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The Canadian Engineer

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The Canadian Engineer.

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For the CANADIAN ENGINEER.

MUNICIPAL OWNERSHIP.

BY RODERICK J. PARKE.

The discussion of this interesting and important question has during the past few years called forth arguments so varied and so numerous that to the non-technical, although directly interested, citizen, the matter has assumed of late a more or less chaotic condition, and a satisfactory solution seems to be no nearer achievement than formerly. For the benefit of those who have been unable to follow the arguments through the columns of the various technical journals, the writer will endeavor to present as briefly and clearly as he can the principal considerations influencing the agitations for and against, and the actual control of, municipal industrial services, and more particularly that branch of the services which embraces the supplying of electrical current for street lighting and private consumers' purposes. This article is not intended to advocate municipal in preference to private ownership, or vice versa, but merely to place before the reader those facts which will have to be carefully considered before an intelligent, unprejudiced conclusion can be arrived at respecting either form of ownership, to the possible exclusion of the other, in those localities in which the question may arise.

To present the subject in a proper light, it is necessary to first ask and answer this question, namely, "What are the principal motives prompting the increasing agitations in favor of municipal ownership? The answer is found to be: (1) The prospect of reducing the cost to taxpayers and private consumers for street and private lighting services. Other motives in the order of their importances are: (2) That the municipality should avail itself of the profits of commercial services, for obvious reasons; (3) Dissatisfaction with the service as rendered by the local company; (4) Local political considerations, and less frequently; purely personal motives among some certain citizens.

Granting, then, that the first-mentioned motive is the prime one influencing the agitation, the question resolves itself not as to who should own the source of supply, but as to whether a cheaper and more efficient public and private service cannot be obtained, and if so, at what proportionate reduction on present cost. Present results show beyond the possibility of a doubt that, giving the same conditions as formerly, in reference to population, cost of fuel and other local conditions, electrical current can be profitably supplied at in some cases a very considerable reduction to the consumer, if modern methods and apparatus be adopted by the central station manager. Competent authorities emphatically point to the fact that if it can be shown that private enterprise can supply municipal industrial services as cheaply and economically as through municipal ownership, very few will be disposed to question the policy of permitting private ownership to continue, providing, of course, that the private corporation will accede to the popular demand. Unfortunately, however, the local company, secure in the monopoly it holds, more often exhibits an utter disregard for the rights of the public, hence the movement for supplying a remedy through municipal ownership. Other reasons for this disregard are lack of enterprise and ability on the part of those responsible for the inefficient and unprofitable condition of the system. In villages and the smaller towns, however, where the demand is necessarily confined within certain limits, the cost of manufacturing is proportionately higher, even with the most efficient machinery, than is the case in the larger towns and cities, hence the public should exercise careful discretion when attempting to compare prices existing in any two localities having a marked difference in population. The individual commercial conditions should also be carefully compared.

The public has every right to demand in return for the privileges accorded to the private corporation in the locality, that the service shall be rendered in the best manner known to be commercially practicable, and at the lowest reasonably profitable prices. Failing in this, the owners of the system can have no cause for complaint in the event of the municipality taking the matter into its own hands, as already illustrated in a number of cases. The question now comes up, whether the company is giving a sufficiently good service to the municipality and at the lowest consistent prices. On this question a great many differences of opinion are found to exist among those directly interested, the only apparent method of arriving at an exact estimate being to have the methods and operations of the system carefully investigated by a board of competent and thoroughly disinterested electrical experts appointed one from each side, and a third chosen mutually by the first two. In this way, assuming the rigid integrity of the experts, the municipality and the company cannot fail

in having their respective interests protected fully and impartially, and a mutually profitable and agreeable understanding promoted. If the results of the investigation show that improvement is warranted and feasible, then let such improvement be made. There should be no reason why central stations should be behind the times, or be commercial failures any more than other industrial enterprises, and if through any avoidable mistakes or errors the owners persist in forcing an unsatisfactory and needlessly expensive service on the community, it is plainly the duty of the citizens of that community to endeavor to set matters on a better basis. And conversely, if the company honestly will make every effort to do its work well and in good faith, it certainly has every right to expect and demand good faith from the municipality.

In the majority of instances of disagreements existing between municipal authorities and the central station owners, the trouble is due in a great measure to misconceptions and exaggerated ideas arising through technical ignorance on the part of the former, and often a mutual distrust of the other's intentions and motives, on the part of both, with consequently disastrous results to the vested interests of the owners when the power of a majority is taken advantage of by the municipality. To instruct the authorities sufficiently to enable them to conduct an impartial and competent inquiry into the workings and methods in vogue in the local central station is out of the question, while to expect them to blindly accept the arguments and statements of the owners is in the majority of instances equally inadmissible. The establishment of a provincial board of industrial commissioners, capable of technically inquiring into and competently advising municipalities on such matters, would seem to be the most advantageous method for all concerned, or, in the event of there being insufficient necessity for the permanent existence of such a board, a temporary one could be drawn from among the ranks of those disinterested members of the electrical profession making a specialty of works of this nature. The central station owners where they have not legally forfeited the right to expect leniency and consideration at the hands of the municipality should certainly have due regard shown their interests as far as can be consistently done, in view of the fact that at the time when the station was established, assuming this to have taken place not less than five years ago, comparatively much inferior and more inefficient methods and apparatus were taken advantage of as being the best then known. In those instances where during the profitable operation of the central station for a period of several years, the owners have shown culpable lack of enterprise in failing to improve the particular system where such would be necessary in order to assure the supplying of an increasingly efficient and up-to-date service at proportionately lower prices, the justice of compelling the municipality to repay to the owners their original outlay for the equipment, is open to serious question, particularly if that equipment be out of date, insufficient, and in a badly depreciated condition. And even though the owners be willing to accept a considerably reduced price for their equipment, the fact must be borne in mind that in order to place such on a modern and more efficient basis the only alternative left is that accepted by the wide-awake manager, namely, to discard the old and install more capacious and efficient machinery and to practically reconstruct the system. Where any part or portion of the old equipment can be advantageously continued in use as a part of the new system, a reasonable allowance should be made on such to the owners, and that part or portion adopted. The tendency, however, seems to be in the majority of cases to ignore the owners as far as possible, and to purchase an entirely new outfit. Whether this policy be a judicious one depends altogether on the nature and quality of the local system to be supplanted, and will be discussed in a future article. It may be remarked just here, however, that a great deal of the machinery and apparatus installed a few years ago would be dear at any price if adopted in a modern central station, where the latest types and highest quality of equipment are necessary to meet the conditions under which the station should be operated. The enterprising manager, alive to his own interests, has already perceived the necessity of operating his equipment under the most economical methods, and that in order to do this the many needless and avoidable wastes of power in process of translating the energy of the coal pile into light and motive power due to poorly designed and inefficient devices must be stopped, as far as the latest developments of the science have shown to be practicable. In consequence of this the said devices have been disposed of to the dealer in second-hand apparatus, or sent to the scrap heap, and the more efficient apparatus installed. If, then, the practical manager finds it to his interests to get rid of his out-of-date machinery, is there any valid excuse for compelling the municipality to cover the losses incurred through the incompetent manager's failure, when it is found necessary or advisable to establish an improved system on its own account, and where in any event the old system would have to be replaced by a new one?

An article of much interest, bearing on up-to-date management of public lighting plants, appears in the editorial columns of the Electrical Engineer of May 26th, 1898, and is well worth reproduction, in view of the fact that this journal actively opposes municipal ownership. This article, entitled "An Object Lesson for Municipal Plant Advocates," says:—

"It is now about ten years ago that the then Mayor Grant of New York ordered the electric light poles of this city to be hacked down with axes and the wire carted to the city junk yard. This policy of violence was the first step toward the placing of the wires underground, and although no one would now go back to overhead wires, the method adopted for bringing about the result will always be considered arbitrary and uncalled for. In striking contrast with the ex-mayor's procedure is the painstaking and intelligent manner in which the officials of Providence, R.I., have gone about adjusting questions of this kind with the local lighting contractors, the Narraganset Electric Lighting Company. The latter company has an exclusive franchise for electric lighting in the city, but instead of abusing its privilege, has steadily increased its hold on the public confidence by its policy of fair dealing emphasized by a steady reduction in rates. Recently a committee of the city council was appointed to report upon the placing of high tension wires underground, and the committee's report now lies before us. Before formulating its report the committee undertook a trip of inspection of underground work in various cities, and that it was not a junket is evident from the fact that the committee traveled at its own expense. The proposition which it sanctions for adoption by the city council is substantially that submitted by the electric lighting company. This contract provides for the gradual removal within three years of all the overhead wires and their placing in underground conduits within what is termed the first building district of the city. At the same time the lighting company agrees to a gradual reduction of the price for lighting from 35 cents to 30 cents, to take effect in 1903, for 2,000

c.p. arc lights burning 4,000 hours per year. Considering the expense which the burying of the wires will entail, the rate just quoted will be conceded to be very low—one indeed that will require the highest economy in all departments of station work. But President Perry of the Narraganset Co. has always had a reputation for wanting the best that money can procure, and we doubt not that under his management the company will, as heretofore, remain among the most substantial electric lighting properties in the country. At the same time we must express our gratification in these days of municipal ownership agitation that the city council of Providence has among its members men who are sufficiently intelligent and patriotic to weigh and determine the questions submitted to them in a spirit of fairness to the interests both of their constituents and of their lighting contractors. We feel certain that if every city in the Union had adopted the arrangement entered into by the city of Providence and the Narraganset Electric Lighting Co., by which the latter is limited to a profit of eight per cent. on its share capital in lieu of the grant to it of an exclusive franchise, very little would now be heard of municipal ownership of electric lighting plants in this country."

If, as shown in the above instance, the manager of a large and influential electric lighting company has found it much more to the interests of all concerned to endeavor to please the public as far as he can, instead of abusing the privileges accorded him, is it not apparent that for those cases where disputes are now in progress between the municipality and the local lighting company every possible effort should be made towards effecting an amicable settlement, before arbitrary measures are resorted to by the former? Not only in this one instance, but in numerous others as well, have the beneficial results of intelligent, impartial and amicable investigation been clearly and conclusively demonstrated, and there can be no doubt that if the company will show due consideration for the rights of the public at every available opportunity, the latter will not be slow to accord privileges and favors, which under less agreeable circumstance would be denied, perhaps with much indignation.

Where negotiations are to be made between the municipality and the company, the latter has every right to demand that those appointed to advocate the interests of the former, shall be men whom, as far as possible, are capable of conducting an intelligent and competent inquiry, without prejudice to the rights involved, and as the public demand full justice, sometimes with unnecessary vehemence, let them consistently endeavor to provide that justice, in the strictest sense of the term, shall be obtained, not only for the one side, but for both.

(To be continued.)

—Now that Anglo-Saxon unity is becoming a favorite catch word with such as are in high places watching to see which way the wind blows, the people of Toronto are beginning to realize the benefits they have unwittingly conferred upon the Empire and the race by allowing Architect Lennox his own sweet way in building the city hall. Such a combination as it is of Canadian hard-earned gold and United States ready-made fixtures and materials will be a monument to our desire to freely give and take as our neighbor sees fit. Having provided such a monument, we hope that the corpse of the desire will be carefully interred under it, and that in future when Canadian manufacturers tender at less prices than their neighbors for articles of the same class, their tenders may not be rejected merely because the tenderers are not aliens and their wares are not made in the United States.

A POLE RAILWAY.

From Weymouth, N.S., to Nouvelle France, a distance of sixteen miles, there is a railway whose construction and equipment are of great interest to the lumber trade, and in fact to all who are engaged in opening up new or sparsely settled districts. This pole railway was

A Pole Railway in Operation.

built by Emile Stehelin, of Nouvelle France, N.S., who has kindly given The Canadian Engineer some details of this novel work. The line serves six stations in its course: Nouvelle France; Doyle Lake, where there is one sawmill; Riverdale, where there are two sawmills; Woodville, where there are three sawmills; Corberrie, a thriving little village, and Weymouth on the coast.

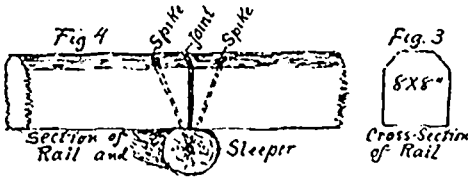
On level ground the construction of a pole railway is a very easy matter, but in this part of Nova Scotia the country is hilly and there are a great many swampy stretches which made construction more expensive than would often be the case. The cost of the whole line, including equipment in this case, was about $3,000 per mile. This included grades of three to six per cent., a number of bridges and several embankments of from ten to fifteen feet high. On level ground the construction con-

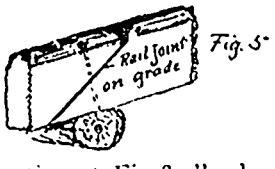
A Pole Railway—Construction.

sists in laying down sleepers ten feet long and three to four feet apart, on which is laid a spruce rail, sawn as shown in Fig. 3. The rails are twenty to thirty-five feet long, and are trimmed square for flat stretches and bevelled for grades as shown in Figs. 4 and 5. The joints are made and the rails secured by twelve-inch wharf spikes as shown.

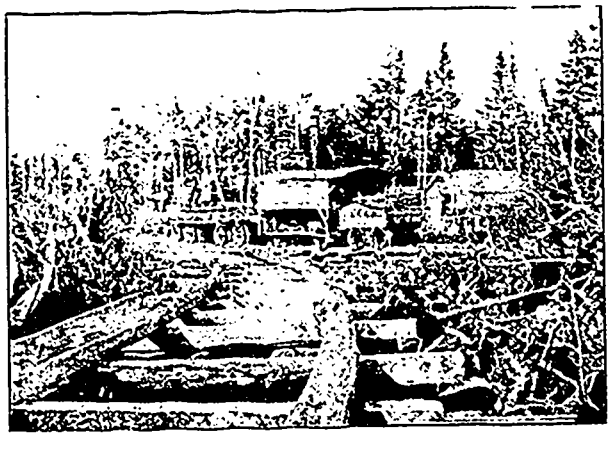
The method followed in building bridges and embankments is to lay a series of timber floors one upon another, each at right angles from the last, till the required height of the pier of embankment is obtained. With careful work and exact cutting of the timber, there is practically no limit to

the height to which such piers and abutments can be carried.





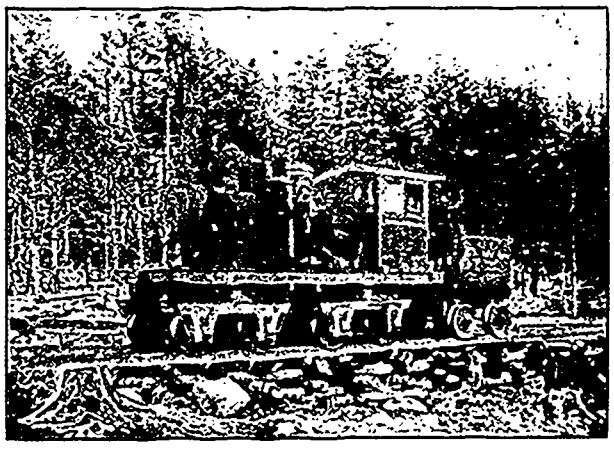
The locomotive "Firefly," shown below, is the one first used by the road. This is an old stationary boiler and a twenty horse power engine, mounted on a truck. The wheels are driven by an intermediate crank wheel. Considerable difficulty was experienced in adjusting the parts of this engine, but it was finally got to run very satisfactorily, and is used for hauling logs to the sawmills.



A Pole Railway—The Locomotive "Firefly."

The "Maria Theresa," shown below, is an entirely new locomotive, built expressly for the line by a Nova Scotia firm. It has four cylinders of twenty horse-power each, driving two trucks of four wheels each.

In operating a line of this kind, one of the greatest difficulties to be contended with is the amount of friction developed by the wheels, which do not run on the wooden rails with at all the same ease as on steel or iron. The



A Pole Railway- The Locomotive "Maria Theresa."

locomotive should, therefore, be made as light as is consistent with the power to be developed, the friction of the wheels being sufficient to compensate for the lack of weight in the locomotive. It is to obviate as much of this friction as possible that the upper surface of the rail is cut in three faces. At present, only six miles per hour is obtained regularly, but Mr. Stehelin hopes with some modification of the locomotive wheels to obtain higher speeds. The engines are wood burning, but it is proposed to substitute coal, which can be had very cheaply at Weymouth. The freight cars used on the pole railway are twenty feet long on two trucks with four wheels each; the passenger car is twenty feet long, and is covered and closed; there is also one small passenger car to carry four persons.

CHROMIC IRON IN CANADA.*

For a long time chromic iron was regarded only as a mineralogical curiosity, and its industrial use only became known when it was applied to chemical industries. The application of the salts of chrome to dyeing dates from 1820, and the industry of the manufacture of bichromate of potash was inaugurated about that time. It was only in 1883 that potash was partially replaced by soda. Down to 1827, the very limited consumption of this product was supplied from the region of the Ural Mountains. In 1827, chromic iron was discovered by Isaac Tyson, jr., in the neighborhood of Baltimore, and subsequent search resulted in further discoveries of it in other parts of Maryland and Pennsylvania. From that time to 1862 the Baltimore region supplied the market in the United States and Europe, the most important centre of consumption in the latter being Glasgow. In 1845, Mr. Tyson, in order to utilize his surplus output, established the manufacture of bichromate of potash, which is still in operation in Baltimore under his direction. In 1848, the deposits in Asia Minor were discovered, which, ten years later, became, so to say, the most important factor in the production of chrome in the whole world. In 1869, discoveries of the ore were made in California, which have supplied the American industry from 1878 down to these latter years, and next in New South Wales and New Caledonia, and lastly in Canada and Newfoundland in 1894.

Chromic iron, or chromite, has a density of 4, 5, say about 7 cubic feet per ton, its hardness is between 5 and 6, it gives a brown stripe and dust; it is unattackable by acids and infusible at the highest temperatures. Some authors say that it is sometimes magnetic, but J. Obalski, M.E., in describing the deposits in Quebec, did not observe that it was so in that region. It is true that some samples of magnetic iron in the serpentine contain chrome, but, at least for the Quebec district, its non-magnetic condition is a distinguishing characteristic of ores that can be worked for chrome; its appearance moreover is that of magnetic iron or titanic iron. It is composed of iron in the state of protoxide and sesquioxide of chromium; nevertheless the elements, iron and chrome may be, in part, replaced by magnesia and alumina, which then reduce its grade, without prejudice to the mixture with the serpentine, which is moreover easy to discern. Theoretically it may be said that the yield in sesquioxide is 68 per cent., but it is rare for the real grade to exceed 56 or 57 in picked specimens, and the industrial tests on shipments very seldom reach 53 or 54. The merchantable grade for the manufacture of bichromate of potash is 50, but some buyers accept 49 and even 48. Under that, the ore is classed as of inferior quality. The Black Lake ores have given 49.8 and 50.3 on shipments (analyses of the Baltimore chrome works), and 54 and 56 on specimens (Donald analyses) 58.06 (Pittsburg testing laboratory), concentrated specimens from Black Lake 56.28 and 60.66 per cent. (Ledoux &

*The facts here presented are taken from a recent report by J. Obalski, M E Provincial Inspector of Mines for Quebec.

Co.). Milton L. Hersey has also made numerous analyses of these ores, which frequently gave high grade. Shipments from Breeches Lake have reached 55 per cent. In chemical industry, the ores which are poor in silica are preferred, and for certain uses buyers fix a limit of 12½ per cent. of metallic iron and 8 per cent. of silica.

The existence of chromic iron in the serpentines of the Eastern Townships, of Quebec, has long been known, but until 1894 hardly any effort was made to develop the deposits. According to the geology of Canada for 1863, the first attempt in that direction was made in 1861, when about ten tons were extracted in the neighborhood of Lake Nicolet. Some twelve years ago, a small quantity was also taken out in lot III, 24 of Wolfestown, and in 1887 Dr. J. Reed shipped to Philadelphia 54 tons derived from lot X, 1 of Leeds. Lot IV, 16 of Thetford, also yielded four or five tons, but of low grade. About the same time, specimens sent to Antwerp Exhibition had attracted attention, and orders for ore had been received, but the known deposits did not appear to be rich enough to be worked with profit. In April, 1894, an unknown mineral having been discovered near Black Lake by a man named Provengal, a specimen of it was brought to the office of the Provincial Mining Engineer, who at once recognized it as chromic iron of a high grade, and advised that the mine should be worked, indicating at the same time where a market could be found for the product. The Nadeau-Provengal mine was thereupon opened; and the selling price of the ore being deemed remunerative, prospectors entered the field and other discoveries were made in the neighborhood, especially in the township of Colraine, thus giving rise to an industry which promises to become prosperous.

The presence of these deposits is indicated by a sort of black spongy crust, of ferruginous aspect, appearing in spots on the serpentine and by the loose rocks found on the surface. Sometimes the crusts are only superficial, and at others they penetrate into the serpentine with a thickness of several inches, which may increase and attain several feet. In still other cases, the mineral shows itself at once on the surface with its metallic aspect and occasionally in its greatest thickness. But the deposits have a character of irregularity; they seem to be almost independent of each other, and sometimes suddenly disappear without leaving any trace to warrant further work. No defined walls except the planes of ordinary fracture in the serpentine are observable. The question of the depth to which these deposits extend has been mooted, and it has even been suggested that borings should be made to determine whether they cannot be found where they do not outcrop at the surface. Such deposits should exist and chromic iron has been found at a depth of 30 feet in an otherwise unproductive shaft sunk for asbestos by the Beaver Asbestos Co. on lot Colraine C. 30. Geologists have given considerable study to the origin of this mineral, and have established, in the Quebec region at least, that while it occurs in the dark green serpentines of the Eastern Townships, it is absent from the buff or honey-colored serpentines of the Laurentian system.

Chromic iron is also further found on the west coast of Newfoundland, at Bluff Head, Port au Port Bay, where a very important bed is being worked by the Halifax Chrome Company, which during the summer of 1896 took out 1,500 tons and shipped about 200 gross tons, of which 145 went to Pittsburg, where it yielded 49 90 per cent. (Transactions of the American Institute of Mining Engineers, Geo. W. Maynard). The author of this paper says that the ore gives from 39 to 50 per cent., and he mentions the discovery of a mass 97 feet long by 45 feet wide.

