	13.6	13.7	12.5	8.6	42
1¼	9 2	12.1	14.3	16.8	18.6	20.0	21.2	21.4	19 5	13 8	54
1½	13.1	17.4	20.7	23.1	26.8	28.8	30.6	30.8	28.2	19 8	60
1¾	18.0	23.7	28.2	32.8	36.4	39.2	41.5	41 8	37.4	27.6	72
2	23.1	30 8	36.8	42.8	47.6	51.2	54 4	54.6	50.0	35.2	84

FIRES OF THE MONTH.

April 3rd.—A. Robson's elevator, Ayr, Ont. Loss, $4,500.——April 3rd.—McKinnon Sash and Hardware Co's factory, St. Catharines, Ont. Japan room damaged, $11,000.——April 6th.—Portland Packing Co.'s lobster factory, Canso, N.S. April 6th.—Jacques' saw mill, Hagersville, Ont.——Apr. 8.—Globe flour mills, Cornwall, Ont Loss, $20,000.——April 10th.—Saw and grist mills, Verner, Ont., belonging to Father Paradis.——April 17th —The Rathbon Co.'s shingle dock at Deseronto, Ont.——April 22nd.—G. A. Burrows' carpet factory, Guelph, Ont. Loss, $4,500. April 22nd.—Norsworthy & Lindop's machine shop, St. Thomas, Ont. Loss, $1,000.

THE "Societe de l'Industrie Minerale" of Saint-Etienne, France, invites original communications from its members on mining, metallurgy and mechanics, for which the Council will award premiums varying from five hundred to one thousand francs. The subjects to be dealt with are: in the mining section, the working of thick-coal seams, and underground haulage by compressed air or electric locomotives in the metallurgical section, the methods for removing dust from combustible gases, the manufacture of open-hearth steel, and the utilization of the waste heat of furnaces for steam boilers; and, in the mechanical section, the use of high pressure, cut-off gears, compounding and condensation in winding engines, and the employment of superheating in steam engines. The papers must be written in, or translated into French, and must be in the secretary's hands by December 31st, 1897.

* Table of the horse power of transmission rope, reprinted from the transactions of the American Society of Mechanical Engineers, vol. xii., page 230, article on "Rope Driving," by C. W. Hunt. The working strain is 600 lbs. for a 2-inch diameter rope, and is the same at all speeds, due allowance having been made for loss by centrifugal force.

PEAT FUEL ON RAILWAYS.

Editor CANADIAN ENGINEER:

In your number for last month there is an article by Herbert Wallis, late mechanical superintendent of the Grand Trunk Railway, on the "Efficiency of Coal Consumption in Railway Practice," in which he makes a comparison between wood and peat as fuel for locomotives; as it stands in Mr. Wallis' paper, peat is made to appear of 50 per cent. less value than wood, a statement which is misleading and requires qualification. I am interested in peat, and have been engaged in its manipulation, more or less, for thirty years, and cannot allow that statement to go forth and remain unnoticed.

Archibald Blue, director of the Bureau of Mines of Ontario, in his report for 1891, has an exhaustive chapter on "Peat, its Use and Value for Fuel." At page 206, speaking of Mr. Wallis' report on his trial with peat, he says. "It is evident from the result of these experiments that the peat which Mr. Wallis had under trial was of inferior quality, and although it is stated to have been compressed, the fact that he objects to it on the score of its losing materially in weight, shows that it cannot have been properly dried. No one could pit green or air-dried peat against dry, hard maple or Welsh coal with the expectation that it would compare favorably with them The tests appear to have been fairly and carefully made but if the peat was not a representative article in point of quality, as is probable was the case, they ought not to be considered as conclusive evidence of its inferiority to the other fuels with which comparison is made"

I can speak with some confidence in corroboration of the deduction arrived at by Mr Blue as to the quality of the peat used by Mr Wallis in 1875, the year in which he says his observations were made The year 1874 was a very favorable year for peat operations, and the Canada Peat Fuel Co., who supplied the peat used on the G T R., made a much larger quantity than usual, insomuch that their storage sheds and drying beds were completely filled The Grand Trunk Railway Co., according to their agreement, were to remove 300 tons per day, but they failed to remove more than 60 or 70 tons per day, consequently there was no room to complete the curing of the peat during the short summer season, and a large quantity, some thousands of tons, was imperfectly cured and was partially frozen during the following winter. A curious feature of peat when condensed by maceration is that if it is allowed to freeze in a partially dry state then thawed and the drying completed, it loses density and weight and returns to its original spongy state.

The larger quantity which had been stacked or stored for the winter incompletely dried, was frozen and then dried the following summer of 1875, was of a loose spongy nature, and had lost that density and hardness which would enable it to resist the blast of a locomotive, and this was the peat used on the locomotives of which Mr. Wallis speaks. There was another reason why the peat did not compare favorably with wood: the fire grates and blast were not altered to suit the peat, but were used indiscriminately as for wood. Numerous trials on the Grand Trunk Railway with fairly good condensed air-dried peat, under careful usage, gave results of from 45 to 55 lbs. per mile

DAVID AIKMAN.

St. Lambert, April 20th, 1897.

SEWAGE DISPOSAL.

We have received the following letter from the International Water and Sewage Purification Co., Ltd., London, Eng., and we append a letter by the author of the article complained of, which gives his explanation of the subject

Editor CANADIAN ENGINEER.

DEAR SIR,—We have had brought to our notice the March number of your valuable journal, in which there appears an article on "Sewage Disposal," by W. M. Watson, Toronto, from which it is evident that the writer of the paper has confused the porous carbon process of sewage treatment with the ferrozone and polarite process of the International Water and Sewage Purification Company It is stated in the article that in the porous carbon process "the sewage is clarified by a precipitant named ferrozone, and then passes through a filter containing polarite. This method has been severally criticized in England . it is stated that the Porous Carbon Co was offered every facility to prove the efficiency of its system at the town of Liecester, England, but they had utterly failed to produce a telling effect." From the above extract it will be seen that it is only right that you kindly allow us space to correct the error into which the author of the article has fallen by mistaking the Porous Carbon Company for the International Water and Sewage Purification Company. The International Company are the sole proprietors of ferrozone and polarite; the Porous Carbon Company, which has now ceased to exist, used materials entirely different from those of this company.

The International system includes all the latest improvements for the efficient and economical treatment of sewage, and has been adopted at over 300 towns and places in this country, and is in most successful operation at a great number of sewage works, purifying all kinds of sewages. Her Majesty's Government have had it in use for the past six years with entire satisfaction, and its adoption is being extended to all parts of the world. We would like to say that at Liecester the International system was demonstrated with complete success after the Carbon Company's process had failed, and the following is an extract from the report of the medical officer of health of that town:

"*Re Polarite Filter*—We have had constructed at our sewage works an experimental filter of the above material, which has undoubtedly yielded better results than any of the numerous processes adopted here It gave a filtrate which remained free from putrescence or appreciable smell after being kept continuously at a temperature of over 70° Fahr for three weeks." The report further adds that the filtered effluent remained free from smell or unpleasant odor, even when exposed for three weeks hot weather in a large tank to the sun and air Fish also lived in it, a striking proof of the comparative purity of the water.

