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The Canadian Engineer.

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METRIC MEASURES AND WEIGHTS.

It is well to hear both sides of a question of such great consequence as a change from the English to the metric system of weights and measures. The change would certainly involve great expense throughout the English-speaking world, especially in the engineering trades, and it is not likely to be undertaken unless manufacturers and merchants feel sure that the present cost will have its compensations in the future. On the last point British manufacturers and merchants appear to have made up their minds, considering the consistent advocacy of the metric system by nearly all the Chambers of Commerce and scientific institutions and expressed opinions of a majority of the members of the House of Commons, and, more noteworthy, by the action of that conservative legislative body, the House of Lords, which has passed the second reading of a bill to make the metric system compulsory in Great Britain in 1906. A bill is also before the United States Congress to make the metric system compulsory in that country in 1907, but it will not pass if the authors of a new book, called "The Metric Fallacy," represent the general opinion of our neighbors. The book is the joint work of Frederick A. Halsey and Samuel S. Dale. Mr. Halsey is an editorial writer on our ably edited contemporary, The American Machinist, a journal whose conductors advocate the metric system as strongly as Mr. Halsey opposes it. Mr. Dale is editor of The Textile World-Record, of Boston, and deals with the metric system as applied to textile manufacturing. The authors must have credit for arraying against the metric system nearly all that can be brought forward. The chief purpose of the book is to show that, while the metric system has been officially adopted in so many countries during the last hundred years, it has not completely displaced the local measures and those pertaining to particular trades, and that, therefore, it has been a failure and a fallacy. This is not a logical deduction. We must admit that the authors have proved clearly the persistence of local weights and measures in certain districts and in certain trades in metric countries; but this only shows the persistence of local customs and the extreme conservatism of artisans in particular trades, where the old guild idea still prevails, in the midst of changes that have affected the general trade and manufacturing interests of the country. It only shows that many people prefer to go on in the ruts their fathers made for them rather than take the trouble to learn a new way. Let us apply Messrs. Halsey and Dale's reasoning to other questions—Christianity, for instance. The Christian life was first fully explained and exemplified by Jesus Christ 1900 years ago. His doctrines have been nominally accepted by peoples speaking over 400 different languages and dialects; and advocates of Christianity claim that these principles form the best rule of life for all those people, and that such principles will be ultimately accepted by the whole world as the ideal system of social and political government. But as a matter of fact we find that after nineteen centuries the doctrines of Christianity have been rejected by thousands of individuals in each one of the so-called Christian countries, and that whole communities have continued from generation to generation in undisguised disregard of the fundamental laws of Christianity; therefore Christianity is a failure and a fallacy.

This appears to be the line of argument brought against the metric system; but, as we are sure that the authors of the "Metric Fallacy" would not make such sweeping deductions against Christianity because a majority of the citizens of Christian countries do not apply those doctrines to their own lives, so we are sure the average reader will not condemn the metric system just because certain trades stick to their local customs and do not appreciate the advantages of the newer system. Although the metric system was proclaimed in 1793, it was not till 1840 that it was made compulsory in France; and even now, after more than 100 years there are industries such as those of silk manufacturing in which old terms are still used in the factories. When we remember that this is the case in the land which originated the metric system, we need not be surprised to learn that local customs still persist in Germany, Turkey and other countries whose Governments have adopted metric measures. The value of Messrs. Halsey and Dale's book is that the facts they bring out will warn us against being over-sanguine of revolutionizing in a single generation all the trade rules and customs of the Anglo-Saxon world by the official adoption of the metric system. But this need not deter us from working for a change which will simplify in an immense degree the commerce of the whole world, and enable all nations to come together and understand each other, in some respects at least. The reasons we have faith in the metric system are, among others, that since it was adopted in France it has so commended itself to other nations that forty-four of them have, of their own accord, adopted it, and that as time goes on it is being used by a greater number of the people of those countries, to the gradual disuse of the local measures referred to; that it is already all but universal in the scientific world and in some special industries, such as the chemical industry, and that educationists as a body commend it for its greater simplicity and for the time that would be saved if it were universally adopted. As we have before said, the reason why the English-speaking people have not adopted the system before now is that heretofore they have held such a predominance in manufacturing, especially in the textile and engineering trades, that their measures have not only been understood by almost all the world, but have governed the system of measures even in metric countries. But the Anglo-Saxon peoples no longer hold a monopoly of manufacturing, and this fact is becoming thoroughly appreciated in Great Britain if not in the United States. It will be appreciated in the latter country as soon as its foreign trade reaches nearly the proportions of that of Great Britain.

TELEPHONES IN RAILWAY STATIONS.

The decision of the Board of Railway Commissioners in regard to the applications of the municipalities of Fort William and Port Arthur for permission to connect their telephone systems with the C.P.R. depots in the towns named is one which interests all other cities and towns which may in the future adopt either municipal or independent telephone systems. It is true that the permission asked is conceded, but the decision of Chairman Blair that compensation must be paid by the applicants renders the concession valueless. The claims set forward by the "Bell" that the voiding of this clause in their agreement with the C.P.R. would involve a loss of $100,000 is too absurd to be seriously considered for one moment. But admitting that such a loss was involved, in the opinion of able lawyers the agreement under which it is claimed is one which comes under the heading of restraint of trade; and furthermore, the clause inserted in the Railway Act last session was intended to give competitive telephone systems connection with railway stations, without compensation, this view being confirmed by all the members of the Railway Commission, the chairman excepted.

If it be true, as asserted by a correspondent in the Toronto World, that the stock of the New Brunswick Telephone Co. is practically in two blocks, one being held by the Bell Telephone Co. and the other by the chairman of the Railway Commission, that gentleman's decision in opposition to the view of the other members of the Commission should not be allowed to interfere with the carrying out of the obvious intention of Parliament in inserting the clause referred to in the Railway Act.

The companies are apparently desirous of compromising the present case by granting the facilities asked for without compensation, but it must not be overlooked that if the two municipalities consented to this, the whole matter would have to be fought out again by the next municipality or company establishing a competitive exchange. While it is most unfair under the circumstances to force the matter into the courts, now is the time that the matter should be finally settled. The very fact that the companies are anxious to compromise implies a doubt on their part as to the chances of the courts interpreting the clause in their favor.

It is surprising that a corporation like the C.P.R. should ever have agreed to a condition which, sooner or later, might result in loss of freight to their line and serious inconvenience to their shippers. The agreement with the Bell Telephone Co. was no doubt intended to provide for free transportation, in exchange for free telephone service, and as such was perfectly legitimate. It is difficult to comprehend that the railway company obtain any real advantage under this agreement, as it would appear that the value in train mileage for the transportation of the large staff of the Bell Telephone Co. would reach a much larger sum than that of the telephone service received in return. In this connection it is interesting to note that the Grand Trunk and other railways are introducing a system of long distance telephony over their telegraph systems. This will, no doubt, be more economical and satisfactory to the railway companies than any combination with the telephone monopoly.

The railway systems of Canada have been built very largely with the money voted by the people; that being so, the companies operating them should act in harmony with the needs of the public, and avoid entering into contracts intended to restrict the use of public utilities, or some day they may find that when they most need the assistance of the people it will be denied them.

INDEPENDENT TELEPHONY.

The subject of telephone competition has, during the past month, been a prominent factor in municipal politics, and the present indications seem to herald the advent of aggressive competition in more than one of our larger Canadian cities at an early date.

The city of Toronto has under consideration applications from two companies for a telephone franchise; the first offering services at flat rates of $36 per annum for business and $24 for residence; the second company promises service at $6 per annum and one cent per outgoing call, with a total maximum charge per annum of $35 for business and $15 for residence, with an increase to $40 and $20 respectively when 10,000 subscribers are reached.

Dealing with the first offer, although the rates proposed are lower than the present "Bell" charges, they are not low enough to effectually compete with the monopoly, or to meet the altered conditions existing in Canada. It is necessary to point out that when telephone competition began in the United States the "Bell" rates left such a wide margin between the amount charged and the cost of operation that independent promoters were enabled to fix the rates high enough to allow them to create a large body of watered stock and pay the cost of construction out of bonds. In other words, in most of the large cities the cost of the independent plant is covered by the bond issue, the share capital being what is known in slang parlance as "all velvet."

A few illustrations of the reductions effected in large American cities by competition will show that the independent rates are governed by the high "Bell" rates, and not by the actual cost of giving service. In Philadelphia rates were reduced: Business from $160 to $80, residence $130 to $48; St. Louis, business $120 to $60, residence $60 to $36; Indianapolis, business $70 to $40, residence $40 to $24; and Rochester, $94 to $48, residence $41 to $36 and 24.

In the January Canadian Engineer a list was given of a number of over-capitalized independent companies which bears out the contention now made. One of the companies referred to was the Columbus (Ohio) Telephone Co. with an average capital and bonded indebtedness for 6,277 subscribers, of $216, with no toll lines, charging rates of $40 and $24. In contrast with this the Citizens' Company, of Grand Rapids, Michigan, with an average capital for 12,367 subscribers and 2,000 miles of toll lines, of $96 per subscriber, having no bonded indebtedness, can afford to give rates of $30 and $20 in the city, down to as low as $9 in villages, and has paid 8 per cent. per annum since its inception in 1896, and has moreover a surplus of over $50,000. The difference in rates between these two cities may be accounted for in the fact that while Grand Rapids pays dividend on capital used in building the plant, Columbus has to find dividends on $705,000 capital in the promoters' hands, and interest on $650,000 bonds, with which the system was constructed.

To come back to the proposed competition in Canada, while it is admitted that the "Bell" rates are excessive, it must also be remembered that they are not as high as the charge in cities of equal size in the United States before the advent of competition. There is, therefore, no margin for the inflation of capital and bonding of plants; hence no proposition can hope to be successful unless it is based on the earning of dividends on stock which is represented by actual value in plant. In other words, there must be no "water."

The City Engineer of Toronto, in an estimate of the cost of constructing and operating a municipal telephone system of 10,000 subscribers, gives the cost of installation at $1,200,000; that of operation, including maintenance, depreciation, interest and sinking fund, as $205,000 per annum. The revenue, at $30 for business and $18 for residence connections, was estimated to produce $252,000. These figures would seem to indicate that the proposed rates of $36 and 24 include provision for a certain proportion of water.

The second offer made to Toronto is one that is likely to prove more successful in competition with the "Bell," inasmuch as a subscriber having two phones is not burdened with the payment of two full subscriptions, the second phone costing him only a fixed rental of $6, beyond which he is only called upon to pay one cent per call when speaking to subscribers not on the "Bell" system. In other words, he gets full value for every cent expended, and is not paying full rate for a second phone, the greater part of which service may, for a time, be obtained on the old system. Such a system not only overcomes the disadvantage of paying for two telephones, but it should result in a more rapid growth of the independent exchange than the old method of charging flat rates. The mayor of Toronto has declared himself in favor of the offer, subject, of course, to the necessary provisions to ensure the proper performance of the terms of the franchise. The decision of the Toronto City Council will be awaited with interest by several cities which are strugglng with the telephone problem, including Ottawa, Brantford, London, Kingston, St. Thomas, Ont., and St. John, N.B. There is no doubt that if Toronto adopts independent telephony, its example will be followed in many other places, and there is every reason to predict that the result will be as successful as in the United States during the past few years.

The Bell and its supporters loudly declaim against the evils of telephone competition and the disadvantages of dual telephony. Evidence has, however, been obtained of a most conclusive and irrefutable character on this subject. The independent subscribers of 189 exchanges, spread over seventeen of the United States, were recently circularized on this matter. Five questions were submitted, and the following is a summary of the replies: Has competition resulted in better telephone service in your city? 1. By an improved service on the part of the Bell Company. 2. As given by the independent company. Answers: 1. Yeas, 982; nays, 154. 2. Yeas, 1,245; nays, 26. Has competition increased the number of subscribers? Answers: Yeas, 1,261; nays, 8. Has competition brought about greater civility and attention? Answers: Yeas, 1,222; nays, 37. Have rates been reduced by competition? 1. By the reduction of Bell rates. 2. By lower independent rates. Answers: 1. Yeas, 1,238; nays, 45. 2. Yeas, 979; nays, 120. Would it be preferable to return to the conditions prevailing before competition? Answers: Yeas, 14; nays, 1,245.

The present telephone service is altogether inadequate to the needs of the Dominion. There is a demand on the part of the people for more telephones. The existing subscribers are universally dissatisfied with the present service, and would welcome any means of providing them with a better and cheaper one. Competition is the one means of supplying the people's need. It, therefore, only remains to organize local companies, as has been done in Toronto, and for the citizens to give such systems their loyal support in preference to the "Bell" monopoly. If this policy were pursued with energy and determination the people would soon have the country covered with a network of exchanges and toll lines in every way equal to the independent service in the United States.

* * *

—We are glad to learn that the proposed boiler inspection act relating to agricultural engines and boilers in Ontario has been withdrawn. The mover, Mr. McKay, has had the good sense to realize that the measure, if passed, would have done injustice to many a man competent to run a threshing machine engine, while at the same time it would have left a clear loophole of escape for those really responsible for the accidents and loss of life due to bad workmanship and materials, apart from accidents due to the ignorance of those operating such machinery. We would suggest to Mr. McKay a study of the British Acts dealing with boiler explosions and accidents to machinery, and that at a later session he introduce a broad measure founded on those Acts, and applying to all classes of machinery and engine accidents. This Act, carefully framed, would, we feel sure, prove to be so just and effective that it could with safety be recommended to all the other Provinces as the basis of a Dominion Act. Such legislation, it appears, falls within the sphere of the Provincial Parliament, but by mutual agreement of the Provincial Government a Dominion Act, based on the proved efficiency of the Ontario Act, could be accepted by all the other Provinces. The advantage of delegating such authority to the Federal Parliament is that the machinery for carrying it out would be simpler, cheaper and more uniform in its operation. We believe most readers will agree that the British law as summarized in last issue is the best in the world, because so evidently founded in equity and common sense, and the remarkably low ratio of accidents in the Mother Country, compared with countries like the United States, Canada and European countries, points to that law as a model for Canada.

MONTREAL, THE GREAT ELECTRIC POWER CITY.

Alton D. Adams in Electrical World and Engineer,

THE CHAMBLY POWER HOUSE.

(Concluded.)

At Chambly two sets of bus-bars are provided at the switchboard for the two-phase, 2,200-volt current from the generators. The low-tension side of the step-up transformers there may be connected with either of these two sets of bus-bars by means of motor-operated oil switches. Each of the eight main generators may be connected by its switch with either set of these bus-bars, but these generator switches are

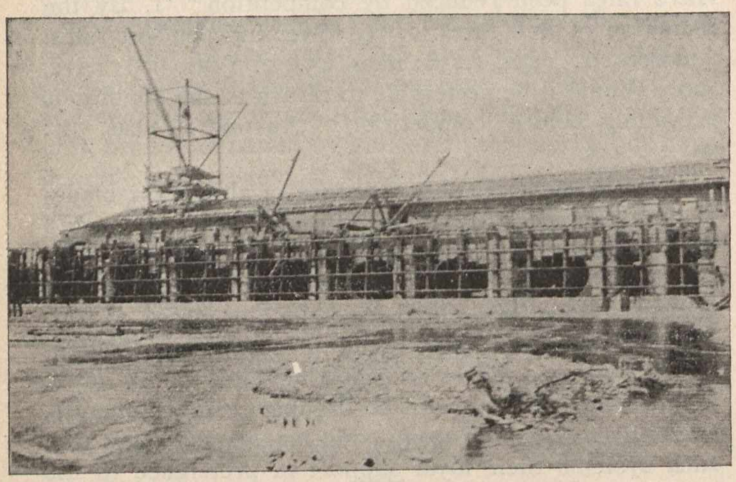


Fig. 1.—Front View of Chambly Power House.

manually operated. The generator switches, like those for the transformers, are of the oil type, with a separate brick and stone compartment for each pole. To provide air under pressure for the ten air-blast transformers, four blower sets are employed, each consisting of a 40-h.p. 550-volt induction motor, direct-coupled to a pair of blowers, one at each end of the motor shaft.

Of the eight alternators at Chambly, four were made by the General Electric Company and are rated at 2,200-K.W. each, at 2,200 volts, two-phase. The other four alternators are of the Stanley make. and each has a capacity of 2,000-K.W., at 2,200 volts two-phase. All of these generators operate at a frequency of 63 cycles per second, this number of cycles having been adopted as a compromise between 60 and 66 cycles both of which frequencies were formerly found in the water-power stations that now contribute to electrical supply in Montreal. By lowering the speed of revolution a little for some generators and raising it a little for others, it became possible to operate the several water power stations in multiple at 63 cycles per second. Each of the eight alternators at the Chambly station is direct-connected to the horizontal shaft of four McCormic turbine wheels mounted together. Each of these turbines is 51 in. in diameter, and under the available head of 31 ft. of water operates at about 152-R.P.M. Two exciters, rated at 300-K.W. and 125 volts each furnish current for the magnet coils of the alternators. Each of these exciters is direct-connected to the horizontal shaft of two 27-in. turbine wheels, which are rated at 450-h.p. and operate at 250-R.P.M. under the water head of 31 ft. The set of wheels driving each main generator and each exciter is regulated in speed by a Lombard governor. Four of the above alternators, those made by the General Electric Co., have stationary armature coils and internal revolving magnets. In the case of the four Stanley alternators the armature coils are stationary, but this is also true for the single magnet coil of each machine, and the only revolving parts are the masses of iron that complete the several magnetic circuits. Eight alternators and the two exciters form a single row that extends almost the entire length of the Chambly power house, and their shafts are all parallel. As may be noted from the above, the total rated capacity of alternators at Chambly is 16,800-K.W.

The room thus occupied by the generators is about 277 ft. long and 28 ft. wide. At nearly the same level with the generator room and on its upstream side, but separated from it by a water-tight wall of concrete 4 ft. thick, are the compartments for the horizontal turbine wheels. The shafts of the main wheels are located 17 ft. above the tail-water level, and each shaft passes into the generator room through a water-tight bulkhead of cast iron. From each pair of 51-in. turbine wheels, of which there are two pair on each shaft, a draft tube of 10 ft. 3 in. diameter passes down to the tail water. Top, bottom and sides of the wheel chambers are all of concrete, and the roof of these chambers rises on its outside to an elevation of 19.5 ft. above the floor of the generator room. The concrete floor thus formed by the roof of the wheel chambers is about 20 ft. 4 in. wide between the plain of the wall on the upstream side of the generator room and the upstream wall of the upper part of the station. This elevated floor over the wheel chambers is about 305 ft. long and carries the switchboard in its central portion and the transformers.

Underneath that particular portion of this elevated floor that is nearest to the generator room, parallel to that room, and directly over the water wheels that are nearest to the wall that separates the generator room from the wheel chambers, there is a tunnel 6 ft. wide and 6.5 ft. high. Into this tunnel, which runs beneath the switchboard and the transformers, cables between the switchboard, transformers and generators are brought. Along the top of the concrete wall that separates the generator room from the wheel chambers there is a row of steel columns that extend to the lower cord of the roof trusses. These columns serve to support a track for one end of the travelling crane, and the track for the other end of this crane is carried by steel columns along the downstream wall of the station. This crane is provided with electric motors for both hoisting and conveying purposes, and sweeps the entire generator room.