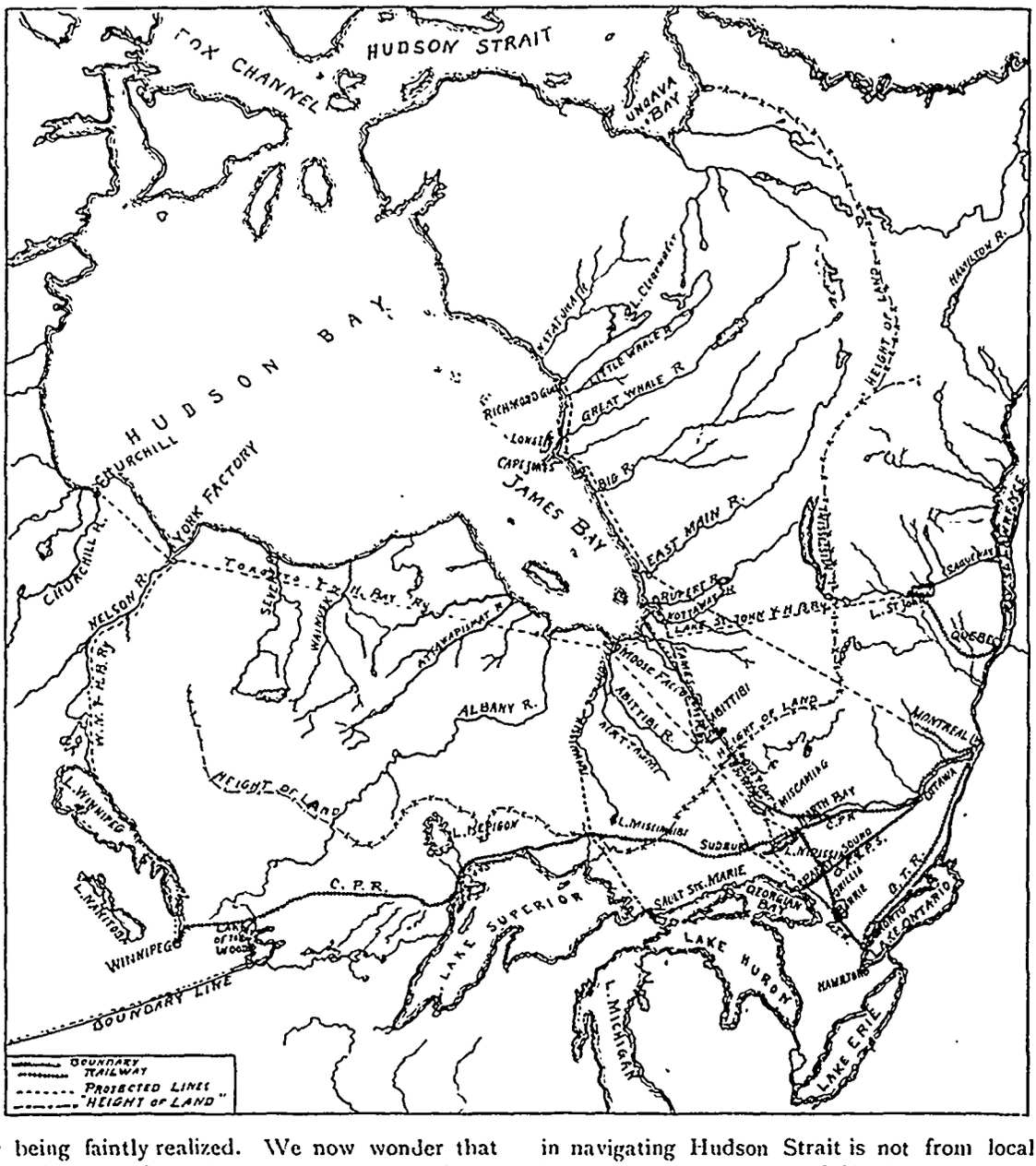
With these deposits in Canada, there seems no reason why a great chemical industry should not be built up in Canada, along with a considerable addition to our mining development. Chromic iron is used for the manufacture of bichromates of potash and soda, which are employed in the dyeing and printing of calicoes. These products form the bases of the chrome colors, yellow, orange, green, etc.; they are also utilized in the construction of certain batteries of electric piles, in the tanning of leather, in chemistry, and slightly in medicine. Chrome enters into the composition of the ferro-chromes, which are used to make the chrome steels that are noted for their very great hardness, and employed for the armor plating of vessels and forts, and for the making of shells, tools for cutting iron, shoes and dies in stamp mills, safes, etc. Ferro-chromes of different grades, ranging from 40 to 90 per cent of chrome, are made while the chrome steels contain from 1 to 10 per cent. of chrome. They are also employed in alloys with aluminium. Chrome imparts to the metals with which it is allied great hardness and inalterability, and increases their elasticity, these qualities varying with the grade in chrome. More recently low-grade chromic iron has been employed on account of its essentially refractory qualities, in the construction of certain parts of furnaces exposed to high temperatures, and especially in the construction of the inside parts of open hearth furnaces and of reverberatory furnaces for copper smelting. A certain quantity of it is regularly used for this purpose in the Pittsburg district, where also special chrome fire bricks are manufactured, two companies being engaged in this industry. In this case, the medium grades are preferred, on account of the price. In latter years about 2,000 tons have been used in the United States for these purposes. It is also employed by the European metallurgical establishments.

In the Province of Quebec there is a pretty extensive region in which chromic iron occurs in commercially workable quantities, and when it is considered that these deposits are located at distances ranging from several acres to five and nine miles from the line of the Quebec Central Railway, and on heights which render their working easy, that labor on the spot is cheap and fuel wood close at hand, it would appear that it would be difficult to find a more favored country as regards this industry. It has been prosecuted there since 1894, but by very primitive methods, not a single steam machine having been yet employed; nevertheless over 10,000 tons have been taken out to a value of about $140,000. Nova Scotia coal is worth $4 a ton at the Quebec Central Railway. Furthermore, the chromic iron ores of the region in question are concentratable and capable of furnishing a very large quantity of high grade. The Government still owns many lots, which can be fully bought out at $400 per 100 acres. There have been no deep workings yet, and it is safe to conclude from what has been said that this district is destined to become an important factor in the production of chromic iron for many years to come.

ON TO HUDSON BAY.

Hudson Bay, Canada's great inland sea, is about 600 miles across from east to west, and measures about the same distance from north to south, or if you include James' Bay, its southern arm, it will be 1,300 miles long from its northern to its southern extremity. Its average depth is 600 feet, and its floor is so level and uniform that if it were raised out of the water it would form one vast prairie

like that of Manitoba. The waters of James' Bay, however, are so shallow (except through one wide channel leading down its centre to Moose Factory), that a boat oar can touch bottom many miles from shore. This vast inland ocean is a basin into which 3,000,000 square miles of land are drained, and so large is the quantity of fresh water pouring down, that the waters of James Bay are only slightly salty. Hudson and James Bays receive the waters of twenty-five large rivers besides those of numbers of smaller rivers, some of which are unknown and unnamed. Notwithstanding the vast area of Hudson Bay (about 500,000 square miles), no part of it is within the Arctic Circle. The resources of this vast region are

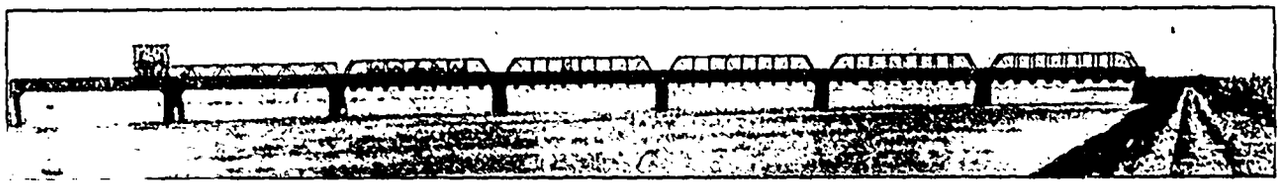


only now being faintly realized. We now wonder that the natural fertility of Manitoba and the North-West Territories, and the great mineral resources of British Columbia and the Yukon, remained so long unknown, or, at least, unappreciated by the people of the older Provinces. In a few years when the great valley of James and Hudson Bays shall have been opened up by railways, we will wonder still more that it, too, should have remained so long locked up. The reports of early travelers and explorers, who, in order to make interesting stories, have exaggerated the character of the climate, have no doubt been one of the stumbling blocks in the way of opening up our great northern land. The climate and surroundings of Hudson Straits also have been so confounded with the climatic features of the great inland basin as to discourage inquiry. Hence it is that many intelligent Canadians imagine that the waters of Hudson Bay form one immense ice field during the greater part of the year. As a matter of fact, Hudson Bay itself is never frozen over any more than Lake Huron or Lake Superior. Navigation can be carried on throughout Hudson Bay proper every day in the year. It is only in Hudson Strait that difficulty from ice is encountered. In James Bay, owing to the shallowness and freshness of the water, ice is formed during the winter, but this ice with the river ice breaks up in April and May at about the same date that the St. Lawrence River is free from ice. The trouble in navigating Hudson Strait is not from locally formed ice, but the great polar ice fields that are annually broken up and drift down Davis Strait and Fox Channel, where quantities of it are deflected by the inset of the Atlantic tides and turned into the Strait. The length of time when the Hudson Straits are navigable, varies according to different navigators and explorers all the way from 3½ to 6½ months in the year. Notwithstanding the pessimistic views of many regarding these Northern waters, the fact remains that though Hudson Bay and Strait have been navigated continuously since 1668, when the Hudson Bay Company was formed, the shipping disasters have been remarkably few, so few indeed that for the last half century the Hudson Bay Company has ceased to pay insurance on

its vessels, having found it cheaper to assume its own risk. Dr. Bell, the Dominion Government explorer, agreed with the reports of those who have spent years in residence on the shores of the Hudson Bay, that these waters are remarkably free from violent storms, particularly in summer months. Taking all months of the year together, the Hudson Bay is a mill pond compared with the north Atlantic, while the total hours of fog in the year are only one-third those of that part of the Atlantic through which most of our present ocean steamship tracks are mapped. These are important points which are now beginning to be realized by Canadians.

When we come to the question of climate, we must remember that we are dealing with a stretch of country nearly 2,000 miles from north to south if you take the Height of Land of northern Ontario and Quebec as its southern boundary. There must of course be a considerable variety of climate in so large an area. Taking the country from the Height of Land to the northern part of the James Bay on both the east and west sides, we have the most positive evidence of a climate as temperate and healthful as any part of the St. Lawrence Valley or that part of Ontario between the Ottawa and Georgian Bay. The voyageurs who accompanied some of the Dominion Government explorers to the James Bay were surprised at the mildness of the climate and the high summer temperatures of the water, compared with their experiences along the shores of Lake Superior where most of their life had been spent. This is accounted for partly by the greater length of the summer day in these northern regions and partly by its nearness to the level of the sea. Dr. Bell found the average temperature of sea along the east coast of the Hudson Bay to be 53 degrees Fah. and of the rivers 61 degrees, and he and his party bathed in the sea almost daily on their journeyings along the coast. The various farm and garden products that have been grown for the last half century or more by the Hudson Bay factors and the missionaries around the Bay, and the character of the forests, are further evidences of the suitability of the climate for successful settlement. Starting from the Height of Land in either Ontario or Quebec, the traveler passes through an extensive shallow basin, comprising not only vast tracts of splendid agricultural land, but numberless lakes of all sizes linked together by rivers and streams. From the northern rim of this broad basin the land again slopes gently towards the shore of James and Hudson Bays, cut through here and there by rivers. These numerous rivers, though navigable for stretches 100 miles or more, have numbers of falls and rapids, which, while they are an impediment to navigation, give promise of immense industrial advantages in the creation of water powers. On the Abittibi one exploring party had to make 21 portages, owing to the rapids, falls or chutes, some of which could be transformed into ideal water powers. There is probably no similar area of country in the wide world capable of yielding such an enormous amount of water power for industrial purposes. Right here we may say, that in view of the illimitable area of splendid spruce land and cheap power in this region a railway through the Hudson Bay Territory could be made a profitable investment if the wood-pulp industry alone were in question. The finest spruce in the world is to be had in these northern forests, the extent of which is beyond estimation. White and black spruce and the larch tree thrive well up to a point north of Richmond Gulf, and when this line is carried some distance inland eastward it again curves north to Lat. 59, or to a point north of Cape Dufferin. Balsam, poplar, canoe birch, aspen, mountain ash, balsam fir, bird cherry and Banksian pine, have their northern limits at various points farther south on the shores of the James Bay, but in each case this limit is also extended farther north as you go inland to the east and west of the Bay. The white cedar, mountain maple, white and red pine, white elm, red oak, ironwood, basswood, birch, ash, and other deciduous trees are to be found in areas of varying extent from the head of James Bay down to the settled districts of Ontario and Quebec. J. C. Bailey, who was on the exploration for the Nipissing and James Bay Railway, found splendid specimens of Norway pine, yellow and black birch, and sugar maple, many trees measuring from 20 to 40 inches in diameter, and standing 70 to 80 feet high. As to the soil, almost every traveler and explorer has been surprised at its fertility and the depth of vegetable mould. Dr. Bell, in his report to the Government on the country between Lake Superior and James Bay, says: "After passing the 'swampy grounds,' the traveler cannot fail to be struck by the abundance and fertility of the soil exposed on the banks of the rivers all the way to Moose Factory. I have no doubt that at some future time this country will support a large population." Among the agricultural products that have been grown year after year at various Hudson Bay Company's posts, and by missionaries living among the Indians, may be noted barley, oats, rye, peas, beans, melons, cucumbers, castor oil beans, tobacco, balsams, cauliflowers, cabbages, lettuce, turnips, radishes, beets, carrots, onions, coleworts, cranberries, gooseberries, currants, strawberries, raspberries and cherries. Wheat has also been grown at the Hudson Bay posts. Sarsaparilla of a very superior quality grows wild over a wide area of country. Archbishop Tache gives at least 223 species of birds, and 72 species of fur-bearing animals to be found in this region. The wealth of the Hudson Bay district in fur is too well known to need emphasis here. Agriculture in the Lake Temiscaming and Temagam districts has passed the experimental stage, tracts of land having been brought under cultivation, the farmers finding a market in the supply of men and horses engaged in lumbering operations there. An abundance of hay is grown, the clover of the Temiscaming district being said to to excel that grown in any other part of Canada. Root crops are successfully raised. Of oats, barley and peas the farmers have large harvests; cultivation of wheat is alone limited by the narrowness of the market. All that is wanted to place agriculture in this district upon a well established basis, and open up the rich territory around Lake Abittibi to the north, is efficient railway communication with the commercial centres of the Dominion.

We now come to the mineral features of the Hudson Bay slope, and here it must be remembered that nine-tenths of the country has remained until now absolutely unknown and untouched by the geologist or prospector. The cursory examination of this one-tenth of the region in question has disclosed the following minerals:—gold, silver, lead, iron (magnetic and hematite), nickel, copper, pyrrhotite, zinc, galena, antimony, arsenic, tellurium, platinum, tin, bismuth, molybdenum, cobalt and manganese. while among the non-metallic minerals may be noted agates, carnelians, epidosite, porphyries, granite, syenite, sandstone, quartzites, flagstones, slates, marbles, ornamental argillites, jaspers, garnets, chalcedony, white quartzites for glass making, asbestos, graphite, actinolite, lithographic stone, gypsum, salt, amethysts, soapstone, ochres and other mineral paint material, kaolin, lignite, mica, peat, axinite, limestones, brick clays, petroleum, and last of all anthracite. When we consider how slight has been the geological examination of this region, the foregoing list is certainly imposing, and of the minerals here enumerated



NEW VICTORIA JUBILEE BRIDGE ON G.T.R., AT MONTREAL—VIEW FROM HARBOR GUARD PIER.

at least one-half are known to exist in paying quantities. In some cases the deposits are of incalculable extent, and all that is wanted is railway communication to develop them. The copper belt, a large part of which is nickeliferous, extends all the way from Lake Huron and Lake Superior to Lake Mistissini. Antimony was found near Echo Lake in a vein eight inches wide of very rich ore. On Moose River the gypsum beds are ten to twenty feet thick, and have been traced for many miles from the river. Carniferous rocks are extensive to the south west of James Bay, and in this formation it is expected oil will be found, as in like formations in the Enniskillen fields of Ontario. Large deposits of clay iron-stone are found on the Mattagami River. The ornamental stones alluded to in the non-metallic list are found in remarkable abundance in many places, while some beautiful varieties of unnamed ornamental stones have been discovered. Samples of the granites have been polished and are said by experts to be finer than Aberdeen granite. Of the samples of marbles, some are banded, some clouded and all are easy to quarry. Some of the yellow ochres and Venetian red paints have been found in such a condition that they can be used without grinding. A bed of kaolin is found on the Missinaibi, below Coal Brook. It is overlaid by a bed of beautiful bright sand, of which E. B. Borron says, "I believe that both the kaolin and sand, the one suitable for the manufacture of porcelain and the other for window glass, are there in large quantities." Lignite is found on the Mattagami, the Missinaibi, and the Abittibi, and the beds of peat are declared to be "absolutely inexhaustible." Of other beds of lignite, Dr. Bell mentions some that are 1½ to 6 feet thick. The sample of anthracite found on Long Island, and shown to Dr. Bell, has a conchoidal fracture and a bright lustre, and on analysis yielded 94.91 per cent. of fixed carbon, and only 0.35 per cent. of ash. Dr. Bell was prevented from visiting the locality, but this discovery is of the highest importance to both Ontario and Quebec. On the Abittibi River, the bituminous limestones and carbonaceous shales closely resemble the petroleum bearing strata of the MacKenzie Basin. Mr. Low, who explored the south side of Hudson Straits last year, says "the schistose rocks of that region are frequently penetrated by numerous quartz veins, and their proximity to masses of igneous rock are conditions favorable to the occurrence of gold. Along with this schistose are large beds of impure iron ore, corresponding with the enormous deposits of bedded iron already found in the Cambrian rocks of the Koksoak and Hamilton Rivers." The clay deposits of Lake Abittibi are unusually rich in aluminum, and this industry alone should justify the exploitation of that region. A sample of the manganiferous spathic ironstone, which is found in such great abundance, was shown on analysis to contain 25.44 of metallic iron and over 24 per cent. of carbonate of manganese. A band of chalcedony seven feet thick was found by Dr. Bell on one of the islands north of Richmond Gulf. "The spathic ironstone bands of the whole Nastapoka chain are found by Dr. Harrington to constitute valuable iron ore. These form a band averaging 20 feet thick throughout the whole group of islands, which have a length of about 90 miles exclusive of the islands to the north." The enormous abundance of the ore is its great feature, and we are told that not only is the ore already broken by nature in inexhaustible quantities, but much of it can be loaded direct into vessels from the steep, rocky sides of the islands. Magnetic ironstone is washed out of the drift in considerable quantities at various places along the coast. The rare mineral axinite, which has been discovered near the mouth of the Little Whale River for the first time in Canada, is found in crystals along with quartz, calcspar, epidote, chlorite and asbestos, also in the granular form. It is of purple color and takes a high polish.

This mere outline of the minerals found in the James and Hudson Basins will show that Canada has more than one Klondyke; and when it is considered that only a few years ago the large areas of gold and nickel of northern Ontario were unsuspected by the geologists who had traversed the region, it is but reasonable to expect that new minerals will be found and more expensive deposits of those already known will be unearthed, in the region under consideration.

The accompanying sketch map is intended to show approximately the routes of various railway lines projected towards Hudson Bay from Ontario and Quebec. The conformation of the country, the abundance of timber, and numerous water channels, render railway construction in this country a most easy problem. The surveys already made show that the highest grades going north from the Height of Land are not more than 1½ to 1.33, and going south not more than 1 per cent. The total elevation above the sea of this Height of Land averages from 850 to 1,200 feet. Though the road projected from Missinaibi is the shortest, it is perhaps not the one best calculated to bring the resources of these northern latitudes to the marts of Ontario and Quebec. The lines extending from North Bay in the one case, and those projected from Lake St. John or Labelle on the other, are the ones most likely to be looked on with favor by the people of Ontario and Quebec to start upon. The commission, of which W. T. Jennings, C.E., is secretary, appointed by the Toronto city council, has done solid public service by bringing this question forward recently; while the James Bay Railway Company, backed by Senator Geo. A. Cox, Wm. Mackenzie and Geo. H. Bertram, M P., has obtained a bonus from the Ontario Government, and it is said the Dominion Government has also promised to assist in the undertaking. The citizens of Toronto, along with other Ontario cities, are now awakening to the possibilities of this new land, and one may hope they will no longer deserve the caustic comment of Mr. Paterson, who, in discussing the subject, said: "Many rich Toronto merchants would rather sit down on a few corner lots in the city and wait until they rise in value, and aldermen would rather squabble over putting on or taking off half a mill of taxation, than stir outside and bring in trade." The city of Quebec is taking a lively interest in the subject, largely owing to the persistent advocacy of its city engineer, Charles Baillairge, C.E. It is hoped that both provinces will be emulous in pushing forward enterprises that are so certain to increase their population and develop their trade.

VICTORIA JUBILEE BRIDGE, G.T.R., MONTREAL, IN COURSE OF RECONSTRUCTION—LOOKING DOWN THE ST. LAWRENCE.

For THE CANADIAN ENGINEER.

REPORT ON THE PRECIPITATION SYSTEM OF SEWAGE DISPOSAL IN OPERATION AT HAMILTON, ONT.

BY W. M. WATSON.

During the month of March I visited and made a superficial examination of each of the two sewage works that are intended to clarify the sewage of about 35,000 out of the present population of 50,000 in the city of Hamilton, Ont., leaving the sewage untreated at the outfalls into the bay, at the foot of James street, Stuart street and Queen street, together with the large brick sewer that drains the whole of the mountain slope property and empties into Cootes Paradise. The small works at the east end of the town on Wentworth street, was built early last year, and it is stated in the engineer's annual report for 1897, that they commenced operations on May 17th. Our readers will find a full description and illustrations of this plant in THE CANADIAN ENGINEER for January, 1897.

It is stated on page 58 of the annual report for last year, that from the date that the Wentworth street works commenced operation to the end of the year, they treated 114,114,000 gallons, or a daily average of 474,000 gallons. When describing the visit of the Toronto aldermen, to inspect the works, it is stated in the Toronto Evening News that the daily run of the sewage works is only ten hours out of the twenty-four each day, which means that only one set of employees is engaged and that for 14 hours each day the sewage passes over the underground overflow weir to the Burlington Bay, raw and untreated. On page 62 of the report it shows that the actual cost of operating the East end works for 220 days from May 17th to end of year was $4,470.87. Law cost, $704.28. The cost of construction and machinery is given at $38,000. The average cost per day for operating with one set of men 10 hours daily will be $20.32, and $7,415.84 for the whole year. Then add four per cent. interest on $38,000, the cost of plant, viz., $1,52c, and allow ten per cent. on the wear and depreciation of value of machinery and works, $3,800, brings the annual cost of only clarifying the sewage at that small works for 10 hours each day from a population of about 12,000, and which appears to be void of trade or strong sewage, to $12,736.80, or over $1 per head. Should the works be run night and day, the management expenses would be double, and still the clarified sewage will go into the fresh water, unpurified, and containing most of the injurious and poisonous matter that is discharged from the skin and intestines of living creatures, jeopardizing the health of the inhabitants residing near the waters into which the clarified sewage is discharged, and afterwards setting up putrefaction, assisted by the lime that is used as a precipitant. If the amount treated, as stated in the report, is 474,000 gallons daily, it will amount to 173,010,000 a year, costing about $1 for each 13,600 gallons of sewage said to be clarified.

The works built at the foot of Ferguson ave. are similar in design and management, but are over double the size of the Wentworth street works. They have six settling tanks double the length of the three at the smaller works, and double the amount of machinery and appliances. They cost $42,000 to construct and are said to be capable of clarifying 3,000,000 gallons of sewage daily. We have no data to show the cost of management of these works, but experience would show that they will at least cost forty per cent. more than the works having less than half the capacity. They commenced operations early in March this year, and will be worked with one set of men 10 hours per day, as at the Wentworth street works. If then 3,000,000 gallons arrive at the works daily the average per hour will be 125,000 gallons, and for the 10 hours the works are in operation 1,250,000 gallons of sewage treated and 1,750,000 sent forward to the bay untreated per day. The Hamilton newspapers reported that a test was made by the engineer and part of the committee to prove the amount of sewage that actually came to the works, and they found that it amounted to 2,200,000 gallons per day at the Ferguson ave. works, or 800,000 less than the capacity of the works is stated to be. The population served by the two works is probably about 35,000 and the united cost of operating the two works 10 hours per day will be $30,600 per year, over 87 cents per head of contributory population, and if worked night and day, as they ought to be, the working expense will be double that amount, less interest on capital.

The sewage leaves the sewer and flows to a well, and is then lifted out by centrifugal pumps about 20 feet high and discharged into a wooden trough that leads it to the brick culvert that feeds the settling tanks. During the passage of the sewage from the pumps to the culvert lime an alum solution is dropped into the stream at the rate of 3½ grains of lime and 1½ grains of alum for each gallon of sewage. All the settling tanks stand full of sewage in a quiescent state, and the volume of sewage pumped enters the top of the settling tank through an opening about four feet wide, at a speed to all appearances of about twenty feet per minute, floating over the surface of the fluid at rest in the settling tank to the opposite end, when it passes through a similar opening made in the partition wall between tanks Nos. 1 and 2, then floats back to the commencing end, where it enters tank No. 3 and repeats the process until all the six tanks have been traversed, when it falls into the discharge culvert that is connected with a covered-in drain, which we suppose conveys it to the bay.