When we mention that such towns as Middleton, Nelson, Wednesbury, Royton near Oldham, Maidenhead, Bowness on Windermere, Failsworth, Blackburn, Darwen, Chorley, Crompton, Melton Mowbray, etc., etc., as well as the Home Office and War Office Departments of H M. Government have adopted the ferrozone and polarite process, and that it has been favorably reported on by some of the most eminent scientists and sanitarians of the day. We trust we have made it clear to your readers that, instead of being a failure, the International system is a highly successful, and the most economical method of treating a town s sewage, as is proved by its very extensive use.

The Engineer in Chief to the Local Government Board of England, Major H. Tulloch, R E C.B., has inspected the International process in operati at several sewage works, and the following is a copy of the opinion he expressed:

"The results are most excellent. The sewage was very strong, but the effluent from the polarite filters was most beautifully clear, and without any smell or taste."

We are, yours obediently,

THE INTERNATIONAL WATER & SEWAGE PURIFICATION CO., LTD.

Editor CANADIAN ENGINEER:

DEAR SIR,—Replying to the letter from the International Sewage Purification Company, dated March 27th, I may say that I am not confused, for I believe I rightly understand the International Company to be a new name for the Porous Carbon Company, which they very properly say ceased to exist when they registered themselves as the International Water and Sewage Purification Co., and that what ever kind of percipitant they thought it necessary to use for clarifying sewage they alone should be allowed to call the chemical ferrozone and the material used for filtering, polarite. This statement may be proved by referring to their own advertising pamphlet, page 5, where they say that the polarite filter beds at Acton sewage disposal works are now (1894) working as well and effectively after continuous use since 1887 (a date previous to the registration of the new name) as when they were laid down. Then turn to the report on the Treatment of Sewage made by Arthur Turley, Esq., C.E., of Leeds, England, dated 1890. On page 11 he reports that the porous carbon process has been working at Acton for some time and that the precipitant used is magnetic ferrous carbon—probably some of the same chemical that they now call ferrozone. He also reports that the cost of constructing the works was £400, and annual cost of management was £133 6s 8d. for each 1,000 of the population.

I have a copy of a report from Acton Local Board in 1892, stating that their sewage system was satisfactory, but that they would prefer irrigation. They do not contradict my quotation from the records of the civil engineers, but state that their system was demonstrated with complete success at Leicester. Now I have a copy of a letter before me written by the Leicester corporation, dated 1892, stating that they have lately disposed of their sewage principally by broad irrigation over a space of 1,400 acres of land, and that a portion of their old works was still treating sewage by undergoing a chemical treatment, by mixing six grains of the ferozone and eight grains of lime to each gallon of sewage, but that

they intended to abolish the chemical system altogether when the land was all in working order.

If the International system, after years of trial, was such a grand success, why had not the Leicester corporation adopted the scheme in its entirety. The International Company, on page three of their pamphlet, speak strongly against using lime as a precipitant; but the Leicester people use eight grains of lime to six of ferrozone, and by this time will have given up using ferrozone altogether.

One reason why some surveyors and engineers, in England, criticize the International Co.'s sewage system, is because of the high cost of management and plant. Then it is generally understood, in fact the letter they have written for your publication shows, that they use the American methods of securing orders, and cracking up their business. To further prove this statement, I have a communication from Messrs. Duncan & Pickard, engineers, 89 Albion street., Leeds, England, informing me that in November, 1893, the International Company issued a circular, stating on the authority of W. Naylor, the Sewage Inspector to the Ribbe joint committee, that the Carbonizer Refuse Filter System of cleaning sewage only effected the removal of one per cent. of the organic matter, albuminoid ammonia, and that when they wrote to Mr. Naylor calling his attention to the erroneous statement, Mr. Naylor tested the effluent from the same works of the rival company, viz., the Carbonized Refuse System of sewage purification promoted by their clients, and found that there was removed from the sewage by that process over 62½ per cent. of albuminoid ammonia This statement needs no comment. With reference to expert testimony, I will ask your readers to again look at the third paragraph of my article, page 326 of your March number. There is abundant proof that if a firm be rich enough they can secure plenty of favorable expert evidences. It may at present also be sufficient to show one proof.

On page 117, in the *Surveyor*, dated January 29th, 1887, printed in London, England, your readers can find that Dr. Riddle states that forty-five per cent. of albuminoid ammonia is removed by the new process lately introduced of cleaning sewage by allowing it to stand for a time in a dark tank. This is called the Septic System. Another noted expert named Dr. Voelcker, states that the effluent from the septic tanks is worse than the inflowing sewage, and that nothing whatever is removed by this process. Query--which of the two experts is speaking the truth?

I could give a large amount of information which I have received from England and Ireland referring to the International Purification Co., but it will be unfair to trespass on your space, and will conclude by drawing your attention to the fact that in none of the three articles on the subject which you so kindly put in your paper have I in any way mentioned the International Company's name; had I done so it would have acted as a free advertisement. Therefore I cannot see any cause for complaint against the paragraph mentioned.

W. M. WATSON,
Dundas street, Toronto.

LITERARY NOTES

The published Charter, By-Laws and List of Members of the Canadian Society of Civil Engineers for 1897, forms a little book worthy of the importance of that society. The society was established in 1887, and incorporated by Dominion Act in the same year. The statement of membership for the present stands as follows:

Honorary members	8
Members	271
Associate members	145
Associates	42
Students	121
Total	587

The officers of the society consist of a president, three vice-presidents, a treasurer, secretary, librarian, the past presidents, styled honorary councillors, and 15 councillors. The objects of the society are to facilitate the acquirement and interchange of professional knowledge among its members, and to encourage original investigation. In addition to this, there is evident a great desire to inspire a proper sense of the responsibility, and the code of ethics is admirably adapted to that purpose. It enjoins on every member the duty to perform the work he undertakes to the best of his ability, and in the true spirit of his engagement, feeling it his duty to present all ascertained facts in their true light. He must also loyally obey and support his chief. His reports must be full and explicit on all important points, and exact to the best of his knowledge, cloaking nothing, even though likely to show that previous reports have been inaccurate. He is also to avoid connecting himself with schemes of a merely speculative character, bearing in mind that his professional reputation will be judged largely by the inherent merits of the undertakings with which his name may be connected. The meetings of the society are now being well attended, the papers read before it are of a highly instructive and scholarly character, the library is growing beyond its allotted space, and since there is a respectable building fund, the society may ere long be housed in handsome premises, with provision for the growth which may be predicted for so earnest and important an organization.