In effect the water power station at Chambly forms a part of the dam across the Richelieu river by which the head of water is maintained. This dam, considered as a whole, starts from the west side of the river in a direction approximately at right angles with the bank and continues thus until it is more than half-way across the stream. Then the

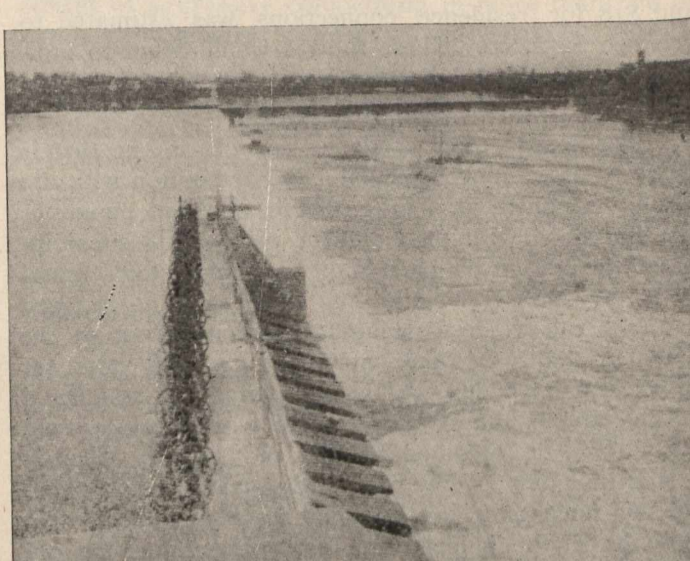


Fig. 2.—View Up Stream from Power House.

dam makes a turn at approximately right angles, and continues down stream nearly parallel with the east bank for perhaps 1,000 ft. At the end of and at nearly right angles to this second part of the dam comes the power house, which extends to the east bank, and thus completes the dam. About

30 ft. of the length of the water power station rests on the bank, and the remainder of its 308 ft. of total length is built up from the bed rock of the river. Up and down stream the width of the station foundations is 82 ft., and this narrows to about 72 ft. at the floor level of the generator room and the wheel chambers. On a level with the top of the arches over the wheel chambers, whence rises the upper part of the wall on the upstream side of the station, its width shrinks to 51.5 ft. over both outside walls. The steel roof trusses span these walls and the lowest cords of these trusses are 34.5 ft. above the floor of the generator room. Foundations of this power station are of concrete up to and including the floor of the generator room on the downstream side, and

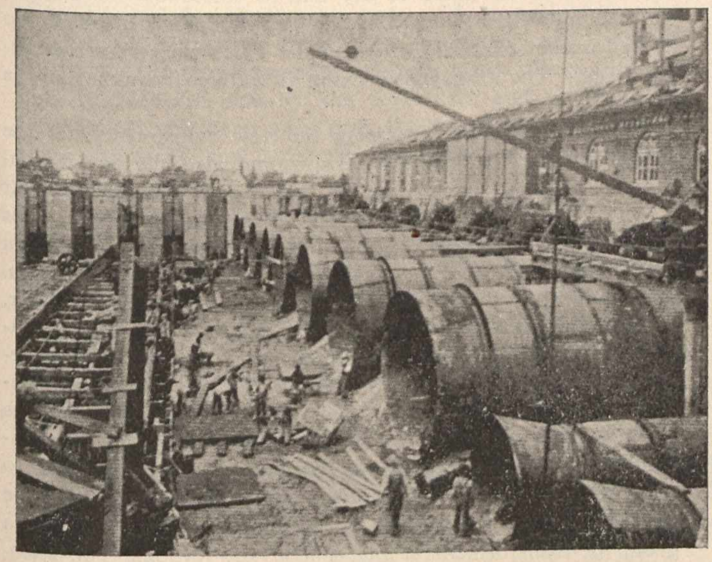


Fig. 3.—Setting the Penstock Tubes.

up to and including the roof of the wheel chambers. These concrete wheel chambers have a total length of 42.5 ft. up and down stream, and of this length 20.5 ft. is outside of the upstream wall of the top portion of the power house. Above the concrete foundations the walls of the power house at Chambly are of brick with vertical steel columns set into them to support the roof trusses. Beneath the upstream side of the power house there are ten wheel chambers for the eight sets of large wheels and two sets of smaller ones. Beneath the downstream side of the power house there are seventeen archways through which the draft tubes of the several sets of wheels pass between the wheel chambers and the tail water.

Each pair of the 51-in. turbines has its own draft tube of 10 ft. 3 in. diameter, and each pair of 27-in. wheels has a draft tube of approximately 5 ft. diameter. There is thus one archway under the generator room for each of the larger draft tubes, and also one archway for the pair of smaller tubes.

At the upstream end of the wheel chambers is the steel rack to keep ice and other floating objects away from the wheels. This rack is 269 ft. long and has a vertical height of 23.5 ft. From the foregoing it may be seen that the flow from head to tail water is directly underneath the power house from the upstream to the downstream side. As at first constructed, the wheel chambers contained the open turbines, but this has recently been changed and a steel penstock with gate has been provided for each set of wheels. Near the river end of the power house a set of waste gates in the dam or forebay wall, through which water may be drawn off into the main channel of the river, are located. The long portion of the dam running up and downstream, as well as the shorter portion that crosses the main channel, was originally built entirely of concrete, save that small iron rods were buried at intervals in the mass to increase its strength. Results of this construction have not been entirely fortunate. Some time after the completion of the dam, that portion containing the waste gates, near the power station, gave way and had to be rebuilt. On December 1st, 1902, that portion of the dam across the centre of the main river channel broke loose and moved some rods downstream in a mass, leaving a clear gap from the bed of the river up for the escape of the water. This detached portion of the dam, bristling with the iron rods that were intended to hold it together, still stands alone in midstream, a monument to its builders. Repair of this break has only recently been completed, and meantime great loss has been sustained through inability to operate the 16,800-K.W. capacity of generating equipment at the power station. While a new section of dam was being constructed in the gap at midstream, a wide apron of timber and stone has been laid along the side, next to the main river channel, of that part of the dam that extends for more than 1,000 ft. up and down stream. As this very large piece of concrete dam work stands, whether from improper design or poor materials, it may fairly be said to illustrate to a conspicuous degree the way not to do it.

Lachine Rapids, on the St. Lawrence river, between the Island of Montreal and the south bank of the stream, is the site of the second water-power station owned and operated by the Montreal Light, Heat and Power Company.

At this station the head of water on the wheels, about 16 feet, was obtained by an unusual construction. The St. Lawrence river at this point passes through a long series of rapids with no great fall in any one place. To render a portion of the water available for power purposes, a large break-water, perhaps a mile in length, was constructed up and down river through the rapids between the Island of Montreal and the south bank, but nearer the former. At a point nearer to the downstream than to the upstream end of this breakwater, a power station and dam was thrown across that portion of the river between the breakwater and the Montreal bank. Water in that portion of the St. Lawrence between the breakwater and the Montreal shore must obviously pass through the power station on its way downstream, and in thus passing it is made to fall through a long row of water wheels. The head of water being so small, only 16 feet, it was necessary to devise some way in which a reasonable speed of revolution could be obtained for the electric generators. The plan adopted was to use single vertical turbine wheels, and to drive each generator direct connected to a long horizontal shaft, which is in turn connected by bevel gears with the vertical shafts of six turbine wheels. As originally designed, each horizontal shaft with its connected generator had a speed of 180 revolutions per minute. Each of the 51-inch vertical turbine wheels geared to this horizontal shaft had a speed of about 77 revolutions per minute.

The total capacity of alternators now at the Lachine station is 6,000-K.W. Four exciting dynamos are provided for

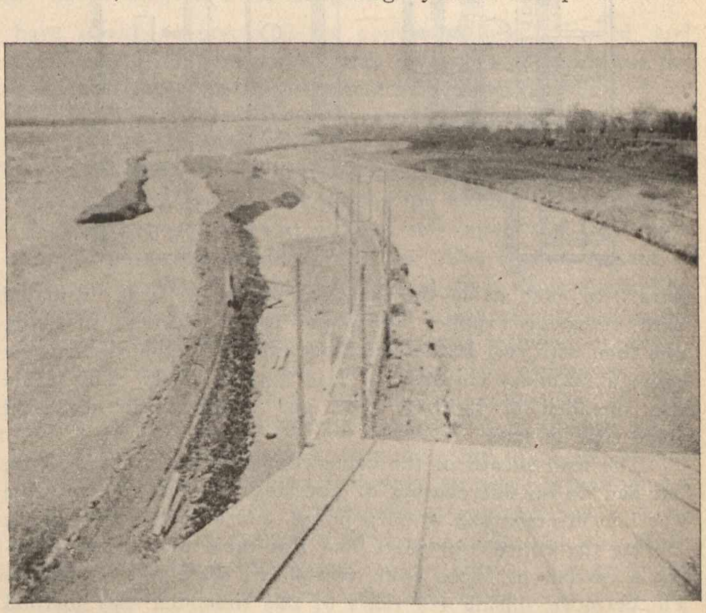
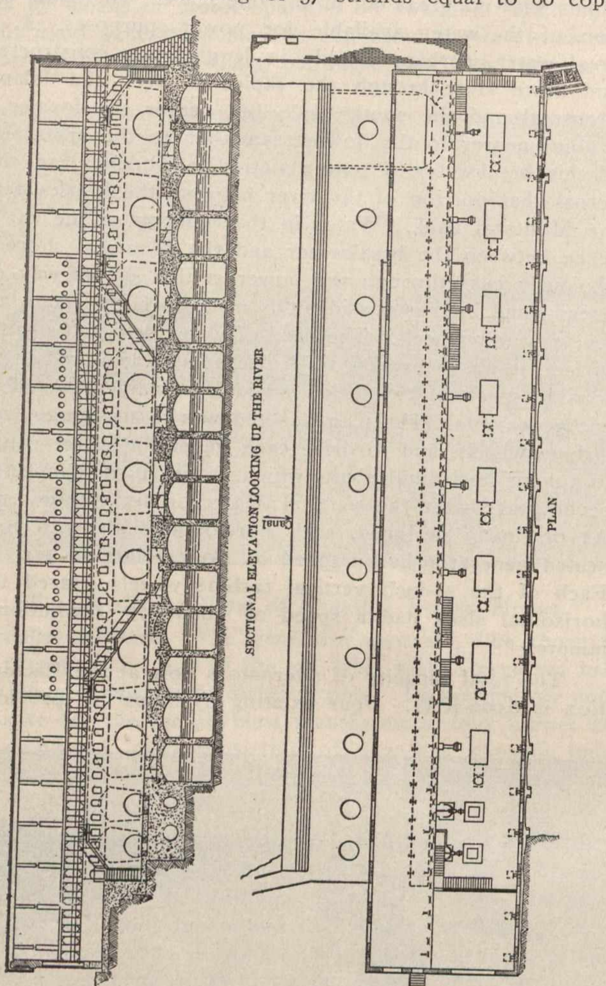


Fig. 4.—View Down Stream from Power House.

these alternators, each being rated at 75-K.W. and 90 to 175 volts. Each exciter is driven at a normal speed of 660-R.P.M. by a belt from a separate water wheel. The wide range of voltage just named was provided for at each exciter because the available head of water at the Lachine power house is subject to much variation, causing changes in the speeds of both the alternators and exciters, and these changes must be compensated for by different currents and degrees of saturation in the alternator magnets, in order to maintain a constant alternating voltage. With a view to these changes of saturation in the magnets of alternators, these magnets were so designed that at full speed and voltage their degree of saturation is below the usual figure.

The distance from the Lachine power house to the sub-stations in Montreal is so short that no step-up transformers are employed to raise the voltage of 5,000 developed in the armature coils of the alternators, and energy at this pressure is delivered to overhead lines for transmission to the McCord street and the central sub-stations. These lines are carried in large part by steel poles with wooden cross arms. In this case the steel poles are built up of structural shapes, and are erected from 100 to 125 ft. apart, as might be done with wooden poles.

Up to 1902 the transmission line between the water power plant at Chambly and the central sub-station in Montreal was operated at 12,000 volts, and in this line there were 12,000 ft. of cable in pipes and conduits under ground and under water. This 12,000 ft. of cable was all of the single-conductor type, conductor consisting of 37 strands equal to 00 copper wire. In each cable the stranded conductor was insulated with vulcanized rubber compound to a thickness of ¼-in. and then with two layers of rubber tape. Outside of the tape came a seamless covering of lead 3-32-in. thick. This cable was installed in January, 1898, and continued in use until some time in 1902.



The lead sheath of the cable contained 3 per cent. of tin, but had no outside coating or covering. A part of this cable was laid in creosoted wooden boxes, and a part in iron pipes. During the entire four years that this cable was in use carrying a current of 12,000 volts, two-phase, there was no failure. Furthermore, during 1½ years of this time, the only method used to protect the cable from lightning discharges was that of barbed wires strung on the poles that carried the overhead conductors, and connected to a ground wire at each pole. As the territory between Chambly and Montreal is subject to frequent and severe thunderstorms, this freedom from injury to the cables is of interest as bearing on the protection afforded by barbed wires against lightning.

On the 25,000-volt transmission circuits between the power house at Chambly and the central sub-station in Montreal switching is done only when there is no load. All switching of transformers under load is done with their low-tension coils, and this has given satisfactory results. No fuses are employed in these high-tension lines. Operation with a grounded neutral to protect transformers has led to no trouble with the transmission circuits themselves or with nearby telephone wires. In spite of the high voltage on this line the insulators have given no trouble by puncturing, and no arcs have started between the wires. Telephone service with its wires on the same poles with the power circuits is satisfactory, but has been found more subject to noise in wet than in dry weather, and with heavy than with light current on the line. No one has been hurt by electric shock while using a telephone. Repairs on the transmission circuits have been made at all times of day and in all kinds of weather without injury to workmen, but during such repairs no energy is sent over the wires on the poles where work is being done. The transmission line is patrolled three times a week.

For the purpose of testing the new transformers at the Chambly plant and the sub-station, and also the two 25,000-volt transmission lines, a rather novel plan was adopted. At Chambly, near the power house, three 40-ft. cedar poles were fastened together in the form of a triangle, and from each of the three corners a plate of iron 2½-in. wide, ⅛-in. thick, and several feet long was suspended in running water, so that the plates were about 50 ft. apart. The three conductors of one transmission circuit were then connected respectively to these three iron plates. At the central sub-station in Montreal the other ends of these same conductors were connected to the high-tension coils of a group of transformers. The other transmission circuit was connected to the 25,000-volt coils of a group of transformers at the Chambly power house, and to the high-tension coils of a group of transformers at the central sub-station. The 2,400-volt coils of the two groups of transformers at the sub-station were also connected. In this way energy delivered to the group of transformers at Chambly was transmitted to the sub-station, through the two groups of transformers there, and then back over the other line to the metal plates in the water at Chambly.

NORTH-EASTERN CANADA.

BY HENRY HOLGATE, C.E., MONTREAL.

To the average Canadian and even to the tourist, the head of navigation on the Saguenay river is the "ultima thule" of eastern and north-eastern Canada, and the popular holiday trip up the Saguenay has for its greatest inducement the rugged wildness of the country, thoroughly impressing the visitor that unless he wishes to live in a tent, he had better not venture any farther eastward.

When one sees for the first time Tadousac, at the mouth of the Saguenay, and realizes that this was established as a settlement for commercial purposes in the year 1603, before the founding of Quebec, and notes the apparent desolation in all the surroundings, he naturally reasons that the tributary country is wanting in the necessary natural resources which tend to material development, and the thought may arise, did the intrepid and energetic early French and English explorers in their intense anxiety to discover the secrets of the west, overlook what they passed on the way up the St. Lawrence, for they certainly did not leave us any clear information of the country north and east of Tadousac.

No doubt these early explorers did well in pressing west. and even in the discoveries they made there, the world was slow in realizing the fact, that the wilderness then made known was a veritable promised land, the outcome of which has been the firm establishment of a vast food producing area not dreamed of fifty years ago, and which has been brought so close to the world's markets by the development of systems of transportation, that its products are a source of such wealth to its people as promise soon to place their country in a position relatively stronger than other parts of Canada, and in a world-wide sense infinitely valuable.

So much for a so-named wilderness, and what can be developed from it, given at least three factors: 1st. Natural resources; 2nd, desirable immigrants, and 3rd, what will surely follow, adequate systems of transportation. Those who sail from Montreal or Quebec for European ports may think that they are more or less familiar with the St. Lawrence River and Gulf, but if they examine a map they will realize that their course is along the south shore, and but a dim, blue outline of the north shore is visible, and that only for a few hours, for the river broadens into the Gulf on such a grand scale that at a distance of 200 miles below Quebec, the river is 70 miles wide and all signs of land to the north soon disappear. The only way to get an idea of the nature of the north shore is to take one of the small local steamers plying along the coast, or to make the trip in a schooner, and a good navigator must be fortified with a vast amount of local knowledge to pilot his craft safely, tor while the chief dangers to navigation have been provided with warning signals by the Government, there are many places that can only be rendered safe by like treatment, and no doubt the Government will keep pace with the improvements going on along the coast, and anticipate the needs of those engaged in business there.

The history, such as it is, relating to this country in the early period, is well known to your readers, Biarne, the Norseman, having been accredited as being the first European visitor in the year 990. Leif, Szkolney, Cabot, Denis, Aubert, Cortereal, Cartier, Roberval and Champlain have assisted in making known this vast area, or at least the southern part, while Martin Frobisher, John Davis and Henry Hudson explored the northern limits.

In 1661 a French expedition reached Hudson's Bay, by way of the Saguenay and Rupert rivers, and in 1663 the Indians from Hudson's Bay began trading with the French at Quebec. In 1669 what is now the Hudson's Bay Company was chartered, and their first trading post was established at Rupert River, on Hudson's Bay, in 1670. The voluminous relations of the Jesuits describe many wanderings into this vast area undertaken by these fearless pioneers. In 1685 a mica mine was worked on the East Main river, and the history of the Hudson's Bay Company is worth the study of those interested in the very early development. In 1703 the French had more knowledge of the interior than had the English, as evidenced by the maps published, but the best information was very crude and inaccurate. In 1763 the southern and eastern coasts were placed under the jurisdiction of Newfoundland, and ten years later Canada resumed jurisdiction there. In 1809, Newfoundland again assumed part of this tract, and in 1876 the extent of jurisdiction was defined, and limited to the eastern coast line. For those who desire more minutely to follow the history of the exploration of this country, we would refer them to the reports of A. B. Blaiklock, 1860; Henry Yule Hind, 1862; Dr. A. S. Packard's "On the Labrador Coast," 1864; L. M. Turner of the Smithsonian Institute, 1886; R. F. Holmes, Royal Geographical Society, 1887, and to the American Geological Society Bulletin, Vol. 24. There are valuable reports also in the office of the Geological Survey of Canada dating from 1863, the later ones by A. P. Low being interesting and comprehensive.

The surveys and explorations made under the direction of the Crown Lands Department of Quebec contain detailed information of practical value, and embrace good reports relating to timber, minerals and the rivers of the country. Conditions do not point to the probability of this area becoming an agricultural country, but this is more by comparison than otherwise after all, for we have already such enormous areas eminently suited for the raising of staple crops, that naturally, they will be the first to be developed. This, However, does not mean that north-eastern Canada cannot produce hardy crops, which has already been proved. The area of the territory north and east of a line drawn from the mouth of the Saguenay river to James' Bay is about 589,000 square miles, and of which area 234,000 square miles is included in the province of Quebec. The area comprising the southern watershed is about 180,000 square miles, the waters from this area discharging into the River and Gulf of St. Lawrence.

This immense watershed supplies numerous rivers affording in their course southward a great many water-powers varying in capacity from 1,000-h.p. to more than 200,000-h.p. at one development site. The timber yielding area is practically confined to this southern watershed, and although it is but a small proportion of the total area of the whole territory, it is nearly four times larger than the State of New York. The timber consists principally of several varieties of spruce, balsam, and white birch, tamarac being found in the eastern portion. The distribution of the streams and rivers in the southern watershed is such as to render all of the timber accessible, so that when the market demands a rise. the whole of the timber will be available. The existence of the water-powers is a feature tending to encourage development in preference to localities not so favorably situated, especially will this be true of such industries as the manufacture of wood pulp and its products. Several companies have already appreciated the conditions here afforded, and have begun development on more or less large scale, but the field is so great, that development may be said hardly to have begun. The whole country is well supplied with minerals, but wants further explorations to make more fully known its resources. Mr. Low states that the occurrence of gold, copper, nickel and pyrites, render the tracing of these areas of great importance, and we can rely upon the Geological Survey of Canada following this up. The known deposit of iron ore are very large, and will be of great value, depending on transportation facilities, and the advancement of the use of electricity in smelting. Owing to the tremendous water-powers available for the production of electricity, this locality offers unmatched facilities for industries of this nature, as soon as the commercial features of electric smelting shall have been solved. The deposits of magnetic iron sand along the coast, have for years attracted attention, but have not been used to commercial advantage yet, and no doubt await more favorable means of reduction and treatment on the spot, for, owing to the difficulty of gathering and transporting, their great value will lie in local treatment.

The Shortest Route—Europe to the East. Seven Islands—Port Simpson.

At present there is no railway east of the Saguenay river, and internal development cannot progress without such facilities for transportation, and until a railway is built, the products must find their way to the coast by the numerous rivers, thus limiting the usefulness of the products of the interior practically to those of the forest. As, however, many of the large deposits of iron ore are close to the coast, and as the greatest water powers are there also, it becomes more a question of transportation by water that concerns the immediate questions of development.

For navigation, the coast is provided with numerous natural harbors, and many bays that can be rendered safe for shipping purposes by the construction of protection works more or less extensive. One of the best natural harbors in the world exists on this coast, that of the Bay of Seven Islands, for which nature has done her best in producing something better than anything else in America. But when nature turned over this harbor to us, she "kept a string on it," for she closes it up nearly every year with ice. I say nearly every year for there have been years when but little ice has been seen in the harbor, and from what can be ascertained from personal observation and enquiry, navigation could be maintained all the year round, with an ice-breaking ship of very modest proportions. The question of navigation all the year round from and to Seven Islands appears to be one of harbor facilities only, for once outside, there are no obstructions not even from the ice, at any season of the year, except such as may arise from ice coming through Belle Isle, and this is, of course, common to all navigation in the Gulf, and occurs in the early summer months.

From the facts before us, we must look upon the development of such a harbor as that of Seven Islands as not only a possibility, but a probability. It becomes an objective point farther east than Quebec as an outlet for trans-Atlantic commerce, and in the regular order of progress must sooner or later be reached by a railway from the West.

Geographically considered, Seven Islands occupies a favorable place, its latitude is 50 deg. 13' N. and its longitude 66 deg. 24' W., and is about 200 miles farther south than Liverpool. The following table of distances may serve to illustrate its relative location more clearly, taking Liverpool as the point of destination:

Sailing Distance from	Miles.
New York	3,105
Boston	2,807
Portland	2,789
Montreal	2,778
St. John	2,700
Quebec	2,633
Halifax	2,450
Seven Islands	2,304

Seven Islands is 800 miles nearer Liverpool than is New York. The objections to the opening up of a new trade route are always strongly urged, and sometimes facts are ignored which tend to strengthen the claims of the new route for recognition, so it is well to state the main facts in its favor and these are, the shortest sailing route across the Atlantic, the coast is accessible all the year, and the harbor itself is magnificent. These are certainly good things to start with. Who will develop this new route?