We expect that the stream of moving sewage will not sink more than one foot into the quiescent liquid contained in the tanks, or spread out over the surface more than 8 feet, and the rapidity of the flow will prevent the lightest solids held in suspension from settling down, so that the sludge extracted will be chiefly the heavy harmless grit or scouring dirt from roads, yards and floors, and the solids from the sewage that is allowed to rest in a quiescent state

in the tanks, while the bulk is flowing over the top. The alum was observable in the pressed sludge cake which had a clayey feel; but ammonia or urine usual in domestic sewage was not noticeable.

When comparing the sewage entering the tanks with the effluent leaving the last tank, No. 6, there was little difference in the appearance of the two samples, probably, first, because the flow was too rapid, second, because the sewage enters the settling tanks at the top when it ought to enter the bottom, third, because the precipitants are *not in sufficient quantity or thoroughly incorporated before* they enter the tanks; and, fourth, the lime solution is made from unslacked lime which will cause it to be attracted by the water rather than by the dirt composing the sewage.

We were informed that some improvements would shortly be made, and probably filters added to purify the sewage after clarification, as the engineer has been experimenting with great success in purifying sewage on Mr. Garfield's principle of passing it through pea coal, on the lines laid down in the September issue of THE CANADIAN ENGINEER. The design and arrangements of the works are such that they can perform efficient clarification, and when filters are added and the whole sewage that comes to the works treated and the overflow weir becomes useless, except when a big storm is in progress, then the $80,000 and cost of management will become a reasonable outlay, though just as good results might have been secured at a far more moderate cost.

The culvert carrying the effluent from the tanks to the bay should be open and made broad and shallow, so that the effluent could secure aeration during its progress to the bay and be easily inspected; also the by-pass channels and overflow weir should be open to view, so that they could be easily observed and show when all the sewage was passing through the works. Sewage, during and after treatment, requires all the atmospheric air it can secure. It is hard for a deputation to get at the true value of any sewage works in a two hours' visit, because any works or process can be made to work efficiently for a short period, but the difficulty is increased if the bypass, the discharge channels and overflow weir are not all open to sight. Moreover the assistance of an expert analyst should be had to show the exact contents of the effluent.

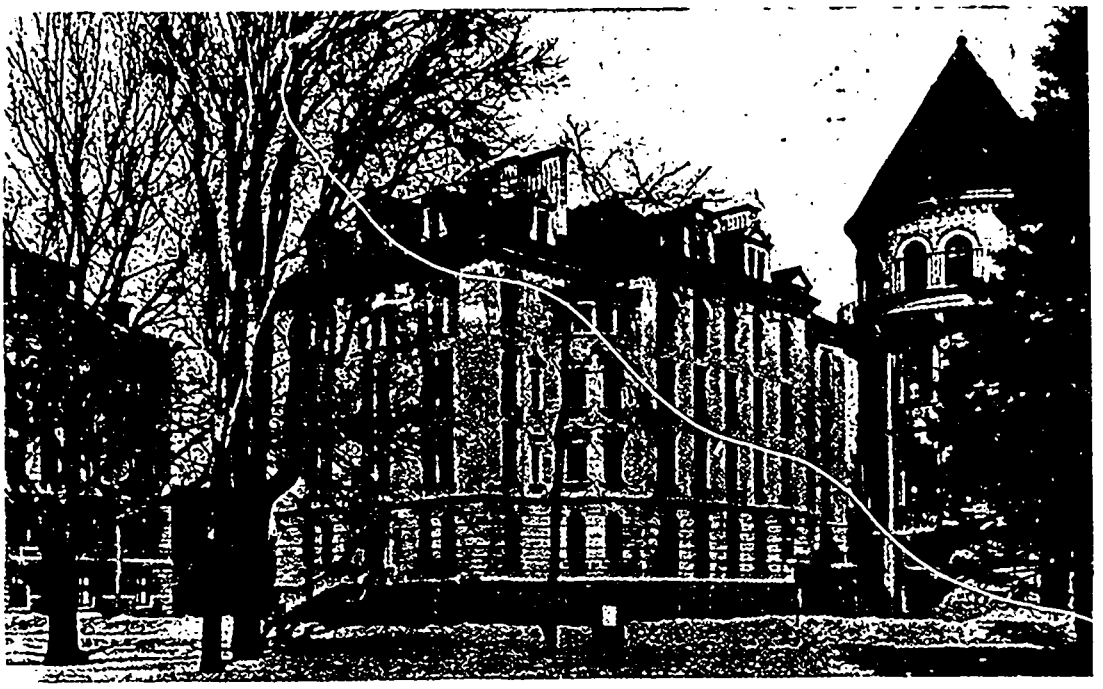
As previously stated in articles in THE CANADIAN ENGINEER, to clarify sewage it should remain at rest for some time, and if the continuous flow system be adopted, to save expense of a regular attention, then both ingiving and discharging flow should be thin and very slow, so that the volume of sewage resting is only very slightly disturbed and no perceptible motion created. The flow should be at a rate of about half a foot per minute, entering the full width of the settling tank near the bottom at the deepest end, and overflowing over a level lip the full width at the opposite end, and the quantity allowed to enter should be so regulated that it would be three hours before it reached the overflow. The Hamilton tanks can easily and cheaply be made to work on the continuous flow plan, and they can, as at present arranged, be worked on the quiescent system. Each settling tank would then work separately, as they ought to do, to perform good clarification.

We believe that each of the six long tanks at Ferguson avenue holds about 127,000 gallons; so to clarify 3,000,000 gallons in 24 hours the sewage should enter each tank at the rate of 170 gallons per minute, which would be sufficiently slow when the width of the tanks is taken into account. This should answer almost as well as the quiescent system worked with the float and discharge valves that are attached to each tank. When raw sewage enters at the bottom of a settling tank during the act of rising to the surface the suspended solids are encouraged to stay behind at the bottom.

Lime should not be used as a precipitant when the clarified sewage is discharged unfiltered, because it will not destroy microbes, but rather assist in multiplying them, and after a space of about two days, when the sewage effluent has mixed with fresh water, the lime will assist the clarified sewage to set up putrefaction, and the result will be equal to, if not worse, than would have been the case if the sewage had been well screened and passed in raw and untreated. The most suitable precipitant is stated by Mr. Slater, an expert in the sewage business, to be salts of manganese, which carry down the organic together with the dissolved suspended substances. It also destroys certain impurities by transferring to them a continual supply of oxygen from the atmosphere and from the air in the sewage fluid. This precipitant was expensive, but Mr. Adeney has found a substitute, by utilizing the waste products from certain iron works that are very rich in manganese, and which contain all the valuable properties claimed to be in the manganese compound sold as a sewage precipitant. An equally good precipitant may be made from the rust of iron, from iron ores or the refuse oxide of iron discharged from sulphuric acid works, dissolved by hydrochloric acid, which, when manufactured, is called perchloride of iron; ¾ of a pound will precipitate 1,000 gallons, it will never set up decomposition, and has great settling power. It could be made at a cost of $15 per ton.

With reference to the manufacturing of a solution of lime for use as a precipitant, we have found that the lime should first be slacked in thin layers with about 7 per cent. of water sprinkled on with a fine rose sprinkler, just sufficient to cause the lime to separate into fine powder, then bank it up into a heap and cover it over to keep in the steam, and allow it to remain in that position for over a week, or until it becomes thoroughly cooled. Afterwards mix it with the fluid at the rate of two parts fluid to one of lime, and mix it together well, when a solution is produced that is heavy enough to bear down and be attracted by the solids held in suspension by the sewage, and if the lime is delivered into the fluid sewage at the rate of eight grains or over of slacked lime to each gallon of raw sewage, and the lime solution is delivered into the sewage at the point where it enters the works, so that the action of the pumps and sharp angle movements will thoroughly incorporate the lime solution with every particle of sewage in equal proportions, and then the sewage is allowed to rest motionless for a short time, the lime will settle to the bottom of the tank, leaving a colorless clarified fluid behind it. But if sufficient be not put in, and it is not properly mixed with the sewage, or the solution is made from hot fresh unslacked lime, then it becomes saturated with the fluid, and does little or nothing towards compelling the dirt to separate from the water of the sewage.

It can be easily found out when the lime is properly incorporated with the sewage by filling a clear glass vessel with the sewage from the point where it enters the tanks. The liquid will appear full of small globules or flakes similar to the air during a heavy fall of snow. If the fluid is allowed to quietly rest in the glass, it will be seen that the flakes settle down to the bottom, leaving a clear fluid, which, though beautifully clear, is strongly tainted by urine and lime, and if preserved in a bottle it will soon be seen to ferment and change color, proving that it needs filtering, and that lime should not be used to clarify sewage if that sewage is discharged unpurified into fresh water. The



THE CHEMICAL AND METALLURGICAL BUILDING, McGILL UNIVERSITY

sewage at Hamilton did not show the presence of the precipitant when I examined it.

We have gone into the details of Hamilton sewage works as we found them when we had the privilege of inspecting the plant and process, and have used the printed reports of the city engineer to get at the expenses, and so give our readers the facts in regard to the purification system that is held up as a pattern, though the cost per head of population for construction of the plant is over $2.25, and the annual cost of management, including interest on capital, shows at least 75 cents per head for clarifying less than half the daily run of sewage. Granting that the sewage is really efficiently clarified, if purification filters are built and the sewage after being clarified is purified, then the cost to the ratepayers will be almost twice the present amount; and should all the sewage be handled that flows to the works the cost may be increased by one-half again, so that a stiff bill will have to be paid by those who adopt this system.

In Europe many millions of dollars have been wasted in the erection of useless and inadequate works, many fine-looking plants have been built and operated to mislead and keep the people quiet, by pretending to do a work that they certainly were not doing, and glowing and misleading reports have been published about them. But careful inspection by the government officials has shown these works in their true light. All the defects and the reasons for these expensive failures in Europe have been published, and Canada can have the benefit of the Old Country's fifty years' experience and experiments for nothing. She can avoid the expensive works and pitfalls, and adopt systems that have cost large sums of money to discover. It is a remarkable fact that the systems so far adopted by Canadian towns are the ones that are the most expensive and the least efficient of a majority of the methods at present in use in Europe.

Jos. Walker, of Parry Sound, Ont., fireman on an engine on the C.A. & O.A. & P.S. Railway, was instantly killed in a rear end collision last month near Parry Sound

The bill to incorporate the Nickel Steel Company of Canada, provides that the company, with the consent of the Governor-in-Council, may lease or purchase the following lines of railway. Bay of Quinte, Central Ontario and Irondale, Bancroft and Ottawa Railway.

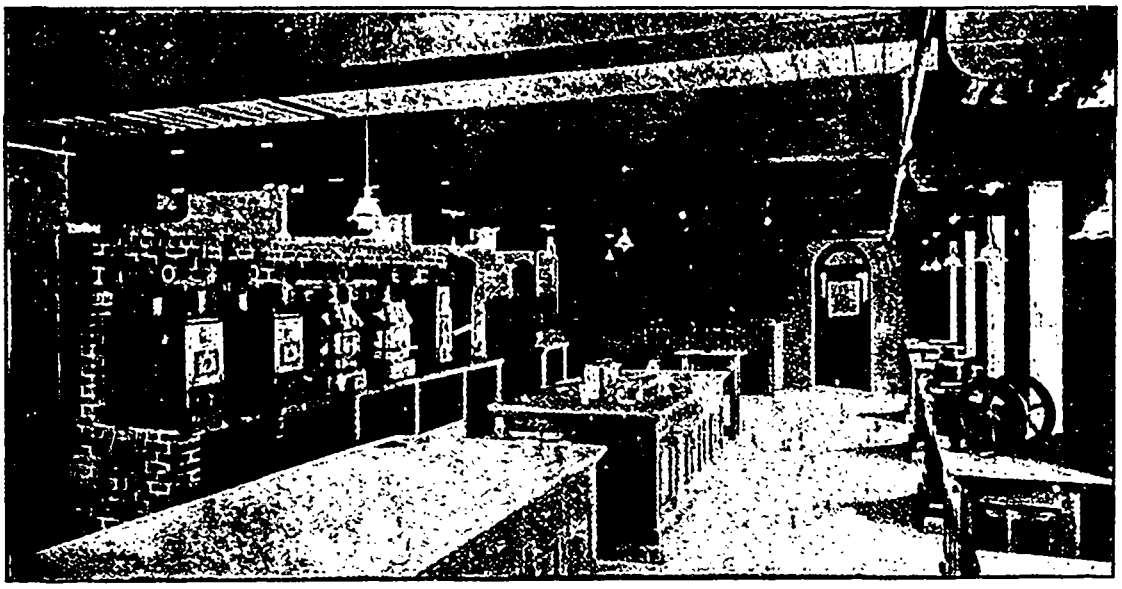
McGILL UNIVERSITY.

McGill University is one of the world's great universities, not only because of the massive piles which shelter its lecture rooms and laboratories, and the great money value which they represent, but on account of the standing in the world of intellect of the men connected with it and the enthusiasm which they bring into their academic work. The university is a monument to the liberality and public spirit of a large group of Montreal's most distinguished citizens. The first of these was Hon. James McGill, who, dying in 1813, left the manor of Burnside to endow a university in which one college was to be called McGill. From this beginning the present flourishing institution has grown up, and the original endowment has grown by gifts from private individuals from one hundred and twenty thousand dollars to almost four millions of dollars.

CHEMICAL AND METALLURGICAL DEPARTMENTS OF McGILL UNIVERSITY.

On the authority of Dr. W. C. Roberts-Austin, C.B., chemist of the British Mint, McGill University has now the best equipped metallurgical laboratory in the world. A similar remark might be applied to the mining department which has been in operation since March 1st. The mining department of McGill is splendidly housed in the McDonald Chemical and Mining Building, as shown in the accompanying engraving. The building is five stories in height, with basement and sub-basement. Extending from either side, at the back, are two large wings rising as high as the top of the ground floor. In these and in the rear part of the building are situated the principal rooms devoted to mining. There are the ore dressing room or mill, the smelting room, the metallurgical laboratory, the assay laboratory, wet assaying rooms and the teaching departments. These occupy a floor space of about thirteen thousand square feet.

The ore-dressing room has a twenty-foot ceiling and occupies the whole north wing. Here the ores of silver, copper, etc., and gold-bearing quartz in the condition in which they leave the mines, are received, and turned out metals in a form suitable for the furnace-room. The ores of gold, silver, copper, lead and iron are most important—but others can also be treated by this plant. It is full size



ASSAYING ROOM—MINING AND METALLURGICAL DEPT.—McGILL.

and differs from the ordinary mine equipment in that it is much more extensive. The usual commercial plant is designed as a matter of course to treat the ore of one mine, but the McGill appliances are sufficient to treat any kind of ore found in the Dominion of Canada. The student trained here will thus be at home with any first-class mining plant, and the plant at McGill being devoted to research and investigation only, unlike the average commercial plant, will be the means of producing many improvements in the methods of ore treatment now in vogue. The equipment consists of three rock crushers, known as "Blake," "Dodge" and "Comet" machines, two batteries of stamps, one of five five-hundred-pound

FURNACE ROOM—MINING AND METALLURGICAL DEPT.—McGILL.

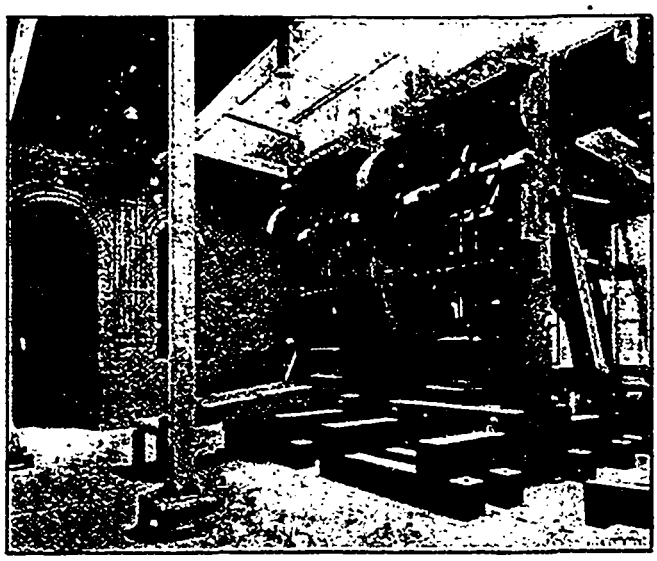
heads, the other of two of a thousand pound heads each; a Huntington mill; coarse and fine crushing rolls; trowels and sieves; *Hartz and Collum jigs, revolving, bumping* and belt tables, and various pieces of apparatus such as magnetic separators, etc.

The crushers reduce the large fragments of rock to make easier the separation of the metal. The machines consist essentially of jaws moved by levers of great power. Into these the large pieces of ore fall, and are broken to a size convenient for the separating machines. The crushers are set in a high platform, the ore being carried up to them by means of a bucket elevator. The broken-up product of the crushers drops down, and is received in trucks which are capable of being rolled along the floor, or being hoisted up and moved about by the overhead system of travellers. According to its kind, the ore on leaving the crushers is carried to the stamp batteries or to the Huntington mill. Into either of these machines it is fed by an ore-feeder. In the stamp batteries the ore is pounded by swift blows from heavy hammers until it becomes a powder. Then, if it is gold ore, the mixed powder of gold and rock is passed into a quantity of mercury in a pan. The gold forms an amalgam with the mercury, and is held while the valueless rock is taken out. The heavy blows of the stamp battery are borne by a huge block weighing many tons, which extends deep into the earth. The Huntington mill accomplishes the breaking up of the ore in another manner, The ore being fed in falls into a heavy, tub like receptacle, in which are four heavy iron disks attached to a shaft, in the centre, which revolves rapidly. The disks are so attached that they are free to move toward or away from the centre within the limits of the tub, but centrifugal force caused by the revolution of the shafts keeps them against the sides of the tub, and they revolve as they move thus in a circle. The ore is thus moved about inside, and is ground up into small fragments.

The methods of separating the ore from the rock involve a number of interesting machines. The Frue Vanner is one of these. It consists of a wide continuous sheet of rubber, with turned-up edges, stretched upon two revolving cylinders. One cylinder is lower than the other, so that the plane of the rubber sheet is inclined slightly. The broken mixture of metal and rock is fed upon the central part of the incline, and moves up (the sheet moving in that direction), until it encounters a spray of water which impinges on the sheet and carries down with it the rock. The metal being of greater specific gravity, holds its place on the sheet in spite of the water, and is carried until automatically washed off into a basin prepared for it. The jig separator is fed from three large hoppers connected to a revolving screen immediately above it. Through all its compartments water flows continually, and the ore is separated and sorted into the several qualities according to its specific gravity and size. The amalgamator and settler are rather complicated instruments, which extract gold from the slime resulting from previous separating processes.

As a preparatory process to treatment on the Rittenger table or Evans Buddle the pointed box may be used. This is a series of boxes or basins of conical shape, and varying in size. The sand from the stamp battery is fed

first into the smallest box, through which a stream of water is flowing so swiftly that only the largest grains are allowed to sink. The remainder is carried into the next larger box or basin, where the water spreading out has a less velocity, and the next size of grain is deposited, and so on.



Stamps—Mining and Metallurgical Dept.—McGill.

The Evans table serves to concentrate slimes and fine sediments on a circular bottom. It is a large round table sloping from the centre. As the table revolves the slime is fed upon it at the centre and flows toward the circumference, leaving in its progress the heavier portions of its constituents, while the surface is continually swept smooth by means of revolving brushes. Thus the particles of different densities are arranged in concentric circles, and can be carried by properly directed jets of water each into its proper receptacle.

The Rittenger table is a huge inclined plane of plate glass, which is jerked abruptly from side to side and mixed pieces of ore are sorted as they travel down its inclined surface, water flowing along with them. The repeated jerks cause the heavier pieces to travel steadily away from the lighter, and eventually the two come off the table at opposite corners. A good deal of the ore reduction machinery is supplied by Fraser & Chalmers, Chicago.

Adjoining the ore-dressing room is a second very large room used as the smelting room. Here the ores will be

Balance Room—Mining and Metallurgical Dept.—McGill.

roasted or smelted, which ever is necessary. The room will contain an English cupellation furnace, a reverberating roasting furnace, a Bruckner cylinder and a twenty-inch water-jacket furnace, as well as two-pot furnaces, each eighteen inches in diameter. Part is the tool room, and alongside is a small motor to run the machines in the immediate vicinity. The lowest floor of the south wing is taken up by the assaying rooms. In the dry assaying room are fourteen assaying furnaces of the best and latest pattern. Opening from it is the balance room. The apparatus of this room is of the sort commonly used in chemical laboratories, and the rooms themselves are nicely finished with white and buff-colored enamelled brick.

The portion of the building devoted to teaching, and designing and drawing rooms, is admirably arranged. The lecture room is fitted with numerous appliances for demonstrating the subjects taught, including an electric lantern for illustrations. Adjoining this is the office of Dr. Porter and his private research laboratory.

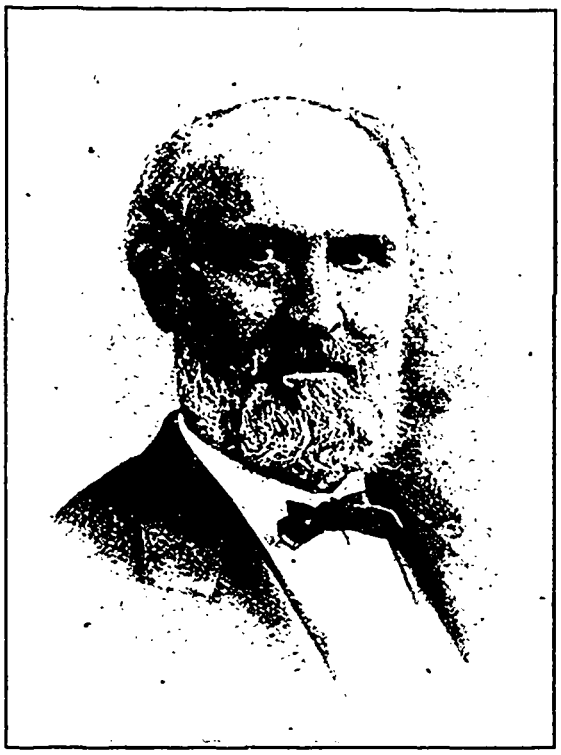
The portion of the building occupied by the chemical department is spacious and well equipped, and the ground floor and first basement floor are lecture theatres constructed on the latest plans. Throughout the buildings are lofty ceilings, ample lighting and modern appliances for ventilating and guarding against fires. On each of the three floors above the ground floor, extending all across the back of the building, is a large room—each of which is fitted up as a chemical laboratory, with every convenience and appliance which has been suggested by the experience of all the largest chemistry schools in the world. In addition to an unusual accommodation in

A Lecture Room—Mining and Metallurgical Dept. McGill.

the line of draught cupboards for the carrying off of unpleasant or poisonous gases, there is a system of large flues in every part of the building connected to large ventilating fans in the roof. A noticeable convenience is a store-room on each floor adjoining the elevator. On the first floor in front are the offices of Prof. Harrington and his assistants and a commodious library and reading-room.

Among the many citizens of Montreal who have given largely for the provision of educational facilities in that city, none has been more generous in giving, nor has any one made wiser disposition of his gifts, than W. C. McDonald, whose endowments of McGill University now amount in buildings and funds to almost two millions of dollars, being more than has been given by any other Canadian to any educational cause.