A first prize of $500 and a number of smaller prizes have been offered by The Century Co., publishers of The Century Dictionary and Cyclopedia, for the best answers to a hundred and fifty questions covering a broad range of information. A sample question, which is easier than some of them, is as follows. "What is the approximate difference in altitude between the loftiest Alpine summit and the bed of the greatest depression in the Mediterranean basin?" An additional prize of $500 is offered to any one who can answer 90 per cent. of the questions from any ten published works of reference other than The Century Dictionary and Cyclopedia

We have just received the 1897 edition of the *Indian and Eastern Engineer* Diary, which is issued gratis to subscribers from 137 Canning St., Calcutta, and 28 Victoria St., London, S.W. It is a substantial quarto volume containing all the internal evidence of a successful publication, interleaved and substantially bound. The information it contains is that which is most frequently required by engineers and the various trades allied to engineering. It includes the Christian, Bengalee, Fuslee and Mohammedan calendars, Indian railway, hotel, bank and club directory, the customs tariffs of Ceylon, China, Corea, England, Japan and Netherland India, English and metric weights and measures. Indian steamship lines, postal information, patent stamp fees and a wealth of technical data for professions and trades.

Walter G. Berg, of the engineering staff of the Lehigh Valley Railway, made an interesting speech before the New York Railroad Club during the discussion on G B. Leighton's paper on "The Profession of the Railway and a suggested Course of Training therefor."

The Colliery Engineer Co., Scranton, Pa., proprietors of The International Correspondence Schools, announce that commencing with the February issue the name of the journal, *Home Study*, which they publish, will be changed to *Home Study Magazine*; the page will be reduced to magazine size, but the number of pages will be doubled.

Mining Matters.

THE gasoline engine is now operating the hoist at the R. E. Lee mine at Sandon, B.C.

THE Anglo Canadian Asbestos Co. has commenced to work its chrome pits at Black Lake.

THE Thetford, Que., asbestos mines are said to possess the largest deposit of that mineral yet discovered.

THE discovery of a bed of sand which assays nearly $500 per ton in gold, is reported from the Parry Sound district.

A. DICK, M.E., has recently inspected and surveyed the Rawdon gold areas owned by C H. Dimock, Windsor, N.S.

DR W. T. STUART Toronto, is interesting himself in the introduction of the Beams process of reducing the refractory ores of Hastings county, Ont.

CONSIDERABLE excitement was caused at Selkirk, Man., over some splendid samples of asbestos that were brought in from Lake Winnipeg by gold prospectors.

THE lithographic stone from W. H. Casement's quarries, near Lakefield, Ont., is said to be of a good quality, and recent tests pronounce it almost equal to European.

PREPARATIONS are being made for the construction of a 50-stamp reduction mill at the Dick and Bannim Water Power, Keewatin, and work will be commenced at once.

THE Joggins mine is now producing daily about 320 tons of coal, mined in such a way as to give perfect satisfaction to all consumers. Manager Archibald is putting in new boilers.—*Amherst News.*

THE Ottawa Gold Milling and Mining Co. propose to erect a large stamp mill at Keewatin. The promoters, among whom are John Mather and A W. Fraser, of Ottawa, propose to expend $100,000.

THE township of Madoc, Hastings, derives an income from a hematite iron mine situated under the county road on lot 12 in 5th and 6th concessions. The mine was recently disposed of to A F Wood for a royalty of 60 cents per ton

SELKIRK, Manitoba, reports say M. O'Donohoe and R. Smith returned home from the north a few days ago from a prospecting trip, and brought specimens of anthracite coal from the west shore of Lake Winnipeg, about 160 miles from Selkirk.

THE Broughton Mine, Danville, Que., owned by the Glasgow and Montreal Asbestos Co., was leased and worked the past season by the United Asbestos Co., and some of the best asbestos in the world was taken out, having a length of from six to seven inches.

TORONTO Tudor Gold Mining Co has sold the Craig mine, near Bannockburn, to a company represented by J. D. Edgar, Oronhyatekha, M D., and others, for $47,000. This is a mine that was purchased a few weeks ago from Peter Vankleek, James Maitland and others for $12,000

IT appears to be beyond reasonable doubt that the silicious ores of Rossland are free milling and that at least 75 per cent. of the values can be saved on the plates and in the concentrates Captain Hall, superintendent of Le Roi mine, has recommended the construction by his company of a 200-ton milling plant.

THE Canada Copper Co. is operating its Sudbury mines at a profit of ten per cent The Cliff, Evans and Slater are the names of the three nickel mines now being worked by the company. On the cliff the shaft is down 700 feet, and in this mine there is said to be enough ore in sight to maintain the present output of ore—viz., 400 tons daily - for 60 years to come.

WHEN the people in the east recover from the circular insanity that caused them to buy so much wild cat stock last year, they will be wild with rage As in the matter of prize fights, their own press is more to blame than the sharks from Spokane and other American cities who have worked their graft so successfully upon the fools of eastern Canada.—*New Denver Ledge.*

THE issue of shares at the price of a single dollar has been a good deal talked about, but a company has been formed in Dublin with shares of a par value of one penny. A director must own one thousand shares, the vale of which is a little over $20 The object of the company—which is called the Jehol Mining Co.—is to carry on mining operations "in Asia or elsewhere."—*Ex.*

THE Delaware and Mount Brydges Oil and Gas Company, Ltd., purposes to explore for petroleum. It has a capital stock of $10,000 in shares of $5 each, and is composed of Henry Johnston, Frank Haycroft, John McEwen and John Ackland Miller, of the township of Delaware, and Thomas Pearce, Geo. Bignall and John Howe, of the township of Caradoc, county of Middlesex, Ont

THE Calgary *Tribune* says A big gold-saving machine, occupying two freight cars, has arrived in Calgary from the east. It was billed as a "smelter," and is intended for extracting gold from the richly mineralized sands of the Saskatchewan River. It has been found that the old-fashioned method of gold-washing with grizzlies saved only 50 per cent. of the gold, and this accounts for gold continuing to be found in sand which has been worked over and over again. The present machine has been imported from Omaha, Nebraska. The owners took some of the black sand to their own smelter at Omaha, and found that it assayed as high as $268 to $280 to the ton.

DR R W. ELLIS was engaged during the past summer in the counties of Renfrew, Addington, Frontenac, Lanark and Carleton in Ontario. North of the Mississippi River, from Ardreh to Long Lake, there is an area in which silver-lead ore in paying percentages is to be seen Gold is also found there, and although the appearances indicate pockety quartz, it is thought probable that fissure veins will some day be discovered, as there is every probability of the area of rock being identical with that found in Madoc and Marmora. This formation has in fact been pretty well traced and is found to end at the juncture of the Bonnecher and with the Ottawa River. Having its northern apex lying between this point and the town of Renfrew, the band has been traced in a generally southeasterly direction through the Country of Lanark into Leeds a few miles, Frontenac, Addington and Hastings; the main direction of good prospecting country being through the townships of Marmora, Madoc, Elzevir, Kaladar, Anglesea, Barrie, Clarendon, Palmerston, Lavant, Darling, Pakenham and McNab

REPORTS from White River, some 300 miles east of Port Arthur, are very encouraging in their nature. Gold has been discovered in more than one instance, and it is also said that splendid samples of iron ore, going 62 per cent metallic iron, have been brought in. If this thing keeps on every C.P.R. station along the line from Sudbury to Rat Portage will be turned into a mining camp. The list of stations and towns now recognized as mining or semi-mining camps includes White River, Jackfish, Schreiber, Nepigon, Ouimet, Port Arthur, Fort William, Finmark, Savanne, Bonheur, Ignace, Wabigoon, Rat Portage.—*Toronto World.*

THE statistics of the mineral production of the United States, which appeared in our last issue, were reprinted from *The Engineering and Mining Journal*, New York, which publishes the mineral statistics about a year before the government, and which are much more accurate and complete than those collected by the United States Geological Survey, a fact so well known that the British Government has adopted these statistics exclusively in its blue books, and the French Government also uses them. It was quite an achievement to be able to publish January 1st, the statistics of mineral production for the whole United States up to the 31st December, 1896, as the *Engineering and Mining Journal* did.