It must also be borne in mind that having the rail terminal at Seven Islands also shortens the length of rail haul from the West if a northerly trans-continental route be built, and as Canada is now served with a trans-continental rail route to the south, it will be a matter worth careful consideration for any future trans-continental route, as to whether Seven Islands should be the terminus. Northeastern Canada has received in the past but scant attention, yet as there are certain elementary conditions which render it valuable as a producer, and as a channel for the products of the West, it must at no distant date receive the attention of the manufacturer, and of those interested in transportation in its larger sense, and this is emphasized by the fact that having Seven Islands as the eastern railway terminus, affords a route very considerably shorter than any existing trans-continental railway. A short study of the accompanying map clearly shows the comparison between the routes.

(To be continued.)

It is stated that the Dominion Coal Co. will extend their general machine shop at Glace Bay, C.B., this spring. Also that a large dam will be constructed on McAskill's brook, a reservoir built, and an improved water system provided around the collieries.

TELEPHONE AND TELEGRAPH.

The long-distance telephone line between Sydney, C.B., and Halifax, N.S., was formally opened on March 15th by an exchange of messages between the Mayors of Halifax, Sydney, North Sydney, Sydney Mines, Glace Bay and Louisburg.

It is proposed to erect an independent rural telephone system in Ontario, from Thornbury and Clarksbury up to the Tenth Line, taking in Heathcote, Redwing, Ravenna, and Kolapore, with possible extensions to Feversham, Duncan, and Kimberley.

The C.P.R. Telegraph Co. will extend their system in the North-West this year, and will construct additional circuits between Quebec, Montreal, and Winnipeg, and between Peterboro, Toronto and Windsor. When completed, the system will comprise 66,000 miles of wire.

The Bell Telephone Co. will erect new premises at Winnipeg, Man., to accommodate 10,000 telephones. Extensions will also be made from Morris to Emerson, via Letellier, St. Jean and Dominion City. A new exchange will be erected at Carman, and the Calgary exchange enlarged.

RAILWAY NOTES.

The Edmonton town council have granted a 30-years' street railway franchise to Mr. Tretheway. The system is to be in operation by September 1st, 1905. A deposit of $25,000 is required. The company is exempt from taxation for ten years, after which it will pay, in addition to taxes, $20 per car per year, and 5 per cent. on its gross earnings until they reach $500,000, when the percentage will be 8 per cent. The town has the right to acquire the system by arbitration when the franchise expires.

The Sydney and East Bay Railway Co. has been incorporated to build a road from Sydney, C.B., to Johnstown Harbor, Richmond County, with power to acquire mines, hire or construct ships, barges, ferries, etc.; build hotels and establish summer resorts on the Bras d'Or lakes. The route will be via the south side of East Bay, with a branch from the head of East Bay to Eskasoni, on the north side. The line will not enter Sydney, but will connect with the Intercolonial near Gibbons' Bridge, on the Sydney river. It has not been decided whether the motive power will be steam or electricity. A. C. Ross is the chief promoter.

The G.T.R. report for the half year ending December 31st shows gross receipts of £3,138,468; increase, £326,590; passengers carried, 5,159,073; increase, 451,423; tons of freight and live stock, 5,738,702; increase, 590,172; working expenses, £2,214,084; net receipts, £924,000; net revenue charges half-year, less credits, £526,000; balance, £398,400. Maintenance and equipment increase, £52,485; cost of transportation increase, £179,616, due to increased cost of materials and higher wages. Total increased expenditure, £239,263. Surplus, including balance of £5,500 from June last, £404,300. Full dividends for half-year on 4 per cent. guaranteed stock and first and second preference stocks, and dividend of 2 per cent. for the third preference stock have been paid. Balance carried forward, £2,000.

The irrigation scheme of the C.P.R., in the North-West, will be under the direction of J. S. Dennis. It will cost $2.75 per acre, and will affect five million acres. In India, where the British Government has carried on for years extensive irrigation works the price has been $6.65 per acre. $127,000,000 has been spent in the work, resulting in the reclamation of 19,000,000 acres. The results are much more valuable in a densely populated country, like India, than they will be in Canada for a long time to come. In India the irrigated soil produced seventy times as much as an equal area of dry soil. The C.P.R. looks forward to a profitable return, especially through the cultivation of vegetables and other garden truck. Mr. Dennis will commence in the spring the digging of a large central canal through the territory which is to be irrigated.

THE CANADIAN MINING INSTITUTE.

The annual meeting of the Canadian Mining Institute was held at the King Edward Hotel, Toronto, March 2nd, 3rd and 4th, under the presidency of Eugene Coste, with a good attendance. Unfortunately, the meeting was clouded by the news of the death, on February 29th, of B. T. A. Bell, secretary of the Institute.

At the first session the reports of the officers and council were presented, showing a membership of 435 and cash balance in hand of $2,912.73.

Resolutions of sympathy with Mrs. Bell were passed, and Messrs. Coste, Brown and Major Leckie were appointed a special committee to represent the Institute at Mr. Bell's funeral. It was also decided that the annual dinner be cancelled. Messrs. Obalski, Hobart and Mills were appointed scrutineers of the ballot for officers.

Nine papers were submitted by student members. The Committee of Award in the Geological Section recommended that the cash prize of $25 be given to S. H. Boright for his paper "On the Geology of the Northern Portion of the Boisdale Hills. Anticline." In the Mining Division the committee recommended that Norman W. Parlee be given a similar cash prize for his paper on "Rock Drilling and Blasting." None of the papers being deemed to have sufficient merit to warrant its award, the president's gold medal was not given.

The afternoon session opened with the president's address, in which he expressed his pleasure that the Institute was meeting in his native Province. The membership tended more and more toward the West, 108 Ontario members, 68 from British Columbia, and 11 in the Yukon having to be set against 69 from Quebec and 30 from Nova Scotia. He outlined the historical development of the Institute from the various provincial mining societies. The Government had recognized the value of their publications by an annual grant of $3,000. They were the only body in the Dominion upon whom it devolved in the terms of the charter to take "concerted action in such matters as affect mining and metallurgical interests in Canada." Their recommendations to the Government had invariably been accepted. Three notable instances were adduced. Export duties on nickel ores and matte were not imposed, though approved by the Ontario Government in 1899. Taxes on nickel and copper ores and matte had been recognized as an interference with the industrial independence of these interests, which was essential to their development. The reduction to 2.5 per cent. of the export gold duty in the Yukon was a third point in which they had used their influence. They had helped to defeat the alien labor and eight-hour laws in British Columbia. Good roads and mining legislation in the Yukon and the free listing of gold, dredging and mining machinery were other matters in which they had acted. The president then discussed at some length the possible aid to mining which could be rendered by the Government. He called attention to the fact that, notwithstanding the great growth of the mining industry, the Geological Survey appropriations had not been increased, and its operations had been restricted by limited means. He advocated a great extension of the work now done; whether such extension could best be made by the establishment of a new bureau, or by extending the organization of the Geological Survey, would be a matter of detail. In either case the proposed bureau ought to contain several branches, as the general administration; the geological survey proper; the topographical and geographical survey; the preparation of reports and monographs on mining districts and mineral deposits; the collection of statistics; economic results and commercial facts bearing on the mining interests—which would be closely connected with the statistical bureau; and a department interested in metallurgical and chemical work. The work of such a department would not interfere with the mining rights and the making and administering of mining laws in the several Provinces. To them would be reserved the selling and leasing of mineral lands, the inspection of mines, the keeping of maps, plans and records; the collection of dues, license fees, taxes or royalties; the collection of statistics; the fostering of technical education, public assay offices, roads and transportation in mining districts; custom concentration and reduction works; deep sinking and testing deposits; issuance of papers on newly dicovered mineral districts, etc.

A paper was read by Frederick Keffer on "Mining in the Boundary District, B.C." It supplemented his paper presented at the 1902 meeting, describing the improvements in mining and handling ore recently made. This was followed by a paper on "The Rossland Ore Deposits," by E. B. Kirby. W. Thompson followed with an account of the work now being done on the low-grade ores of the Rossland district, including the application of the Elmore oil concentration process.

At the evening session Mr. Thompson gave an account of the method adopted by him in building bulkheads in the Nickel Plate mine at Rossland to hold back water in an adjoining mine, having a head of 450 feet. They were built of brick and cement, and proved equal to the work. R. W. Brock read a paper on the "Lardeau District, B.C.", which was illustrated by maps and photographs. The district extends from the head of Kootenay lake to Arrow lake, and contains three zones of mineralization. Between Poplar lake and Silver Cap mountain had not been prospected, but the rich strikes of free gold at Poplar Creek were very remarkable. The Lucky Jack claim had been staked three years ago and thrown up by Buckle, the original prospector. The railway ran past it for a year before the rich discovery of free gold was made.

B. A. C. Craig described the new concentration mill of the Canadian Corundum Co. Dr. W. A. Parks spoke on the value of stratigraphical geology, which, he claimed was being neglected for petrography. The importance of this branch of study was shown. Mr. Coste, the greatest economic stratigraphist in the country, had discovered the two oil fields on which the Canadian manufacture of oil depended. Stratigraphical research might develop other native resources. S. Dillon Mills read a paper on "Recent Rock Movements in the Laurentian."

Thursday morning was devoted to the reading of students' papers. The following were read and discussed: "Relative Attraction of Different Minerals for Residuum Oil," J. F. Hamilton, School of Practical Science, Toronto; "Limitations of the Cyanide Process," T. H. Plunkett, School of Practical Science, Toronto; "The Treatment of the Dry Ores of the Slocan District," T. W. Cavers, School of Mining, Kingston, Ont.; "Notes on Some Deposits in the Eastern Ontario Gold Belt," C. W. Knight, School of Mining, Kingston, Ont. These papers generally showed careful work.

The afternoon session was adjourned as a mark of respect to the memory of B. T. A. Bell.

In the evening J. Obalski read a paper on "Minerals Containing Radium Found in Quebec. These included a specimen obtained from a pegmatite dike at the mica mine near Lake Pied des Monts, about eighteen miles from Murray Bay, in the county of Charlevoix, Quebec, part of which showed 70.7 per cent. uranium oxide, and exercised a strong radioactive influence. Photographs taken by means of the radioactivity were shown. Another specimen was a substance resembling coal, also found in a pegmatic dike, the ashes of which contained a large percentage of uranium oxide, and showed a high degree of radioactivity. Dr. McLennan, Toronto University, said that it was interesting to learn that such ores had been discovered in Canada, and suggested that exploring parties be provided with testing apparatus. In reply to Prof. Miller, he said that so far the only economic use of radium was in medicine. Prof. Curie, being unable to obtain the ore from Austria, the great value of radium having caused an embargo to be put on the ore, was now looking elsewhere, and would be glad to buy such ores from Ontario or Quebec. Dr. McLennan suggested that the Government give a bounty for the discovery of specimens.

E. L. Fraleck, Belleville, referred to the white mica discoveries in Ontario, and Prof. Miller said that these deposits would be explored this summer by an electric company, which hitherto has been obliged to import from India.

E. J. Davis, Commissioner of Ontario Crown Lands, in an address, said that he had met the suggestions of the mining engineers by abolishing royalties and leaving the mining laws unchanged. He regarded the presence of so many young men as a hopeful sign for the development of the country's mining interests, and referred appreciatively to the valuable services of Prof. Miller, Prof. Coleman and Thomas Gibson. Mr.

Davis, in closing, promised all possible assistance to the mining interests of the Province.

Professor Coleman read a paper prepared by A. B. Willmott, of Sault Ste. Marie, on "The Exploration of the Ontario Iron Ranges." Mr. Willmott referred to the geological similarity between certain belts in Ontario and those found south of Lake Superior. The lack of known ore bodies was owing to the fact that they had not been properly sought. He instanced the Josephine and Frances mines, where surface indications were slight, but where deep drilling had met with entire success. During the past two years systematic work had been done on the Steep Rock, Animikie, Michipicoten and Hutton ranges, and in most cases good ore bodies have been discovered. The work done in Ontario, however, was trifling compared with that going on on the American side of Lake Superior. The time had gone by when ore bodies were found by running through the woods with a canoe and a pick. Iron ranges had been found, and the question of their value could only be determined by careful and intelligent work.

F. T. Snyder read a paper on "Magnetic Separation." In the discussion which followed, it developed that Mr. Snyder was the inventor of a magnetic cencentrator of a new type, with which very successful work had been done.

Friday morning was devoted to the reading of students' papers, which comprised "Mica," E. T. Corkill, Kingston; "Pioneer Iron Mine, Ely, Minnesota," E. J. Carlyle, McGill University; "Chlorination at North Brookfield, N.S.", H. Forbes, McGill University; "Notes on Mining in the Regent Group, Negaunee, Mich." M. B. Atkinson, McGill University; "The Tyee Mine," Vancouver Island, B.C., D. C. Livingstone, McGill University.

In the afternoon a paper was read by W. G. Miller, Provincial Geologist, on "The Undeveloped Mineral Resources of Ontario." The presence of rare minerals had been determined in Laurentian formations, and with the advance of mining methods they would prove profitable fields for exploration. The wide area of gold-producing rocks discovered gave promise of vast undeveloped resources of this metal. A valuable silver mine was in operation at the head of Lake Superior, while silver had been discovered 500 miles east. The abundance of iron already in sight was an indication of the extent of undeveloped resources in this mineral. When facilities for transportation were provided, these would become paying properties. Good reasons existed for the belief that diamonds would be found in northern Ontario, the necessary geological conditions existing there. In discussing this paper Mr. Gibson referred to the success attained in briquetting Ontario peat.

A. C. Garde, of Sandon, B.C., called attention to the waste of zinc which had been going on, and reviewed some methods for overcoming it.

J. A. Dresser, Montreal, described an area of copper-bearing rocks in the Eastern Townships of Quebec, between Lake Megantic and the Arnold river, near the Maine boundary. These he believed to be a continuation of the New Hampshire copper ranges. The building of the Grand Trunk Pacific would open up this region and permit these deposits to be developed. A number of papers were read by title.

The concluding session was held on Friday evening. T. W. Gibson gave a statistical paper showing the progress of mining and the manufacture of its products during the past year in Ontario. The total output for 1903 was about 4.5 per cent. less than for 1902, but the special causes, such as the Sault situation, leading to this reduction, when carefully considered, showed that progress had been most satisfactory. He referred especially to the remarkable growth of the cement industry in Ontario, and to the possible over-passing of the demand by construction.

A discussion followed, in which reference was made to the uses of cement in buildings, in culverts and bridges, in foundations, in lining mine shafts, etc, including the use of reinforced concrete, or concrete and steel construction.

Professor L. T. Walker, of Toronto University, spoke briefly on "The Geological Survey of Canada as an Educational Influence," after which the Institute unanimously adopted a resolution presented by Mr. Craig: "That the president (Eugene Coste), Major Leckie, Treasurer Brown, Dr. F. Adams, Prof. R. W. Brock, Prof. T. L. Walker and B. A. C. Craig be a committee to confer with the Minister of the Interior and the heads of the provincial mining bureaus on the necessity of giving preference to geological students when making up geological survey parties; that the committee also point out the necessity of the Minister of the Interior and the Provincial Government taking steps to maintain the efficiency and increase the size of the permanent geological staff."

Mr. Coste read a paper on "Some Suggested Improvements in the Mining Laws in Canada," in which he advocated the passage of a Dominion mining act, to take the place of the present clumsy system of regulation by order-in-council. He pointed out that in some sections owners of placer mines were compelled to perform assessment work to the amount of $40 per acre each year, while quartz mine-owners only had to do work to the extent of $2 per acre for five years. He favored the imposition of assessment work to the amount of $5 per acre on all mining lands, with immediate forfeiture to the Crown in case of non-compliance. He pointed out that only about one-half of one per cent. of the mining lands granted in Ontario in the last six years were being worked. This meant that the chances of finding paying properties were reduced to one in several thousands. He characterized inactive claim owners as drones, who prevented others from taking advantage of the country's resources. He suggested a law to provide for some return to the people for a grant, either by doing work on their claims or by the payment of a yearly tax, if no work was done. The principle was that the grantee should make some return, either in development or money. With regard to the Dominion, he thought that the great interests of the Yukon and other territories—such as Alberta, Assiniboia and Saskatchewan—should be governed by a known and definite law, and ought not to be left to the discretionary regulation of orders-in-council, which are liable to be changed at any time.

Many members took part in the discussion, including Messrs. Thompson, Hardman, Gibson, Leckie, Blum, Miller, McCharles, Coste, Craig, Hobart and others. Unfortunately, some of the speakers seemed to have missed Mr. Coste's main point, that the law should prevent the locking up of mineral lands by parties who only wished to hold them for a possible rise in value, or, perhaps, to prevent others from working them.

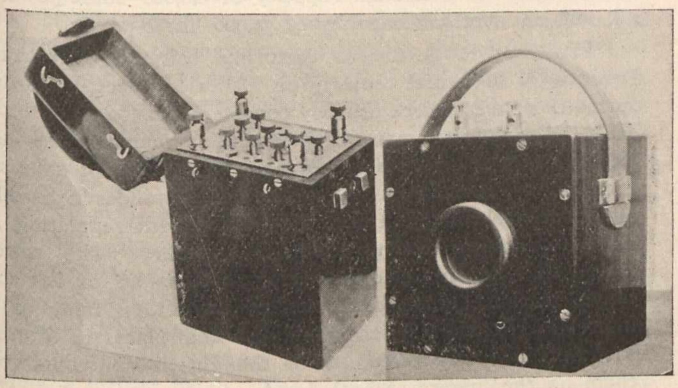
This closed a successful meeting, notwithstanding the depression caused by the regrettable and untimely death of Secretary Bell.

The following officers were elected for the ensuing term: President, Eugene Coste, Toronto; vice-president, E. B. Kirby, Rossland; treasurer, J. Stevenson Brown, Montreal. Council —J. McEvoy, Fernie; W. F. Robertson, Victoria; A. W. B. Hodges, Granby; W. G. Miller, Toronto; Major R. G. Leckie, Sudbury; John Blue, Eustis; Frank D. Adams, Montreal; Graham Fraser, North Sydney. As the by-laws require nominations to be made three weeks before the convention, no nomination could be substituted for that of the late B. T. A. Bell as secretary. The council will name an acting secretary, who will fulfil the duties of the office until the next convention.

PORTABLE VOLTAGE AND SERIES TRANSFORMERS.

The ordinary equipment for making electrical measurements affords chances for error which care cannot always overcome. It is frequently impossible to have at command instruments of all the capacities required to give the best results. Readings should be taken well within the range of the instruments, upon the portion of the scale where the divisions are large and open and errors in observation not likely to occur, but when, owing to lack of instruments of the proper capacities, readings are taken at the ends of the scale where the divisions are narrow, the greatest care cannot always prevent errors, or uncertainty as to the correctness of the readings taken. Even when instruments of all the desired ranges are at hand, it is still often difficult to obtain absolute accuracy and uniformity of results, owing to the variations in the different instruments, which make it impossible to check up the results obtained. In checking and testing electrical instruments with the use of the ordinary appliances, the standards often present the same difficulties and make it impossible to certify absolutely to the accuracy of the results obtained. In fact, the greater number of the errors and discrepancies in tests can be traced directly to lack of legibility of standards and to variations in the different instruments.

Manifestly, the ideal instrument either for taking measurements or for making comparisons with other measuring devices is one which will combine a great degree of legibility with a capacity for all ranges in which readings are to be taken, and any means by which these characteristics can be imparted to the instruments now in service is of practical value. The best method for accomplishing the desired result is by the use of transformers which will adapt the voltage or current to be measured to the capacity of the instrument to be used, adopting a ratio which will permit readings to be



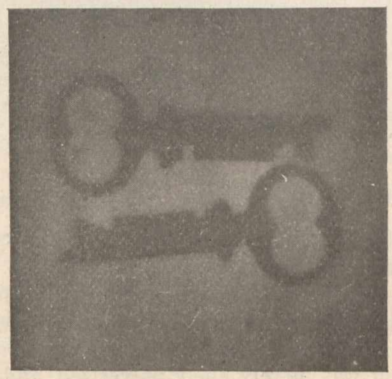
taken from the most legible portions of the scale. By this means any difficulty in readings is obviated, uniform accuracy at all capacities is assured, and a single voltmeter, ammeter and wattmeter will fulfil all the requirements of the most exacting service.