Mr. McDonald is the youngest son of the late Hon. Donald McDonald, some time President of the Legislative Council of Prince Edward Island, and is grandson of Capt. John McDonald, 5th chief of the Clan Macdonald of Glenaladale, who after founding the Scotch settlements at Tracadie, Scotchfort, Glenfinnin and Fort Augustus, P.E.I., served during the American Revolutionary War as a



W. C. McDONALD.

captain in the 84th or Royal Highland Emigrant Regiment. He was born at Glenaladale, Tracadie, P.E.I., 1833, and was educated at the Central Academy, Charlottetown, also obtaining his business training in that city, under the late Hon. Daniel Brennan. He left P.E.I in 1854, and removing to Montreal became an importer and general commission merchant there. Subsequently, he embarked in *business as a tobacco merchant and manufacturer, and now* owns the largest tobacco factory in Canada. He is a governor of McGill University, a governor of the Montreal General Hospital, and a director of, as well as the largest shareholder in, the Bank of Montreal. He is an honorary member of the Architects' Association of Quebec. Among his gifts to McGill are: $20,000 to the Thomas Workman endowments for mechanical engineering; the erection and equipment of the W. C. McDonald engineering building, valued at $350,000, and an endowment for its maintenance, the endowment of the chair of Electrical Engineering with the sum of $40,000; the erection and equipment of the Physics building, valued at $300,000, and two chairs of Physics, with endowments amounting to $90,000, the endowment of the Faculty of Law with $150,000, a further sum of $150,000 for the maintenance of the engineering building; $50,000 towards the endowment of the Pension Fund, and the erection of a new building for the department of chemistry, mining and architecture, at a cost of $500,000.

The Goldie & McCulloch Co., of Galt, Ont., have shipped a big Wheelock engine to the Montreal Belt Line Railway Company. The engine weighed 19,440 pounds.

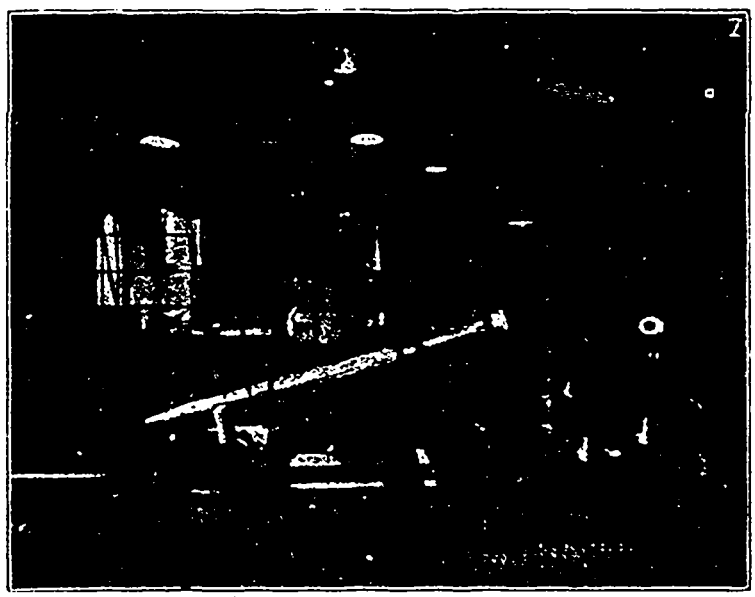
The Montreal and Southern Counties Railway Company, which obtained its charter last year, has been given power to extend its operations to the counties of Beauharnois, Chateauguay, Huntingdon and Napierville, and bonding powers increased from $20,000 to $25,000 a mile, in addition to preference stock, $10,000 a mile. There are extensive powers for connecting with other railway companies or crossing the St. Lawrence, and for amalgamating with other companies, but the company is debarred from running along the streets of Montreal or adjoining municipalities. Powers are also given to run steamers, maintain pleasure grounds, and sell electricity for light, heat or power.

HYDRAULIC LABORATORY, M'GILL UNIVERSITY.*

BY HENRY T. BOVEY, M. INST. C.E., LL.D., ETC., AND J. T. FARMER, M.A.E.

The laboratory is 39 feet in length and 31 feet in width. On the north side, near the centre, stands the experimental tank, having its base on a level with the bottom of a flume. The flume, which is 5 feet wide and 3 feet 6 inches deep, runs from the tank and terminates in an adjustable weir. The water flowing through the flume may pass over or under the weir and may run to waste or may be made to pass into five large carefully calibrated tanks, 8 inches below the floor level and ranged in series on the south side of the laboratory. The covering of the tanks is on the level and forms part of the floor. Over the easternmost of the tanks stand the experimental pump on a base formed of suitably designed carrying girders or trunks. The section pipes descend into the tank and thus allow the water passing.

On the west side, at convenient points along the flume, are the following pieces of apparatus: A 16-inch Pelton wheel, with brake attachments, a turbine tester of special design and an experimental centrifugal pump. Along the west wall is fitted up a Rife hydraulic ram with all the necessary pipes and tanks for experimental work. The pumps are driven from a line of 3½-inch steel shafting near and running parallel with the east side of the laboratory. The shafting is operated by a 100 h.p. Mackintosh & Seymour high-speed horizontal engine, standing in an adjoining room. By means of an electro magnetic coupling, designed by Prof. Carus-Wilson, and connected with a switch conveniently placed near the experimental pump, the main shaft can be almost instantaneously thrown in and out of gear, and without sudden impact or shock, as the circular armature permits a partial rotation until the resistance is overcome. A 90 h.p. automatic recording transmission dynamometer is placed on the shaft between the magnetic coupling and the nearest point at which power is transmitted. An 8-inch line of piping makes a complete circuit of the laboratory near the ceiling. The several pumps and motors are connected with this circuit, and the movement of the water is controlled by suitably placed 8-inch straightway valves, branch tees, elbows, etc. By means of a short vertical length of 8-inch piping,



terminating in a goose neck, the pumps can be made to discharge into the top of the experimental tank, from which the water passes into the flume, then into the large tanks, and is thus again available for supply. The whole of the water used in the laboratory is drawn from the city high level reservoir, which gives at the base of the tank a pressure of more than 120 lbs. per square inch. The city service is connected with the 8-inch circuit, which can therefore, if desired, be made to act as a supply pipe to the turbines and other motors. Provision is also made for connecting the latter directly with the city service. The pumps and motors all discharge into the flume, and the water then passes over the weir where the volume of discharge can be measured. If the volume is not too great, it can be at once measured by passing the water into the large calibrated tanks.

The weir may be used the whole width of the flume without side contractions, but by means of suitable cheeks one or more side contractions can be introduced and the width of the weir diminished to any required extent, or the weir may be subdivided into two or more independent weirs. A large number of experiments have already been made to determine the co-efficient of discharge with and without side

*Extracted from a paper read before the Canadian Society of Civil Engineers.

contractions, and with different depths of water over the weir lip. The results will be given as soon as the experiments have been completed. The water may be conveyed to any one of the five tanks through an iron channel provided with properly placed manholes, and the five tanks can all be connected together by means of a 10-inch pipe running along the bottom of a deep trough next the wall, and having the

necessary valves and 6-inch branches communicating with the several tanks The water may also be run to waste through this 10-inch pipe. In this channel and next the weir there is a flap-door with edges inclined at 45° to the vertical The edges of the gap closed by the door are also inclined at 45° to the vertical, and the fit between the door and gap has been made as perfect as practicable An india rubber cord is inserted in an endless groove running along the centre line of the edges, so that when the door is closed and pressed home it is absolutely water-tight The door can be instantaneously opened and closed by means of a lever and a system of links acting as a toggle-joint, and each movement is recorded by an electrical chronograph. In any given experiment the door is opened and the water allowed to run to waste until the head over the weir lip is steady, when at a signal the door is instantaneously closed, when the water is conveyed by the channel into any or all of the tanks.

The stand pipe for the fire hose rises vertically at the back of the tank and extends to the full height of the building. At the base it is provided with a number of unions varying in size from six to one inch, and to these unions are attached the lines of piping for pipe-flow experiments. The position of the stand-pipe was selected so as to allow of straight lengths of more than 400 feet of pipe being used. To secure a uniform pressure a Locke Regulator has been provided, which responds, though slowly, to a variation in the pressure. A special piece of apparatus for hose testing has been placed in the south-west corner of the laboratory. It is connected by hydraulic piping with the Blake pressure pumps in the testing laboratory. A large number of tests have been made on the strength, and on the longitudinal and circumferential extensibility of different varieties of hose, which in the great majority of cases was in lengths of 50 feet. The pressure, which often exceeded 800 lbs. per square inch, was directly indicated by a standard Crosby gauge, while the time and pressure were also registered automatically by a recording gauge specially designed for this work.

Of the remaining apparatus the following may be briefly noticed. –

A glass tank, 72 inches by 18 inches by 12 inches, with circular diaphragm chamber at one end. This serves to illustrate vortex ring motion, and also, with the aid of glass tubes with flared ends and of different diameters, the critical velocity and other stream-line phenomena Inverted glass domes, with an orifice in the bottom, with which are demonstrated the phenomena of circular and spiral vortex motion, of the inversion of the vein, etc. A series of very carefully made nozzles with a perfectly smooth bore, and having pressure gauge attachments at each end. Each nozzle is 36 inches in length between the gauge connections, and has a taper corresponding to a diameter, varying from 3 inches to 2¾ inches in the largest to 3 inches to ½ inch in the smallest A series of sixty hydrostatic gauges, each with a range of 20 lbs and embracing pressures up to 140 lbs. per square inch. The gauges are graduated to tenths of a pound, and the range of every gauge is overlapped by the two consecutive gauges. A mercury column 27 feet in height, is fixed to the north wall near the experimental tank, and in addition to this there are several small portable mercury columns, which are used in the experiments for determining the resistance to flow in small pipes due to elbows, bends, convolutions, etc. These pipes are 13 in number, have a smooth bore and are ⅛ inch in diameter. The laboratory is also supplied with a Venturi and other piston and rotary meters, a number of hook gauges, Darcy's improved Pitot tube, brass standard gallon, quart and litre measures with glass strikes, etc., etc.

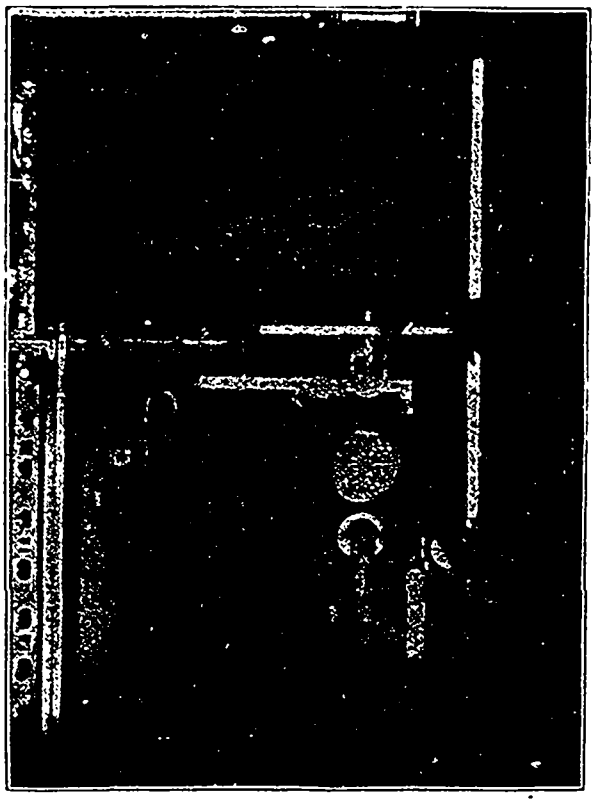
There are several copper measures of capacities varying from 10 to 100 gallons. They have been carefully calibrated, and the calibrations are frequently checked. When in use they are placed upon a plane-table with adjustable feet so that a true level can be always maintained. Each of the large tanks already referred to is 6 feet by 3 feet 6 inches by 9 feet deep, and discharges into the 10-inch header through a 6-inch straightway valve. Each tank is also connected with a separate vertical 4-inch brass pipe, in which the water freely rises and falls with the water in the tank. This forms the float chamber. These tanks have been carefully calibrated, and the contents can be readily measured to within the sixteenth of a gallon. The float is attached to a vertical ⅜-inch brass rod with a pointer at the upper end, indicating on a brass plate the quantity of water in a tank. A fine cord, fastened to the top of the rod, rises vertically, passes around a frictionless pulley, and carries a constant weight at the end which counter-balances the rod, etc., keeps the cord taut, and so prevents the pointer from rubbing against the plate.

The experimental tank is of cast iron, is 28 feet in height, square in section, and has a sectional area of 25 square feet. Every care was taken to make the inside surfaces of the tank walls perfectly flush, and to this end the flanges, by which the several sections were bolted together, were placed on the outside.

The impact apparatus was constructed for the purpose of determining the force with which jets from orifices, nozzles, etc., impinge upon veins of different forms and sizes. A massive cast-iron bracket, 8 feet in length, has one end securely bolted to the front of the tank, and the other supported by a vertical tie-rod from one of the oak beams in the ceiling. The upper surface is provided with accurately planed slides, which are set level about 5 feet above the orifice axis. If, from any cause, the end of the bracket farthest from the tank is found to be too high or too low, the error can be corrected by loosening or tightening the nut on the tie-rod. The balance proper is carried by a sliding frame, which can be moved horizontally into any position along the bracket by means of a rack and pinion actuated by a sprocket wheel with chain. At one end the frame has two equal arms with a common horizontal axis parallel to the bracket, and each arm has a stop on its lower surface which serves to limit the oscillation of the balance. The balance, in its mean position, consists of a main trunk

with horizontal axis rigidly connected with a vertical slotted arm and with two equal horizontal arms at one end. The common axis of the latter is horizontal and perpendicular to the axis of the main trunk. The hardened steel knife edges of the balance are 4 feet centre to centre, and rest in hardened steel Vees inserted in the ends of the sliding frame on each side of the bracket. The bottom of each Vee is in the same horizontal line (called the axis of the Vees) at right angles to the bracket. A bar with the upper portion graduated in inches and tenths has a slot in the lower portion, which is bent into a circular segment of 9½ inches radius The bar slides along the slot in the vertical arm of the balance. A radial block, with the holder into which the several vanes are screwed, moves along the slot in the circular segment, and may be clamped in any required position, the angular deviations from the vertical being shown by graduations on the segment. The centre of this segment in every case coincides with the central

point of impact on a vane is in the vertical axis of the balance arm, and is also vertically below the axis of the Vees Thus the jet can always be made to strike the vane both centrally and normally The scale pan hangs from a knife edge at one end of the horizontal arms of the balance, while to the other end is attached a fine pointer which indicates the angular movement of the balance on a graduated arc fixed



to the sliding frame. The balance is in its mid-position when the pointer is opposite the zero mark. When a vane has been secured in any given position, the preliminary adjustment of the balance is effected by moving a heavy cast iron disc along a horizontal screw fixed into the main trunk The sensitiveness of the balance is also increased or diminished by raising or lowering heavy weights on two vertical screws in the top of the trunk.

In motor testing it is often of importance to know the pressure of the water at certain points in the supply (or delivery) pipe, and, generally speaking, it is impracticable to employ either a mercury or a water gauge. The pressure is therefore observed by standard Bourdon gauges, of small individual range, which are frequently tested, a record being made of the errors. The method usually adopted to diminish the oscillating effect of the gauge of the fluctuation in the flow is to connect the bore of the pipe with an annular chamber by a number of small holes. In the McGill Laboratory these holes have been replaced by a continuous opening around the bore, less then .005 inch in width, with the obvious result of obtaining a better mean pressure. Similar chambers are also being used in experiments on the resistance of bends to flow. There are four sets of bends of 1 inch, 1½ inch, 2-inch and 3-inch diameter, and each set consists of 30 bends, 10 having a radius of one diameter, 10 of two diameters and 10 of four diameters. At the central cross-section of each bend, provision is also made for ascertaining the pressure, either by a mercury column or by a gauge, at the extremities of the radii to the outer and inner surfaces of the bore. The chambers for the bends are combined with union couplings, of the same bore, which allow the attached part to be swivelled through any required angle.

The speed of the motor is taken by a revolution counter and also by a tachometer. A sliding slotted sleeve at one end of main shaft of the motor can be made to engage with the spindle of the revolution counter, which can therefore be readily thrown in and out of gear at the commencement and end of a test, and the readings can be taken at leisure. The tachometer is supported on a bracket fixed to the motor frame, and is driven by a cord passing over a pulley on the motor shaft.

Besides a Halpin brake of 50 h.p. capacity, the laboratory is equipped with a friction brake which has been designed by Mr. Withycombe, the superintendent, and which can be used with wheels both of the horizontal and the vertical type It possesses many novel features of which the most important are: That it is self-adjusting, and that a single direct weighing gives the total drag The brake wheel is of cast iron and finished on a lathe The outer and inner surfaces of the rim are shrouded, the shrouding on one side being formed by the solid disc connecting the rim with the boss. A stream of water is delivered tangentially into the channel inside the wheel through a narrow rectangular mouthpiece of nearly the same width as the channel The surplus water is carried away by a scoop of somewhat similar form but reverse in action. The tight portion of the brake band is of leather, and the slack portion consists of two strips of copper. In the mean position, each portion embraces about one half of the circumference of the pulley, and its end is attached to a lug projecting from a rod. The lug to which the slack portion is joined is capable of sliding along the rod, and by means of a screw, can be adjusted so as to increase the slack tension as desired, and therefore to produce any required total drag The rod in the direction of its length has a practically frictionless range of five inches, which corresponds to a variation of about 16° in the angle of band contact. The resultant force along the rod is the difference between the tight and slack tensions, and measures the drag The force is balanced by dead weights which are placed in a tray at the top of the rod for a vertical wheel, and if the wheel is horizontal, in a scale pan suspended by a cord which passes over a frictionless pulley and is attached to the head on the rod.

If from some cause, the band friction should increase, the drag would also increase, and there would be a corresponding movement of the rod. Thus a portion of the leather band would be unwrapped, while an equal portion of the copper band would be brought into contact. But the frictional co-efficient for leather exceeds that for copper, so that the drag would be less and would continue to diminish until it again balanced the weight. The reverse, of course, would be true, if the band-friction should diminish. The rod would move in the opposite direction, an excess of the leather band would be brought into contact and the drag would continually increase until equilibrium was again restored. Hence, within a certain range, the band will find a position of equilibrium, although the friction may vary, and the total drag will then be measured by the dead weight in the tray or in the scale-pan. If the movement of the rod should be so great that it may come against one of the stops provided to limit its action, the drag can be readjusted by means of the screw attachment. This, however,

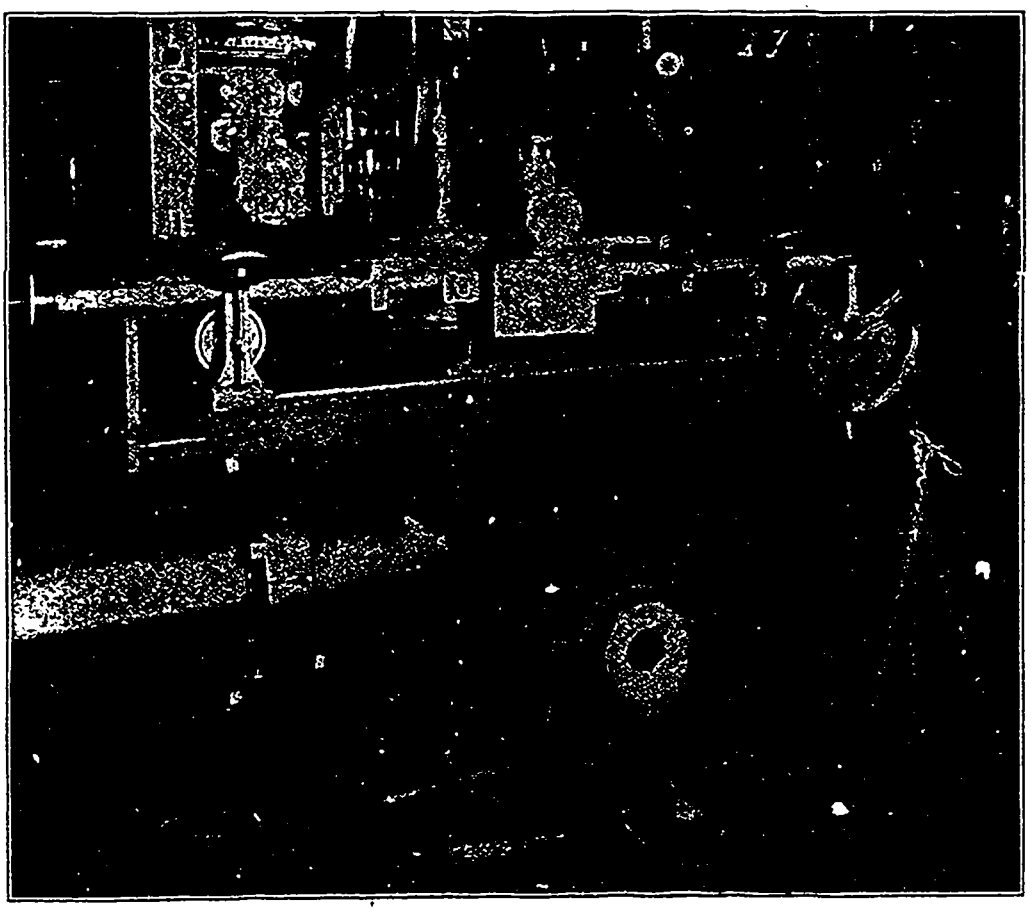
is very unlikely to happen, as the range already allowed is sufficient to admit of a large variation in the value of the co-efficient of friction. It has been found that the best results are obtained by running the wheel without any lubricant on the rim; care should be taken to protect the rim from water or oil, which would necessarily produce a considerable variation in the frictional resistance. This brake has been in use only a few months, but in the several trials which have been made it has fully realized the expectations that had been formed of its efficiency. It has been employed in measuring directly off the jack shaft the power developed by a 6 inch turbine with vertical axis and a 16-inch Pelton wheel with horizontal axis.

The whole of the water is discharged into the flume, and passes over the weir into the large calibrated tanks. If the quantity is too great to be measured in the tanks, the water is run to waste and the discharge calculated from the normal weir formula. Co-efficients of discharge have been found for various depths over the lip, and the co-efficient for any particular depth can be very approximately determined by interpolation. The depth over the lip is obtained by means of the depthing apparatus, which consists of a deep girder stretching across the flume and carrying three hook gauges with Verniers which read to .001 inch.

The centrifugal pump is erected over the flume in a framework which allows it to be raised or lowered so that the heights of suction and discharge may be varied at will. For this purpose the piping is made in interchangeable lengths of 2 feet. The pump is driven by a 9-inch belt and discharges into the ceiling circuit already described. From this circuit the water is delivered into the top of the experimental tank, flows into the adjoining flume, passes over an intercepting weir for calibration and is then again conveyed along the flume to the pump. Thus, the same water can be used over and over again.

approximate maximum delivery is estimated to be 1,000 gallons per minute when the pump is running at a speed of 150 revolutions per minute against a pressure of 120 lbs per square inch. The suction valve chambers are placed directly over the calibrating tank nearest the east wall, and draw the water from this tank through two 10-inch suction pipes. Each discharge valve chamber is directly connected with a 12-inch header, which discharges into the 8-inch ceiling circuit. The water may be made to flow in almost a direct line to the point of discharge, or it may be made to pass around the three sides of a rectangle so that the effect of the additional bends and increased length of piping may be estimated. The water flows into the experimental tank at a point 20 feet above the level of the discharge valves.

One of the features of the pump is the provision made that the valves can be taken out and replaced by others of a different type. The valves at present in situ are a Riedler valve and two with groups of 36 circular disc valves of 1⅛ inches diameter in each. In addition to the usual pressure gauges, tachometer and revolution counter, the pump is fitted with a specially designed continuous triple indicator apparatus, which autographically records during any given time of a trial the



The turbine is supported upon an angular flange bolted to the bottom of a cast-iron cylinder. An 8 inch tee is secured to the crown of the cylinder, and a cover with a specially designed gland is bolted to the upper flange of the tee. The jack-shaft passes through this gland, which forms an almost frictional bearing. No packing is required, as provision has been made for carrying away any slight leakage that might occur. The jack-shaft passes through a piece of pipe screwed to the bottom of the cover and extending downwards to the cylinder, so that it is protected from the impulsive effect of the inflowing water. The supply pipe is connected with the horizontal branch of the tee, and the entrance of the water is controlled by an 8-inch straight-away valve placed at some distance from the opening. The gates of the turbine, for example, one of the New American inward and downward flow type, are worked by means of a shaft extending from a pinion geared to the toothed quadrant and passing through a gland in the crown of the cylinder The upper end of the shaft is provided with a handle and pointer, which indicates on a graduated quadrant the extent of the gate opening. Suitable pressure gauge connections have been arranged in the upper and lower parts of the cylinder. The power of the turbine is determined by the friction brake already described.