J. B TYRRELL, of the Dominion Geological Department, says of the country north of Lake Winnipeg that "around Herb Lake large masses of eruptive grey and red granite were found, through which run many quartz veins, associated with a good deal of iron pyrites. On Reed Lake, near by, the green slaty rock is cut by many stringers of quartz. The same is true about Cranberry Lake, also near by. "This area of Huronian rocks," says Mr. Tyrrell, "extending about 75 miles from east to west, and an unknown distance toward the north, presents a good field of exploration for the prospector for gold and other precious metals, on account of the number and variety of eruptive masses that break through it, surrounded by zones of highly disturbed and fissured rocks."

A LETTER has been received from William Ogilvie, the Dominion Land Surveyor, dated January 11th, 1897, and has just come to hand. He says that Thos. M. O'Brien, a merchant of Forty Mile, intends going to Ottawa, and he took the chance of sending an interim report along with him. He reports that the prospects of the Clondyke are still very encouraging. "So much so in this case," he says, "that all the other creeks are practically abandoned. Especially is this so in regard to Forty Mile, in American territory, and nearly one hundred men have made their way from Circle City. Those who cannot get claims are buying in on those already located. Men cannot get anyone to work for love or money, so scarce are laborers, and development is consequently very slow. One dollar and a-half per hour are the wages paid. A few men work for higher wages, and they are permitted to remain on duty as many hours as they please. Some of the claims are so rich that over night a few pans of dirt suffice to pay the hired labor As much as $204 has been reported in a single pan."

IN the anuual reports of the School of Mining, Kingston, Ont., Prof. Goodwin, director, reports a great advance made; 302 students have attended classes in the science hall, and the graduates had all obtained positions in mining work. Thirty had taken the winter prospector's course of eight weeks, and these embraced civil engineers, surveyors, experts and graduates of other science schools. Over 300 had attended the ten outside classes in as many parts of Ontario last summer and fall, under Profs. Merritt and Miller. Instructors Pope and Brock were about to leave, the former to study in Germany under a valuable scholarship, and the latter to join the Government geological survey. Prof. Nicol would return from Germany in August to resume his work. The elections for the ensuing year of the Board of Governors resulted as follows: E. W. Rathbun, Deseronto, James Haydon, Camden; A. Barnet, Renfrew; Hon. Wm. Harty, James Swift, E. J. B. Pense, John McKelvey, G. M. Macdonnell, Robert Crawford, G. Y. Chown, W. B. Carruthers, William Mickle, Kingston. Alds. Livingston and Donnelly represent Kingston city council and Warden Taggart represents the county council.

AT the meeting of the Federated Canadian Mining Institute during the discussion on the C. F. Andrews' paper, "Notes on the Mining of Low Grade Ores in Nova Scotia," J. F. Lewis, of the Rand Drill Co., said: "This paper is very interesting to all of us, especially to those interested in Nova Scotia, for the reason that it proves conclusively that the low grade ores, which are so abundant —not only in Nova Scotia but in British Columbia—can be mined and milled cheaply enough to make such mines pay the investors. It is no doubt very creditable to the management that they are mining this rock at $1.65 per ton, but I wish to suggest that without question it can be mined even cheaper than that, by putting in

proper machinery for breaking the rock. I would cite as an instance the Atlantic Copper Mine in Lake Superior—the rock carrying only .64 of 1 per cent. copper. They are raising this ore 3,000 feet; hauling it four miles by railway train; putting it through the stamp mill for $1.12 per ton, and they expect to get the cost of it down this year to $1 per ton, therefore I think this paper should be a great encouragement to those interested in low grade ores, and also an incentive for every mine manager to produce his ore cheaply."

From a report which has been issued by the Geological Department it appears that the future of the natural gas industry, in the opinion of the mining expert, is very doubtful. It is pointed out that the rock pressure in the wells in Essex county shows no marked decrease, but this is attributed to the recent date at which the consumption became other than of a local character. There have been twenty-six wells drilled, of which sixteen are still active producers The rock pressure is given at 400 pounds to the square inch, and the estimated output is 35,000,000,000 cubic feet per annum A very different condition of things is reported to exist in the Welland gas fields, from which Buffalo draws its supply. As to that district the report continues. According to the opinion expressed by several of the leading authorities on the subject, it would appear to be merely a question of a few years before the gas supply in the Welland field will be exhausted, at least for commercial purposes, though a small flow may still continue for a much longer period, which will be of service for domestic uses to farmers and others with wells on their premises and requiring only a very limited daily supply. In support of this opinion, mention may be made of the Provincial Company's well No. 63, drilled in 1893, which yielded when the gas was struck a flow of 10,000,000 cubic feet per day. The flow from this well has now decreased to such an extent that it does not produce 400,000 cubic feet in the same time, although it has in the interval been several times fed from the other wells.

Marine News.

Capt. Bourman has charge this season of the ferry steamer "Janet Craig," Arnprior, Ont.

The Rathbun Co., Deseronto, Ont., will, it is said, put a boat on the Brockville-Gananoque route.

Oscar Dakin, Digby, N.S., the first officer of the Government steamer "Newfield," has been relieved of duty.

An influential deputation waited on the Dominion Government urging the claims of the Rideau canal to improvement.

W. H. Embree & Son, Port Hawkesbury, Cape Breton, recently supplied a steam yacht to J. Robinson, Newcastle, N.B.

The B.C. Iron Works, Ltd., Vancouver, B.C., is now placing in position the engines in the new C.P.R. steamer at Rosebery, B.C.

The Pembroke Navigation Company is asking for incorporation. The capital stock is $40,000, and Hon. Peter White is one of the directors.

Captain W. O. Zealand commands the McKay steamer, "Michigan," which was rebuilt at Port Dalhousie. Jas. Belanger is chief engineer.

The Hamilton Steamboat Co.'s str. "Macassa's" officers this season are: A. Crawford, captain, L. Walsh, first officer; Purser Arthurs and Engineer Durham.

Supt. Ellis, of the Welland Canal, has been superannuated, and W. G. Thompson, superintending engineer, will combine his duties with that of superintendent.

Davidge & Co., of Victoria, B.C., are asking a yearly bonus of $100,000 for four years to establish a monthly service between Victoria and Central America and Mexico.

The contract for dredging Collingwood, Ont., harbor has been awarded to Boon, Armstrong & Company. One of the most powerful dredges in the lakes will be employed.