The portable series and voltage transformers made by Westinghouse Electric and Manufacturing Company, the former of which is shown in the accompanying illustrations, are especially designed for this work. Ample insulation and generous amount of iron and copper reduce to a minimum the error of transformation. They are designed to give accurate ratios at the load which will normally be imposed on the secondary, by the ordinary type of portable instruments, the output of the voltage transformer being about .15 amperes and the maximum voltage across the secondary of the series transformer being about three volts. The series transformer is made in two types. In one, designed for primary currents up to 100 amperes, the ratio is changed by plugs, somewhat as in the Wheatstone bridge. In the other type, which is designed for larger capacities, there is a circular opening through the transformer, and the conductor is passed through this opening, forming the primary. In this type, the ratio is changed by the number of turns made by the conductor passing it through the aperture once giving a ratio of 400 to 5, twice a ratio of 200 to 5, and four times a ratio of 100 to 5. The voltage transformers are furnished in various capacities up to 750 volts primary, the standard secondary voltage at the maximum primary voltage being 150 volts. The terminals on the primary are arranged so that a number of primary voltages may be obtained although they are not usually required in a great range of capacities as is the case with series transformers. These transformers are mounted in finely finished mahogany cases with carrying handles. The terminals of the voltage transformers and the plug contacts of the series transformers are protected by a cover, which, for convenience in use, is made removable.

RADIUM-BEARING MINERAL IN QUEBEC.

In last issue mention was made of the interesting discovery by J. Obalski, Inspector of Mines, Quebec, of a radium-bearing mineral in an abandoned white mica mine back of Murray Bay. Mr. Obalski showed a specimen of the mineral at the meeting of the Canadian Mining Institute last month, and gave the following account of his discovery:

Since the new element, "Radium," has been discovered attention has been called to the minerals containing it; and so far it appears that the Uranium ores are the only ones in which it has been found. In our Laurentian formations the Uranite, composed of oxide of Uranium and other rare metals, has been met with in the pegmatite dykes, which have been operated as producers of white mica; and we had only the record of the Villeneuve mine, in Ottawa county, with Monazite and Uranite, and the Maisonneuve mine, in the county of Berthier, with Samarskite, although we have several other white mica mines and prospects in the Saguenay district. About ten years ago I found in a white mica mine, then operated by the Canadian Mica Co., a remarkable specimen, which I identified as "Cloveite." This specimen has a specific gravity of 8.43, and weighs 375 grams, or about 12 ounces; it is well crystallized in dodecædron form, being derived from the isometric system. A complete analysis has not yet been



A Radiograph, the Result of Nine Hours' Exposure Through a Piece of Wood.

made, but it contains 70.71 per cent. of uranium. Radium having been discovered and found to exist mostly in connection with Uranium ore, I experimented with the above mentioned crystal, and found it affecting strongly the photo plates, as shown by the accompanying radiographies. It had also a well-marked action on the electroscope. I came then to the conclusion that it contained Radium, and, to have my opinion confirmed, I showed the specimen to Professor Rutherford, of McGill University, who, after testing it, stated that its radio-activity was equal to four or five the one of the crystal if it had been entirely composed of Uranium, and that it contained one-tenth of a milligram of Radium, making it comparable with the best pitchblende so far operated for Radium.

This crystal may be an accidental one, although I have found other small pieces of the same mineral in this vein, but

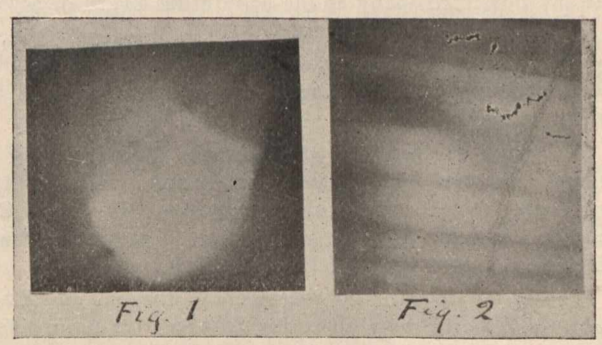
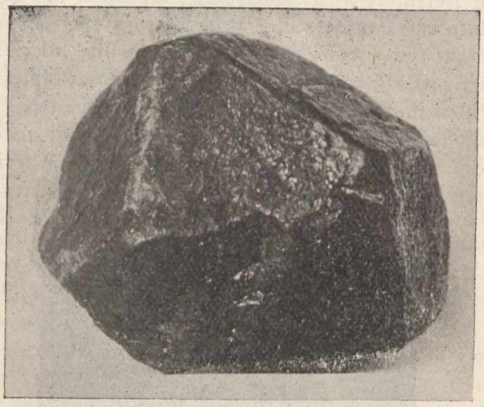


Fig. 1—Photo taken from Rays from the Crystal.
Fig. 2—Radiograph taken through Wood, showing Grain of Wood.

I have also found a carbonaceous material, burning quite easily, and leaving a large proportion of ashes, containing oxide of Uranium. I am not able to state what is the relation between the two specimens, but I think this fact important, and I propose to make a further investigation next summer. The white mica vein where those specimens came from is situated near the Lake "Pieds des Monts," about eighteen miles back of Murray Bay, in the county of Charlevoix, on the north shore of the St. Lawrence.

Specimens of the coal referred to have been tested by M. L. Hersey, of Montreal, with the following results: "This sample of coal has a fibrous, irregular structure, and contains a small amount of mica; it proved to be a non-coking, bituminous coal, yielding considerable gas, which burned with a bright yellow flame.

Volatile matter (including volatile combustible matter and a small quantity of moisture)	40.185%
Fixed carbon	52. 59%
Ash	7.225%



Crystal of Uranium Ore—Actual Size.

"The ash itself was analyzed, and found to contain 2.56 per cent. of Uranium, based on the coal, which is equal to 35.43 per cent. of Uranium in the ash itself. It is important to note that the color of the ash was olive green, being due to the presence of oxide of Uranium. In another test the coal was not burnt, but was merely finely pulverized, and the powdered coal treated with boiling nitric acid to dissolve the Uranium compounds. It is then interesting to note that the Uranium may be extracted by the direct treatment of the coal with nitric acid."

LIGHT, HEAT, POWER, ETC.

Dundas, Ont., is discussing the question of acquiring the gas works.

The I.C.R. is erecting electric plants at Mulgrave and Point Tupper.

Sudbury, Ont., will have electric power in June. It will bring 3,000 h.p. from the Vermilion river, eleven miles distant.

The citizens of Kingston, Ont., on March 21st passed the by-law authorizing the city to take over on April 1st the light, heat and power company at the arbitration award of $170,373.

Owing to the defective lighting at Stratford, Ont., the city council will employ an expert to examine the gas and electric lighting plants. Cancellation of the company's franchise is talked of.

A branch company of the Victoria Manufacturing Co., Auburn, Me., has been formed comprising: J. H. Whitman, Port Dufferin, N.S.; Mr. Howland, Boston, Mass.; and C. W. Waldron, Auburn, Me., to establish a factory for making acetylene gas generators at St. John, N.B.

The by-law to purchase the plants of the Gas and Electric Light Co., Sherbrooke, Que., for $233,000 has been defeated by reason of the fact that the aggregate value of property owned by the minority who voted against the purchase was greater than the majority who favored it.

The Stayner Electric Light and Power Co. has been incorporated to develop the water power on the Nottawasaga river, five miles from the town, to transmit light and power to Stayner and other municipalities. The provincial directors are: Messrs. Jos. Knox, M. Gartlan, S. L. Deylin, W. A. Doner and D. G. Bell.

The Collingwood Light, Heat and Power Co., Ltd., Collingwood, Ont., has been incorporated, with $200,000 capital, to operate the gas lighting franchise granted to E. D. Morris last year. The contracts have been let for a carboretted water gas plant, to be in operation by October 1st. The provisional directors are: W. G. Parsons, W. Postlethwaite and A. D. Crooks, of Toronto.

The Brome Lake Electric and Power Co., Waterloo, Que., contemplate installing an auxiliary steam plant to provide against a shortage of water power.

The first annual report of the Trinidad Electric Company, the third electric plant built by Canadians in the West Indies, just issued, shows gross earnings, $176,631; operating expenses, $75,446; bond interest (on $720,000), $36,000, leaving net earnings, $65,186. A quarterly dividend at 5 per cent. per annum on the capital ($1,032,000) was paid in January, leaving $55.921 surplus. As construction is not yet completed, this showing is most satisfactory.

On its transmission line from Niagara Falls to Toronto the Electrical Development Co. will use steel towers, 8 or 10 feet square at the base and from 40 to 45 feet high, instead of poles, between Niagara Falls and Toronto. They will be 400 feet apart. The company will commence with four transmission lines of a normal capacity of 40,000 horse-power in all, and an overload capacity of 50,000 horse-power.

Professor R. B. Owens, lecturing before the Insurance Institute of Montreal recently on "Interior Electric Wiring," stated there were three primary considerations to be observed: First, the conductor must be of ample current carrying capacity in order to avoid overheating with consequent danger of fire; second, it must be so insulated as to render it harmless and prevent leakage; third, the best current regulating and pressure limiting devices should be installed. The speaker stated that interior electric wiring had, as far as he could judge, been as much neglected as any other thing of like interest. He knew a few buildings and places in Montreal that were properly wired, but he thought that he could count them on the fingers of both hands.

PLUMB BOBS.

F. W. Salmon, C.E., Burlington, Iowa, gives readers of the Canadian Engineer a useful caution about the material in plumb bobs. He says: They may be made of cast brass or bronze or of bar brass, but should not in any case be made of cast iron because at the present time electricity is so common that a cast iron plumb bob is often drawn out of its proper position by some local electrical attraction. For this reason the steel points are made comparatively small. The small cap that screws into the head of the plumb bob and receives the string or line should be knurled on the edges so as to be readily screwed in or out.

—A great amount of attention is being given to the question of rapid change gear appliances on lathes, both by lathe builders and by lathe users,, and an ever-increasing preference is being shown for such lathes over less modern types. It will, therefore, be of much interest to the machine tool trade to learn that the American Tool Works Company, of Cincinnati, have, through purchase, acquired manufacturing rights under the several patents which have been issued pertaining to such devices. This gives them the undisputed right to build without restriction their improved new "American" engine lathe with quick-changing mechanism for thread cutting and feeding. This lathe has previously been shown in these columns, and its merits are recognized by progressive shop managers. The line of sizes in which this lathe is built ranges from 14-in. to 36-in., inclusive, and full information on any size will be furnished by the makers.

THE METRIC SYSTEM.

Sir,—Mr. Halsey has invited me to reply to a letter of his on this subject which appeared in your issue for this month. I very gladly do this, though, as a matter of fact, I think that your leader on the question, which appeared in the same number, left very little more to be said. The statement which I made previously as to the survival of old weights and measures, and old names for new weights and measures, was based upon information which reached me from correspondents in different parts of Europe, and I have every reason to believe their testimony to be trustworthy.

It is not to be supposed that it would be impossible to find, even now in France and Germany, in villages remote from railway communication isolated cases of persistence in using old units, or old names for new units. I will go further, and say that after the metric weights and measures have been introduced into this country it may be many years before the old names will die out altogether in the mountains of Wales and the Highlands of Scotland. But what has that to do with the question? It will be found that wherever the inspectors of weights and measures can reasonably reach the users the new weights and measures will soon be adopted; and what does it really matter if some of the old women, who keep village shops, and only have a few transactions a week, fail to fall into line as quickly as do the residents in busy centres?

I maintain that, with such exceptions as above alluded to, there is no continuance of the old names or units in France or Germany, and I have excellent authority for this contention. Most decidedly do we claim a country as a metric using one wherever a law has been passed for the adoption of that system. For the purposes of our trade with such a country it does not matter whether the system has penetrated entirely through the interior of that country. If it be used in the customs house, we have to send invoices based on the metric scale.

We shall very soon now be able to claim that the metric system is used throughout the whole of the British Empire. Our bill has been read twice in the Lords, and has every prospect of passing both Houses with but slight modification. We have already presented a large number of extensively signed petitions in support of the measure, and are about to present a further batch. The attitude of the British colonies has been very clearly shown to be entirely on our side by a Government paper published about ten days since, of which the following is an abstract:

"The metric system is already used in Mauritius and Seychelles. The following are favorable to its adoption: Australia, New Zealand, Cape of Good Hope, Transvaal, Orange River Colony, Southern Rhodesia, Gambia, Northern Nigeria, Gibraltar, British Guiana, Trinidad, Leeward Islands, Windward Islands. Also, with a reservation that it must be adopted in the United Kingdom or in the Empire generally. Sierra Leone, Southern Nigeria, Ceylon, and Falklands. Hong Kong would take common action with other colonies. The States of New South Wales, Victoria, and Western Australia are also favorable, but together with South Australia and Tasmania, consider that the matter is one for the Commonwealth Government. Fiji is doubtful, but must follow Australia and New Zealand. British New Guiana would go with Australia. Jamaica and British Honduras need the adoption of the system in the United States of America. The practice of India is important to the Straits Settlements, who would be followed by Labuan; and the Bechuanaland Protectorate would follow the rest of South Africa. St. Helena, Cyprus, Lagos, Wei-Hai-Wei, Barbados, and Bahamas are on the whole unfavorable. The Gold Coast Colony and the State of Queensland are prepared to adopt, but consider that inconvenience would occur. Natal cannot consider the matter until some general lines of legislation have been agreed upon by His Majesty's Government. No definite answer has been given by Newfoundland, Malta, or Bermuda. Canada has not yet replied."

I will admit that Mr. Halsey should know better than I do what are the prospects of the Metric Bill at Washington, but I am convinced that it will give a great advantage in competing for foreign trade if we should have a few years' start of the States in the use of the metric system, and so I do not trouble very much about this particular prophecy of his.

I am, Sir, your obedient Servant,

E. Johnson,

Secretary Decimal Ass'n, London, Eng.

* * *

Capt. J. W. Pierce, the steamboat designer, of Portsmouth, near Kingston, who designed some of the fastest steamers and yachts on the St. Lawrence, died last month, at the age of 84.

MINING MATTERS.

Armand Moscovisi, engineer of the Matane Mining and Smelting Co., states that operations will be increased this year. Much machinery will be installed at Matane, Que., and the ores concentrated on the spot.

C. O. Macdonald is visiting Europe in the interests of the North Atlantic collieries, Port Morien, N.S., to study the principal British sub-marine collieries and the economical methods adopted in foreign countries.

Anderson Bros., of Woodstock, Ont., will establish a furniture factory in Newcastle, N.B., costing $25,000, and employing 75 men. The town will lend $20,000, without interest, repayable in twenty yearly instalments, and will give free water and exemption from taxation beyond $5,000.

The Eastern Townships Mining and Smelting Co. proposes to establish a copper smelter in Sherbrooke, Que. The capital is $40,000, and the company agree to put in a plant costing $25,000 within fifteen months. They ask the city for a bonus of $10,000, and exemption from taxation for ten years.

J. H. Plummer, president of the Dominion Iron and Steel Co., states that, when completed, the company's plant will have a capacity of from 200,000 to 250,000 tons of steel per year, and he believes they could turn out all the pig iron Canada could consume. The capacity of the washing plant is 200 tons per hour, and all coke will be produced from washed coal, thereby freeing it from sulphur and other impurities. 2,000 men are now employed.

* * *

INDUSTRIAL NOTES.

C. Karsh, of Aylmer, Ont., has started a spring mattress factory at Dundas, Ont.

The Maritime Engineering Co., St. John, N.B., has taken over the business of J. Weir & Son.

Representatives of the Henderson Roller Bearing Co. visited Brantford, Ont., recently, with a view to locating there.

A company with W. St. Clair at the head will establish in the old building of the Blatchford Organ Co., Galt, Ont., a factory for the manufacture of cement and mining machinery.

F. L. Smidth & Co., now located at 80 William St. and 66 Maiden Lane, New York, N.Y., will move to the J. Monroe-Taylor Building, 39-41 Cortlandt St., New York, on or before May 1st, where they will have a more desirable location and larger and better lighted offices.

A. J. Stevens, C.E., 499 Ontario St., Toronto, has been appointed Canadian representative of the Trussed Concrete Steel Co., of Detroit. The company proposes to have the shearing of the bars used in their structural work done in Canada, and Mr. Stevens will be glad to receive offers from firms who have a "bull dozer" or heavy power shears.

The new elevator at Collingwood, Ont., will be built of steel and concrete, and will have a capacity of 1,000,000 bushels. It will have 18 circular bins, 30 feet in diameter, 90 feet high, with a steel cupola 65 feet high, containing two 1,500-bushel scales and garners. The new marine leg will be 72 feet from that of the present elevator and their combined capacity will exceed 25,000 bushels per hour. The estimated cost, including the buildings, tracks, and a new dock, is $250,000.

The Colburn Machine Tool Co., of Franklin, Pa., has arranged with the Ludwig-Loewe Co., a large machinery firm having warehouses in London and Berlin and other continental centres, to represent them in Europe. H. W. Brickenridge, of this company, paid a short visit last month to leading cities of Ontario and Quebec, and reports that the boring mills, which are the sole specialty of his company, are meeting with an active demand in foreign countries, as well as in America.

LITERARY NOTES.

"Facts about Peat." By T. H. Leavitt. $1. Lee & Shepard, publishers, Boston, Mass.

The author built peat works years ago at Lexington, Mass., and wrote a treatise on the subject, of which the present book of 115 pages is a revised edition. He tells what peat is, where it is found, and describes some of the processes of manufacture, including his own. In this connection he refers to the experiments made in Canada, and speaks highly of the methods adopted by A. Dobson at Beaverton, as described in The Canadian Engineer of February last, in which article, by the way, an injustice was done the author in stating that his work had been abandoned. He calls attention to the enormous deposits of peat in Canada and the States, and looks forward to the time when it will be one of the chief fuels for steam and domestic purposes. The other uses of peat, such as a material for paper, for textiles, for fertilizing and as an antiseptic and disinfectant are also touched upon.

"The Metric Fallacy." By Frederick A. Halsey and Samuel S. Dale, 200 pp.; 8vo., cloth; illustrated; $1. Published by D. Van Nostrand Co., New York.

The authors oppose the introduction of the metric system of weights and measures in the United States, and claim that its adoption would necessitate the abandonment of present mechanical standards. They point to the persistence of old units in metric countries, such as France, Germany, Spain, Turkey, etc., as evidence of the failure to make the system effective in the countries which have adopted it officially.

"Steam Carriages and Traction Engines." By Wm. Fletcher, M. Inst., Mech. E. Illustrated; 428 pp.; 8vo.; 15s. net. Published by Longmans, Green & Co., 39 Paternoster Row, London, Eng.

Mr. Fletcher, who is the author of two previous works on traction engines and steam locomotives on common roads, and of two treatises on the steam jacket, gives in this volume an account, historical and mechanical, of the various types of steam carriages and traction engines in use in Great Britain and the United States. The mechanical features of most of these are dealt with and explained in 250 illustrations, and the future of steam road carriages and load-hauling by steam is indicated as very promising. It is the most comprehensive work on the subject that has come to our notice.

"Reinforced Concrete Construction." By L. J. Mensch, C.E. 217 pp.; illustrated; $2. Published by the Cement and Engineering News, Chicago.

The object of this work is to give in simple language the applications of reinforced concrete to structural work. By means of diagrams, half-tone illustrations and tables, much information is given on the possibilities of economical construction by this method of combining steel and iron with concrete. As the subject is not well understood by many engineers, architects and contractors, because of the fragmentary character of literature dealing with it, the present work will be very helpful. It gives examples of steel concrete applied to bridges, culverts, sewers, dams, docks, factory and other buildings, tanks, girders, columns, etc.

"Oil Engines." By W. A. Tookey. 138 pp.; illustrated; one shilling, net. Published by Merritt & Hatcher, Limited, Grocers' Hall Court, London, E.C., Eng.

A compact and convenient hand book on the construction and operation of oil engines with hints on how to purchase, erect and run them, with notes on the character of oils used. A short description is given of the principal types of oil engines in use in Great Britain. The author is also the compiler of a useful hand book on gas engines issued at the same price and by the same publishers.

Other publications received are:

Report of speeches in the House of Lords on the bill for the introduction of the Metric System, with copy of petition in support of the measure. Published by the Decimal Association, Botolph House, Eastcheap, London.

A pamphlet on the Metric System at 25 cents, published by Gottman & Leroy, 2265 St. Catherine St., Montreal.

L'Electricité dans les Mines en Europe. By Emile Guarini. Price 5 francs. Published by Ramlot Freres et Sœurs, Rue Gretry, Brussels, Belgium. A pamphlet of 46 pages with illustrations on the applications of electricity to mining in Great Britain and European countries. Also by the same author at one franc "L'Electricité en Agriculture."

Index to the Technical Press, giving the titles, and an indication of the contents of articles in the engineering press of the world. Published monthly at 10s. 6d. per year, at 11 Queen Victoria St., London, Eng.

Report of address, "Build up Canada," by Sir Sandford Fleming before the Canadian Club, Toronto. 15 pp. and map. A plea for the construction of a new transcontinental railway opening up the more northerly territory of Canada.

American Railway and Maintenance of Way Association, 1562 Monadnock Block, Chicago. Bulletin No. 48, reports of committee on wooden bridges and trestles, on ties, on roadway, and on yards and terminals, with recommendations and discussions; also Bulletin 49 on reduction of gradients and elimination of curvature on Union Pacific Railway, by J. B. Berry, chief engineer.

Year Book of the American Society of Mechanical Engineers for 1904, containing constitution, by-laws and list of members. F. R. Hutton, secretary, No. 12 West 31st St., New York. Next convention in Chicago, May 31st to June 3rd.