The experimental pump is of the vertical triple-throw single acting plunger type, and is driven by two 10-inch double leather belts running on 48-inch pulleys formed on the outer crank throws, or discs. The plungers are 7 inches in diameter and have an 18-inch stroke. The

speed, variation and duration of the valve chamber pressure at any point of the stroke Sight holes are provided for observing the movement of the valves and indicators for recording their lift. A special recording gauge also registers the pressure in the delivery pipe. As the pump is for experimental work, it has been made unusually heavy, its total weight being about 55,000 lbs. The plungers, valves and valve seats, all internal screws, nuts, etc , are of bronze, and weigh more than 3,700 lbs.

TORONTO AND SEWAGE DISPOSAL.

Editor CANADIAN ENGINEER:

SIR,—On March 17th, Jno. McDougall, of the Detroit Purification Company, who pushes the old system of the International Water and Sewage Purification Company, of London, England—which company has within the last two years improved its methods by making its filtering process into an intermittent, in place of a continuous flow system, thereby purifying the sewage by bacteria which require atmospheric air regularly at short periods—appeared before a special committee of the Toronto City Council and described the method of treatment, and also showed blue print drawings of the precipitating tanks and filters that they adopted. The plan of the tanks and full information we have before published in the October and November issues of 1896, and the March and May issues of 1897.

Mr. McDougall's remarks showed that his company keeps to the old methods of continuous flow both in the settling tanks and filters, while

his principals in England have been compelled by the sanitary inspectors to march with the times and adopt the intermediate system. This system is about the most expensive one that can be adopted, and includes some intricate sludge machinery that soon gets out of order and is really unnecessary because the sludge will come away better without it The ferrozone precipitant necessary to this system would be a heavy, constant and useless expense The polarite used for the filtrate is said to cost $30 per ton, and it is now a recognized fact that screenings of coal that only cost $2 50 per ton, are far more efficient and lasting when used as a filtrate, standing ahead of every other material except charcoal made from wood or towns' garbage On page 320 of the March, 1897, issue of THE CANADIAN ENGINEER, there is a table showing the cost of sewage disposal in twenty towns of England. The last one, Swinton, is worked on Mr. McDougall's plan. Of this town, Mr. McDougall's company states that there is 16,000 population, the average daily sewage is 300,000 gallons, that they can give their sludge away, that their tank capacity is 240,000 gallons, that the plant cost $30,000; it costs $3,000 each year to manage it and pay for ferrozone The population of Toronto is over twelve times that of Swinton, and Dr. Sheard said that there will be a much larger quantity of sewage per head discharged in Toronto than in British towns. In that case our sewage works may cost about $360,000 for plant, and $36,000 per year after, and then we might have to provide sludge presses and furnaces to burn the sludge cakes in addition.

Mr. McDougall was ably supported in showing the advantages of his company's system by Mr. Warner, who had come all the way from Nottingham, England He is the patentee of the Low Temperature, Slow Burning and Natural Draught Garbage Destructor, which has been fully described in page 286 of the last February issue of THE CANADIAN ENGINEER. When answering a straight question put by Ald. Lamb, Mr. Warner stated that the Toronto garbage destructors were similar to the ones he built twenty years ago, and it will be admitted that the high temperature fume consuming, quick burning and heat raising destructors are five years ahead of the low temperature ones, so that Toronto must be a quarter of a century behind similar towns in this line of sanitary appliances. The saying of the late Benjamin Franklin, viz., "Be careful that you do not pay too much for your whistle," is applicable when a sewage scheme is under construction EXPERT.

Toronto, May 15th.

CEMENT IN ONTARIO.

During 1897 the cement industry in Ontario has made satisfactory progress, as shown in the report of the Bureau of Mines. Both the natural rock and Portland cements are showing a large increase of production, and manufacturers are establishing a good reputation for the qualities of the cements they are putting on the market. The increase, however, is not shown in the number of establishments, which are two less now than four years ago; but in number of men employed and amount of wages paid for labor, in quantity of cements produced and in their value there is a gratifying evidence of progress. The number of men employed in these four years has increased from 168 to 231, the wages paid for labor from $44,878 to $89,060, the quantity of cement manufactured from 85,903 barrels to 181,495 barrels, and the value of the cement from $109,834 to $246,425 The greatest increase, however has taken place in the production of Portland cement, which has gone up from 30 580 barrels to 96,825, while the natural rock cement has only increased from 55,323 barrels to 84,670. In value natural rock cement shows an increase of $27,349, while the Portland cement shows an increase of $109,242. This, no doubt, is largely, if not chiefly, owing to the growing interest in the building of good roads in our towns and cities.

All of the natural rock or hydraulic cement works are now situated along the Niagara escarpment, extending from Queenston, near the Niagara River, to Limehouse, on the main line of the Grand Trunk Railway.

One of the Portland cement works is situated at Shallow Lake in Grey county, where the business is carried on by the Owen Sound Portland Cement Company. New machinery was added during the past year, and new buildings and more kilns are now in course of erection which, when completed early this summer, will bring the output up to over 300 barrels per day. The product of the works is known as the Samson brand, and the manager states that not a single complaint was received last year regarding the quality of the material put upon the market. Both the marl and the clay used in the manufacture of cement at these works are obtained from the bed of Shallow Lake.

The works of the Rathbun Company at Napanee Mills were also enlarged last year, and they have now an estimated capacity of about 350 barrels per day. The plant embraces the latest and best developments in Portland cement making, and is constructed with a view to produce material of very uniform quality. The clay and marl are mixed in proportions carefully regulated by chemical analysis, and the slurry is so finely reduced in the mixing mills that it will all pass through a seive of 100-mesh, or 10,000 holes per square inch. Two new burning kilns were erected last year, making three in all, they are of the continuous type, and produce a very uniform well burnt clinker. In the grinding mill the clinkers are ground to an extremely fine powder, and, so finished, it is conveyed to bins in a new storehouse, which has a capacity of 50,000 barrels. The Rathbun Company's cement is known as the Star brand, but they are now producing a quality called the Silica Portland. The marl for the works is drawn from an extensive deposit on the line of the Bay of Quinte Railway, and the clay from a property adjoining the works.

During the fiscal year ending June 30th, 1897, Canada imported 210,871 barrels of Portland cement, valued in the Trade Returns at $252,587. so there is yet considerable room for expansion in the industry at home.

PNEUMATIC GRAIN-HANDLING MACHINERY.*

BY FREDERIC ELIOT DUCKHAM.

The grain trade of the world has been steadily increasing, and the bulk of the cargoes and the tonnage of the vessels is now so great that the time consumed in unloading and the cost of keeping the vessel in docks are very serious considerations. To deal with such a large amount of trade, the old method of working by hand has been gradually replaced by the use of various machinery, such as the endless band, carrying a number of comparatively small buckets travelling at a speed of about 100 feet per minute in an enclosed trunk, and which has for some years been in use in America, in Liverpool and elsewhere; but where the cargoes to be discharged are of a mixed character, e g., general goods and packages in the 'tween decks, and grain in bulk in the lower hold, it has been found more convenient to use hydraulic cranes with self-opening and closing grabs, or buckets filled by hand and self-discharging, or other contrivances with which to lift the grain, but which can at any time be exchanged for slings or hooks for the discharge of the ordinary merchandise. In all these methods, however, it is only possible to reach such of the grain as is within the area of the hatch, the other portion, which may extend 100 ft. or more fore or aft, has to be trimmed to the hatch by manual labor or by the so-called steam shovel. Grain is often brought in bunkers and other confined spaces in which it is not practicable to employ either of these machines, and so the grain in these places has to be filled into sacks and unloaded by manual labor. But when one has to deal with present-day vessels of 10,000 tons capacity, representing a capital expenditure of £70,000, and a debit of £70 for each day in dock, it is of very great importance to increase by every possible means the speed with which their cargoes can be loaded or unloaded. In this direction the skill of the naval architect has been shown, and must still continue to be shown, in so designing the vessels that they may not only be safe and otherwise satisfactory for navigation, but present the greatest facilities obtainable for the receipt and delivery of their cargoes.

It is also of importance that such improvements be made in the machinery employed that the greatest amount of work may be done in the shortest time and at the lowest cost, with safety. It was with such requirements in view that the author directed his attention to the employment of air for elevating and conveying bulk grain. There was no originality in this idea—air under vacuum, as well as under pressure, had from time to time been tried in this country and abroad for this purpose; but several difficulties presented themselves and prevented the successful operation of the machinery. Prominent among these were the difficulties of sucking or forcing grain in bulk through pipes, of getting the grain out of any vacuum chamber into which it had been drawn, and of separating the grain and its dust from the air which had conveyed it. The author feels that he need not give in uninteresting detail the various steps by which these and other difficulties were overcome, but would at once refer to two types of pneumatic elevators now in successful operation. One of these is employed for the discharge of sea-going vessels overside into barges at the Millwall Docks and the Albert Docks, London, Bremerhaven, Hamburg, etc. In these the machinery is afloat in a hull of, say, 80 feet by 24 feet by 10 feet, in each the machinery under deck consists of a compound engine connected direct with air-exhausting pumps capable of producing and maintaining a partial vacuum 15 inches of mercury in a tank into which, say, 5,000 feet of air, under atmospheric conditions, is being admitted per minute. The boilers are of the ordinary marine type, the engines are surface-condensing. On the deck of the craft, one, or in some cases, two or three towers are erected each to support a vacuum tank, which acts as a grain receiver, and is say, 10 feet in diameter by 16 feet high. This tank is coned at the

* From a paper read before the Institution of Naval Architects.

bottom, and has connections for two or three pipes through which the grain is drawn with the current of air from the hold of the ship. An automatic air lock is fitted through which the grain discharges itself from the tank into the hopper of the weighing machines, and after weighing, it flows into the barge in bulk, or it may be sacked and delivered in that way. The men required for the discharge of, say, 100 tons per hour, are an engineer, a stoker, one man to each of the pipes, a leading hand, and three others for moving barges and general work. The coal consumption is about 5 cwt. per hour. This is heavy compared with the coal consumed by the ordinary bucket elevator, but as this pneumatic machine effects a direct saving of the cost of trimming the grain to the hatchway, the comparatively greater coal consumption sinks into insignificance. In fact, the whole operation of discharging is often less than what would have been the cost of trimming alone.

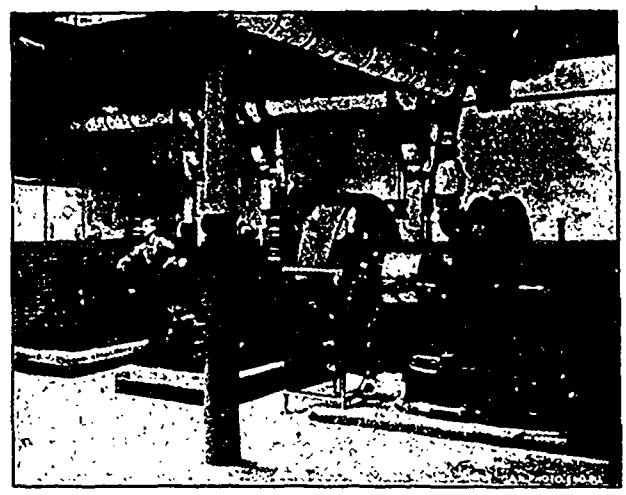
The pneumatic machine has moreover other advantages; it is worked in all weathers, it not infrequently happens that the pneumatic grain elevators are the only ship-discharging appliances at work on a wet day on the Thames. In addition to this important saving of the ship's time, it is also to be noted that the suction pipes, being suspended from the elevator derrick, can be lowered into the ship's hatchway and the discharge commenced within a few minutes of the machine being brought alongside. There is none of the usual loss of grain in handling, as the cargoes are conveyed within closed conduits from the discharging ship into the receiving barge, and the grain is, moreover, improved by such intimate contact with the conveying air. This is specially so when the grain is heated and out of condition. The suction pipes, which are semi-flexible, can be taken by any tortuous route into the bunkers or other confined spaces, and the grain can be drawn out therefrom almost as readily as from the ship's hold. There is obviously an entire absence of the dangers to life and limb that are inseparable from the ordinary lifting machinery. The elevator vessels are fitted with steam capstans to assist in moving themselves, as well as the barges that come alongside for loading.

IMPROVEMENTS IN THE ELECTRICAL PLANT AT McGILL UNIVERSITY.

The university has again to thank W. C. McDonald for generously defraying the cost of extensive alterations and additions to the light and power station, connected with the faculty of applied science. The equipment is now installed in a handsomely finished,

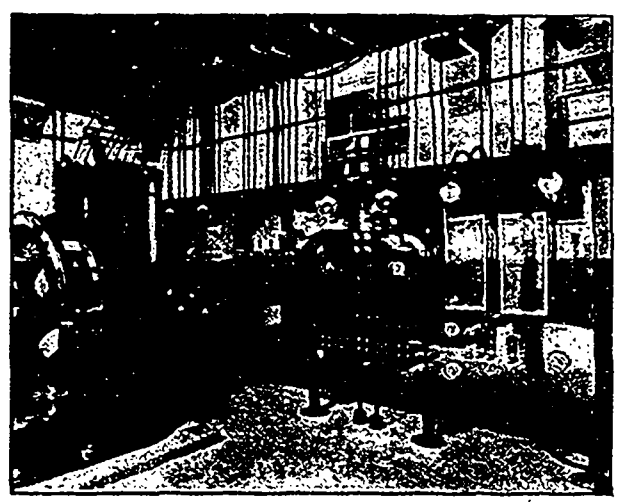
L. Herdt, B.A.Sc., E.E., Lecturer in Electrical Engineering, McGill University.

well-lighted room, and consists of a 30 k.w. Edison-Hopkinson dynamo, and a 30 k.w. Siemens dynamo, each driven by a Willans high speed engine, the dynamos are on the shaft of the engine, making what is known as direct connected units. These two machines are capable of lighting the different buildings of the university, supplying current for more than 3,000 lights. The dynamos are run in series on the three wire system, or if the load is light, one can run on the two-wire system. In addition there are installed a 100 h.p. Goldie & McCulloch engine, directly coupled to a 75 k.w. General Electric dynamo This machine is set apart for power purposes, the motors in the building averaging about 110 h.p. It may be also used for lighting purposes when the demand exceeds the capacity of the two former dynamos The switchboard is made of dark slate in panel form, and it is said to be one of the finest in Canada. The lighting of the buildings at night is effected by the help of accumulators. The accumulator room, standing beside the dynamo room, possesses two batteries of Crompton-Howell storage cells, of a united capacity of 800 ampere hours. These batteries would discourage the antagonism of the adversaries of accumulators, for they are subjected to all kinds of discharges, and after a usage of over six years have an all-round efficiency of 72 per cent. An ingenious arrangement, devised by Louis A. Herdt, lecturer in electrical engineering, enables one battery to be



Electrical Plant—McGill University.

taken out of circuit, and the other one to be put in circuit during the night, as soon as one of the batteries shows signs of being discharged. The plan of the new dynamo room is such as to permit of the plant being extended so as to light any further buildings that may be erected or any of the existing buildings, such as the Library and Museum, which are at present lighted from other sources.



The Switch Board—Electrical Plant at McGill University

To increase the educational advantages of the mechanical engineering department especially, two of the battery of four Babcock & Wilcox boilers have been replaced by a boiler of the Lancashire type, and one of the Locomotive type. Both the new boilers were made in Canada, one by John Macdougall, the Caledonia Iron Works, Montreal, and the other by the Robb Engineering Co., Limited, Amherst, Nova Scotia.

SEWAGE DISPOSAL BY SUBSOIL IRRIGATION.*

By E. Mohun, M. Can. Soc. C.E.

In October, 1894, the author received instructions from the Hon. the Chief Commissioner of Lands and Works to devise some means for disposing of the sewage of Government House, Victoria, B.C., and though the work undertaken is but on a small scale, he trusts that it may prove of interest. It was found that the sewage of the building had been disposed of by the simple expedient of running a 6-inch pipe across a field and discharging into the street ditch, thereby creating an intolerable nuisance. The sewerage system of the city had not been extended in that direction, and to make connection with the nearest point it would have been necessary to construct a sewer about 3,600 feet long, nearly all the trenching for which would have been through solid rock. The contour of the ground being adapted to the purpose, it was decided to dispose of the sewage by subsoil irrigation. Reference to the books of the water department showed that the house consumption as taken by metre was remarkably small, frequently not exceeding 300 gallons a day.

* A paper read before the Canadian Society of Civil Engineers.

The only pipes available were 6-inch circular drain pipes, T pipes, and 3-inch circular drain tiles At a convenient point in the field the old sewer was cut, and an automatic flush tank built, from which the sewage passed down a tight 6 inch conductor to the inlet ends of the 3 inch drain tiles.

In laying the drain tiles the following method was adopted: Contour lines having been set out with the level and the trench cut along them, bricks were laid with a carpenter's level 8 feet long, so as to form level and solid bearings beneath the ends of the drain tiles laid upon them.

The connection with the six-inch conductors was made by turning down a 4 × 6 T, and making connection with the drain tiles by means of a galvanized iron taper. The ends of all the drain tiles are provided with air vents, made by galvanized iron, and connected with the drain by quarter bends. The area irrigated is nearly one acre, and it has not been found necessary to underdrain, as the whole of the discharge appears to be absorbed by the earth The total length of the drain tiles is 1,463 feet, and from their upper surfaces are from 10 to 12 inches below the ground surface. Their alignment is marked on the ground by lettered stakes. The flush tank is provided with an L screen, ¼ mesh, divided into three compartments by weirs: into the first the sewage discharges directly through the old pipe; as the screen becomes clogged with paper it overflows into the second compartment and similarly into the third. It has not been found necessary for the scavenger to clear the screen more often than once in six weeks, though for other reasons it is done once a month. No offensive smell can be detected either at the flush tank or on the lines of pipes, nor is there any indication of excrement sodden soil. The gardener states that the ground never before produced vegetables equal to those grown since the sewage system was installed.

The ground to the north-west is considerably higher than the field and garden, and is very rocky. Shortly after the completion of the work, snow fell, and within a few hours a rapid thaw took place accompanied by heavy rain, the water actually running over the surface in a sheet. Under the circumstances the tile drains became surcharged, and when the rush from the flush tank took place it can hardly be considered wonderful if three or four of the tiles were broken They were of course easily replaced, and a similar occurrence guarded against by cutting an intercepting ditch across the field to lead the surface water into the street ditch. An object sought to be arrived at was to so proportion the tank that each discharge would fill all the drains, practically, simultaneously.

The cost of labor was high, a good deal of rock being met with in laying six-inch conductor. The work was performed by day labor under the author's instructions, and its cost was: Material, $255.68. labor, engineering, etc., $244.30; total, $499.98.

THE POSSIBILITIES FOR SMELTING IN BRITISH COLUMBIA.*

BY R A HEDLEY, NELSON, B C.

My knowledge of the country and my study of its ores enables me to make certain statements, which I feel myself qualified to make somewhat authoritatively. My data, however, are insufficient to handle the subject very thoroughly.

Lead smelting offers some difficulties for any plant possible with present production of the lead producing mines. First, its capacity would not warrant the erection of a complete refinery, and without it lead must be refined in the United States, paying a duty of two cents per pound, while lead in ore pays but 1½ cents per pound. As the bulk of the lead ore shipped is of high grade (over 65 per cent lead) this renders it difficult to compete with the smelters of the United States, as the difference in freight paid is but slight To illustrate this point, let us suppose that ore is shipped to the United States carrying 65 per cent. lead. Assume freight at $8 per ton, duty is $19 50, making $27 50. Smelted here, bullion shipped at same freight rate will pay $5 20 and duty will be $26, making $31.20. It would seem, then, better to leave a high grade lead ore severely alone, unless the product can be disposed of to better advantage than by refining in the United States, paying duty on lead. Suppose a 40 per cent. lead ore shipped; it will pay freight, $8, and duty, $12, making $20. Smelted in this country and bullion shipped, freight will be $3.20 and duty on lead $16, making $19.20.

This is in favor of smelting as regards these two items of cost. Now the ores carrying 40 per cent. lead or less are as yet but a small item, and generally speaking carry a high percentage of zinc, or else the gangue is a barren silica, making fluxing costly.

The production of the whole Slocan district may be roughly stated at 100 tons per day, of which 60 per cent. is of high grade, over 65 per cent. lead, and 25 per cent. at least, carries fully 15 per cent. zinc. The question of flux is an important one in considering the treatment of these ores Lime is very abundant, of good quality and cheap, but iron oxide of fair purity does not occur, and metallic iron as scrap is procurable in but limited quantity at the rate of $15 per ton. The ores of Rossland district have been spoken of as suitable for fluxing lead ores, but that is a very questionable point. An average Rossland ore will carry excess silica, and no little arsenic, and they strike me as an expensive flux when the cost of roasting is considered. Also the difficulty of making a good roast cuts some figure in the cost of treatment. A complete roast on a mixture of galena and pyrites, enables one to charge a certain proportion of raw galena ore, a manifest saving. Until recently, I was firmly convinced that a blast furnace matting plant would handle the ores of Rossland camp very economically and to great advantage. I still believe so, though I consider the difficulties are not few.

I have no definite information regarding the treatment of Le Roi ore at the Trail smelter. Would like to be able to state to what degree of concentration they attain, and what proportion of calcined ore they use on the charge Having analyzed samples from many of the mines, I am of the opinion that, given an assortment of ores from different mines, matte smelting can be successfully and economically carried on. The consumption of fuel and flux should be kept very low, and as these two items form by far the major portion of the cost of first concentration, it is of importance to determine whether 10 or 15 per cent is necessary. A year ago I was told that they were using but 10 per cent of coke, and I analyzed a piece of slag produced without extraneous flux, finding.—

Silica	49.2 p.c.	
Ferrous oxide	23.2 p c.	
Alumina	14.9 p.c.	Gold .045 ozs. per ton.
Lime	5.7 p c.	
Magnesia	5.4 p.c.	

It would be very interesting and instructive to see pyritic smelting thoroughly tested on these ores, with a well adapted plant. It may be said that pyritic smelting has never yet proven a success, but it has never yet had a fair trial. In Newfoundland, it has been stated that purely pyritic smelting was successfully carried on, but the ore treated, if I understand aright, carried very little slag forming material, and therefore, the concentration was low. Professor James Douglas made a trip expressly to see that plant in operation. Robert Sticht wrote at length on the subject, and described the operations of plants at Boulder, Kokomo and Toston, stating that there were obvious reasons why they were not successful, either through faulty plant or ores unsuitable.

As yet we do not know what the Rossland mines are capable of producing. Wild statements have been made on this head, but I believe that a 500-ton plant, erected at such a point and run so economically that it could make a smelting rate of $7 per ton f.o.b., Rossland, would soon have to increase its capacity. If these ores will smelt with a concentration of 10 to 1, using 12½ per cent. coke and 10 per cent. flux (limestone), that figure will leave a profit to the smelter. Speaking of possibilities, however, I consider that they are far greater in the Boundary Creek district. There, the variety is greater, and a perfectly self-fluxing ore is obtainable. I do not pretend to say that there is an abundance of ore of such grade as to maintain a large plant but I do say that there is every indication that such will prove to be the case. Once transportation is had, development will be pushed and plants will follow. Ores will be treated, both by direct smelting for matte and by previous concentration. There are very clean ores of mixed pyrites, chiefly pyrite and chalcopyrite, that will carry 8 to 12 per cent. copper and low silica; others of low pyrites and gangue, that will form an excellent slag.