Hon. A. G. Blair, Minister of Railways and Canals, has made the announcement that all the St. Lawrence canals will be enlarged to a depth of fourteen feet by the spring of 1899.

The Wahnapitae Navigation & Transportation Co., Ltd., applies for an Ontario charter; chief place of business, Sudbury, Ont.; capital, $50,000. The incorporators are A. Gordon, F. Cochrane, D. O'Connor, F. Hamilton, Sudbury, Ont., and I. Eastwood, Wahnapitae, Ont.

Capt. J. S. Moore will be in command of the "Leonard Tilley," of the McKay line, and James H. Brown will be first engineer. Richard Freeman will be captain on the "T. R. Merrit"

The Pembroke Navigation Company has given orders to the Polson Iron Works, Toronto, for a new steel steamer, to ply on the Ottawa River between Pembroke and Des Joachims, to be ready about July 1st.

During a gale on the St. Lawrence, April 26th, the steamer "Rosedale," of the St. Lawrence and Chicago Steam Navigation Company, loaded with grain, ran aground and damaged her hull. She is docked at Kingston.

The following have been appointed officers on the Dominion Government cruiser "Petrel". Capt Ed. Dunn, first mate, A. J. Frame; second mate, F Arnold Jarvis, chief engineer, A. J. Brown, second engineer, W. H. Linter

The first vessel to lock through the Welland Canal this season was the Canadian schooner "Wawanosh," for Toledo. She was followed by the steamers "Rosedale," "Algonquin," "Niagara," "Bannockburn," and "Erin."

The officers appointed to vessels by the Merchants Line, G. E. Jacques & Co., Montreal, Can., are as follows: Steamers "Cuba," Capt H. Chestnut, Engineer, E. L. Foley; "Melbourne," Capt. R. Chestnut, Engineer, Thos. Milne.

The *Algoma Pioneer* says: It is now proposed to establish a line of boats to Manitoulin Island, with headquarters at the Sault, and make this the depot for the valuable products of the islands and north shore, instead of carrying them to Collingwood, etc.

The "Massena," a steamer plying between Brockville, Ont., and Ogdensburg, during the storm on April 19th, was run into Maitland, but while tied up at the wharf her upper works were knocked in by the storm, and she sank. She was loaded with oats, lumber and cement.

Dunbar & Sullivan, Welland, Ont., have recently launched a scow for use on the Lachine Canal, capable of carrying 600 cubic yards of earth. It is one hundred and twenty-five feet, by twenty-eight feet beam and eleven feet sides, built in six pockets. Each pocket is lined with steel and has two steel doors, weighing 4,200 pounds each.

Captain Delaney, of the str. "Grand Lake," has, it is said, been asked to take charge of R. G. Reid's new fast steamer to run from Sydney to Newfoundland to connect with the western terminus of the Newfoundland railway, which is being hurried forward on the Clyde. It will be about 1,200 tons in size, and capable of steaming 16 knots

The officers appointed to vessels by A. W. Hepburn, Picton, Ont., are as follows: Steamers—"Alexandria," Capt. B. Smith, Engineer Chas. M:William; "Empress of India," Capt. Geo. O'Brien, Engineer M. Tetro; "Aberdeen," Capt. M. Hefferman, Engineer George Gown; "Water Lily" to be appointed. Schooner—"Onteora," Capt. Homer Perron.

The Collins' Bay, Ont., Rafting & Forwarding Company, Ltd., has placed the following captains and chief engineers in charge of their steamers and vessels. Str. "Orion," Capt. Alexander Milligan, Engineer Wm. Spencer; str. "Saturn," Capt. Alexander Anderson, Engineer Wm. Kennedy; str. "Rival," Capt. John A. McDonald, Engineer Z. Hamlin; str. "Petrel," Capt. McDonald, Engineer Joseph Branch; barge "Muskoka," Capt. Patrick Gallagher; barge "Waubaushene," Capt. Henry Milligan; schr. "S. Neelon," Capt. Charles Beaupre.

The wreck of the Beaver Line chartered steamer "Assaye," on the Blonde Rock, off the Seal Islands, on the Nova Scotia coast, took place on April 5th The steamer was coming from Liverpool to St John, N.B., with a general cargo and passengers, the whole ship's company numbering 65. She is a steel screw, four-masted steamer with a gross tonnage of 5,129 tons, and a net tonnage of 3,981 tons, and classed 100 A 1 at Lloyds. Seal Island lies at the western point of the triangle formed by Pubnico Harbor light, Bon Portage light and its own light, being almost midway between Cape Sable and Tusket light, but off from the coast.

Moran Bros., Seattle, Wash., propose to build steamers at Seattle, take them to the head of Lynn Canal in Alaska in sections, pack them over the mountains to Lake Bennett, in British territory, a distance from the head of Lynn Canal of about thirty-one miles, and there assemble the vessels and navigate the chain of lakes and rivers to and down the Yukon River to the gold fields. This, it is claimed, will offer a very practicable route to the new gold fields, and the trip can be accomplished in about two weeks from Seattle, whereas it now requires about two months or longer to reach the same destination by way of the mouth of the Yukon.

Ottawa River Navigation Co has appointed the following officers for its fleet for the season Str. "Empress," Capt A. Boure, Engineer Geo Menish, 2nd Engineer Geo. Hodgson, str. "Sovereign," Captain H W. Shepherd, Engineer J F Marchand, 2nd Engineer Thos Therault; str "Duchess of York," Capt J McGowan, Engineer A Menish; str. "Princess," Capt. P. McGowan, Engineer F Piche; str "Maude," Capt E Gauthier, Engineer N. Fugere.

Manager Foy, of the Niagara Navigation Company, has appointed R Clapp first officer of the "Chicora," to the captaincy of that vessel, in place of the late Capt Harbottle, deceased. Captain Clapp has been with the Niagara Company since 1893, occupying the position of chief officer. Previous to that he was first officer on the "Empress of India" under Captain Solhmes, now of the "Corona." The new captain has selected as his first officer, C Smith, who last year was second officer of the "Chippewa." W Palen will again act as second officer, and H. Parker, engineer

It is very gratifying to Canadians generally to note the remarkable developments of the winter traffic at the port of St. John, N.B., and the evidence that a Canadian harbor can compete with the United States ports While there has been a development of about 50 per cent. in the traffic during the present season over that of the preceding winter, the local manager of the Canadian Pacific Railway states that the business has only been limited by the amount of ocean tonnage offering; also that if the steamers had been available, the business would have doubled that of the present season.

The following are the officers of the fleet which wintered at Deseronto, Ont., for this season: "Resolute," Capt. John Gowan, N Palmateer, Mate, J Harrison, 1st Engineer, S Larue, 2nd Engineer; "Reliance," Capt. Jas Daugherty, Mate, B. Barnhart, Engineers, John Toppins and A. McKain; "Ella Ross," Capt. D B. Christie, Mate, P Farrington, Engineer, John McFaul, Purser George McGaughey; "Deseronto," Capt. Wm. Skillen, Mate, G. Arthurs, Engineer, J Rice; "Rescue," Capt. John Rowe, Engineer, M. McFaul; "Nile," Capt. W. Daly, Engineer, Jas. Quigley; "Armenia," Capt S. Anderson, Engineer, Rice. "Ranger," Capt. M. Woodcock, Engineer, McKain; "Norah," Capt. D. McVicker, Engineer, Toppins.