"Gold Deposits of New Zealand." By Alexander McKay, F.G.S., Government Geologist. An estimation of the relative quantities of reef and allevial gold, reprinted from New Zealand Mines Record and published at Wellington, N.Z., by the Colonial Government.

In a pamphlet of 74 pages, Charles Baillairge, C.E., Quebec gives a very instructive summary of the various papers, pamphlets, and articles he has written on engineering and cognate subjects since 1866. There are over one hundred entries, and the summary here given is a measure of Mr. Baillairge's tireless energy, no less than a revelation of his intelligent study of a wide range of topics not always limited to the work of the engineer. Price 50 cents per copy.

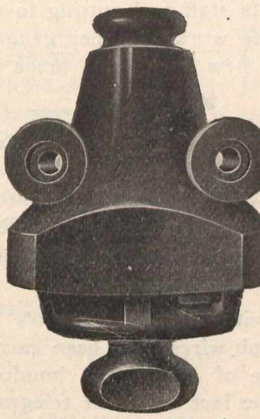
The publishers of "Knowledge," 326 High Holborn, London, issue a diary and handbook which is very valuable for amateur astronomers and students in science. The edition for 1904 contains, besides a monthly astronomical ephemeris, and charts of the paths of the planets for the year, twelve star maps showing the night sky of each month of the year, many miscellaneous notes and tables, and the chief celestial phenomena of the year. There are special articles on the camera, as applied to science in the region of astronomy, microscopy and natural history; on the uses of microscopes and telescopes; on practical meteorology and other subjects. There are 340 pages, 6 by 9-in., ruled for the users' notes, with index and special headings. Price 3s., net. The publishers of "Knowledge" have added a second title to their excellent monthly which is now called "Knowledge and Illustrated Scientific News," expressive of the more general scope which the paper now takes, while still maintaining its special fields of astronomy, natural history, botany, etc.

The Marine Review, of Cleveland, issued last month is an elaborate "fitting out" number. Besides the news of the spring movements, it was devoted to a discussion of the shipping question in all its various phases. The list of contributors embraced the Hon. Geo. B. Cortelyou, secretary of the Department of Commerce and Labor; Senator Wm. P. Frye, of the United States Senate; John McNeil, president of the Brotherhood of Boilermakers and Iron Ship Builders of America, and Winthrop L. Martin, author of "The History of the American Merchant Marine," and many others. Detailed drawings are published of a new dipper dredge for the Canadian Government. The number is splendidly illustrated throughout with more than ninety beautiful photographs.

The Robb Engineering Company has received an order from J. G. White & Co., of London, England, for a 300-h.p. Robb-Armstrong tandem compound engine to be a duplicate of two engines supplied by them for the Perth Tramways, Western Australia, five years ago.

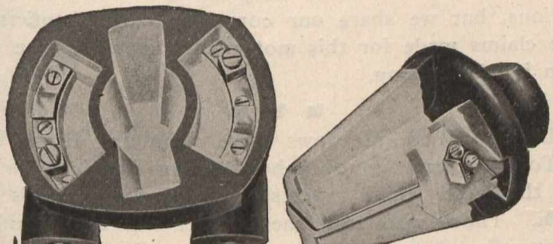
TRANSFORMER PRIMARY CUT-OUT.

An improved form of a transformer primary cut-out, designed to protect the high tension side of transformers, is being introduced by the Westinghouse Electric and Manufacturing Company. It is made entirely of porcelain, and its form is such that it has high insulating and arc-breaking qualities. The plug to which the fuse is attached projects between the terminals, the upper end of it rising well into the top of the block, and interposing an effective barrier, and thus



Transformer Primary Cut-out.—Showing insulator top, holes for screws and openings for viewing fuse.

making it impossible to maintain an arc. The fuse is eleven inches in length, making a long break, and is so placed that the vapors of a discharge are blown down and out of the device and away from the terminals. The line wire is carried directly to the top of the device and attached to it as to an ordinary insulator, which it thus displaces. To reach the terminal the wire must be bent around the edge of the block, and is so supported in an angle between the terminal post and the porcelain case that it cannot be loosened by any swaying of the wire in the wind. The plug enters from the bottom. When it is raised into place, a partial turn draws the knife



Transformer Primary Cut-out.—Showing terminals, plug with groove for fuse, and locking device.

blades on the plug into the jaws on the block, preventing the plug from dropping out or being blown out. All live parts are protected from the weather by the projecting edges of the block and by placing the terminals well above its lower surface, with no apertures in the side or top. A bend in the fuse wire brings it into plain view at all times, and it is thus possible to observe its condition without removing the plug, guarding against any liability of opening the circuit when there is a current upon the line. It is fastened to the cross-arm or other support by two screws, passing through porcelain tubes, which form a portion of the block. It has a rated capacity of 2,500 volts, 30 amperes. It is light and easy to re-fuse.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

At the February meeting of the Electrical Section of the above society, a paper was read by Dr. Winship, of the Gould Electric Storage Battery Company, of New York. It was a description of the construction and application of storage battery of the present day. Some discussion took place, and the question of battery deterioration and the effect of varying temperature upon the battery was gone into. At a meeting on 24th March, the subject of the use of electricity on canals was up for discussion, and papers were read by L. A. Herdt on "The Use of Electricity on the Lachine Canal," and by F. H. Leonard, Jr., on "Electrical Equipment for the Cornwall Canal."

At the last meeting of the Mining Section a paper was read by C. P. Campbell, on "Mine Timbering in Section 16 of the Lake Superior Mining Co., Michigan."

At the meeting of the Mechanical Section on March 14th, a paper was read by A. W. Robinson, on the hydraulic dredge, "J. Israel Tarte."

On the evenings of March 3rd and 10th, meetings of the General Section were held for the continuation of the discussion of Mr. Jamieson's paper on "Grain Pressure in Deep Bins." Both meetings were well attended, and the discussion was carried up to a late hour. The following took part: Messrs. Vautelet, Kennedy, Toltz, Goldmark, Johnson, Sherwood, Lordly and Prof. Bovey.

J. J. Taylor's paper on the "Shubenacadie Bridge" was put down for 31st March.

A ballot for new members will be opened on the 14th April.

A meeting of the General Section will be held April 7th. Business talk on rock asphalt and mastic asphalt, and their use in the construction of bridges, reservoirs, etc., illustrated by lantern slides, by Mr. Wiederhold, visitor.

GRAIN PRESSURES IN DEEP BINS.*

By J. A. Jamieson, C.E., Mem. Can. Soc. C.E.

The comparatively recent changes in the materials of construction of grain storage bins or silos has made the question of grain pressure one of great importance at the present time. Until within a comparatively recent date practically all grain elevators on this continent were built of wood, the storage bins being of laminated or cribbed construction, formed by building a number of walls both longitudinally and transversely of the building. The walls were constructed of plank 2-in. thick, laid flat and spiked one to the other, and from 6 to 8-in. wide, according to the quality of the material used and the size of bin required. The width of plank or thickness of wall decreased towards the top, and the walls were spaced 12 to 14 feet apart in both directions, thus subdividing the storage space into deep bins 12 to 14 feet square and 60 to 70 feet deep.

So long as this construction and size of bin was maintained, there was no great urgency for knowing accurately the lateral pressures produced by grain, as the thickness or necessary strength of the walls to safely resist the lateral pressure, and the strength of the hopper bottoms of the bins to carry the vertical load, had been well established by practice.

With a wooden bin wall of sufficient strength to resist the lateral pressure, the wall had ample area as a column to carry the vertical grain load transmitted to it by friction. This form of bin construction has been in use practically from the inception of the grain elevator system on this continent, and in many respects is admirably adapted for the purpose. The defect from a structural point of view was its lack of vertical rigidity, by reason of the shrinkage of the wood and the compressing of the many horizontal joints during the first loading of the bins, which usually amounts to a settlement of 12 to 18 inches in 70 feet, thus necessitating very great care being taken to distribute the grain load when first filling the bins in order to prevent undue strain of the structure. When, however, the initial settlement has taken place, no further precautions are necessary. The chief defect, however, of the wooden elevator is its liability to destruction by fire, involving heavy loss on the building and contents, and therefore high insurance premiums.

The increasing cost of insurance and timber, combined with the great inconvenience and loss of business to transportation companies by the destruction of an important terminal elevator, created a sudden demand for fireproof buildings; and the consequent change in the materials of construction made it necessary that a more accurate knowledge

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

of grain pressures under all working conditions should be obtained to permit of the intelligent design of bins of different materials or increased diameter and depth. Notwithstanding that the modern elevator system had its inception, and has reached its highest development in America, there is no record of any systematic series of tests having been made on this continent, with a view of obtaining a definite knowledge of the pressures produced by grain in deep bins. In fact, there is ample evidence that some who have undertaken the design and construction of bins for the storage of grain, coal, or other granular substances have been entirely lacking in knowledge of this subject; and there have been very few of even those engineers making a specialty of grain elevator or coal bin construction who could calculate with any degree of confidence the pressures produced by granular materials in bins having a breadth and depth varying to any considerable extent from standard size or constructed of different materials.

The author does not, however, wish to convey the impression that all grain elevator designers have been entirely groping in the dark on this subject, nor does he claim to have had a superior knowledge of grain pressures over other experienced elevator engineers, before undertaking the extensive and systematic series of tests which form the chief subject of this paper.

It has been well understood by experienced grain elevator engineers that grain stored in bins of standard dimensions (12 to 14 ft. square and 60 to 70 ft. deep), produced comparatively small vertical and lateral pressures, and that much the greater part of the grain load in the bin is carried by the walls and only a small part on the bin bottom, and that this is due to the friction between the grain and the bin walls.

Very few, if any, have, however, realized to what extent this was governed by ratio of breadth to depth of bin, and the ratio of the horizontal area of the grain column to the bin walls; and therefore to what extent the vertical and lateral pressures are increased, due to increase of horizontal dimensions of the bin.

This lack of data by which to calculate the pressures and strength of grain storage bins of varying dimensions and materials of construction, has been greatly felt by experienced grain elevator designers who have fully realized the importance of an ample factor of safety combined with economy of construction. It has, therefore, been rather surprising to find that some designers instead of conducting a series of tests to obtain the pressures produced by grain, which would enable them to intelligently proceed with their designs for bins of any dimensions, have built experimental tanks or bins at large expense, from which they gain very little practical information, since some parts of the construction when loaded may be strained far beyond its safe strength, and the weaknesses only be developed by time, while other parts may be of unnecessary strength. This may be called the "fit and try process," on which the wooden grain bin was originally developed and which was no doubt necessary in ancient times, but should now give place to modern engineering methods.

With an accurate knowledge of the pressures produced by grain and the necessary experience to enable the data to be intelligently used, and with the present knowledge of the strength of different materials of construction, there is no reason why a grain elevator may not be designed and built with the same regard to safety and economy as any other engineering work. It must, however, be borne in mind that while engineers may keep up with the times, their clients do not always do so, and that a structure actually built and in use, even if it has many weaknesses of which he is not aware, will often be selected by the prospective owner in preference to the most carefully prepared designs based on accurate data.

Most of the experienced elevator designers, knowing the very heavy loads that have to be carried in grain elevators or storage structures, have hesitated to depart from the standard sizes of bins. Unfortunately the demand for cheap storage and low insurance rates, has brought men into the field without either engineering knowledge or grain elevator experience, who have undertaken the design and construction of storage tanks apparently built by pure guess work, or at best, on some indefinite percentage of water pressure, with the result that in most cases serious weaknesses have developed and in others total failure and serious losses have occurred. This has frequently been the fault of the prospective elevator owner to whom low first cost of construction is often the chief and sometimes apparently the only consideration.

(To be continued.)

—The Hamilton Tool and Optical Co., Hamilton, Ont., has been increasing its staff and putting in new special tools for fine punch and die work. Caliper gauges and graduated scales are among the new lines being made by this company.

—Among the papers read before the Engineers' Club of Toronto during the past month was one on "Military Engineering," by Prof. W. R. Lang, of Toronto University. An instructive topical discussion, led by E. R. Clarke, of the Canada Foundry Co., took place on pumping machinery.

—Experiments with Signor Perego's system of telephoning over telegraph wires have been carried out at Milan, Italy, over a distance of about two hundred and forty-five miles. In spite of the fact that four telegraph stations were working on the same line, messages were heard clearly at either end of the wire.

—Among the papers read before the Engineering Society of the School of Practical Science, Toronto, last month was one by Willis Chipman, C.E., on "Sewage Disposal," and one by A. G. Christie, of the Westinghouse Co., of Pittsburg, on the steam turbine. Mr. Christie's paper was read by Mr. Dunlop, of the Hamilton branch of the Westinghouse Co.

—We have received enquiries regarding the new motor reported in last issue to have been invented by a man named Thornley, of Burton-on-Trent, Eng. In these days of remarkable achievements one must keep an open mind as to new inventions, but we share our correspondent's skepticism as to the claims made for this motor until more definite information is forthcoming.

The George B. Meadows Wire, Iron and Brass Works Co., Toronto, have issued a booklet on baby's wire cots, which they justly think reflects credit on the printer's art in Canada. Those who read the booklet will also think the booklet reflects equal credit on the compiler, who is apparently a good father as well as a good writer.

John S. Fielding, M.E.,and C.E., has returned to Toronto to resume practice as consulting engineer at No. 20 King St. East. Mr. Fielding is well known in Ontario, having been prominent in the construction of bridges, piers, breakwaters, etc., and has had extensive experience in recent years with the Carnegie Steel Co., at Pittsburg, Pa., and also at Sydney, C.B., where he spent three and one-half years as one of the designing engineers of the steel plant there.

Hon. Charles A. Parsons, the inventor of the steam turbine bearing his name, has applied for an extension of time within which he must manufacture in this country to save his Canadian patent. In his application he states that a steam vessel fitted with turbine machinery of about 3,000-h.p. is being constructed on the Tyne in England to ply on Lake Ontario and other inland waters this coming summer. It has been found impracticable as yet to equip and start a factory in Canada for the manufacture of turbine machinery, which is practically a new art, but arrangements are on now with the view of manufacturing on a commercial scale in this country.

MINERAL PRODUCTION OF CANADA LAST YEAR.

The following is a summary of the mineral production of Canada prepared by Elfric Drew Ingall, M.E., Mining Engineer to the Geological Survey of Canada, assisted by J. McLeish, B.A., of the same department. These figures are subject to revision.

Product.	Quantity. (a)	Value. (a)
†METALLIC.		
Copper, pounds	43,281,158	$ 5,728,261
Gold, Yukon, $12,250,000	}	18,834,490
Gold, all other, $6,584,490	}	
Iron ore (exports), tons	368,233	922,571
*Pig iron from Canadian ore	42,052	707,838
Lead (c), pounds	18,000,000	762,660
Nickel (d), pounds	12,505,510	5,002,204
Silver (e), ounces	3,182,000	1,700,779
Zinc (i), pounds	900,000	48,600
Total metallic		33,707,403
NON-METALLIC.		
Actinolite, tons	550	3,108
Arsenic, tons	257	15,420
Asbestos, tons	31,780	891,033
Asbestic, tons	10,548	13,819
Chromite, tons	3,383	33,830
Coal, tons	7,996,634	15,957,946
Coke (f), tons	544,132	1,663,725
Corundum, tons	No returns.	
Felspar, tons	13,228	18,066
Fire clay, tons	2,317	2,505
Graphite, tons	738	23,745
Grindstones, tons	5,538	48,302
Gypsum, tons	307,489	384,259
Limestone for flux, tons	277,452	259,244
Manganese ore (exports), tons	135	1,889
Mica, tons		159,473
Mineral pigments—		
Baryta, tons	1,163	3,931
Ochres, tons	6,226	32,440
Mineral water		100,000
Moulding sand, tons	3,568	7,256
Natural gas (g)		168,900
Peat, tons	1,100	3,300
Petroleum (h), barrels	461,336	922,672
Phosphate, tons	1,329	8.214
Pyrites, tons	33,530	126,133
Salt, tons	53,537	334,088
Talc, tons	688	2,064
Tripolite, tons	835	16,700
STRUCTURAL MATERIALS AND CLAY PRODUCTS.		
Cement, natural rock, 92,252 barrels		75,655
Cement, Portland, 627,741 barrels		1,090,842
Granite		150,000
Pottery		200,000
Sands and gravels (exports), 355,792 tons		124,006
Sewer pipe		317,970
Slate		22,040
Terra-cotta, pressed brick, etc		386,532
Building material, including bricks, building stone, lime, tiles, etc		5,650,000
Total structural materials and clay products		8,017,045
Total all other non-metallic		21,202,062
Total non-metallic		29,219,107
Total metallic		33,707,403
Estimated value of mineral products not returned		300,000
Total, 1903		$63,226,510
1902, Total		$63,885,999
1901 "		66,339,158
1900 "		64,618,268
1899 "		49,584,027
1898 "		38,697,021
1897 "		28,661,430
1896 "		22,584,513
1895 "		20,648,964
1894 "		19,931,158
1893 "		20,035,082
1892 "		16,628,417
1891 "		18,976,616
1890 "		16,763,353
1889 "		14,013,913
1888 "		12,518,894
1887 "		11,321,331
1886 "		10,221,255

†It is to be borne in mind that the only general and definite standard for valuing the varying and various products of the metal mining industries of the country is that herein adopted, viz., the final value of their metallic contents at the average market price for the year.

This reduces them to a common datum line for the purposes of this general table and results in such uniformity of presentment that the figures are reasonably comparable from year to year in illustration of the fluctuations and the growth of different industries.

The non-metallic minerals having a tangible use—value as individual minerals are put down at the average spot value for each.

Whilst this plan of course results in some discrepancies it is adopted as the best attainable method for the purposes of this general statement which is practically an advance presentation of the mineral industry as a whole.

The detailed presentation of the particulars of the various subordinate industries from other standpoints is reserved for the annual report of the Mines Section.

*The total production of pig iron in Canada in 1903, from Canadian and imported ores amounted to 297,885 tons, valued at $3,742,710, of which it is estimated 42,052 tons valued at $707,838, should be attributed to Canadian ore and 255,833 tons, valued at $3,034,872 to the ore imported.

(a) Quantity or value of product marketed. The ton used is that of 2,000 lbs.

(b) Copper contents of ore, matte, etc., at 13.235 cents per lb.

(c) Lead contents of ores, etc., at 4.237 cents per lb.

(d) Nickel contents of ore, matte, etc., at 40 cents per lb.

(e) Silver contents of ore at 53.45 cents per oz.

(f) Oven coke, all the production of Nova Scotia and British Columbia.

(g) Gross returns for sale of gas.

(h) Includes crude oil sold to refiners and oil sold for fuel and other purposes.

(i) Zinc contents of ores at 5.400 cents per lb.

REMARKS.

The main feature presented by the mineral industry of Canada, as a whole, consists in the decrease in the grand total of production of a little over one per cent. in comparison with the figures for 1902. A comparison of the items for the two years shows the reason for this falling off. The shrinkage in the production of the Yukon placer gold fields accounts for $2,250,000 of the total diminishment of over $2,500,000 in the gold output of the country. This is augmented by over $1,000,000 decrease in the values of the output credited to others of the metallic class, viz., pig iron, silver, lead and nickel. To offset this, the copper, iron ore and zinc industries exhibit increases aggregating nearly $1,500,000, leaving a minus amount of a little over $2,000,000 against the metallic class as a whole, equivalent to nearly six per cent.

Advances were shown in several of the non-metallic class, notably in coal and coke, limestone, mica, salt, cement and in some of the clay products. The total growth in all the non-metallics showing increases, amounted to nearly $2,000,000, the advance in the coal and coke output accounting for over $1,600,000 of this. As against these non-metallic industries showing increases, decreases are exhibited in the values of the production in asbestos, natural gas, petroleum and a number of others aggregating about $500,000 leaving a net gain in this class of somewhat under $1,500,000, or a little over five per cent. to offset the above mentioned falling off in the metallic class, the final difference in the grand totals for the two years amounting to nearly $660,000, or a proportional decrease of close on one per cent.

Product.	Quantity. Increase. p.c.	Quantity. Decrease. p.c.	Value. Increase. p.c.	Value. Decrease. p.c.
Metallic—				
Copper	11.54	....	26.97	....
Gold	....	....	....	11.73
Pig iron (from Canadian ore only)	....	41.32	....	32.14
Pig iron (from both home and imported ores)	....	16.77	....	11.80
Lead	....	21.59	....	18.35
Nickel	16.95	....	....	0.47
Silver	....	25.85	....	24.02
Non-metallic—				
Asbestos and asbestic	4.73	....	....	21.20
Coal	11.17	....	10.22	....
Coke	8.38	....	9.51	....
Cement	4.54	....	3.45	....

The above table gives the percentage of growth or decline in regard to the chief items in the general table. It will be noted that decreases both in quantities and values, have been the chief characteristic of the leading metallic industries with the notable exception of copper and nickel. In the latter case, however, the considerable increase in the output has been more than offset by the lower valuation which has been given to the metal following the drop in the average market price for the year. The increase in the copper output was on the other hand considerably enhanced by the higher average market price of the metal. It is interesting to note also that with regard to pig iron, lead and silver, higher market prices modified the heavy falling away in these items. The whole of the group classed as metallic, shows a decrease of 5.8 per cent.