Should the coal, on development, prove to be of good coking quality and in sufficient quantity, a plant with large capacity will treat ore as cheaply as anywhere on the continent. Even bringing in coke at a cost of $12 per ton laid down, I have no hesitation in stating that a 500-ton plant (two furnaces) using steam power, will smelt at a cost not to exceed $2.75 per ton of ore. This of course will produce matte the grade of which will depend on the degree of concentration and the percentage of copper in the ore.

In order to get at the margin on treating a ton of ore, let us assume certain values, and figure the cost by shipping matte, and also converting to copper, and shipping for electrolytic treatment, assume:

4 p.c. copper, at 10c	$ 8 00	
4 dwts. gold, at $1	4 00	
4 ozs. silver, at 50c	2 00	
		$14 00
Shipping matte: 40 p c. copper, conc. 10 into 1.		
Freight to New York	$18 00	
Deduction: 3½c per lb. copper	28 00	
5 p c of silver	1 00	
	$47 00	

* A paper read before the Federated Canadian Mining Institute.

Representing 10 tons of ore, or per ton..	$ 4 70	
Blast furnace treatment, per ton	2 75	
Losses, say 7½ p.c. (excessive).....	1 00	
		$ 8 50
Leaving a margin to miner on $14 ore		$5 50
Or converting 40 p.c. matte to metallic copper.		
Roasting and reverberatory furnace work, per ton of copper.....	$30 00	
Marketing one ton of copper.....	40 00	
	$70 00	
Representing 25 tons of ore, per ton	$2 80	
Blast furnace treatment	2 75	
Losses on treatment, say 10 p.c. (excessive)	1 40	
	$6 95	
Leaving a profit to miner on $14 ore		$7 05

You will observe that for the purpose of facilitating these calculations, I have taken my copper value at 10c. per pound. It is customary to figure at $1 per unit, or 5c. per pound in ores, which would make this a ten dollar ore. That there is every indication that such grade of ore will be developed in enormous quantity, I am sure most mining men familar with the country will agree. With East Kootenay I am not familiar, but I believe that the range between Kootenay Lake and Fort Steele will produce ores that after concentration will materially assist smelting operations in the country. West again of Boundary Creek, in the Okanagan country, I have seen evidence of ores in veins of unusual size, that will yield handsomely. The coast too, if report be true, has its ores of character suitable for smelting, and exceptionally situated for economical treatment.

My figure on converting 40 per cent. matte to copper and marketing that, seems abnormally high, but it is based on roasting in the hearth furnace by expensive hand labor, and can be greatly reduced by automatic machinery. The New York market being the best, necessitates a high freight, and if all values are paid for they must charge a good treatment rate.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports of interest to the metal trade from Great Britain during April and the four months ending April, 1897, 1898:—

	Month of April.		Four months ending April.	
	1897.	1898.	1897.	1898.
Hardware and cutlery	£5,899	£2,694	£17,917	£8,112
Pig iron	..	2,683	455	5,224
Bar, etc.	858	1,682	3,889	3,967
Railroad	9,504	50	13,351	6,972
Hoops, sheets, etc.....	4,608	1,817	11,009	5,470
Galvanized sheets	6,182	9,522	12,023	14,071
Tin plates.....	10,778	14,996	72,320	40,545
Cast, wrought, etc., iron	4,081	4,117	11,085	10,250
Old (for re-manufacture)	.. ..	495	572	898
Steel	4,752	3,486	14,987	19,421
Lead	712	1,602	2,782	4,305
Tin, unwrought	1,872	2,454	7,316	5,930
Alkali.....	3,667	6,042	8,189	11,558
Cement	1,110	3,503	2,953	5,491

CANADIAN ELECTRICAL ASSOCIATION.

The following is the programme of the convention of the Canadian Electrical Association, to be held at the Windsor Hotel, Montreal, this month:

BUSINESS PROGRAMME.

Tuesday, June 28th.—9.30 a.m.—Meeting of Executive Committee. 10 00 a.m.—Opening of the first session in Convention Hall, Windsor Hotel; President's address; reading minutes of last meeting; secretary-treasurer's report; reports of committees and general business. 2.00 p.m.—General business; presentation of papers; discussion.

Wednesday, June 29th.—9.00 a.m.—Consideration of reports of committees; election of standing committees; selection of place and time of next meeting; general business; presentation of papers; discussion.

Thursday, June 30th—9.30 a.m.—Election of officers.

LIST OF PAPERS.

"How to Overcome Some of the Difficulties Encountered by Central Station Men," A. A. Wright, Renfrew, Ont. (1) "The Unconscious Ownership of an Important Key"—(A Plea for the Introduction of Goods Traffic on our Suburban Tramways); (2) "The Quimby Electric Screw Pump," W. T. Bonner, Montreal. "Experiences of an Inspector," Dr. J. K. Johnstone, Inspector of Electric Light, Toronto. "The Electric Current in the Rainy River Gold Mines," W. W. Hopkins, B.Sc., C.E., etc. "The Importance of Proper Methods of Illumination," F. A. Bowman, M.A., B.E., New Glasgow, N.S. "Economics in the Boiler Room," James Milne, Toronto. P. G. Gossler, Montreal, is also expected to read a paper.

SOCIAL FEATURES.

Tuesday, June 28th.—7.30 p.m.—Trip around Mount Royal by special Park and Island cars, afterwards ascending Incline Railway to lookout on mountain to view the city under illumination.

Wednesday, June 29th.—1.00 p.m.—Visit to (1) Bell Telephone Company's new building; (2) Street Railway Company's power house; (3) power house and works of the Lachine Rapids Hydraulic and Land Company, returning to city at 7.30 p.m. 9 00 p.m.—Annual association banquet at Windsor Hotel.

Thursday, June 30th.—11.00 a.m.—Visit to McGill University. 1.30 p.m.—Visit to Royal Electric Company's lighting station and factory, then by special G.T. train to visit the works of the Chambly Manufacturing Company at Chambly.

FIRES OF THE MONTH.

May 1st—S. Buyant's sawmill in Tecumseth, Ont., together with 50,000 shingles. No insurance.——May 4th—The factory and manager's house of the Truro Condensed Milk and Canning Co., Truro, N.S. Loss $55,000; insurance on stock and buildings $35,000.——May 7th—One of the Canadian Gold Field Co.'s buildings at Deloro, Ont. Damages, $75,000; insurance, $41,000.——May 8th—Premises formerly occupied by Ontario Pump Co., Cecil st., Toronto, destroyed. ——May 10th—J. H. Connor's washing machine factory, Sussex st., Ottawa. Loss about $10,000.——May 17th—McBuril's furniture factory at Moosomin, N.W T The loss on the furniture factory is $5,000; no insurance.——May 25th—The Thornbury, Ont., woolen mills, completely destroyed; supposed to be incendiary; insured for $5,000.

LITERARY NOTES.

There has just been published the second edition, revised and much enlarged, of "Gas, Gasoline and Oil Engines," by Gardner D Hiscox, M.E. This is a book designed for the general information of every one interested in this new and popular motive power, and its adaptation to the increasing demand for a cheap and easily managed motor requiring no licensed engineer. The book treats of the theory and practice of gas, gasoline aud oil engines, as designed and manufactured in the United States. It also contains chapters on horseless vehicles, electric lighting, marine propulsion, etc. The following are the subjects discussed:—History of the system, theory of the gas and gasoline engine, utilization of heat and efficiency in gas engines, heat efficiencies, ratarded combustion and wall-cooling, causes of loss and inefficiency in explosive motors; economy of the gas engine for electric lighting; the material of power in explosive engines, gas, petroleum products and acetylene gas; carburetters, and vapor gas for explosive motors; cylinder capacity of gas and gasoline engines, mufflers on gas engines; governors and valve gear; igniters and exploders, hot tube and electric; cylinder lubrication; management of explosive motors; measurement of power by pony brakes, dynamometers and indicators; measurement of speed, the indicator and its work; vibrations of buildings and floors by the running of explosive motors; explosive engine testing; various types of gas and oil engines, marine and vehicle motors; United States patents on gas, gasoline and oil engines, and their adjuncts—1875 to 1897 inclusive; list of the manufacturers of gas, gasoline and oil engines in the United States, with their addresses.

"The Making of the Canadian West," is the title of a new contribution to Canadian history, by the Rev. R. G. MacBeth, M.A. This is the second appearance of the author before the Canadian reading public, and his pursuit of historical work is amply justified by the warm reception given to his first effort recently published under the title of the "Selkirk Settlers in Real Life." This was a description of the mode of life and surroundings of the early settlers in the region now known as the Province of Manitoba, and the story told by one who lived among them, was so life-like and charming that the reader longed to know more of the leading actors in this interesting drama of colonization. Hence the present book, which gives graphic sketches of the leading men who figured in the political and social life of the Selkirk settlement. To use the words of the author in his preface, he has simply gone back and lived through the past again, seeing the faces and hearing the voices of other days, and what he has seen he has written. The result is a most valuable contribution to Canadian history, and the work is embellished with portraits of some ninety individuals, more or less prominently associated with affairs in the North-West. The author's style is easy and unaffected, and his sketches have a life and force derived from personal experience and

observation. The work is dedicated to Lord Strathcona, whose portrait appears as a frontispiece. The publisher is William Briggs, Toronto, a name which is invariably associated with good typography. We warmly commend this excellent book.

"The Pioneers of the Klondyke," which is an account of two years' police service in the Yukon before the country became so well known as it is now, is narrated by M. H. E. Hayne, of the North-West Mounted Police, and written by H. West Taylor. The illustrations, which are numerous, are from photographs taken on the spot by the narrator. The typography is excellent, and the whole volume is worthy of the publishers, Sampson Low, Marston & Co., London, England.

The Engineering Society of the School of Practical Science, Toronto, has issued its annual volume of papers read before the society during the year Among the contributors are A W Campbell, C E; P H. Bryce, M A., M.D; W M. Tinty, B A Sc; L. B Stewart, D.T.S., and others.

We have before us proofs of a paper read before the Society of Arts, London, England, by Edwin O. Sachs, on "Stage Mechanism," which gives a valuable insight into some of the underlying principles of this most necessary adjunct of the mimic art.

The Rand Agency, Ltd., Johannesburg, S.A.R., has sent us the list of members and associates of the Chemical and Metallurgical *Society of South Africa.*

Industrial Notes.

Clinton, Ont., will probably buy a steam road roller at an early date.

Ottawa city council has passed plans for main drainage system to cost $414,000.

Berlin, Ont., has passed a by-law to buy the waterworks from the local company.

Craig Street, Montreal, is to be repaved with scoria blocks at a cost of $73,500.

The Gartshore-Thomson Pipe and Foundry Co, Ltd, has increased its capital to $60,000.

Wm. Stokes, Amherstburg, Ont., proposes to establish a cold storage plant in Windsor, Ont.

The Diamond Glass Co., Ltd., is applying for power to increase its capital to $1,000,000.

The Brompton (Que). Bridge Co. is about to build a new bridge with iron superstructure.

The Bushnell Oil Company is enlarging the Sarnia refinery so as to almost double its capacity.

The House of Industry, Bradford, Ont., will have two wings added this summer, at a cost of $13,000.

A great deal of permanent pavement will be laid in Guelph, Ont., this summer, chiefly cement sidewalks.

The Canadian Brewing Company, Montreal, is installing a new steam plant using the Kingsley water tube boilers.

Peterboro will soon vote on a by-law authorizing the issuing of debentures for the purchase of a steam road roller.

A flood-prevention dyke is proposed by the city engineer of Brantford, Ont., T. Harry Jones, C.E., to cost $47,583.

The Bennett & Wright Co., Ltd., Toronto, is to put in the plumbing and sewage of the House of Industry, Bradford, Ont.

A. N. Bishop, Annapolis, N.S., is enlarging his sawmill, and has bought an engine and boiler from the Goldie and McCulloch Co., Galt, Ontario.

The McEachren Heating and Ventilating Co, Galt, Ont., has placed an order with the Jenckes Machine Co., Sherbrooke, Que., for a Dake engine.

The Western Loan and Trust Co., Montreal, is installing a new heating system in its building, using the Kingsley water tube boiler. David Ogilvy is the architect

The MacGregor-Gourlay Company, Galt, Ont., has completed the purchase of the London, Ont., Machine Tool Company's business, and will transfer the business to Galt.

J. R. Booth, president of the Ottawa, Arnprior and Parry Sound Railway, has stated that he will not, at present, build a large flour mill at the Chaudiere, as had been reported.

The Consumers' Gas Co., Toronto, is building brick and stone steel skeleton retort house, Parliament st., Toronto Bond & Smith, Temple Building, Toronto, are the architects.

N P. Tanguay, Weedon, Que., has placed an order with the Jenckes Machine Co., Sherbrooke, Que., for a Crocker Turbine complete with gate, draft-tube and gearing for his sawmill at that place.

The Great North Western Telegraph Co. is installing a new heating system in its large building in Montreal, using the Kingsley water tube boiler installed by E A. Wallberg, Montreal. David Ogilvy is the architect.

Ed. Mohun, C.E., Victoria, B.C., has made an examination of Rossland, B.C., with a view to scientific sewage disposal, and has reported in favor of a sewage farm below the town, with settling tanks to collect the solids.

G. B. Burland, Montreal, has installed a Kingsley water tube steam boiler plant in the Union Card and Paper Co.'s new works. This is the second order that Mr. Burland has given for Kingsley boilers after using them for four years.

It is reported that a European petroleum syndicate, which controls the immense oil wells at Baku, has purchased the property of the Newfoundland Oil Co., situated on the West Coast of Newfoundland. The price paid is said to have been upwards of $400,000.

The work on the large C. P. R. station and office building in Vancouver, B.C., and the C.P.R. Hotel, at Revelstoke, is progressing rapidly. Most of the materials are procured in the West, and the steel structural work is supplied by E. A. Wallberg, Montreal.

John McDougall Ltd., Caledonia Iron Works, Montreal, had a contract for water filtration with the town of Windsor, N.S., which was set aside by the water commissioners upon a vote of the citizens. They brought suit and recovered the full amount for work done.

If Brantford and Kingston do not grant large bonuses to the Dominion Cotton Mills Co. the factories of the company will probably be concentrated at Three Rivers, Que., where electric power can be had from the Shewanegan Falls. About 5,500 hands are now employed

The Frost Wedge-Lock Wire Fence Co., Cleveland, Ohio, intends starting a branch in Canada, and is corresponding with Welland, Ont., to ascertain what inducements the town is prepared to offer. All the company ask is 1,500 to 2,000 square feet floor space and six-horse power.

The Montreal contracting and building firm of A. Lebeau & Co. has assigned with liabilities aggregating some $60,000 in all, some $55,000 of which is due on mortgage. A demand of assignment was made in March, which they contested, but a second demand results in an abandonment of their estate.

The Laurie Engine Co., has recently installed in its works a high pressure compound Corliss Engine and a Kingsley water-tube boiler plant designed for 175 lbs. working pressure. This is considered in every way a model and a highly economical plant. The Kingsley boilers are installed by E. A. Wallberg, Montreal.

F. B. Gaylord, W. Gerhauser, S. T. Miller, F. A. Goodrich and A. O. Cowles, Detroit, U.S., and E. W. Rathbun and F. S. Rathbun Deseronto, Ont., have been incorporated as the Deseronto Iron Company, Limited, to carry on, in all their branches, the operations of mining, milling, reduction and development, with a capital of $990,000.

The General Engineering Co., of Ontario, Limited, has published a neat volume "Smokeless Heat," which describes the mechanism and application of the Improved Jones Underfeed Mechanical Stoker A large number of these stokers have already been installed in the large power plants in Toronto and the neighborhood with most satisfactory results, it is stated.

A. C. Hutchinson, architect, Montreal, recently had tests made of the new Kingsley water tube boilers in the Ottawa General Hospital These tests gave highly economical results, exceeding the maker's guarantees by 10 per cent This type of boiler was used in nearly all the recent Ottawa work, including the American Bank Note Co.'s Works, the C. Ross Co.'s building, the Russell Theatre, the Sun Life Insurance Building, the Hotel Cecil, the Harmony Hall, and the Grand Opera House. These boilers were installed by E. A. Wallberg, Montreal.

Belleville, Ont., has been negotiating for the removal of the Thames Iron Works from Norwich, Connecticut, to that place, and has on the report of a deputaiton which visited Norwich, unanimously resolved to submit to the electors a by-law granting a bonus of $50,000, a site of ten acres, free water, exemption from taxation for ten years, and to pay the duty on the plant, which will be removed from Norwich. The company, the chief member of which is F. Mitchell, will first erect a rolling mill, and subsequently, if profitable opening be found, a smelting furnace, nail factory, etc.

The Alberta Railway and Coal Co has lately caused a survey to be made of the lands lying south of Lethbridge, and proposes to put in irrigation ditches. As the country is adapted in every sense for

irrigation, this will open up for cultivation an immense tract of land, which at present is only used for grazing, owing to its dryness. Where water has been applied in gardens the growth has been very luxuriant. It is expected that on completion of the system there will be a large influx of settlers from the United States, who understand and appreciate irrigation better than Canadians. The Kootenay market for hay, oats, vegetables, etc., will be quite close to this land.

The old suspension bridge across the Niagara River, connecting the Queen Victoria Park with Niagara Falls, N.Y., has been converted into an arch bridge of the same model as the Grand Trunk's new single-arch bridge. The steel arch was built up from either side of the river directly under the platform of the old bridge, and the work of alteration did not obstruct traffic over the bridge, except for a very short time. Both the arch bridges across the Niagara were designed and built under the supervision of L. J. Buck, C.E., New York. The new bridge is of the same pattern as the one built for the Grand Trunk, but is larger and has a greater span of arch, but is not calculated to sustain such heavy traffic as crosses the railroad company's bridge. The steel arch of the new bridge has a span of 840 feet, and the full length of the bridge is 1,240 feet. The length of the arch in the Grand Trunk bridge is 550 feet, and the length of the bridge, including approaches, is 1,100 feet. The centre of the new bridge is 190 feet above the river. The material of the old suspension bridge is to be used in the construction of a new suspension bridge across the Niagara River from Lewiston to Queenston.

The tenderers for the Port Colborne, Ont., waterworks, in whole or in part, are: St. Lawrence Foundry Co., Toronto; Londonderry Iron Co., Nova Scotia; Adam Hope & Co., Hamilton; Gartshore, Thompson & Co., Hamilton; Hamilton Fire Escape Co., Hamilton; Drummond, McCall & Co., Montreal, Kerr Engine Co., Walkerville, Ont.; Rumsey & Co., Seneca Falls, N.Y.; Northey Mfg. Co., Toronto, Goulds Mfg. Co., Seneca Falls, N.Y., J. W. Ruger Mfg. Co., Buffalo, Walsh Boiler Works, Springfield, Mass.; R. Brown & Sons, New Glasgow, N.S.; C. Richmond, Humberstone; Hunter Bros., Kincardine, Ont.; Geo. W. Moore. Buffalo; J. G. McKay, Thamesville, Ont.; W. B. Wilson, Buffalo; J. E. Kennedy, Owen Sound, Ont.; Clark & Connelly, Toronto; McQuillan, & Co., Toronto; W. W. Reid, Niagara Falls; Craig & Lynch; Hill & Gowanlock, Toronto; Fairbank, Morse & Co. The following are the lowest tenders. For cast iron pipes, hydrants, valves, etc., St. Lawrence Foundry Co., Toronto, $7,255 50; for complete system, Clark & Connelly, Toronto, $17,800; McQuillan & Co., Toronto, $18,960; Hill & Gowanlock, $16,899. Lowest figures, taking separate bids for completed work, $16,503.78. Pumping station was W. B. Wilson, Buffalo, $900. For stand-pipe, Walsh Boiler Works, Springfield, Mass., $995.

Mining Matters.

During one fortnight recently over forty miners left Johannesburg for the Klondyke.

The discovery of rich gold-bearing deposits is reported from Lake Clare, twenty-one miles north of Ste. Anne de Chicoutimi, Que.

The Jenckes Machine Co., Sherbrooke, Que., shipped on the 5th inst. a complete 10-stamp mill to the Cariboo Mining, Milling and Smelting Co., Fairview, B.C.

The Jenckes Machine Co., Sherbrooke, has equipped the Athabasca Mine, Nelson, B.C., with complete hoisting outfit and boiler. This mine is sure to become a producer of prominence.

D. S. McArthur & Co., Nelson, B.C., are developing their properties, and recently purchased, through the Rossland branch, from the Jenckes Machine Co. a complete hoisting plant.

The Monte Cristo Mine continues sinking in the main pit, and has lately added a No. 6 Cameron vertical pump, purchased through the Rossland branch, from the Jenckes Machine Co., Sherbrooke, Que.

The Rat Portage Diamond Drill Company has shipped machinery to Shoal Lake, where work has been commenced on the Cornucopia property.

Rossland, B.C., has organized a mining school by means of local subscriptions. About sixty students began the study of geology there early in April.

Mining in Newfoundland is likely to become more active very soon. The agents of at least five wealthy companies are at present in the Island examining properties, chiefly copper, with a view to purchase.

The Dundee Mining Company, Rossland, B.C., has just let a contract for furnishing material for a three-line gravity tramway. The price is $1,400. The company will erect trestles and install the tramway.

The Bonanza Nickel Mining Company at Wahnapitae, Ont., has erected a ten-stamp mill at the Mammoth gold mine, which is now in operation under the management of Henry Dierlamm, formerly of Chesley, Ont.

W. M. Slack, Petrolea, Ont., Fred. Beresford, London, and John MacRae, Petrolea, are on their way to Edmonton, N.W.T., to test an oil well for the Dominion Government. They expect to drill 2,200 feet before they strike oil.

George Wilson, contractor, Kingston, Ont., has bought a large mica mine situated two miles back of Gananoque, Ont. The mine was opened some time ago, and $2,500 spent on it. Samples of the mineral show it to be of a superior quality.

The London and British Columbia Gold Fields Co., Ltd., Rossland, B.C., is developing its property, and recently added to its equipment a 6 x 8 special hoisting engine and 40-h.p. locomotive-type boiler from the Jenckes Machine Co., Sherbrooke, Que.

Prof. Frank D. Adams, professor of geology and paleontiology in McGill University, has declined, out of regard to the wish of the university, the position of Provincial Mineralogist of British Columbia, the position until recently held by Prof. Carlyle.

The Coleraine Mining Company is reorganized, and the new directorate has employed A. Davis, their consulting engineer, to put in a complete new plant for mining at Black Lake, Megantic, Que. The company has orders for the entire output for three years.

The Jenckes Machine Co., Sherbrooke, Que., recently supplied the Sydney mine at North Sydney, Cape Breton, with a special coal hoisting engine, to be operated by compressed air. The compressor was supplied by the Canadian Rand Drill Co., Sherbooke, Que.

Geo. M. Webster & Co., Quebec, coal handlers, are improving their facilities for unloading steamers, and for this purpose have placed an order with the Jenckes Machine Co., Sherbrooke, Que., for four of their double cylinder rapid coal-hoisting engines with boilers.

The Dominion Coal Co. is improving the facilities for unloading from its steamers at Levis, and has purchased for this purpose four *8¼ x 10 double cylinder special coal hoisting engines from the Jenckes* Machine Co., Sherbrooke, Que., with a powerful 100 h.p. locomotive boiler.

The British American Corporation, Rossland, B.C., is pushing the development of its properties, and the Jenckes Machine Co., Sherbrooke, through its Rossland branch, has supplied it with special pumping apparatus for the Nickel Plate, and Columbia and Kootenay mines.

Manganese iron ore is freely imported into the United States from various countries in Europe and South America. Extensive deposits of this ore exist in New Brunswick and Nova Scotia, and it would appear that Canada is losing a profitable trade which is lying right at her doors.