The Richelieu and Ontario Navigation Co. has made the following appointments of officers for the fleet for the season. The list is complete as far as appointments have been made:—Steamer, "Algerian," captain, A. Dunlop; mate, Dan. Mills; 1st engineer, T. Wadsworth, 2nd engineer, G. Bourk; purser, — Dubois. Steamer "Berthier," captain, Chas. Gouin; 1st engineer, — Arcand; purser, G. Paulet. Steamer "Canada," captain, Thos. Dougall; mate, E. Duguay; 1st engineer, Ed. Dennis; 2nd engineer, — Matte; purser, F. Wurtele. Steamer "Chambly," captain, — Tranchemontagne; mate, — Robillard; 1st engineer, Chas. Gendron. Steamer "Corsican," captain, — Esford; mate, — Bushell; 1st engineer, Wm Parker, 2nd engineer, — Guibault; purser, — Boyle Steamer "Hamilton," captain, — Baker; mate, — Graves; 1st engineer, Wm. Black, 2nd engineer, Alex. D'Martigny. Steamer "La Cultivateur," captain, — Raymond; 1st engineer, — Noel. Steamer "Montreal" captain, L. St. Louis; mate, P. Kane; 1st engineer, H. Hamlin; 2nd engineer, E. Baudoin; purser, J. O Prevost Steamer "Passport," captain, J. McGrath; mate, — Corrigan; 1st engineer, Alex Milne, 2nd engineer, A. McBride. Steamer "Quebec," captain, L. O. Bouchier; mate, — Rocher; 1st engineer, Frs. Gendron; purser, L. Gorman. Steamer "Saguenay," captain, Geo. Riviere; mate, — Fortin; 1st engineer, — Lacroix; purser, J. Lapierre. Steamer "Spartan," captain, — Grange; mate, I. Carway; 1st engineer, Ned. Taylor; 2nd engineer, T. Noble; purser, — Tandy. Steamer "Terrebonne," captain, — Laforce; mate, — Laviolette; 1st engineer, Geo. Gendron, purser, — Masse. Steamer "Three Rivers," captain, F. St. Louis; mate, F. Ladibouche; 1st engineer, Johnny Matt; 2nd engineer, P. Papineau. Steamer "Fire Fly," captain, — Crepau; 1st engineer, P. Bouchey. Steamer "Longueuil," captain, — Jodoin; mate, — Laurin; 1st engineer, M. Beadett; purser, F. Brossard. Steamer "Sorel," captain, — Berthiaume; 1st engineer, — Beaucage. Steamer "Hochelaga," captain, — Mandeville; mate, — Poulett; 1st engineer, C. Chapdeline. Steamer "Laprairie," captain, — Coursel; mate, — McClean, 1st engineer, — Beaudoin; purser, Geo. Brossard. Steamer "Island Queen," captain, — Moneau; 1st engineer, Jos Matt, purser, M. Gill. Steamer "River du Loup," captain, — Faubert, 1st engineer, — Gouin.

Electric Flashes.

It is proposed to develop power at the Nigger Rapids, Magog, Que.

The $5,000 bonus voted by Perth to the proposed Perth-Lanark road has lapsed.

Work was begun on the Slocan City—New Denver, B. C.—telephone early last month.

An electric line is projected to connect St. Catharines and the H., G. & B. at Beamsville, Ont.

The Rat Portage Electric Light Co. has its new generators for arc lighting and power running.

Work on the Quebec Street Ry is now being pushed, and the road is expected to be in part operated by June 22nd.

S. Douglas, Stanley, N.B., is putting in an electric lighting plant which will light the village as well as his own premises.

John Graham, Toronto, recently recovered $300 damages from the Street Railway for being pushed off the cars by an employee.

The Portage la Prairie power scheme was killed by the refusal of the legislature to allow the town's issuing the bonds necessary to carry it out.

The citizens' committee of Fort William, Ont., has reported to the council in favor of an electric lighting and water supply plant to cost $42,000.

The effects of the Holmes Electric Protection Co., Montreal, were sold by the liquidator at public auction, and were purchased by Alexander Foster for $3,400.

G. C. Huebner, Detroit, and J. N. Vandegrift, Philadelphia, have, it is said, decided not to build an electric road from London to Port Stanley, as it would not pay.

The Montreal Belt Line, the electric railway which runs from Maisonneuve to Longue Pointe, Point aux Trembles and Bout d'Isle, has secured the mail contract between these places.

In Davis vs. Ottawa Electric Ry. Co., the Divisional Court has justified the company's employees in ejecting a passenger who violated the company's rules by sitting with his feet on another seat.

The Lachine Hydraulic and Land Co. has made a contract with the Standard Light and Power Co, Montreal, for the delivery of 1,000 electrical horse-power which the latter will deliver to its customers.

The ratepayers of Dartmouth, N.S., are asked to provide the following sums: $5,000 for improved sidewalks and water and sewerage extensions; $1,500 for repairs to the steam fire engine, and $50,000 for purchasing the plant of the electric light company.

The Windsor Electric Railway Co. is said to be anxious to secure the charter of the proposed line from Sandwich to Amherstburg, Ont, because it has already got a charter from Amherstburg to run a track along the lake front to Kingsville and Harrow and to other points.

The Hamilton council will not grant the Cataract Power Co. permission to erect poles and string wires till more definite information is furnished as to the company's plans. It is said that the company intends to draw its supply, not from the Decew's Falls, but the old Welland Canal.

At the annual meeting of the shareholders of the Hamilton Radial Electric Railway Company, the following board of directors was elected: A. Turner, president; T. E. Leather, vice-president and managing director; S. E. Malloch, secretary; John Moodie, James Dixon, T. H. Watson and Geo. S. Lynch-Staunton.

Waterloo, Ont., citizens are about to adopt incandescent lighting for their places of business and residences. Two companies in the field to supply the lighting. The Gas Company, with an incandescent system, and a newly formed association called the Waterloo Electric Light Co., Wm. Snider & Co., millers, will furnish the latter electric powe..

A. J. Corriveau, who was the chief promoter of the system of electric railways which now covers the Island of Montreal, is interested in a scheme to build an electric railway from St. Lambert or Longueuil, opposite Montreal, to points in eastern Quebec not touched by the trunk line railway, as far as Sherbrooke, with crossing powers over the bridges, ultimately connecting with the railway systems at Newport, Vt. The company also propose to put electric launches on the River Richelieu, to run from St. John's to points

on Lake Champlain. The whole system will cover something like 150 miles, and the power is to be supplied by the Chambly Rapids Water & Power Company.