In the non-metallic class the more important contributors are given in the table and all exhibit substantial increases in quantities, but lower prices reversed the effect in the case of asbestos and lessened the advantage gained in the case of coal and cement, coke only showing a slight advance. In the grand totals of the non-metallic class the figures for structural materials and clay products show a slight advance. In the grand totals of the non-metallic class the figures for structural materials and clay products show a slight advance of 1.5 per cent., all other non-metallics being credited with an advance of over 6.6 per cent.

Product. 1902.	Per cent. of total production.	Product. 1903.	Per cent. of total production.
1 Gold	33.41	1 Gold	29.79
2 Coal and coke	25.05	2 Coal and coke	27.87
3 Building material	8.43	3 Copper	9.06
4 Nickel	7.87	4 Building material	8.94
5 Copper	7.06	5 Nickel	7.91
6 Silver	3.51	6 Silver	2.69
7 Asbestos	1.80	7 Cement	1.84
8 Cement	1.77	8 Petroleum	1.46
9 Pig iron (from Canadian ore)	1.63	9 Iron ore (export)	1.46
10 Petroleum	1.48	10 Asbestos	1.42
11 Lead	1.46	11 Lead	1.21
12 Iron ore (not used in making pig iron in Canada	1.09	12 Pig iron (from Canadian ore)	1.12

The relative importance of the different mineral industries contributing to the grand total will be apparent from an inspection of the above table in which the figures account for all but about 5 per cent. of the aggregate. As usual gold together with coal and coke constitute Canada's most valuable mineral assets and account for 57.66 per cent. of the value of the whole mineral output of the country. To the metallic class as a whole must be credited 53.31 per cent. of the mineral output, the structural material division contributing 13.15 per cent. and the other non-metallic products a little over one-third or 33.53 per cent. The per capita value of the total mineral products for 1903 was $11.29, as compared with $2.23 in 1886, the first year for which figures are available.

Gold.—A decrease of over two and a half million dollars is shown, of which two and a quarter millions is to be ascribed to the decreased output from the Yukon District, leaving approximately a quarter of a million falling off in the other provinces. The Yukon output for the year. $12,250,000, is based on the receipts of Canadian Yukon gold at the United States mint, at San Francisco. and other receiving offices. The contributors to the total, as formerly, were Nova Scotia, Quebec, Ontario, Saskatchewan, the Yukon Territory and British Columbia.

Silver.—Silver production, according to present indications, shows a considerable decrease, over a million ounces, compared with last year's output. Over 90 per cent. of the production is obtained from British Columbia.

Lead.—The production of lead in 1903 has been estimated at about 9,000 tons. The exports, according to custom returns, were 9,314 tons, valued at $426,466. The production is practically all the output of British Columbia mines, no returns having been received of production in Eastern Canada.

Copper.—The copper contained in ore, matte, etc., shipped from Canadian mines in 1903, was about 21,640 tons, an increase of 2,238 tons or over 11.5 per cent. over the previous year's output. In Ontario and Quebec there was little change, perhaps a slight falling off, the increase being practically all in British Columbia. From the Sudbury district, Ontario, about 13,832 tons of high grade matte were shipped containing 3,576 tons of copper. (See further under nickel.) In British Columbia shipments of ore from the boundary district were approximately 625,000 tons in 1903 and from Rossland about 377,000 tons. For statistical purposes the copper is valued at the average price for the year of electrolytic copper in New York, viz., 13.235 cents per pound. This is an increase on the average price for 1902 of nearly 14 per cent.

Nickel.—The following were the results of operations on the nickel copper deposits in 1903:

	Tons.
Ore mined	136,033
Ore smelted	207,030
Matte shipped	13,832
Matte in stock at end of year	1,246
Copper contents of matte shipped	3,576
Nickel contents of matte shipped	6,258
Value of matte shipped	$2,686,469

According to customs returns exports of nickel were as follows:

	Lbs.
To Great Britain	1,335,677
United States	11,363,470
Other countries	80
Total	12,699,227

Zinc.—About 1,000 tons of zinc ore, worth $10,500 were shipped to Swansea, Wales, from the Long Lake zinc mine in the County of Frontenac, Ont. No returns have been received of zinc production in British Columbia.

Iron.—Exports of iron ore were 368,233 tons valued at $922,521. About 81,035 tons of iron ore from Canadian mines were charged to blast furnaces in Canada and valued at the furnace at about $247,229. In addition to the above Canadian ore, 485,911 tons of imported ore valued at $823,147 were used in Canadian furnaces. The total quantity of pig iron manufactured from both Canadian and imported ores was

297,885 tons of which 19,614 tons were made with charcoal as fuel and 278,271 tons with coke.

Arsenic.—The arsenic plant at Deloro, Ont., was worked for three months only producing 257 tons of white arsenic valued at $15,420. Exports of arsenic were 198 tons valued at $10,583.

Coal and Coke.—An increased production is reported from all the provinces in which coal mining is being carried on.

The Dominion Coal Company, the largest producing company in Nova Scotia, increased its output notwithstanding the serious check caused by the fire in Dominion No. 1 colliery in March. The Nova Scotia Steel and Coal Company also shows a very largely increased output from their Sydney mines. Considerable activity has been displayed in the operation of the mines in the North-West Territories, especially on the eastern slope of the Rocky Mountains in the district about Blairmore. In British Columbia the output of the Crow's Nest Pass Coal Company exceeded that of 1902 by 49.8 per cent. and the company has made substantial progress in the development of their properties. On the coast the Western Fuel Company are actively operating and developing the properties formerly worked by the New Vancouver Coal, Mining and Land Co. The Wellington Colliery Company have been opening up a seam of anthracite coal from which it is expected shipments will soon be made.

Corundum.—Returns have not yet been received of production of corundum, but railway shipments at Barry's Bay are reported at 1,090 tons, which may, however, include corundum ore as well as grain corundum.

Asbestos.—The production of asbestos divided into crude and mill stock was as follows:

	Tons.	
Crude	3,134	$361,867
Mill stock	27,995	554,021
Total	31,129	$915,888

Exports of asbestos according to customs returns were 31,780 tons valued at $891,033. The product was all obtained from the Eastern Townships, Quebec.

Cement.—The production of natural rock cement is at present small in comparison with the output of Portland, and the sales in 1903 were less by 35,679 barrels than in 1902. Detailed statistics for 1903 were as follows:

Cement sold during the year	92,252 brls.	valued at $75,655.
Cement manufactured	96,152 "	
Stock on hand, January 1st, 1903	23,000 "	
Stock on hand, Dec. 30th, 1903	26,000 "	
Wages paid	$29,550	

Portland cement statistics have been partially estimated in the absence of complete returns. The following is probably a close approximation:

Portland cement sold	627,741 brls.	valued at $1,090,842.
Portland cement manufactured	714,136 "	
Stock on hand, Jan. 1st, 1903	41,991 "	
Stock on hand, Dec. 31st, 1903	128,386 "	
Wages paid about	$400,000	

The imports of Portland cement in 1903 were:

	Cwt.	
Six months ending June	1,061,358	$385,216
Six months ending December	1,646,516	674,880
Total	2,707,874	$1,060,096

This importation is equivalent to about 773,678 barrels of 350 pounds each.

EXPORTS OF PRODUCTS OF THE MINE, CALENDAR YEAR, 1903.

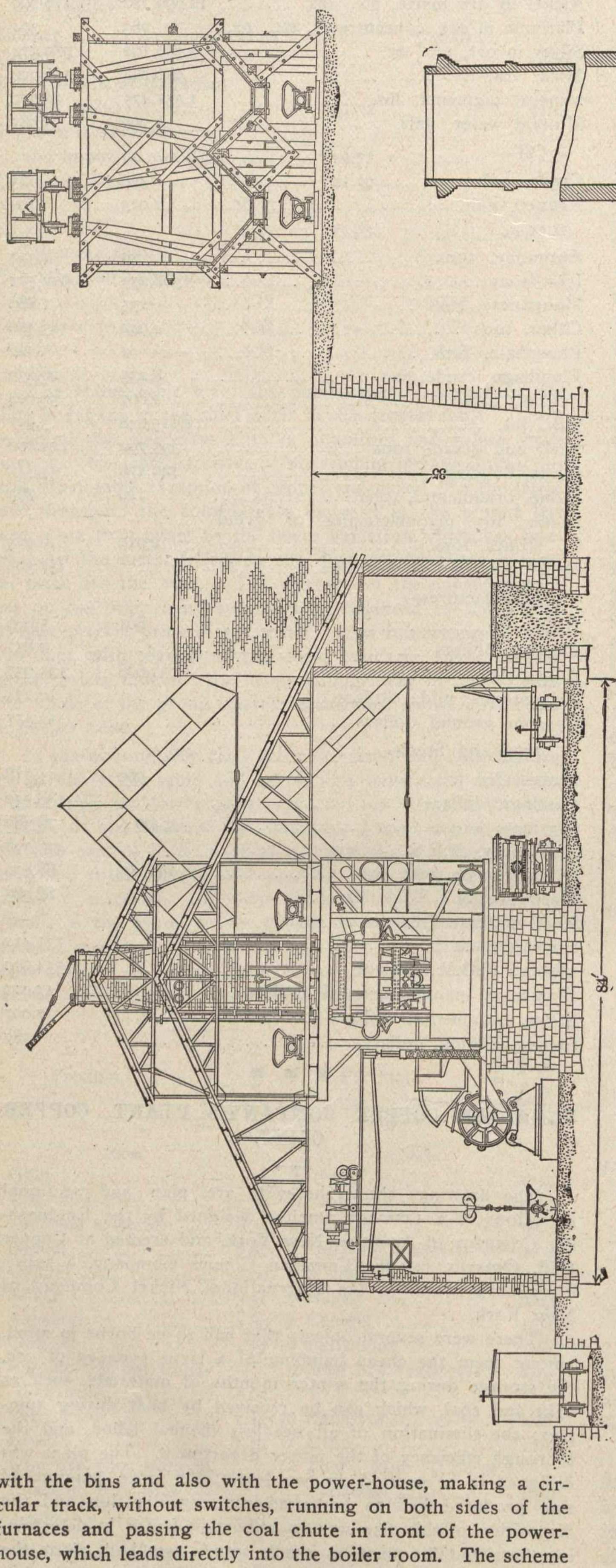
Product.	Quantity.	Value. $
Arsenic, lbs.	395,573	10,583
Asbestos, tons	31,780	891,033
Barytes, cwt.	406	368
Coal, tons	1,954,629	5,219,860
Chromite, tons	1,013	20,524
Felspar, tons	13,760	23,319
Gold-bearing quartz, dust, nuggets, etc., dollars	....	17,566,540
Gypsum, crude, tons	....	....
Copper, fine, in ore, etc., lbs.	37,039,175	3,702,368
Copper, black or coarse, cement copper and copper in pigs, lbs.	203,701	25,226
Lead in ore, etc., lbs.	18,624,303	426,466
Nickel in ore matte, etc., lbs.	12,699,227	1,116,099
Platinum in ore, concentrates, etc., oz.	283	304
Silver in ore, etc., oz.	3,360,192	1,989,474
Mica, lbs.	956,244	196,020
Mineral pigments, lbs.	1,351,475	12,770
Mineral water, gals.	5,709	3,585
Oil—		
Crude, gals.	350	15
Refined, gals.	1,013	190
Ores—		
Antimony, tons	33	4,332
Iron, tons	368,233	922,571
Manganese, tons	135	1,889
Other, tons	4,942	143,470
Phosphate, tons	1	20
Plumbago, crude, cwt.	8,235	26,230
Pyrites, tons	2,067	59,604
Salt, lbs.	11,915,648	5,927
Sand and gravel, tons	355,792	124,006
Stone, building, tons	140,476	45,512
Stone, ornamental, tons	129	783
Stone, for manufacturing of grindstones, tons	2,019	16,925
Other products of the mine	....	157,568
Manufactures—		
Bricks, m.	801	5,699
Cement, dollars	....	2,851
Coke, tons	32,608	135,957
Grindstones, mfd., dollars	....	10,734
Gypsum, ground, dollars	....	12,457
Iron and Steel—		
Stoves, No.	960	11,718
Castings, dollars	....	138,352
Pig iron, tons	4,400	78,382
Machinery, N.E.S., dollars	....	416,397
Scrap iron or steel, cwt.	131,263	88,839
Hardware, N.E.S., dollars	....	88,285
Steel and manufactures of, dollars	....	2,078,328
Lime, dollars	....	131,412
Metals, N.O.P., dollars	....	554,900
Plumbago, manufactures of, dollars	....	17,412
Stone, ornamental, dollars	....	7,097
Stone, building, dollars	....	587

CANADIAN COPPER COMPANY'S PLANT, COPPER CLIFF.

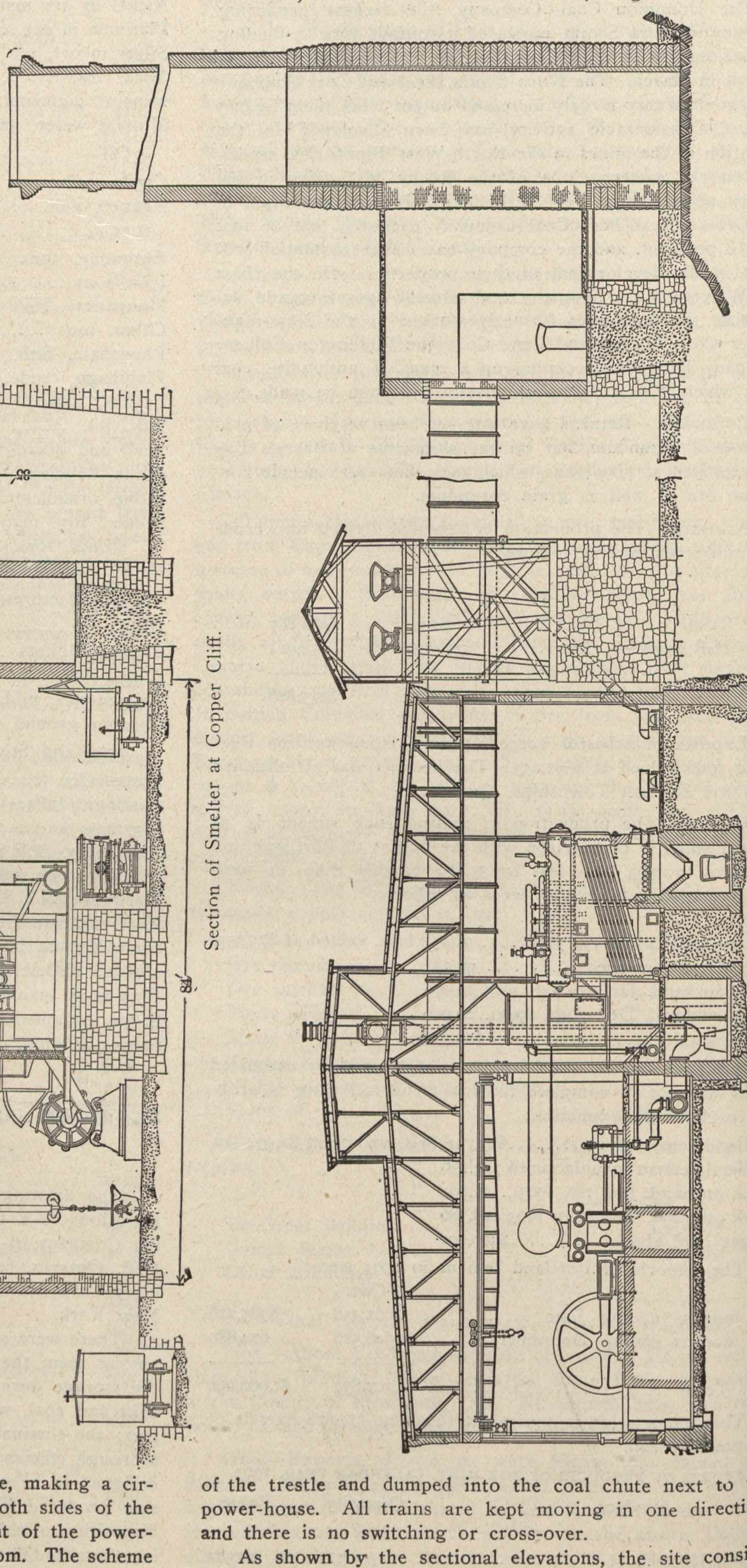
The drawings shown herewith are plan and sectional elevations of a 1,000-ton smelter designed by the Engineering Company of America, New York, and erected at Copper Cliff, Ontario, for the Canadian Copper Company, a subsidiary corporation of the International Nickel Company of New York.

There were several objects that had to be borne in mind, among them the cheap handling of a large tonnage of ore, the storage during the winter months of materials such as coke and coal, which can be received by boat during summer; the elimination of all needless manual labor, and the thorough efficiency of the power department. The plant was designed to be erected on two levels; the large amount of slag produced had to be taken into consideration and the disposition of this slag was an important factor in determining the site. The plant, as it now stands, was built along the face of a cliff on the northern side of the deep valley in which the town of Copper Cliff stands.

The problem was to take the roasted pyrrhotite from roast heaps and convert it into 80 per cent. matte, the presence of nickel precluding the advisability of a higher concentration. On the upper edge of the cliff a system of bins has been constructed for storage purposes. The smelter building proper is situated parallel to these bins with the power-house at the eastern end. A trestle was built on the grade level of the bottom of the bins, which is also the grade level of the charging floor, connecting the charging floor and drawn up to the top of the bins. The track leading to the top of the trestle is on an easy grade all the way, and is also connected with the main track leading to the Canadian Pacific Railway. All ore, flux, coke, coal, etc., is handled on these tracks and dumped directly into the bins. Running on the circular track underneath the bins and into the smelter building and past the power-house is an electric railroad, with side-dumping cars drawn by electric locomotives. The ore, coke, etc., is loaded into these cars, weighed on the end



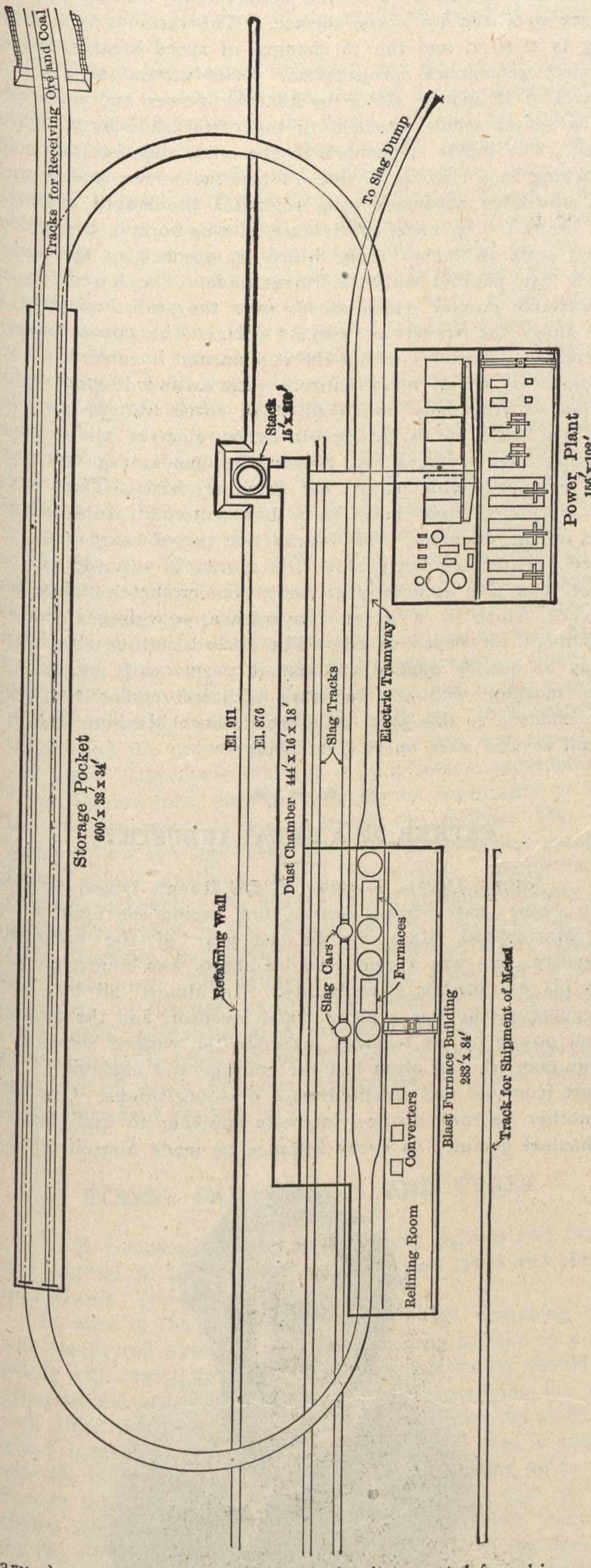
Section of Smelter at Copper Cliff.



Section of Works at Copper Cliff.

with the bins and also with the power-house, making a circular track, without switches, running on both sides of the furnaces and passing the coal chute in front of the power-house, which leads directly into the boiler room. The scheme of operation is as follows: Three miles from the plant is the largest mine. The ore is taken from this mine to the roasting-beds, which are about one-half mile from the smelter. After roasting, the ore is loaded into hopper-bottom cars of the trestle and dumped into the coal chute next to the power-house. All trains are kept moving in one direction, and there is no switching or cross-over.