The *Smuggler Gold Mining Co.*, headquarters Toronto, has decided to put a 20-stamp mill on its property at Fairview, B.C., this summer, and an order has been placed with the Jenckes Machine Co., Sherbrooke, Que., for Corliss engine, boiler, 20 stamps, vanners and four miles of aerial tramway.

The Bell Asbestos Co., Thetford Mines, Que., is changing over the system of operating the mine hoist, and for this purpose has placed an order with the Jenckes Machine Co., Sherbrooke, Que., for a 100-h.p steel tubular boiler, and have also purchased from the same company a small locomotive for shifting cars in pits.

The Canadian Copper Co., of Copper Cliff, Ont., is fitting a new shaft, has placed an order with the Jenckes Machine Co., Sherbrooke, for two 100-h.p. special steel boilers, one 12 x 15 double cylinder double drum winding engine, three large steam pumps and rock breaker, and necessary gear for operating them.

The annual meeting of the Newfoundland Oil Company was held recently, the majority of the shareholders being present, and President Thompson occupying the chair. The report of the Secretary-Treasurer which was presented and adopted was of a most satisfactory nature. The officers of last year were re-elected.

Supplementary letters patent have been issued by the Quebec Government granting the Combustible Gas Company an exclusive privilege of working and making use of the combustible gas which exhales in various parts of the province, for the purpose of lighting, heating, and supplying motive power until August 30th, 1901, inclusive.

E. T. Wilkie, C.E., Carleton Place, Ont., and Andrew Bell, C.E., Almonte, Ont., are in charge of the survey now being made for a tramway to connect the iron mines now operated by the Hamilton smelting works, in Darling township, Lanark county, Ontario, with the Kingston and Pembroke Railway at Flower Station. The line may be ultimately an electric railway.

A Rossland, B.C., report states that the recent strike on the Jumbo is a good one. The body of ore was struck in the lower tunnel, and the whole force of the working is said to be in rock assaying $113 to the ton. The tunnel referred to was started in August, 1896, and has now been run in 800 feet in the ledge. It is 200 feet below the ore body discovered two years ago, and gives a "back" of 350 feet.

Vancouver, May 5.—The city council has, subject to the ratifying vote of the taxpayers of Vancouver, agreed to pass a by-law granting to the Van Anda Gold and Copper Mining Company a subsidy of 40 cents a ton on ores smelted by it at a smelter to be built and operated at some point within five miles of the limits of Vancouver, the total subsidy payable to be limited to an aggregate of 125,000 tons, making $50,000 in all.

The Vancouver, B.C., city council has accepted the offer made by the Anglo Continental Public Works Company of London, Eng., and that city is to have a smelter. The proposition in brief was as follows It is stipulated that the city shall give the company a bonus of 50 cents per ton on ore treated, not exceeding 30,000 tons in any one year, in return for which the company shall give the city £50,000 in preference 10 per cent shares

At Belle Island, in Conception Bay, Newfoundland, the Nova Scotia Steel Co. have developed extensive iron deposits. The company is the lessee of four grants of land, each of one square mile, and during the past few years have erected an extensive and costly plant for the mining and handling of the ore. The bulk of the ore has been shipped to New Glasgow, where it is mixed with Nova Scotia iron and produced pig iron The company employs an average of 200 men, and the deposits are estimated to contain some 40,000,000 tons of ore and the assays give from 48 to 56 per cent. of metallic iron.

The directors of the War Eagle Consolidated Gold Mining Company have decided to begin paying monthly dividends of 1½ per cent The first dividend is payable on 1st June The company is capitalized at $2,000,000, in one-dollar shares, of which 350,000 still remain in the treasury. The June dividend upon the 1,650,000 shares in the hands of stockholders will total $24,750. The mine ships to the C.P.R. smelter at Trail 100 tons per day, or 3,000 tons per month. The smelter people buy the ore as it arrives, upon its assay value, the War Eagle netting about $17.50

The Canadian Pacific evidently intends to supplement its network of railways in the Kootenay by a system of smelters. Having bought the Heinze smelter at Trail, B C, the C.P R is now adding to its plant two new blasts, which will bring the daily capacity up to 500 tons It is also stated that the railway company will erect a lead smelter at Trail, the plant to be in operation before the first of next year. This lead stack will adjoin the property acquired from Heinze, and will have a capacity of 150 tons a day, the idea being to treat the Slocan and Ainsworth galena ores in conjunction with the pyrrhotite ores of Rossland camp.

At the annual meeting of the Toronto Smelting Company, Limited, which was held in Canada Life Building, Toronto, recently, James Kendry, M.P., was elected president; J. D Hay, Toronto, vice-president; W. A. Hungerford, Belleville, general manager; F. C. Flannery, secretary-treasurer. The company proposes to establish smelting works at Madoc, if satisfactory arrangements can be made; if not, they will establish works at Duoro or Marmora. The company has already made tests at Millbridge, and the results have been so satisfactory that it has decided to erect a custom and testing smelter. The company intend to pay special attention to arsenic, as the mispickel ores of this region are especially noted for the production of arsenic.

The Ontario Bureau of Mines has received news confirming the reported discovery of placer gold near Sudbury The finds are said to be on the Vermillion River, to the north of Sudbury, probably at the head waters of the river, near the Height of Land, west of Lake Wahnapitae. The Department has received numerous applications for mining location in this district recently, but none has been granted, as this part of the country has been withdrawn from sale on account of its valuable timber, which has not yet been disposed of by the Government. Some prospectors who have come out state that the gravel is abundant, but the pay is not high, and that only on a large scale would the diggings pay to work. Others say that three to five dollars a day can be easily taken out.

The Crow's Nest Pass Coal Company, Fernie, B.C., expects to be able to supply the smelters in Montana, Idaho, Northport, Trail and Nelson, which are at present using the Welsh coke, which costs them from $16 fo $18 per ton. The Crow's Nest Co. hopes that it will be able to furnish better coke to the two Canadian plants for $7 per ton It will, of course, be higher delivered in the United Sates. The Crow's Nest coke is said to contain 95 per cent. fixed carbon and only 4 per cent ash. It is estimated that by this reduction in the price of fuel the smelters will be able to save $1 50 per ton in the cost of treating ore. The present consumption of coke at the smelters which the company hopes to supply is as follows: Northport, 40 tons per day; Trail, 60 tons; Hall Mines, 40 tons; Everet, 60 tons; Tacoma, 40 tons; Great Falls, 150 tons; Helena, 50 tons; Butte and Anaconda, 400 tons. It will at the outset be called upon to furnish 840 tons a day.

A letter from Rossland under date May 11th gives some items of interest respecting what is doing in the Kootenay mining district. Development is active, and the hopes of both prospectors and miners appear to be high. The War Eagle mine proprietors have been negotiating with the General Electric Company about a compressor plant and elevator, and have at last closed a contract for the same. The Boundary Creek country is progressing up well, and a ten-drill compressor plant, with hoisting-engine, heaters and pumps, is under contract from the Cooper Company, of Montreal, to be furnished to the British Columbia Copper Company, of Anaconda. At the Le Ro smelter they are said to be running 250 to 300 tons of ore per day, principally from the Le Roi mine. At the Hall mines smelter, at Nelson, by their published report, the output for twenty days up to 30th April was 218 tons of matte from 4,734 tons of ore, where in 31 days ended 2nd April, they had turned out 357 tons matte from 7,437 tons of ore treated. The new superintendent of the smelter, R. R. Hedley, is proving his ability and has, it appears, done more successful work than either of his predecessors, even although he is a Canadian, born and educated outside of "Europe." The people here, or perhaps I should say some of the people here, did not like what Mr. Hedley said, in 1897, about the character of the Rossland ores, but he is proving to be about right in his estimates of what can and cannot be done with it. Other experts were planning and working on a basis of 60 and 65 per cent. copper matte. But the matte does not pan out anything of the sort In fact the Hall Mines people are at present producing only a 45 per cent copper matte, which is a very different story. It will give you an idea of the extent of the activities in this part of Kootenay, the writer says, if I tell you that, as I learned from the custom authorities, there was raised and shipped through the Nelson custom house 31,920 tons of ore, valued at $3,116,212 during the period from 1st January to 30th April, 1898. The banks are finding that it is worth while to look after business here, and I am told that the Bank of Montreal will very shortly erect a handsome three-story building in Rossland for banking premises and other purposes.

Marine News.

The Yarmouth Steamship Co.'s new steamer "Express" has been fitted up at Liverpool. She will carry 200 passengers and will arrive at Yarmouth early in June

The Bertram Engine Works Co. have secured the contract to build a steel grain-carrying propeller to be used in place of the Rosedale. The new vessel is to be 255 feet long by 43 feet beam.

The Lake Champlain and St. Lawrence Ship Canal Company charter has been granted by the Dominion Government, but it is not to become operative without the consent of the Governor-General-in-Council.

L. Lacouture, Sorel; J. O. Blondin, La Baie des Peres; D. Gillies, M.P.P., Carleton Place, Ont.; J. Gillies and J. Gillies, Breaside, Ont., have been incorporated as the Lac Temiscamingue Navigation Company, Ltd., capital $25,000.

The port of St. John, N.B., did a much larger business during last winter than the one previous. Last winter there were 53 steamers sailed as against 46 the winter before, and there were 3,639,000 bushels of grain trans-shipped as against 1,436,000 bushels in 1896-97.

Capt. Macauley, of the Dominion liner "Canada," has been appointed to the command of the company's new steamer "New England." His successor will be Capt. Maddox, of the "Scotsman." The latter will be commanded by the second officer, Capt Skrimpshire.

The large freighter built at Leigh's shipyard, Victoria, B.C., for Capt. W. Grant, was launched a short time ago The steamer is 107 feet in length with 24 feet beam and 7 feet deep. She will have a speed of eight knots and will enter the freighting business. Spratt & Gray are fitting her with machinery, and Shaw's Iron Works will supply her boiler.

Murray & Munroe, Pembroke, Ont., have completed the new wharf at L'Orignal, Ont.

The Richelieu & Ontario Navigation Company has declared a semi-annual dividend of 3 per cent.

The C.P.R. is arranging for the construction of a $6,000 dock at Kaslo, B.C., similar to the one at Nelson.

The steamers "New York" and "Empire State" will supply a daily service down the St. Lawrence rapids this summer, running from Clayton to Montreal. The Folgers of Kingston are the proprietors of the line.

A. J. Harvey & Co., St. John's, Newfoundland, have bought the steamer "Lucerne" from the Allans, to carry pulp and general freight from Newfoundland to England. Capt. D. Taylor has been appointed to the command.

James Playfair & Company's tug, the "Magnolia," was launched at Midland, May 24th. She is 140 feet long, 21 feet 6 inches beam, and will draw, coaled, fourteen feet of water. She will be used principally for towing and wrecking.

The earth under the River St. siding and the coal docks, Owen Sound, slid into the river recently, allowing both to sink about five feet for a distance of over two hundred feet. Dredging the harbor is supposed to be responsible for the slide.

The Furness line will formally take over the business of the Canada and Newfoundland Steamship Co., which it has bought, on July 1st. The four men who owned these boats were: *David McPherson, W. Barry, P. Pierson, and* S. M. Brookfield.

Two new passenger steamers of the Dominion Line will be on the St. Lawrence route from Montreal this season, viz., the "Dominion," a fine twin screw steel ship of 6,000 tons, equal to the "Canada" in finish, and the "Yorkshire," also new and of similar construction and equipment.

Captain Thomas Howard, the late harbor master of Montreal, who died recently, was well known and much respected in commercial circles in Montreal, where he had been a resident fifty-six years. He was born at Shinrone, Queen's County, Ireland, on Sept. 15th, 1826, and came to Canada in 1842. For a time after his arrival he was in the employ of the late Hon. John Hamilton, and later entered the service of the Richelieu & Ontario Navigation Company. For some years he commanded the "Banshee," "St. Lawrence," "Magnet" and other vessels of the company plying between Montreal, western ports and the Saguenay, and was subsequently appointed manager of the Ontario division of the company. In March, 1881, he was appointed harbor master. He had thus been connected with the business of the port for nearly half a century.

A large deputation from Kingston, Prescott and Deseronto, waited upon the Minister of Marine and Fisheries recently, to request that the department should make an order suspending the regulations for this year, which require American passenger steamers to comply with the same regulations as Canadian passenger steamers. The Canadian inspection requirements are not the same as American, differing particularly with respect to life preservers and the inspection of boilers. It has been the custom in the past to accept the American inspection, but an amendment to the Canadian Act requires conformity to the Canadian regulations. The deputation comprised delegates from Kingston and other towns and was accompanied by the following members of parliament: Messrs. Britton, Charlton, McGregor, Frost, Hurley, Edwards and Snetsinger. The Minister promised to give the request a favorable consideration if possible.

The Manchester Liners, Limited, is formed to acquire and run three steamers between Manchester and Montreal in summer, and St. John, N.B., in winter. These steamers are to cost £90,000 each, are to steam twelve knots an hour, and to have a carrying capacity of 8,500 tons. One is to be ready in August and two in the spring of next year. But two steamers are to be immediately acquired for the work, so that the approaching autumn and winter will now be amply provided for. There is no question of the extent of the traffic available, and we share the confidence of the directors that the new service will have remunerative results. The authorized capital is £1,000,000 in shares of £10. Sir Christopher Furness is chairman of the company, and his experience is security that the company's business will be conducted with intelligence as well as vigor.

The Pembroke Navigation Company has launched the new vessel recently built for them in Toronto by the Polson Company. She is built of iron and is 125 feet in length, with a twenty five foot beam, and is capable of attaining eighteen miles an hour. The cost was $30,000.

The Donnelly Wrecking Company of Kingston have purchased the sidewheel steamer "Columbia," which ran ashore at Sarnia last summer. She will be put on the government dry dock at Kingston. The "Columbia" was formerly worth $10,000.

Mr. O. E. Young, of Magog, is building a small pleasure boat for Mr. L. B. Ward, of Brooklyn, N.Y., to be used on Lake Memphremagog, and an order has been placed with the Jenckes Machine Co., of Sherbrooke, Que., for one of their 7 h.p. Dake marine engines, with boiler to run the same.

The two steamers for the Dominion Atlantic Railway Company, being built on the Humber, England, are the "Prince George," which will reach this country about the middle of June, and the "Prince Arthur," which will come a fortnight later. Both steamers are alike. They are 300 feet long, 38 feet beam, 15 feet draught and 6,500 h.p. They have a speed of 21½ knots on the measured mile and are guaranteed 19½ knots at sea in any weather. Each engine has four sets of cranks instead of the usual three. All the heating will be done by electricity and they will have electric fans.

An announcement of some commercial interest to Canada *is to the effect that the enlargement work on the Erie canal* will have to be suspended for at least two years. Through some miscalculation or mismanagement the nine millions voted for the work has been expended, and the waterway is available for no larger craft than have navigated it for years past. It will take two years, under the law, it seems, to obtain authorization for a further loan, and some time more to complete the enlargement operations. Meantime, if the present programme is carried out, next season will see the enlarged St. Lawrence canals available, and Canada will have at least a year's start of New York in the use of the improved waterways.

The Polson Iron Works, Toronto, have just shipped a steamer, which will be the first to reach the Yukon, intact from this port. The boat started from here to Vancouver on two C.P.R. flat cars, whence it will be forwarded on an ocean steamer to the Yukon—an exploration boat, built for either day or night service, and to accommodate four mining engineers and crew. She is called the "Burpee," after her purchaser, and is, length on water-line 45 feet, over all 53 feet, beam 9 feet, draught of water 10 inches. She was designed by W. E. Redway, is built with a steel frame and wood planking, with boiler and engine aboard ready for immediate service on reaching her destination. Her speed will be about 10 to 12 miles; cost, $6,000.

Railway Matters.

The C.P.R. will build a new station at Almonte, Ont., this year, it is expected.

The management of the G.T.R has decided to construct 250 refrigerator cars for the general service of the system.

There are at present 200 men at work in the Perth, Ont., car shops of the C.P.R., and work is continued each night up till midnight.

Dutton, Ont., has defeated the by-law granting a bonus to the L.E. & D.R.R. in aid of the extension from Ridgetown to St. Thomas.

The bill of the Ottawa, Montreal and James Bay Railway Co., was passed by the Dominion Government recently. The intention is to build north from Labelle, about 100 miles north of Montreal, and to continue to the shores of Rupert's Bay, a distance of 375 miles.

It is stated that Louis Coste, chief engineer of the Dominion Public Works Department, has pronounced against the Mackenzie-Mann Teslin Lake Railway scheme, and that it was on account of this hostile report of the government's own engineer that Sir Wilfrid Laurier telegraphed to British Columbia that the ministry could not support the scheme.

The Ottawa and New York Railway Co. has offered to build its workshops in Ottawa if it is given a bonus of $100,000.

The case of Hannaford v. Grand Trunk is postponed for some time, because it has been decided to appoint a commission rogatoire to take the evidence of Sir Charles Rivers-Wilson and Messrs. L. J. Sargeant and Linley, the commission being returnable on June 18th. Charles Russell, son of the Lord Chief Justice, will act as the commissioner.

The city of Montreal has offered a free site for an office building for the G.T.R., and the Grand Trunk has accepted the gift. This finally disposes of Toronto's fancied prospect of securing the office. The terms upon which the site will be given, are as follows: That the company be offered part of the McGill street property, owned by the city, as follows: 198½ feet on McGill street, and 135 feet on St. Paul and William streets, respectively; the building to cost not less than $250,000, the assessment to be levied on that amount only for a period of twenty years, this latter arrangement to be submitted to the legislature for ratification. The plans of the proposed building to be submitted to the city for approval.

Sixteen "Mogul" engines have been purchased by the C.A. & O.A. & P.S. Railways for the freight business. The engines are much larger than the ordinary passenger locomotives. Compared with the new engines the old ones look quite small. Ten of these new engines are of the ten-wheel "Mogul" type and each weighs 156,000 pounds without the tenders. They have three couple-wheel drivers and are equipped with compound cylinders. The other six engines are of what is known as the consolidated type of "Mogul." They are equipped with four couple-wheel drivers, and have compound cylinders. They weigh 173,000 pounds exclusive of tenders. The engines will be used exclusively for freight.

It would seem that the C.P.R. has definitely decided to push forward a line from Toronto to Sudbury at once. Two corps of surveyors are already at work in charge of H. D. Lumsden, who surveyed the Crow's Nest Pass road. One party will spend the entire summer in the Nipissing district, and another party will start out from Coldwater and survey southward through Barrie to the Orangeville branch of the G.T.R. at Kleinburg or Bolton. The new line will take the shortest cut between Parry Sound and Sudbury, and will extend inland so as to open up the Nipissing and Parry Sound districts. From Parry Sound the road will extend southwards to the west of Muskoka lakes, and across the Muskoka river at Bala, thence to Muskoka wharf and south-west across the Severn river to tap the Midland branch of the G.T.R. at Coldwater. The new line will save 55 miles haulage between Toronto and Winnipeg, and will be completed in about two years.

The British Columbia Government has passed a railway aid bill, which provides $4,000 per mile for the following railways: From Penticton to Boundary Creek, 100 miles; from Robson to Boundary Creek, 80 miles; from the Pacific coast to Penticton, 230 miles; from Bute Inlet to Quesnell, 230 miles; from Teslin Lake to a British Columbia seaport, not exceeding 400 miles. The act provides for the commencement of the Penticton-Boundary and Robson Boundary lines on or before the 8th of August, 1898, and on the coast to Penticton and Bute Inlet to Quesnelle on or before the 8th day of May, 1898, work to commence on the Yukon line on or before the 8th day of June, 1898. The bill further stipulates in the case of the line from Robson to Boundary being built by a company entitled to a land grant, that such company shall relinquish its claim to the land grant for such portion of its line on accepting cash subsidy. It was expected that McKenzie & Mann would build this line but they have notified the British Columbia Government that they cannot carry out the work.

Bystander, in the St John's, Que., News, commenting on the Hannaford v. G T R. case, and contrasting the old regime of that railway with the new, says: "Mr. Hays is down at his work at nine o'clock in the morning. He generally walks to the Point, but, if in a great hurry, he will permit himself the luxury of a street car. This may seem a trifle in a man who can think as clearly at ten as at nine o'clock, but it has worked a revolution in the Grand Trunk system. Punctuality is understood for the first time in the history of the company. Duty means enthusiastic and earnest and unflagging work. Nepotism has been taken by the shoulders and bundled out of the thought of the new management. The sole test is merit. The humblest person has as much chance of preferment as the nephew of the president. Mr. Hays is a direct, simple, democratic personality, and every officer under him is accessible to the public at all times. The new manager would be vastly surprised to see one of his officials coming down to his office in his carriage at eleven o'clock in the day, as was the case under the old regime.

Electric Flashes.

Belleville, Ont., Street Railway is to be extended to a park on the lake shore.

Free power is obtained from the Canada Coal and Railway Company to run the electric light plant at Joggins, N.S.

Bonuses are being sought for the proposed electric road from London, through Stratford, Arkona and Thedford, connecting the Canadian Pacific with the Grand Trunk.

S. H. Kent, secretary of the Hamilton, Ont., Committee on Municipal Lighting, is carrying on an extensive correspondence in pursuit of information regarding civic electric lighting in other municipalities.

Simeon H White, Andrew L. Price, C Geo Armstrong, Walter J. Mills and Hamilton B. Price, Sussex, N.B., have applied for a New Brunswick charter as The Little Salmon River Telephone Company, Limited, capital $1,500.

The by-law authorizing the agreement with the Montreal Street Railway Company was voted on at Verdun recently, when eighty-three proprietors voted in an approval of an immediate street railway service, and only six voted contrary. The by-law was therefore affirmed.

At the annual meeting of the Quebec Electric Street Railway Company, Andrew Thomson was elected president; E. W. Methot, vice-president; and W. Shaw, Jno. Breakey, Judge Chauveau, E. E. Webb and Harold Kennedy, directors for the current year.

A company from Bellechasse has asked for Quebec letters patent under the name of the Ste. Philomene Telephone Company. It will place telephones in the counties of Bellechasse, Montmagny and Dorchester, with headquarters at St. Raphael, and a capital of $1,500.

The Toronto City Council is engaged in a dispute with the Electric Light Company, the result of an effort on the city's part to compel the company to light the Island, which is within the city limit, at the city rate of 20¼ cents per lamp per night.

The contract for covering the pipes and boilers in the power house of the St. John Railway Co., St. John, N.B., has been completed by the Eureka Mineral Wool and Asbestos Co., Toronto. This company has had several large covering contracts of late, not a few of which were repeat orders.

The Niagara Falls, Ont., Electric Light Company has purchased machinery from the Westinghouse Company, to provide electricity for heating and power purposes, in addition to the present lighting system. The changes that will be made at their power house, and wiring of streets, etc., will involve an expenditure of about $10,000. They will be able to supply from one to seventy-five horse-power 24 hour service.

The plant of the Acetylene Light, Heat and Power Company, known as the Carbide works, at Niagara Falls, N.Y., was sold under chattel mortgage proceedings a short time ago. The action was brought by the Electro Gas Company, of New York, who held the mortgages, and the plant, machinery and power rights were bought by them for about $85,000. The Electro Gas Company will continue the business.

The Kingston Street Railway has about completed a branch line to the outer G.T.R. station on Montreal Street, going by way of Bagot and Montreal streets. It will be in operation early this month. The line will be in competition with the Grand Trunk Railway, which has reduced fares to five cents per trip. It is expected that much of Princess Street will be double-tracked and a belt line made on the northerly side of the city by way of Division, Pine and Montreal streets.

A dynamo and a number of lamps have been supplied by the Royal Electric Company to the Soulanges Canal.

Wood Bros., Brantford, Ont., have recently bought from the Royal Electric Company a 70 h.p. synchronous motor.

The Montmorency Power Company, Quebec, has bought a 600 K.W. "S.K.C." generator from the Royal Electric Company.

C. E. Campbell, Weymouth, N.S., has been supplied with a direct-connected lighting plant by the Royal Electric Company.

A 300 K.W. "S.K.C." synchronous motor has been bought from the Royal Electric Company by the Golden Cache Mining Co., B.C.