A TORONTO syndicate, which has been securing options on the stock of the Street Railway Company and other lines, of Hamilton, Ont., has laid before the city council a proposition looking to the control of the electric railways in that city. It is proposed that a company, to be known as the Hamilton Franchise Company, shall be formed to acquire from the syndicate the property upon which it has options, including the Hamilton and Dundas Railway. The syndicate will accept its pay half in stock of the company and half in bonds. The interest on these bonds is to be first charged on revenue of the company; then at 6 per cent. dividend on stock, after which the city is to receive all the balance of the net revenue up to $20,000, when the stockholders may receive another 1 per cent., and the city all the remainder. The city is to relinquish its mileage and percentage on the Street Railway earnings, which now amount to about $14,000 annually. The city will have the right to appoint certain directors in the new company. It is probable considerable discussion will take place before the deal goes through.

W. A. JOHNSON ELECTRIC COMPANY, 34 York street, Toronto, report the following sales made during the last 60 days, and not previously reported: Thomas B. Angus, Kingston, Ont., one 3 h.p. motor; Theo. Frederick, Ottawa, Ont., one 1 h.p. motor; Antelope Bicycle Works, Toronto, 12 h.p. motor; Nasmith & Co., Toronto, 4 h.p. motor; D. Hibner & Co., Berlin, 150 lt. incandescent plant; W. J. Miller, saw mill, Thessalon, Ont., 30 lt. incandescent plant; Grip Engraving Co., Toronto, four 8 h.p. motors; Murray Printing Co., Toronto, four 3 h.p. motors; Luxfer Prism Co., Toronto, our 600 ampere dynamo for depositing copper; Luxfer Prism Co., Toronto, one 4 h.p. and one 6 h.p. motor; McLaren & Co., St. Catharines, one 3 h.p. motor; Rat Portage, Ont., two 3 h.p. and one 5 h.p. motor; New Denver Electric Co., 500 lt. incandescent plant complete; Rat Portage Electric Co., 100 arc light automatic dynamo and lamps; Rat Portage Electric Co., one 4-panel marble plug switch board, 12 x 5, for four alternating dynamos and eight circuits and for one arc dynamo, and one power generator; Waterloo Electric Co., 1,000 light incandescent plant complete, with wiring for residences, stores, etc., 25 lt arc plant complete, with long burning arc lamps, one marble switch board; Macgregor, Gourlay & Co., Galt, two power generators, two 8 h.p. motors, two 6 h.p. motors and wiring for 250 incandescent lamps, one marble switch board panel. The W. A. Johnson Electric Co further reports many sales of long burning arc lamps for direct and alternating circuits, "chloride" accumulators, Wagner transformers, etc.

Railway Matters.

THE Township of Russell, Russell county, Ont., has voted a bonus of $10,000 to the Ontario Pacific Ry. Co.

THE Restigouche and Victoria Railway Company is applying for an extension of time in which to complete surveys and begin construction.

THEOPHILE PERRAULT, Montreal, contractor, has sued C. N. Armstrong and John Rankin and the Pontiac Junction Railway Company for $788,754.

THE Lake Dauphin Railway will be extended to Mossy River this year, it is said. The company also expect to make further extensions in 1898, probably to Swan Lake district.

THE Canadian Pacific Railway Company is now constructing, at Perth, Ont., one hundred refrigerator, ten furniture and sixty dump cars, the work on which is being rushed as rapidly as possible.

THE people of Cobourg, Ont., are asking for a subsidy for the Cobourg, Northumberland and Pacific Railway, a line projected to run from Cobourg to Central Ontario Junction on the C.P.R., a distance of 50 miles

AN equalization of power is being made on the G.T.R. All the heavy locomotives are being sent to run between Belleville, Ont., and York, where the grades are the heaviest. The lighter engines will run east of Belleville.

J. H. N. MACLEOD, civil engineer for the Canadian Pacific Railway, has charge of a large and thoroughly equipped survey party which is locating the line of the Crow's Nest Pass road westward from Lethbridge, says *The Nelson Miner*.

THE Nanaimo-Alberni Railway Company, composed of Andrew Haslam, J. H. Davidson and others, is seeking incorporation for the purpose of constructing a railway about Alberni to Nanaimo, with power to operate telegraph and telephone lines, construct wharves docks, etc.

THE Restigouche Railway and Bridge Company applies for an act of incorporation to construct and operate a railway from a point of connection with the proposed railway of the Restigouche and Victoria Railway Company, at Campbelltown, N.B., to a point on the Bay Chaleurs Railway, in Quebec, and to construct, maintain and operate as a part of said proposed railway a bridge across the Restigouche River.

JUDGE OUIMET gave judgment, April 12th, in the case of A. R. McDonald, ex-superintendent of the Intercolonial Railway, against Charles Riordon of St. Catharines, the estate of the late John Macdonald and E. Boswell. The plaintiff claimed a large sum as due him in connection with the construction of the Temiscouata Railway, and the court gave judgment for $197,000, with interest for seven years at 6 per cent. An appeal will be taken.

THE following directors were elected at the annual meeting of the C.P.R., held last month in Montreal: Sir Donald Smith, G.C.M.G.; Sir Wm. Van Horne, K.C.M.G., president; Thos. G. Shaughnessy, vice-president; Richard B. Angus, Montreal; Edmund B. Osler, M.P., Toronto; Sandford Fleming, C.E., C.M.G., Ottawa; Lieut.-Gov. Geo. A. Kirkpatrick, Toronto; Geo. R. Harris, Boston; Wilmot D. Matthews, Toronto; Hon. D. MacInnes, Hamilton; Thomas Skinner, London; J. W. MacKay and Gen. S. Thomas, New York.

AT the shops of the Canadian Pacific Railway at Hochelaga, Que., there will be built this summer twenty-one locomotives for the company's service, which will include two consolidated engines for the mountain section of the road; three compound, ten-wheel engines for the Pacific section, and four of the same kind for other sections of the line; six ten-wheel passenger engines for the western division, and six of the same for the eastern division. Five first-class passenger coaches, together with baggage, express and smoking cars, will also be manufactured for use on the Toronto, Hamilton and Buffalo section.

EDGAR FRENCH has been appointed assistant engineer of the G.T.R. western division, with office at Detroit, in place of G. Masson, retired.

R. W. BROCK, M.A., acting lecturer on mining and assaying in the Kingston School of Mines, has been appointed geologist on the Dominion Geological Survey, at $1,100 per year.

E. P. HANNAFORD, civil engineer, whose services were dispensed with some time ago by C. M. Hays, manager of the Grand Trunk Railway, when he was inaugurating changes on the road, has taken an action for six thousand dollars against the G.T.R. for wrongful dismissal.

AMONG the prominent engineers who came from the United States to Montreal to tender for the construction work on the Victoria Bridge enlargement were. Messrs. Bonzano and Clarke, New York; L. E. Todd, C. W. Bryan, S. P. Mitchell, and W. H. Cornell, Wilmington, Del.

LEWIS CARVELL, who in the early days of the Intercolonial Railway occupied the position of general superintendent, died April 13th in Toronto. Mr. Carvell's connection with the road dated back before the advent of the McKenzie Government. After some years' service he was succeeded by C. J. Brydges.

Industrial Notes.

AN hospital is proposed for Oshawa, Ont.

WALKERTON, ONT., will build a new town hall.