As shown by the sectional elevations, the site consists of two levels with a difference of 35 ft. in elevation. The upper elevation is in the same elevation as the feed-floor, and is occupied by a double-track pocket trestle 32 by 34 by 600 feet. The storage pockets were made to hold enough coal to last over the period of closed navigation; coal being received by boat at a near-by port on Georgian Bay, as well as coke, ore, silica and clay. On the lower level are located the power-house, 156 by 102 feet; the blast-furnace building, 84 by 283 feet; the foundations for the trestle carrying the electric tramway, connecting the storage pockets with the feed-floor; the coal-bins of the boiler-room; the dust-chamber, 16 feet wide, 18 feet high and 444 feet long; the stack, 15 feet inside diameter, 210 feet high; together with the neces-



Plans of Works at Copper Cliff.

sary slag tracks, sunken track for loading metal for shipment, tracks to storehouse, etc.

The power-house is equipped with two horizontal, cross-compound, condensing blowing engines with steam cylinders 13 in. and 24 in. by 42 in. and air cylinders 57 in. and 57 in. by 42 in. When operating under usual working conditions these engines will deliver 20,000 cub. ft. of free air per minute against a pressure of 40 oz. for use in the blast furnaces. Another blowing engine, with steam cylinders 15 in. and 30 in. by 42 in. and air cylinders 40 in. and 40 in. by 42 in. will deliver 10,000 cub. ft. of free air per minute against a pressure of 15 lbs. for use in the converters. Two 13 in. by 26 in. by 20 in. horizontal compound condensing engines built by the Robb Engineering Company, of Amherst, N.S., to each of which is directly connected one 200-K.W., 600-volt, three-phase alternating current generator built by the Canadian General Electric Company, each generator having its own exciter of 11-K.W. capacity belt driven from generator shaft. The electrical energy thus generated is used for hoisting and pumping the mines, operating the electric tramway for charging cars, turning the converters, and operating the travelling crane in furnace building. The station is also equipped with one 25-K.W. motor driven generator set, for furnishing direct current to the electric locomotives. A travelling crane of ample capacity is installed in the engine room for handling all this apparatus. A gravity oiling and filtration system is installed on all engines.

Coal is brought to the power plant by the electric locomotive train above referred to and dumped into bins built in trestle along the west side of building. Then it runs through coal chutes to one-half-ton coal cars in boiler room, from which cars it is shovelled into boiler furnaces. The only available water for boiler use contains considerable sulphuric acid and scale-forming elements, and, to eliminate these, the water is subjected to a chemical treatment and precipitation in a water purifying system. In this way the acid is neutralized and the scale-forming material is removed before the water enters the boilers.

The blast furnace building contains two Holthoff copper blast furnaces; three stands for Holthoff converters; one 40-ton electric crane; the necessary matte-settlers, clay drills, silica and clay storage bins, etc. Room is provided for expansion.

In operation the ore, coke and flux for blast furnaces, silica, and clay for lining converters and coal for boilers is delivered into the top of the trestle pockets by standard gauge cars—Ingoldsby side-dumping in the case of ore—and drawn from the bottom of the pockets into trains of six 2-ton, 36-in. gauge, side-dump cars, made by Arthur Koppel, New York, which are hauled to the blast furnace, silica and clay storage bins or coal bins by 25-h.p. Canadian General Electric Company electric locomotives. When feeding the blast furnaces, a train of six cars will be made up of four cars containing two tons of smelting mixture and two cars each containing the proper amount of coke to go with four tons of charge.

The slag and matte runs from the blast furnace into 16-in. settlers, the slag overflowing into 225 cub. ft. capacity Pollock cinder cars, which are hauled to the dump by standard gauge locomotives. The matte is tapped into 10-ton cast steel ladles and taken to the converter by a 40-ton Case Manufacturing Company's electric crane. The same crane removes the converter shells for relining, and takes care of the converter slag and white metal, pouring them into molds for return into the pocket trestle, or for shipment to the refinery. The coal bins at the boilers and the silica and clay bins at the clay mills are kept full by six-car train-loads of material.

The flue dust is drawn from the dust chamber into a standard gauge, bottom-dump gondola especially fitted for the service, and this car is hauled to the top of the pocket trestle on the upper level and the dust drawn into a pocket fitted for that purpose, whence it is drawn to a briquetting machine, pressed into briquettes and added to the charge.

The electric tramway consists of two parallel 36-in. gauge tracks running under two lines of grates under the pocket trestle, then over suspension scales to opposite sides of the furnaces on the feed floor level, passing over the top of the boiler room coal bins and converter lining house, silica and clay bins. The two tracks have cross-over connections, but under normal working conditions each track carries a train entirely independent of the other.

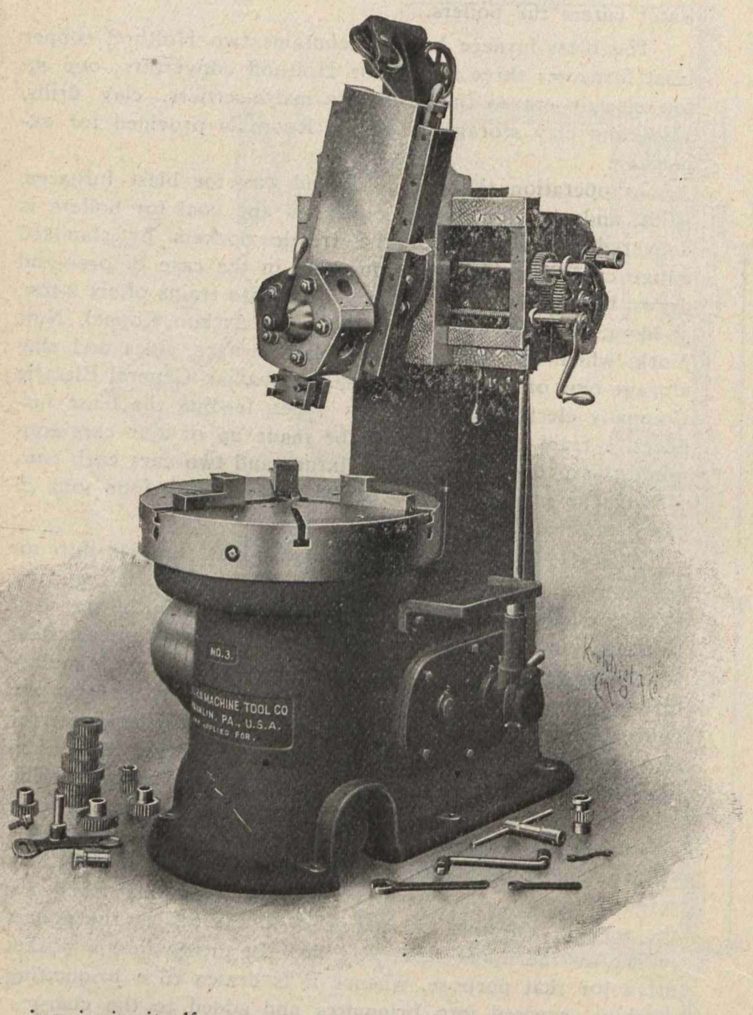
The blast furnaces are 50 in. by 204 in. at the tuyeres; 14 feet 9 in. from centre of tuyeres to the feed floor, and have on each side four lower jackets each 51 in. wide and 8 ft. 6 in. high, and two upper jackets 8 ft. 6 in. wide and 6 ft. high. Each lower side jacket carries four 6-in. tuyeres.

Both ends of the furnace are made alike, so that either end can be used for removing matte and slag. There is no brick work under the deck beams. The converters are 84 in. by 126 in. and are tilted by a train of gears and a worm, driven by the electric motor.

The water for the plant is supplied by a 16-in. diameter pipe running from a dam situated about 5,000 feet from the plant itself. The water is run by gravity into the jackets, and when drawn out is pumped into a tank above the smelting plant for fire purposes or into the reservoir, which is near the foot of the plant, and the hot water is also used in the boilers in order to economize at that point.---Correspondence, Engineering and Mines Journal.

VERTICAL BORING AND TURNING MILL.

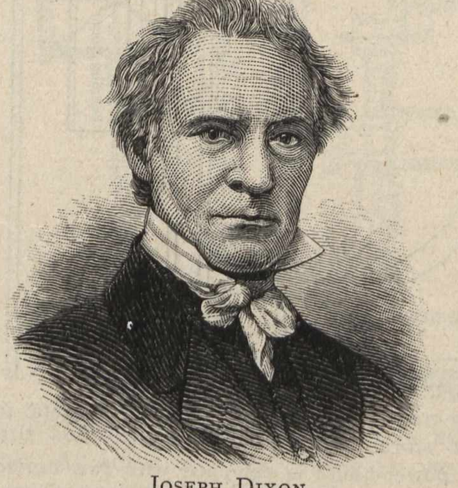
Vertical boring and turning mills have rapidly come into use in many large as well as small machine shops throughout the country during the past few years, and their value as manufacturing tools is daily being more fully demonstrated. Their function is not so much to replace the lathe, but rather to do a variety of work such as chucking, boring and turning, etc., which can be performed more rapidly, economically and easier than on any other type of machine. The facility with which work can be placed on the table of a mill and held until ready for chucking and centering is in itself of no inconsiderable importance in shop economy, where increased production is a factor which receives careful attention. This condition prevails more generally to-day than ever before and in the struggle for supremacy may determine the success or failure of a shop. The accompanying cut shows a 34-inch Vertical Boring and Turning Mill, built by the Colburn Machine Tool Company, Franklin, Pa.



It has a capacity of 34 inches in diameter and will take work under the cross-rail 14 inches high. It has 16 changes of speed varying from 2⅜ to 68¾ revolutions per minute. This affords as great range as is necessary for any work which would ordinarily be done on this size tool. The feeds, both vertical and horizontal, are positive, gear driven, and are provided with adjustable automatic stops. There are eight available changes of feed for each speed of the table. Feeds range from .012 to .125 of an inch in vertical or angular directions and from .025 to .250 of an inch in horizontal direction. The makers of this mill are prepared to furnish either three or four jaw chuck, or plain table, as the user may elect. The driving cone shaft is placed parallel with the cross-rail so that the machine may be located under a travelling crane and belted back to the countershaft, leaving a free space overhead for crane service. The ratio of back gearing is 21 to 1, and the 16 changes of speed are graded in perfect geometrical progression. The vertical slide has a travel of 18 inches, either by hand or power and is carried in a swivel saddle attached to the turret slide by a central stud. The saddle is clamped to the cross slide by four bolts working in a circular T slot. When the power feed is used an adjustable automatic stop regulates the length of travel as desired. An excellent feature of this tool is the graduated scale 18 inches long, which is attached to the turret slide cap parallel with the turret slide. The latter has an adjustable pointer which moves over the scale indicating at all times the travel of turret slide. The counterbalance weight is suspended within the column and is carried in such manner as to do away entirely with awkward overhanging arms, as frequently employed. The turret can be swiveled to any angle up to 30 degrees either side of the perpendicular, has a travel of 15½-in. by hand or power, and is equipped with stops for tripping feed. The turret is five-sided and holes are bored to fit tool shanks 2¼-in. in diameter. The lock bolt is of hardened tool steel, ground perfectly true. It works in a hardened tool steel ring also accurately ground. A micrometer dial is furnished, which is a great convenience, providing a fine adjustment for depth of cut. The thread cutting attachment may be quickly applied and remain permanently attached to the machine without interfering with its regular operation. In addition to this 34-in. mill, the Colburn Machine Tool Co. built several sizes up to 6 ft. swing.

FATHER OF A GREAT INDUSTRY.

Joseph Dixon, founder of the Joseph Dixon Crucible Co., was a native-born Yankee, first seeing the light of day at Marblehead, Mass., in the last year of the eighteenth century. He was a genius whose ability was almost equalled by his extraordinary versatility. In almost all his many occupations he was a pioneer and inventor, and the strength and power of his features discloses the rugged strength of this man who so often had the courage and ingenuity to depart from old and accepted ways of doing things. One after another he took up new interests applying to each his mechanical genius. In every instance he made himself felt and



JOSEPH DIXON.

marked his progress with many new and valuable additions to knowledge and methods. "Before he was twenty-one he invented a machine to cut files; afterwards he learned the printer's trade, then wood engraving, then lithography, and became a thorough chemist, optician, and photographer. He was probably the first to take a portrait by the camera; he first used the reflector, so that the subjects should not appear to be reversed. He built the first locomotive with wooden wheels, but with the same double crank now used. He originated the process of photo-lithography. To guard against abuses of this process, he invented the system of printing in colors on bank notes and patented it, but never received any benefit, all the banks having used it without pay. He perfected the system of making collodion for the photographers, and aided Mr. Harrison in the mode of grinding lenses for camera tubes."

Perhaps his greatest invention was that of the plumbago crucible, as used to-day, and thereby he revolutionized the metallurgical industry of the world and laid the foundation of his large fortune. In 1827 he was established in the manufacture of crucibles and shortly thereafter moved to its present location in Jersey City. The Joseph Dixon Crucible Company was incorporated in 1868, and has grown steadily year by year to its present magnitude. One by one new uses have been found for graphite, and in this field the Dixon Company has always been the pioneer. Stove polish, pencils, paint, lubricants and half a hundred specialties has this marvellous mineral graphite yielded, and each succeeding year has brought forth new uses and new Dixon products.

To-day, the Dixon factories turn out almost three hundred pencils for every working minute, and seven hundred different pencils are regularly made. They own their mines and are also importers so that the exact quality of graphite is provided for the peculiar needs of each application of it. It is very necessary in the manufacture of graphite products that the form and size and chemical analysis of the mineral be exactly adapted to the work in hand. Graphite for lubrication purposes must be of the flake formation as the amorphous is always associated in nature with earthy impurities from which it cannot be separated. Even the Flake Graphite from the Dixon mines has to be carefully milled to wholly free it from the silicates with which it occurs and the processes call for great skill and experience and much elaborate equipment. It is almost impossible to detect impure from pure graphite by the appearance or feeling and the only safe way to avoid the mishaps that will surely follow the application of a gritty lubricating graphite, is to refuse anything but a responsible manufacturer's original packages. The history of the graphite industry can almost be written in the records of the Joseph Dixon Crucible Company, and "Graphite" has come to mean "Dixon" the world over. The company issues a good deal of useful literature on the uses of graphite, alone or in combination with other substances as a crucible mixture, stove polish, protective paint, lubricant, pencil "lead" or electrical specialty, and will no doubt respond to enquiries on these subjects from interested readers.

STREET CAR WHEELS AND TYRES.

R. H. Simpson discusses in The Light Railway and Tramway Journal, of London, the merits of steel tyred and chilled iron wheels. He says:

In view of the present tendency towards equipping cars with steel-tyred wheels, it may be interesting to take up a few points with regard to them. Careful consideration should be given to the question of diameter before specifying the size with which the truck is to be fitted. In America the standard wheel diameter is 33 in., and the type of wheel used is invariably the chilled one. In this country the diameter up to the present time has generally been 30 in., and also that of the chilled iron type. Amongst others, there are two reasons for the adoption of this diameter: one, a relict of the days of horse traction, and the other, that with this diameter the height from the ground to the steps is reduced to a reasonable figure. It is generally known that with 30 in. wheels and with most manufacturers' motors there is not more than from 2¾ to 3 in. difference between the underside of the motor or gear case and the top of the rail head, and it is also invariably found in practice that this dimension does not obtain in the centre of the track between the rails, as the paving, whether of stone setts or wood blocks, is crowned at least ½ in. Besides this, the paving rises after a short time, and it is difficult to prevent it from doing so; therefore, with new wheels 30 in. in diameter, there will be less clearance than is stated above. It is not possible to wear down a chilled wheel 30 in. in diameter to less than 28¼ or 28½ in. on account of getting below the depth of the chill, which is only from ⅝ to ⅞ in. deep; also the clearance between the motor and the ground becomes too small—some 2 in. or so. In changing from cast-iron wheels to steel-tyred, the diameter should be increased for this reason: the steel tyre, which is usually 2½ in. deep, allows a greater depth to be worn down, say to 1½ or 1¾ in. on the radius, instead of ¾ to ⅞ in. in the case of the chilled wheel, and if a 30 in. steel-tyred wheel is employed, the motor will be down on the track before the full life of the tyre can be obtained. This result will be seen to be extremely uneconomical. For this reason the writer advocates the use of a wheel of not less than 31¾ in. in diameter when steel-tyred, which size is in use on several existing tramways. It will, therefore, be seen that it is useless going to the expense of a steel tyre with a depth of 2½ in., which is the minimum, if it cannot be worn down to its working limit on account of the smallness in diameter bringing the motor down on the road. The objection that a larger diameter wheel raises the height of the steps can be easily remedied if these two points are considered together when designing the car underframe, and, as a matter of fact, there are cars running already with wheels 31¾, 32, and even 33 in. in diameter, in which this trouble has been eliminated.

STEEL-TYRED VS. IRON CHILLED WHEELS.

This subject requires thought and experience before an opinion can be expressed; each type has its merits, but the conditions of working should be considered before deciding upon the type of wheel to be installed. The writer has not been able to ascertain that both types of wheel have been run over the same line under equal conditions, and would be glad to be informed if such had been the case. By equal conditions is meant a new track carefully laid and thought out, with the same section of rail throughout, the gauge constant, wheel base of truck arranged to suit the minimum curves, and whether single or double track cars in either case; as regards the wheels themselves, the section of tread designed to suit the rail on which it has to run, especially in respect to the thickness of the flange; and lastly, the correct wheel gauge to which the wheels should be pressed on. The writer is of opinion that, with all points taken into consideration, the difference it costs between the two types of wheels would not amount to a great deal. It is very well known that on those lines where trouble has been experienced with chilled wheels, due to the flanges chipping, it has not been so much the fault of the wheels themselves as the condition of the track over which they have had to run; also, that some engineers insist on their own design of tread instead of leaving this detail to the wheel manufacturer. While on this point of section of tread, I think it is now quite time that a standard section should be agreed upon, taking into consideration that in the near future cars owned by various corporations and private companies will be running over one another's lines. It is argued that steel wheels have stronger centres than chilled ones; this may be so, but there have been few failures in this respect with the chilled wheel. The steel-tyred wheel appeals more to the mechanical engineer, especially to the steam or railway man, who has been used to these wheels on his steam locomotives, but whichever wheel is adopted much depends on the quality and price of the wheel purchased, the amount of attention it receives, the gradients over which it has to run, the condition of the permanent way, the radii of the curves, whether electric braking is used extensively or not, and to the skill (or lack of it) on the part of the motormen, all of which vary considerably. On a road which is properly managed, both as to upkeep of rolling stock and education of its drivers, it will be found that not only wheels, but other renewable parts, last some 50 per cent. longer, and even more, than on those lines which are left practically to run themselves till something gives out. The writer has noticed that with steel-tyred wheels the flange has sometimes worn hollow at the throat, but this has usually happened on bogie trucks, which have had insufficient lubrication on their side bearings, causing them to work stiffly, the truck consequently not adjusting itself to the track after having passed round curves.

The comparative cost of steel-tyred and cast-iron wheels, as here given (sterling money being converted to Canadian), is based on a two years' working, and for a total mileage of 60,000 miles for the two years. The scrap value of the cast-iron wheels is taken into account in the sum allowed for new wheels. It will also be noted that an amount of $9.73 per wheel has been allowed in the case of the steel-tyred wheels as the value of the centres, which point has been entirely overlooked in all previous articles dealing with the advantage of one type of wheel over the other. A sum of $4.87 per car has been allowed for re-turning steel tyres after one year's working, which could be omitted, as in many cases these wheels run the full mileage without returning, but it is safer to let this sum stand. No allowance has been made for taking out or replacing the wheels and axles, as in all well-managed car sheds these come out in any case for examination of axle boxes, etc. A year's working has been taken as 30,000 miles, as this mileage is a fair average for a car in most districts.

STEEL-TYRED WHEELS.

One set of four wheels at $19.47 each	$77 86
Re-turning at end of first year's working and 30,000 miles' wear, which in several cases has not been necessary	4 87
Total cost at end of second year's working and 60,000 miles' wear, tyres now worn out	82 73
One set of new tyres at about $9.73 each	38 93
Re-turning at end of third year's working and 30,000 miles' wear	4 87
Total cost at end of fourth year's working and 60,000 miles' wear, tyres now worn out for the second time	126 53
Value of the four wheel centres	38 93
Cost of wheels at end of fourth year, after allowing for material not requiring to be scrapped	87 60

CHILLED CAST-IRON WHEELS.

One set of four wheels at $5.36 each, after allowing for their scrap value	21 42
Four new wheels, with refitting on axles, at end of first year's working and 30,000 miles' wear	28 71
Total cost at end of second year's working and 60,000 miles' wear	50 13
Four new wheels, etc., at end of second year's working	28 71
Ditto at end of third year and 30,000 miles	28 71
Total cost at end of fourth year's working and 60,000 miles' wear, a new wheel being required at the end of each year and 30,000 miles' wear	107 55

The foregoing figures show a saving at the end of two years of $6.33 per car, and at the end of four years $19.47 per car in the case of steel-tyred wheels, and is brought about entirely by allowing for the value of the wheel centre, which can be retained on the axle and does not depreciate. The figures have been carefully gone into, and facts obtained from an entirely unbiassed standpoint.