The contract for building the Canadian branch of the Carborundum Works, Niagara Falls, Ont., has been secured by James Harrison. The structure will be frame 30 x 60 feet.

The B. C. Bullion Extracting Co. has made a contract with the Canadian General Electric Co. to supply a 100 horse-power synchronising motor, and a 50 horse-power induction motor for their works, which are about a mile and a half from Rossland, B.C.

John Forman, importer of electrical supplies, 644 Craig street, Montreal, has recently issued catalogue "B," which contains a great deal of useful information for all users of electrical apparatus of any kind. Edison lamp, Ericsson telephones, Anchor switches, and a great many other standard appliances, as well as numerous novelties, are always carried in stock.

J. R. Scott, an enterprising citizen of Napanee, has closed a contract with the Canadian General Electric Co. for a 100 K.W., 4,000-volt three-phase generator of the revolving field type, for the purpose of supplying light and power to Napanee from a water-power eight miles distant. He will also supply light and power to intermediate points such as Napanee Mills, Camden East, and Newburgh.

A meeting was held at the Halifax Hotel, Halifax, N.S., April 12th, 1898, at 3 p.m., for the purpose of organizing an association of all those interested in the electrical industries in the Maritime Provinces. The following gentlemen were present: John Starr, C. E. Harris, Jas. Waddell, N. L. Ross, J. H. Winfield, L. A. Somers, J. D. Briggs, P. Mosher, A. Miller, John Griffin, J. A. Anderson, P. R. Colpitt, F. A. Bowman, E. T. Freeman, I. H. Smith.

The West Kootenay Power and Light Co. is rapidly completing its power plant at Bennington Falls. The poles are set and two wires are stretched between the falls and Rossland, a distance of 31 miles. The line goes into Rossland over the Monte Cristo Mountain, and it is the intention of the company to stretch another wire so that in case of accident there will be no interruption of the current. The first cost of the plant is placed at $125.000, but it is said that the expenditure upon it may be extended to half a million.

A Dominion charter has been granted to the North Shore Electric Railway Company, the applicants being: Wm. Owens, Westmount; V. W. Larue, Quebec; Wm. Strachan, R. Prefontaine, Thos. Gauthier, and Albert J. Corriveau, Montreal. Mr. Corriveau says that it is intended to use power generator at the Shawenegan Falls. The railway is to start at Three Rivers, and general powers are given for the counties on the north shore of the St. Lawrence. Privileges are conferred similar to those granted to Montreal and Southern Counties Railway Company.

E. A. C. Pew's project to produce water power by the construction of a channel from the river Welland, east of Wellandport, to the river Jordan, although remaining in abeyance for some time past is coming to the front again. The works will be gone on with if satisfactory contracts can be made for disposing of the power when generated. Wm. Pearson, C.E., Oswego, has, it is said, pronounced the scheme a feasible, safe and practical one, pointing out that the great source of expenditure in connection with the development of power at Niagara Falls—the construction of wheel pits and tail race—will not be necessary in this project. The principal expense will be the excavation.

Barrie, Ont., is advertising for tenders on an electrical installation to consist of a street lighting plant of 65 arc lamps of 2,000 candle power, an alternating current plant to supply 2,500 incandescent lamps for private lighting, and a direct current 500-volt power plant to furnish cheap electrical motive power to manufacturing establishments. An up-to-date electrical fire alarm system will also be installed. The estimated cost of the entire equipment is placed at $35,000, and as quality of machinery and apparatus will be made a first consideration before prices, the town will, no doubt, obtain a very complete and high-class installation. Tenders will be opened on June 6th next, but the awards will not be made before the ratepayers have voted the necessary moneys. Roderick J. Parke, of Montreal, is the consulting engineer for Barrie.

The C.P.R. copper telegraph line, from Montreal to Vancouver, is now building. The line passes via Vaudreuil and the Short Line to Ottawa, and thence by the main line to the coast. It will be strung under the general superintendency of W. J. Camp, the C.P.R. electrician, in three divisions. The first one will reach from Montreal to Fort William, and will be conducted by Jos. Townsley, with about 100 men, working simultaneously in four gangs. The next division will reach from Fort William to Donald, B.C., and will be under B. S. Jenkins, Supt. of Telegraph, Winnipeg, with three gangs of men. The final division will reach from Donald to the coast, and will be under the charge of J. Wilson, Supt. Telegraph. A great deal of trouble has been experienced by telegraphic companies, through wires coming in contact with each other, through the breaking of the glass insulators by which the wires are attached to the poles. A test was therefore made at McGill University with a view to ascertaining the comparative resistancy of glass and porcelain insulators, with the result that it was found that porcelain resisted much heavier, and a greater number of blows, than the glass. Tests were also made with a thirty-two calibre revolver from a distance of eight feet. The glass flew to pieces at nearly every shot, while the porcelain frequently showed no mark, save the lead from the bullet, and when they did break it was in such a way that, had they been attached to the pole, the wires would not have been affected. The testing of the wire is also going on at the Applied Science Department of McGill, under the care of Mr. Drinkwater. Each day he selects at random a sample of wire from each lot of ten bundles being turned out by the Dominion Wire Mfg. Co., and subjects them to tests in order to insure that they *come up to the requirements of the contract. The wire must* be .137 of an inch in diameter; one one-thousandth of an inch only of a variation being allowed above or below this gauge. It must be perfectly cylindrical and weigh 300 pounds to the mile; four pounds of a variation being allowed in this distance. Frequent electrical tests are made upon pieces one one-hundredth of a mile in length, to determine the purity of copper used, which must be 97 per cent. Each bundle weighs 170 pounds, and the wire must be in one continuous length, without joint or break. Each six inches of wire must be capable of being twisted thirty times at a uniform speed of one twist a second. The tests show that it will stand forty to fifty twists before breaking. It must stand six close turns around another wire of equal diameter and be unwound without breaking. It must also stand an average breaking strata of 975 pounds, and before breaking it must have stretched at least one per cent. When completed there will be a length of about 2,900 miles of wire.

Personal.

H. M. Bolger, secretary of the Richelieu and Ontario Navigation Co., Montreal, was married a short time ago to Miss Mills, of Quebec.

P. Kennedy, employed in the C.P.R. car shops, Perth, Ont., had his head crushed between two cars, and was instantly killed, May 13th.

R. G. McConnell, of the Dominion Geological Survey, and J. B. Tyrell have left for the Yukon, and will spend the entire season in that district.

H. C. Landon, C.E., Cornwall, Ont., has removed to Austen, Pa., where he will have charge of a section of the Buffalo and Susquehana Railroad.

Frederic Nicholls, managing director of the Canadian General Electric Co., sailed on the "Campana" recently for a visit to England and the continent.

Alexander Milloy, after fifty years of service in the Richelieu and Ontario Navigation Company, acting as traffic manager, has retired G A. Browne will be his successor

Wallace Bell, the well known well sinker, Montreal, has gone to Newfoundland, where he has been asked to help in developing the newly discovered oil regions in the island.

D J. McDonald, British Columbia inspector of mines, has resigned his position to enter the service of the British America Corporation, under W A. Carlyle, late provincial mineralogist

Wm. Bunney, who has been for the past six years in the employ of the Wm Cane & Sons Mfg. Co, Newmarket, Ont., as foreman, has taken a situation with W. C. Edwards & Co., Ottawa.

Samuel Lyons, head engineer of the Stewiacke, N.S., foundry, was instantly killed a short time ago He was working at the emery wheel, when it suddenly broke, a portion of it striking him violently over the heart.

O. H. Sheppard has accepted the position of cashier of the Toronto Ferry Company, made vacant by the resignation of Walter Garwood, who has been appointed to a more lucrative position with the Queen City Oil Company, Toronto

Mr D A. Starr, president and manager of the Cornwall Electric Street Railway Co., was waited upon by a deputation of the employees and presented with a handsome gold headed cane, with many good wishes, on the occasion of his birthday a short time ago.

News reached Montreal last month from Liverpool, of the drowning of a well known Canadian Pacific official, T. F B. Evans, who was agent at Liverpool for the company for the past ten years. Mr. Evans while boating off Bangor, Wales, where he was enjoying a short holiday, fell out of his boat and was drowned.

W. J. Carroll, St. Catharines, Ont., who has been engaged in engineering work upon the Crow's Nest Pass Railway since last September, has received an appointment as chief engineer of the Sindicate Industriel de Sud America, a company formed to build a railroad from Quito to Pailon, on the west coast of South America. The district about Pailon is famous for its rich gold deposits. The company receives from the Government a concession of about seventeen million acres of land.

W. Robert, cashier of the Richelieu and Ontario Navigation Company, received a handsome present and illuminated address a short time ago The presentation was made by C F Gildersleeve, the general manager, representing the staff of officials, and the occasion was the severance of the connections between Mr. Robert and the company. Mr. Robert will shortly leave for Quebec, to fill the position of paying teller in the new branch of the Hochelaga Bank, about to be opened in that city.

Robert N. Stevens, mechanical superintendent of the I.C.R. at Truro, N S., died at his home there May 18th He was about 64 years of age, and was well and favorably known both in New Brunswick and Nova Scotia. He has been identified with the I.C R. ever since it was opened and was engineer of the first train over the road, going as far as Coldbrook. He rose in the service, and was for years mechanical superintendent at Moncton. During the past three or four years he has been mechanical superintendent at Truro.

Milton L. Hersey, the well-known chemical expert and assayer, on whom the degree of Master of Applied Science has been conferred by McGill University, is the youngest son of Randolf Hersey, Montreal. His primary education was by private tuition, and he soon entered the Royal Arthur School, from which he was promoted in 1881 to the Montreal High School. From the latter he graduated in 1885, entering the Department of Applied Science of McGill University the same year. Mr Hersey graduated from McGill nine years ago as Bachelor of Applied Science and has since then held some very important positions, during a portion of the time being connected with the teaching staff of the University He spent most of the years 1889 and 1890 studying and traveling in Europe and the United States, and on his return to Canada in 1891, he was appointed chemist of the Canadian Pacific Railway From this position he resigned in 1896 to take up the general commercial chemistry and assaying, but still remains the consulting chemist of the Canadian Pacific Railway.

F. C. ARMSTRONG.

The Canadian General Electric Company is about to lose an important member of its agency staff in the person of F C. Armstrong, who has resigned his position of general agent for that company to take up similar work with Dick, Kerr & Co., Limited, London, Eng., well known as a large engineering and contracting firm throughout Europe and the British Empire Mr Armstrong is a Canadian by birth He commenced his education at Peterboro, Ont., with Dr. Tassie, and afterwards graduated from Toronto University. After leaving the university, in 1889, he engaged in electrical work and spent three years of those pioneer days as an electrical and engineering contractor. Since 1892 he has been in the employ of the Canadian General Electric Company, as chief of the agency staff, and during this time not only has he become favorably known to the public, but has obtained a broad technical and commercial knowledge, which no doubt will be of immense benefit to him in his new and larger sphere Mr Armstrong has prepared at different times several papers for the meeting of the Electrical Association, and has also materially added to its success by his efforts as a member of the Executive Committee While Mr Armstrong's departure is to be regretted as being a loss to the country, yet he must be congratulated on the recognition of his marked ability and promotion to the important position which he will hold with Dick, Kerr & Co.

ELECTRICAL POWER TRANSMISSIONS.*

BY R. A. ROSS, E.E., M. CAN. SOC. C.E.

The subject of electric power transmissions over long distances has for the last few years been the field in which the most prominent electrical engineers have found a scope for their energies, and the advance in consequence has been most marked So much so that, while four years ago there was not a power scheme of any magnitude, at the present they are numbered by the score, and are of such size as to utilize an immense amount of power formerly unavailable. A noteworthy point in modern plants is the similarity of the methods in use, especially in America, which is always more given to standardization than are European countries. The several types of alternating transmission have practically crystallized into two standard forms remarkably alike in detail and equally applicable to most cases The controversies over the relative merits of direct and alternating current for transmission purposes have been settled, and the latter having come out victorious is now carrying the war into the hitherto undisputed territory of the former, namely, the application to general motor purposes, and the results are not doubtful. With the application of alternating current motors to traction purposes, which appears to be not far distant, the last territory held exclusively by the direct current will have been invaded. The reason for this state of things is not far to seek, as the alternating system which formerly was applicable only to incandescent light, has recently made such strides as to prove itself more generally useful for all purposes of transmission and for most cases of distribution than the other. This triumph of the alternating is due to the fact that with extremely simple and durable apparatus, the power is so readily transformed into that form which meets the requirements of most cases.

The efficiency and durability of the newer types of apparatus are such as to leave but scant room for improvement, and it appears probable that unless some fundamental discovery is made, which will render present types entirely obsolete, these forms will persist for some time to come. Accompanying this standardization of apparatus has come a remarkable decrease in first cost and maintenance charges affecting the interest and depreciation accounts correspondingly, and resulting in decreased cost of power to the consumer. In consequence we may expect to see the field of steam generation for many purposes invaded by the simpler, cheaper and more cleanly electric power. If we may judge by present indications, the next phase of the problem to be attacked will be the adaptation for railway purposes of power for large water falls This only awaits the development of a satisfactory motor for alternating traction purposes, and, from the reports of several recent installations in Europe and the statements of prominent traction engineers in this country, the day of the alternating railway motor for use on the longer railways is not far distant.

To illustrate the methods adopted in transmission work, a few of the larger plants in operation or building are given below.

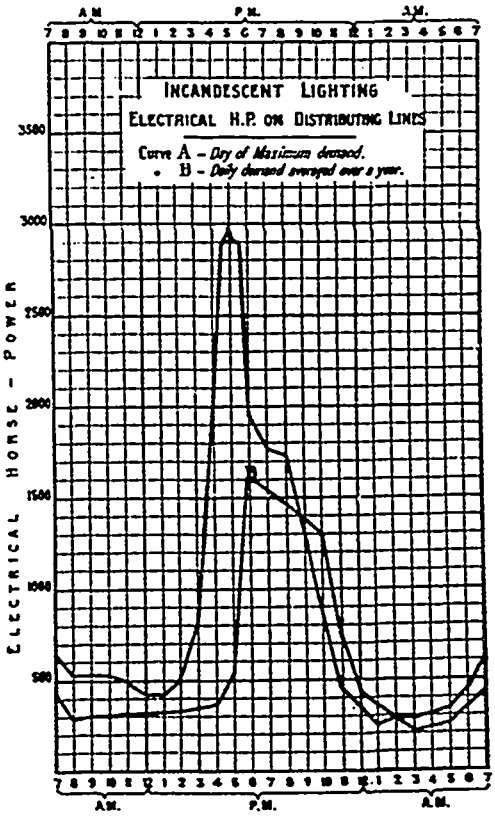
	System	Distance.	Voltage	Horse-power.
Brescia,	Direct cur.	12	15,000	700
Pomona,	Single phase.	29	10,000	800
Fresno,	Three phase	35	11,000	1,400

*From a paper read before the Canadian Society of Civil Engineers.

Lauffen,	Three phase.	100	20,000	300	Experimental
Portland	" "	12	6,000	5,000	
Ogden,	" "	38	16,000	3,000	
Three Rivers.	Two phase.	17	12,000	600	
Kootenay,	Three phase.		20,000	2,000	Building.
Hamilton.	Two phase.	38	20,000	3,000	"
Lachine,	Three phase.	5	4,400	20,000	
Chambly,	Two phase.	16	12,500	20,000	Building.

With one exception these are all alternating plants, and it will be noticed that Canada is well to the fore, as might be expected from the almost unlimited powers available. Montreal stands at the head of the world so far as transmitted power is concerned, and it appears probable that the two magnificent schemes at present under construction will find an ample market in the city and vicinity. Montreal's demands, covering as they do the whole field of consumption of power for street railway, incandescent and arc lighting, and motor power, offer a good example for illustrative purposes, and it has been deemed advisable to give point to the discussion to follow by reference to the demands existing in that city at the present time, without reference to future necessities, as these will no doubt be much of the same kind.

With this end in view, the following curves have been drawn, showing the demands for all classes of power at the present time for twenty-four hours.



The higher curve in each case shows the maximum demand during the year, and the lower the average load at each hour of the day for the year. From these demands the transmission scheme will be figured, but necessarily in a general way for illustrative purposes. The problem consists in laying down the power in the city to suit the demands in the most complete way as regards economy, efficiency and suitability. As these demands affect the transmission by their nature, as well as by their amount, they must be considered briefly before taking up the transmission proper.

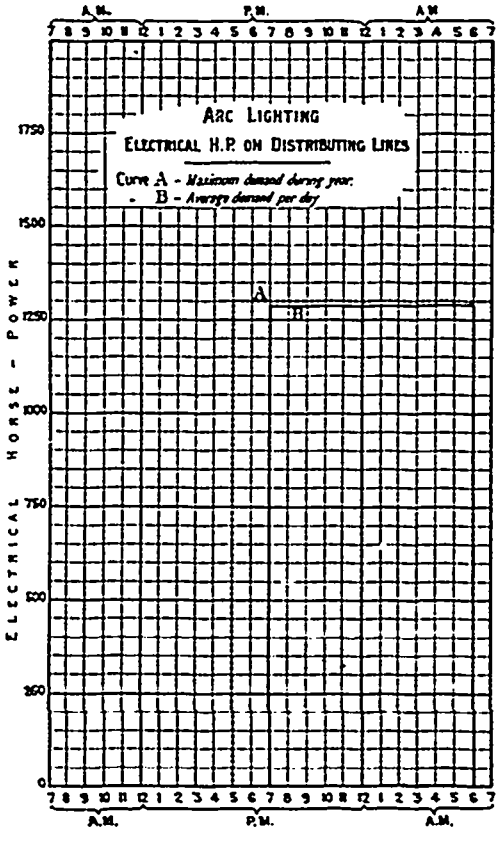
Incandescent Lighting.—The demand curves shown have been figured from the actual curves of one of the present stations in the city, with an allowance for the loads of the other operating companies; in all to cover 100,000 lights wired up. To meet this demand it will be readily granted that direct current is unsuitable, owing to the distances to be covered, and alternating currents of single, two or three phase are the only alternative, any of these being readily obtained from the transmission voltage by means of static transformers to feed the distribution at a voltage of say 2,000, which is considered safe for city work. This potential will of course be again reduced before entering customers' premises, thus involving two sets of transformers. This system will also cover interior lighting by alternating arc lamps, and perhaps a few small alternating motors.

The demand curves for the arc lighting have been figured on the supposition that there are 2,000 arc lamps on series circuits in the city, lighted from dusk to dawn, the curves in this case being elevated into straight lines. For this service several plans present themselves as below.

(1.) By rectifying the alternating transmission currents into direct through the agency of rectifiers, which are simply revolving commutators driven by small synchronous motors from the transmission line, and using this current in the present series arc lamp. This system has been in use for a short time in several European stations, with varying results. It appears to have a great future before it when it has come through the present doubtful stage.

(2.) By means of alternating arc lamps fed from the incandescent circuits. This system, while perfectly applicable for interior lighting, where each unit is treated as an incandescent lamp and ed on or off at will, is not so suitable for street lighting, as it does not lend itself to ready control from the station. Further, as the light distribution of alternating current lamps is inferior per watt of consumption to that of direct, it becomes more expensive in operation.

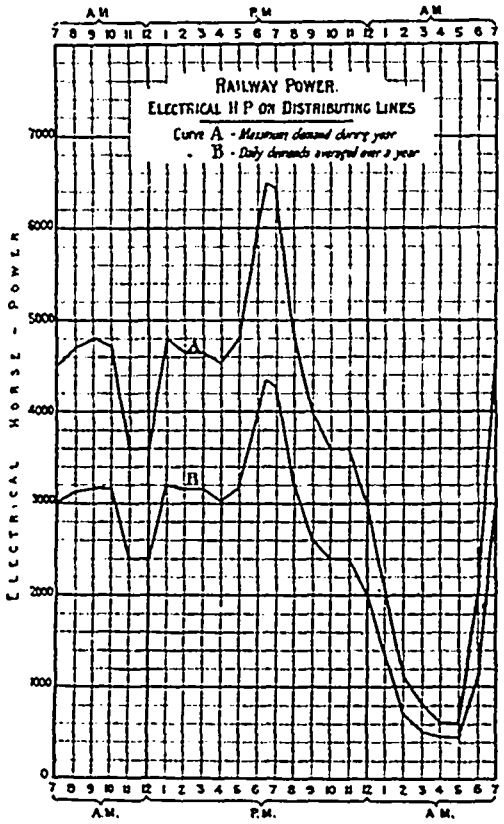
(3.) The series arc system as at present used, with motors instead of engines to drive the dynamos, while necessitating more apparatus than either of the others, is more simple and controllable in operation, and will be accepted for illustration. The number of units necessary to cover the 2,000 lights will be 16 if of 125 lights each, which is about as high as is available per machine. If these were coupled in pairs to 200 H. P. motors, the units would be eight, and the addition of a spare would make a total of nine, which would be ample for present demands.



Either alternating or direct current motors are suitable for general work, but, where variable speeds are necessary as for elevator purposes, the direct is at the present time the only one available. The cost of the former is also higher at the present time. The advantages of the alternating motor distribution are, less cost of circuits, greater simplicity of apparatus, and the ability of reaching outlying demands at small cost, and that it involves no special apparatus in the distributing station other than the necessary lowering transformers. As the objections to

the alternating (on the score of price and unsuitability where speed regulation is required) appear to be within reach of correction in the near future, that method will be adopted for this case. The demand curves are based upon the actual load curves of one of the present stations, with allowance for the other operating companies' loads. In all it represents about 1,100 H P. of motors installed, to be driven from a two or three phase motor circuit, fed directly through reducing transformers from the transmission line, at a voltage of say 2,000, and again reduced by individual transformers at the motors.

The curves shown in the accompanying figure are the actual records for the past year for the railway company's plant. As at the present time only direct current motors are applicable to this purpose, means must be adopted for transforming the alternating to direct current for the trolley circuit. This is easily



accomplished by means of rotary transformers with small loss. These rotaries are practically direct current generators, with collector rings through which the alternating current flows to the windings driving the machine as a motor, while from the commutator connected to the same windings the direct current, which has been commutated from the alternating, flows to the trolley line.

(Continued in next issue)

—The Jas. Robertson Mfg. Co. has issued a very finely illustrated catalogue of the various bath-room, closet and sink fittings which this firm places on the market. The company also manufactures lead pipe, saws, plumbing goods, brass plumbing goods, fence wire, solder wire, triangular bar solder, paint and varnishes, putty, shot and bullets. The nickel plating plant operated by the firm is on a large scale.

—In the course of a recent address upon building stones by Prof. Julien, of Columbia College, New York, before the Mineralogica Section of the Franklin Institute, some interesting facts were brought out. Professor Julien is an authority on building stones, and an expert in the preparation of thin sections of rocks—sections so thin that they are transparent, and their structure can thus be readily seen under the microscope On this occasion the thin sections were placed in an electric projecting microscope, and the enormously magnified images were thrown upon a screen. The light was polarized by interposing suitable prisms, and under these circumstances each particle composing the stone revealed itself by its shape and color. The mechanical structure, porosity, density, etc., of each variety of stone were shown, revealing the way in which aggregations of rock particles are sometimes loosely held together without orderly arrangement and with spaces between, sometimes dovetailed into each other, and sometimes cemented together into a homogeneous mass. In some of the sections, which were as thin as a sheet of tissue paper, bubbles of liquefied carbonic acid gas were observed in the cavities of the small crystals. This liquid is held in the stone under pressure, and not infrequently the heat of the electric light, or even of the hand, is sufficient to explode it, shattering the specimens. It was easy to perceive from these illustrations why some building stones will stand great compressive strains and may yet be unsuitable for buildings in these latitudes, while other stones, much weaker inherently, may possess greatly superior weathering qualities. The statement was made that no "weathering tests" of building stones worthy of the name have yet been made. It seems very necessary that this should be done.