GRANT & KERR'S new sawmill at Ladner's Landing, B.C., is nearing completion.

THE Canada Paper Co. is to build a pulp and paper mill at the new dam, Windsor Mills, Que.

J. FLEMING, iron founder, St. John, N.B., recently turned out a five-ton cylinder for a marine engine.

P. MCMURRAY, Welland, Ont., has invented an acetylene gas generator, to cover which he has applied for a patent.

THE Webster Combination system of steam heating is handled in Canada by Darling Bros., Reliance Works, Montreal.

IT is said that the Grand Trunk moulding shops, at present located in Hamilton, Ont., will shortly be removed to London.

J C. FOLEY & Co., of the Foley gold mines in the Seine River district, are putting in a new saw mill of 25,000 ft capacity

THE Rathbun Co., Deseronto, Ont., has completed four fine passenger coaches for the Montreal Park and Island electric railway

THE Goldie & McCulloch Co., Ltd., Galt, Ont., has supplied a 150-horse-power engine to the G T R for the car shops at London, Ont

WALTER BEATTY, Pembroke, Ont has the sub-contract for the carpenter work on the new C P.R car shops at Carleton Place, Ont

WILLIS CHIPMAN, C E., was recently engaged to value the plant of the Barrie, Ont., waterworks, which the town proposes to take over

A LARGE cold storage warehouse is to be built at Halifax, N S., by the Canadian Atlantic Cold Storage Co., Ltd. The Linde system will be used

THE Ontario Legislature, at its last session, threw out the bill to amend the Ontario Architects Act, making the association virtually a close corporation

THE Rathbun Company, Deseronto, Ont., has received an order for 25,000 barrels of cement from the Dominion Government, to be used in canal construction

THE Masterman Sulphite Pulp Mill Miramichi, N B., is to be operated for a short time for the satisfaction of representatives of intending English purchasers

DARLING BROS., Montreal, are sole agents in Canada for the Webster system of steam heating referred to in our article on steam heating on another page.

J B COATES, Ridgetown Ont., and J and R. Nichol, Blenheim, Ont., have gone into partnership in the manufacture of staves, hoops and headings, at Ridgetown

WILLARD KITCHEN, Fredericton, N B., has been awarded the contract for the piers and masonry on the bridge over the Memramcook River at College Bridge, N B

THE Owen Sound Portland Cement Co has secured the contract for 10,000 barrels of cement to be used by the Dominion Government on the St Lawrence canals.

THE Wm Hamilton Manufacturing Co., Peterboro, Ont has the contract for equipping the new Howrie saw mill at Penelon Falls, Ont., capacity 150,000 feet per day

BELLHOUSE, DILLON & Co., Montreal, have secured the contract for 20,000 barrels of Portland cement, to be used by the Dominion Government on the St. Lawrence canals

IN return for a 25 year extension of its monopoly, the Winnipeg Gas Co proposes to reduce the price of gas to $1 50 net for lighting purposes and $1 50 net for cooking purposes

THE Canada Carriage Co., Ltd., Brockville proposes to establish a branch establishment at Ogdensburg, N.Y., to evade the McKinley duties to be imposed by the Dingley bill now pending.

THE bursting of the fly-wheel of an engine used for threshing on the farm of J R. McDonald, near Cornwall, Ont., recently killed the owner of the premises and seriously injured his brother.

THE firm of Albert Holden & Co., Montreal, dealers in railway and machinery supplies in which line they succeeded to the business of Samuel Waddell, have assigned to the court The liabilities are scheduled at $19,780

THE Brotherhood of Locomotive Engineers of Canada will hold its annual union meeting in Windsor, Ont., in July, the exact date not having been fixed About six hundred members and their wives are expected to attend

JAMES A CANTLIE & Co., woolen manufacturers' agents, Montreal, have abandoned their estate on demand of the Bank of Montreal Liabilities about $200,000 A number of Canadian woolen mills will be affected

THE Quebec Bridge Co has elected the following directors: R Audette, Mayor Parent, J B Laliberte, H M. Price, Hon. J. I. Tarte, H J Beemer, G Lemoine, C. Duquet, J B. Forsyth, president, A Lavigne and J. Breakey.

NOTICE is given of application for incorporation of the Lordly Furniture Mfg. Co., Ltd., St. John, N.B The applicants are Joseph Allison, J. A Likely, R G Haley, Isaac Burpee and S B. Lordly The capital stock is $20,000.

RECENT experiments made at the University of Nebraska Agricultural Experiment Station, U.S., on the relative values of coal and corn (on the cob), as fuel, showed that corn at 9 cents per bushel was equal to coal at $4 87 per ton.

THE Gilmour Co are removing a large quantity of their sawmill machinery from Trenton, Ont. to their new mill at Canoe Lake, in the Algonquin Park They have taken away eight of the sixteen boilers and more than half the saws.

AT a meeting of the creditors of E D. Cotterette, hardware, Montreal, he made an offer of 20 cents on the dollar The liabilities were shown at $20,575, partly mortgaged and privileged, and assets about $15,000, but largely depreciable

THE Holland Emery Company of Tawas, Mich., has bought the site of the Georgian Bay Lumber Company at Byng Inlet, Parry Sound, Ont., and will, it is stated, build a couple of mills and docks and bring in from Tawas its complete plant.

R DONALDSON & SONS, machinists and iron workers, Montreal, have assigned on demand The concern failed only last July, on which occasion the estate was bought in, and the firm reconstructed The liabilities then were $22,000; now they owe $9,400

A RETURN brought down in Parliament recently shows that the bounties paid on iron and steel manufactured from Canadian ore since February, 1896, is as follows On pig iron, 42,404 tons, $84,809; iron puddled bars, 4,353 tons, $8,708; steel billets, 35,757 tons, $71,514

THE plant and good-will of the Safe Lock Metal Shingle and Siding Company of Smithville has been bought by a new company at Preston, Ont., formed under the name of the "Metal Shingle and Siding Company." Cyrus Dolph, J. N. Clare, and H. D. Walker, all of Preston, are the first directors, and the capital of the company is $10,000 The new company started operations last month in the Preston Carriage Company's old building.

HIS Excellency Lord Aberdeen has accepted the office of patron of the Architects' Association of the Province of Quebec, as a mark of his appreciation and good wishes for the profession in general and for the association in particular At a recent meeting of the association, William C. McDonald, Montreal, was elected as honorary member in recognition of his great generosity in founding, endowing and equipping a chair of architecture in McGill University.

PREPARATIONS are now being made in the townships of Faraday, Dungannon, Herschel, Monteagle, Carlaw, Mayo, Bangor, Wicklow and McClure, in the county of Hastings, and by the townships of Cardiff, Monmouth and Glamorgan, in Haliburton county, for the taking of a vote on a proposal to give a bonus of $80,000 to aid in establishing a charcoal iron smelter there. Providing the bonus is passed, Manager Pusey, of the Irondale, Bancroft and Ontario Railway, says the Philadelphia Engineering Works is prepared to at once commence the erection of a charcoal furnace to cost about $200,000 in the vicinity of some of the mines along the route of the I B. & O Railway.