The following gives particulars of steel-tyred and chilled iron wheels manufactured by Hadfield's Steel Foundry Co., for whom Peacock Bros., of Montreal, are Canadian agents. These wheels consist of a cast steel centre, on which is fitted a renewable steel tyre.

Centres.—The centres are made of Hadfield's best toughened cast steel of a special grade. They are capable of withstanding a test load, applied by steady pressure to the centre of the boss, of about 112,000 lbs. without producing any permanent set, and will withstand a load of about 179,200 lbs. applied in the same manner, without showing signs of fracture. The centres are carefully turned up and recessed on the front side of the rim, the back edge being slightly tapered off. The boss is faced on both sides and bored for the axle.

Tyres.—These are 2½ to 2¾-in. thick, and are constructed of a specially hard and toughened rolled steel, having a tensile strength of 112,000 to 123,200 lbs. per square inch, with an elongation of 67,200 lbs. per cent. in 2-in. The tyre is carefully heated and shrunk on the centre mentioned above. The wheel is then placed in a lathe and has the projection on the back edge of the tyre folded over by a special appliance. In this way the tyre is so fixed that it is impossible for it to become loose laterally. The complete wheel is pressed on to the axle at a pressure of not less than 67,200 lbs.

Mileage.—These tyres will give a mileage of about 60,000 miles before requiring to be renewed. The wear for this mileage will be from 1½ to 1¾in. on the radius or ¼-in. on the diameter for every 5,000 miles run. At Sheffield, where the conditions are severe, due to the steep gradients, the average life has come out at 65,000 to 70,000 miles.

Weight.—The average weight of a 31¾-in. wheel is approximately 330 lbs.

Axles.—These are of a special quality of best toughened steel, and so far there is no breakage on record against these axles.

THE "ANGUS SHOPS" OF THE CANADIAN PACIFIC RAILWAY.

From a Paper read before the Canadian Society of Civil Engineers.

BY HENRY GOLDMARK, C.E., ENGINEER IN CHARGE OF CONSTRUCTION.

(Concluded from March issue).

It may be added that the wooden Howe trusses in the car shop were adopted instead of steel trusses mainly to save time. The saving in cost did not exceed 12½ per cent. In the outcome there was probably no saving of time from the use of timber, but on the other hand no great disadvantage resulted from using this form of construction.

The heavy timber girder and post construction as used in the truck shop, etc., was adopted as being cheaper and better than truss work, and its use is believed to be fully justified.

The principles of mill construction were fully carried out, the purlins being in no cases less than 6 by 12-in. and in many buildings 8 by 16-in. They are spaced from 8 to 10 feet apart. The roof boards are 3-in. thick in all cases.

In the locomotive shop they are 11-in. wide, T. and G. In most of the other buildings this roofing was built up of strips of 3 by 3-in. laid with broken joints in random lengths and well nailed horizontally and vertically. These strips were surfaced on three sides, but were not tongued and grooved. On top of the boards a four-ply tar and gravel roofing of standard construction was laid. There is a galvanized iron flashing around the skylight, but there are no gutters or downspouts.

The flooring throughout consists of three-inch unmatched plank nailed to cedar sleepers 4 feet apart and bedded in from 15 to 18 inches of cinders. It may be added that the roof loads were taken at 70 lbs. per square foot. (total loading), and the stresses in the timber beams at 1,500 lbs. per sq. inch. The structural steel is of simple construction though every attempt was made to secure rigidity especially where crane runways had to be supported. Tensile stresses are 15,000 lbs. per sq. inch on the net section and compressile stresses 12,000 lbs. reduced for length. In the crane runway girders the tensile stresses were reduced to 12,500 lbs. per sq. inch.

HEATING.

The heating of the shops was the subject of an extended study in order to determine the most practicable and feasible system. This question was necessarily taken up in connection with the design of the power plant. The economy of producing power in an independent station is dependent on the utilization of the exhaust steam of heating. As exhaust steam possesses from 85 to 90 per cent. of the heat units contained in the steam before it has passed through the engines, it is clear that every consideration of economy will lead to its utilization if possible. Whether any additional boilers will be required over and above those necessary for power will depend, of course, on the amount of power, the size of the shops, and the prevailing temperature. In the "Angus" shop, about 26,000,000 cubic feet had to be heated in the various shops, while the horse-power installed in the engine room of the power-house is nearly 3,000.

A somewhat careful calculation, based upon the prevailing practice, and a study of the temperatures in Montreal, as recorded by McGill University for many years past, led to the conclusion that about 2,400 boiler horse-power would be required, and that the heating requirements were very nearly the same as the power requirements under average weather conditions. The choice lay between three systems of heating—the hot blast or Sturtevant system, ordinary direct steam radiation, and a hot water system. In the first, exhaust and live steam are taken to one or more points in each building and used there to heat coils of steam pipe and also to drive a small engine operating a fan. Air is taken either from outdoor or from the inside of the building, drawn by the fan over the heating coils so as to be warmed to about 130 degrees, and then blown through ducts over or above ground to different parts of the building. This is the system finally adopted for all the buildings though the hot water system presented some advantages. The requisite radiating surface for heating by hot water is, however, difficult to obtain, and the cost of the system is considerably greater.

In the arrangement of the pipes, care was taken to proportion them in such a way as to utilize the exhaust steam as much as possible. In extreme weather certain portions of the buildings will have to be heated by live steam by day as well as by night.

A considerable amount of economy was possible in proportioning the pipes to fit the estimated amount of exhaust steam rather than the total that might possibly be available.

The steam pipes are carried from the power-house to the several buildings in a tunnel 6-ft. high and 4½-ft. wide, built of brick. A few of the smaller mains are, however, carried under ground in wooden boxes.

POWER PLANT.

All power, whether for mechanical or lighting purposes, is generated in the central power plant. This contains four 415-h.p. Babcock & Wilcox boilers of 150 lbs.' pressure, 150 degrees superheat and one B. & W. boiler that can be raised to a pressure of 300 lbs. for test in the completed locomotive boilers in the boiler shop, a special 4-in. main being led to that point. A "Green" economizer is used and a Sturtevant induced draft fan and stack. The engine and generator equipment is as follows: Three 750-h.p. Cross compound engines, non-condensing, connected to 500 K.W. alternating current generators. These have a voltage of 600 and a frequency of 7,200 alternations per minute. The speed of the units is 150. An auxiliary unit of half this size with a simple engine is provided. These generators provide all current for lighting as well as for power, excepting that necessary for cranes and a limited number of variable speed tools. For these, two units are provided each being a 300-h.p. simple engine direct connected to a D.C. generator producing 250 volts. The speed of these engines is 180.

The distribution from the power house to the different shops is by bare wire on steel poles. The motor equipment is not yet fully worked out. The larger engines will have individual motors, but group driving will be used for smaller tools, the smallest motor being 10-h.p.

The sewerage system is rather extensive but simple in its character. Two main sewers are carried transversely, connecting with the city sewer on Nolan St. They begin with a diameter of 8-in. at the northern part of the grounds, and increase to 3 ft. by 2 ft. They are connected with all lavatories, etc., and also serve to a limited extent for surface drainage.

For water supply and fire protection the city provides two systems of water mains—one for ordinary use at a pressure of about 35 lbs., the other for fire purposes only with a pressure of 90 lbs. per sq. in. There are two separate systems of mains all over the grounds for these services. The supply system has a 6-in. main on the midway, with smaller mains diverging to the different buildings. The fire service consists of a 12-in. main on the midway, and 8, 10 and 12-in. mains encircling the various buildings. About 60 three-way hydrants are placed at different points in the grounds, and are about 150 feet apart. With the fire mains is also connected the sprinkler system. About 13,000 automatic sprinklers are put in all the buildings, and two 1,500 gallon underwriters' pumps are placed in the power-house as auxiliary measures. In addition to the city water supply, the shops have their own supply of water which consists of two artesian wells 6-in. in diameter and 550 feet deep, sunk through the limestone rock close to the power-house. It is believed that these will furnish nearly 20,000 gallons per hour of very pure water.

As a further safeguard against fire, an open reservoir 66-ft. in diameter with a capacity of 500,000 United States gallons, has been provided. A 75,000-gallon steel tank, 50-ft. in height serves to maintain a uniform head on the supply pipes and gives additional storage.

The general welfare of the employees has been looked after to an unusual degree. A very complete system of lavatories is provided; the latest sanitary plumbing will be installed, and the lavatories are in every case under the same roof as the main building, thus obviating the necessity for the men to go out of doors, which in this climate is very objectionable in winter.

The system of heating also provides most excellent ventilation. Individual clothes lockers made of open iron work will be provided to hold the men's outer clothing while they are at work; while the drinking water taken from the artesian wells will be purer than that obtainable anywhere else in the city.

It is impossible in this brief paper to refer to the machinery to be installed in the different buildings. In passing mention may be made of the wheel foundry equipment. This is the well-known Whiting rectangular system, which has been worked out with great care by the Whiting Foundry Equipment Company, and it is hoped will produce car wheels very economically and of high grade. The Grey Iron Foundry, in like manner, is to be equipped according to the latest and best practice.

The largest locomotive shop is to be fitted with latest machinery working high grade steels of the highest speeds called for by proper economy.

The boiler shop at the west end of the locomotive shop will have a 17-ft. gap hydraulic elevator with a 65-ft. rivetting tower for holding the 25-ton hydraulic cranes. The pressure in the accumulator will be 1,500 lbs. per square inch.

The blacksmith shop is being equipped with oil furnaces throughout. There will be an overhead system of exhausts, and a blast system for introducing air. Shavings will be removed from the planing mill and cabinet shop by the exhaust system, and carried to the power-house for consumption under several of the boilers.

PUMPING BY ELECTRICITY.*

THE CLARKE AVE. MOTOR.

(Concluded.)

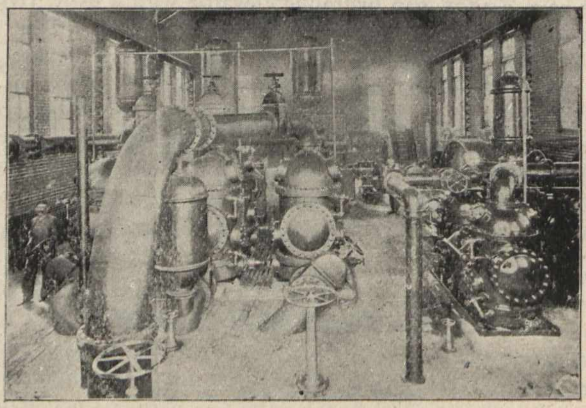
The motor is a 400-h.p., three-phase, 60-cycle, 2 200-volt, 90-amperes induction machine, having 44 poles and therefore a synchronous speed at 60 cycles of approximately 160 revolutions per minute. In order to keep up the power factor with that number of poles a very large machine with a very small air gap or clearance naturally results. The rotor is 13 feet diameter, and the stator 6 feet outside diameter. The clearance between rotor and stator is less than 1-16 inch. The guaranteed power factor at full load is 91½ per cent., full load efficiency 92 per cent., heating limit after 12 hours run 40 deg. C. temperature rise at full load. An overload of 25 per cent. for two hours should not show a temperature rise of more than 50 deg. C. at same efficiency. The above is a very liberal rating on this machine, as another 10 degrees would not be out of the way for regular running, and 550-h.p. could easily be realized at that limit. The machine passed its test satisfactorily. This and its duplicate, are the largest induction motors ever built in point of power, and are much larger in their diametrical dimensions than anything previously at-

* From a paper read before the New England Waterworks Association, by F. H. Pitcher, chief engineer of the Montreal Water and Power Co.

tempted. This motor is started by first an auto starter in the stator. This is simply a series of transformers so arranged that the line voltage may be applied to the stator windings in gradual steps. This arrangement prevents the sudden rush of current so objectionable to the line and so frequently found in starting smaller induction motors. In the meantime the rotor is an open circuit, which after the full line volts have been applied to the stator is closed gradually through the resistance of a water rheostat. The starting current of this motor is only 30 amperes. It would, of course, have been preferable from an operating point of view to have had this machine two-phase like that below, but, in order to meet the condition of the electric company supplying the power, three-phase had to be adopted. This machine is considered a very satisfactory one, remembering that it was the first; the city motor has some slight mechanical improvements. There has been no trouble like that experienced below in the operation of this motor. A strong, short circuit on the line for a few moments makes no trouble in the pumping station. The starting device is much simpler and less liable to get out of order. Even if it did, the motor could still be started by applying the full line voltage at one step. This would, however, not be agreeable in all probability to the central station people.

EFFICIENCY.

With good steam coal at its present price delivered at that station, the duty of this pump corresponds to 162,000,000 foot-pounds per 100 pounds of coal approximately. The difference in duty on this basis between the two installations is due, of course, to the higher price of power below and slightly lower cost of coal—the latter on account of the difference in hauling and the former because some 24-hour power is used there. The stator is in two parts divided along a diameter. The rotor is in one piece. The diameter of the shaft through the bearings is 10 inches. The bearings are not self-aligning, which, for a direct connected machine like this, is considered an advantage. The approximate weights of the parts are as



Water End View of Electric Pumps at St. Gabriel Station.

follows: Stator—Top half, 23,500 pounds; bottom half, 29,500 pounds; rotor, 25,000 pounds. As will be observed, the peripheral speed of this machine is fairly high, being over 6,500 feet per minute. This, however, in spite of the minute clearance and large diameter of the rotor, causes no anxiety with modern methods of rotor construction. This equipment would have been most satisfactory from an operating standpoint if it had been thought possible to consider all metal gearing at the outset. Double reduction gearing was ruled out, both on account of its inefficiency, cumbersomeness, and liability to additional disturbance.

THIRD ELECTRIC PUMP.

The third electric pump was installed at the lower station, due to the following considerations: The additional force and supply mains above mentioned between the lower station and Clarke Ave. reduced the load by more than 30 per cent. on the lower motor. The power contract entitled the company to more than it was possible to use under the new conditions in the same proportion. On this account additional pumping capacity at this station was contemplated in the scheme which included additional force main capacity.

To take full advantage of the capacity of the electric motor already installed, and at the same time utilize all the power available under the old conditions, it was apparent that an additional power pump of one-half the capacity of the original low-level electric pump was possible. The limits of the building did not admit of a direct connected pump. Accordingly the additional pump now running was placed "back" and rope driven from a friction clutch rope pulley carried by an extended shaft of the original 480-h.p. S.K.C. motor.

POWER PUMP AT ST. GABRIEL STATION.

The chief consideration here was compactness in proportion to capacity. A 16½-in. by 18-in. duplex, double-acting centre packed pump was adopted, having a capacity of 2,500,000 Imperial gallons. The general water end design is similar to the foregoing pumps. The pinion shaft was carried back on the cross-head guides to allow of sufficient centres for an efficient rope drive. A feature of this pump, due to the limited space available, was an annular suction air chamber, cast about a section of the 12-inch discharge pipe. The gearing is essentially a double-reduction arrangement, the ratio between the rope pulleys on the motor and on the jack shaft being 1.36, and the spur pinion and gear of the pump 4.19. The spur gearing was as follows: One mortise wheel 9 feet 11.04 inches (83.04 inches), pitch diameter, 88 teeth, 4½-in. circular pitch, 16½-in. face. Machine-cut steel pinion, 28.41-inch pitch diameter, 21 teeth. Total reduction ratio between motor and crank shaft, 5.698. Speed of crank shaft, 32 revolutions per minute. The wooden cogs fared no better than those at Clarke Ave, and failed in much the same way. A loose and badly made key of the pinion shaft pulley might be sufficient account for the failure. This gearing was, however, replaced by that now running, which consists of a machine-cut cast-iron gear with 112 involute teeth, 3.2975-in. pitch, 117.56-in. pitch diameter, 17¼-in. face, driven by a steel pinion, 29 teeth, 30.42 pitch diameter. Ratio 3.86. As far as this can be seen, this is a satisfactory arrangement. The piston speed of this pump is 96 feet per minute at 32 revolutions per minute. An additional 5,000,000 Imperial gallon electric pump is now under consideration for this station to meet the growing demand, and at the same time a 12,000,000 Imperial gallon reserve steam plant for use in emergency only.

THE MOUNTAIN SYSTEM PUMP.

The electric pump used at the Mountain System Station is a small 8 by 10-in. single-acting, vertical triplex, driven through double reduction gearing by a 7½-h.p., 500-volt, S.K.C. induction motor. The capacity of this little pump is approximately 100 Imperial gallons per minute. As mentioned above, this supplies the people living on the Westmount Mountain. There are no special features about this equipment. An exact duplicate can be seen in dozens of cotton mills, etc., throughout the country. They differ from each other only in size and type of drive. No trouble has been experienced with this apparatus.

NEW ELECTRIC PUMP FOR THE CITY OF MONTREAL.

Before closing, mention should be made of an important similar installation now being erected for the City of Montreal at its high-level station. The pump is, briefly, an 18-in. by 24-in. double-acting, horizontal triplex inside plunger packed pump. This is to deliver 5,000,000 Imperial gallons in 24 hours, and will be run at a piston speed of about 115 feet per minute. The general gearing arrangement is similar to that finally adopted at Clarke Ave., except that a hand-dressed mortise wheel and steel pinion will be used. Pitch diameter gear 188.44 inches, 148 maple teeth, 4-in. pitch, 20-in. face. Pinion, steel, 31.83 inches pitch diameter, 25 teeth. Ratio 5.9. As mentioned above, the motor is electrically identical with the Clarke Ave. machine. A change in the method of adjusting the rotor in its housings has been adopted, so that in case of wear at the journals the motor can be easily raised by the wedges and screws for the purpose. The housings or cheeks have been flared outwards and the sole plates widened to give greater stiffness.

The chief problem encountered with large reciprocating electric pumps is in suitably reducing the speed of a comparatively high velocity prime mover. It is undesirable at present on account of the cost, to build an induction motor to run at less than say 150 revolutions per minute with a frequency as high as 60 cycles. The more modern power installations, like that at Shawinigan Falls, generate at 30 cycles. This would be very desirable power for reciprocating electric pumps. Unfortunately such a low frequency cannot be obtained at Montreal. The Shawinigan power used in the city is transformed at a local sub-station to 60 cycles so as to coincide with the original Lachine system. The high-speed turbine pumps, so much used abroad and now being introduced into the United States, may prove, everything considered, more desirable as electrically driven pumps than the reciprocating type. The principal advantages of large electric pumps in this district are a high comparative duty, which, when the power is on a flat rate, remains absolutely constant. This is a great advantage and eliminates the personal equation of firemen and attendants. They certainly require less attendance than steam pumps of an equal capacity beyond the small sizes. They are clean and generally cause less annoyance to surrounding property-holders. They run with less oil and waste. In this district, with the larger sizes, the capital cost of the equipment per horse-power is less than a steam plant of equal duty. A great disadvantage is that not unfrequently the water supply is at the mercy of an outside electric system, which is liable to accident, often causing frequent interruption. In other words, the operation of the pumps is not, from the nature of things, entirely under the control of the water-works.

NOTES FROM UNITED STATES MACHINE SHOPS.

BY CHAS. S. GINGRICH, M.E.

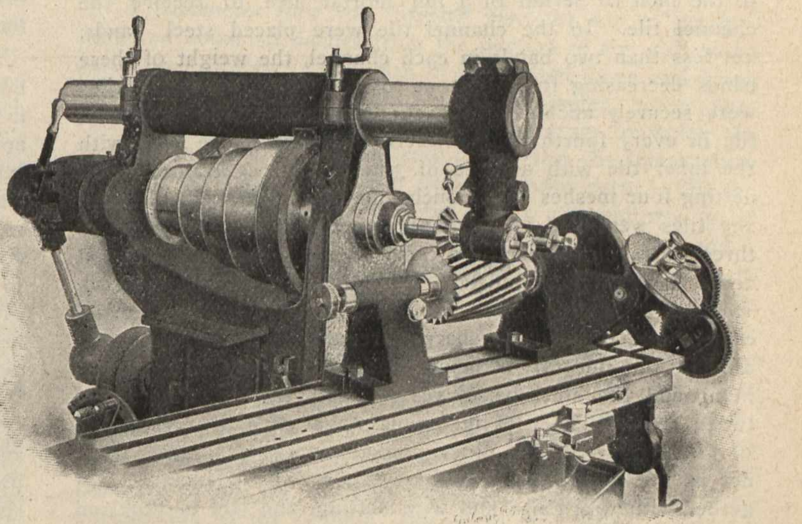
IV.

Small Tool Manufacture.

The extensive use of large quantities of small tools, such as milling cutters, reamers, taps, etc., has developed such a great demand for these tools that their manufacture is now becoming quite an extensive, independent industry, there being several good-sized concerns who make the manufacture of small tools a specialty.

A large percentage of these small tools has spiral flutes, and one of the drawbacks to their economical manufacture has been the weakness of the Universal Miller, on which machine most of this work is done. There has been considerable improvement in this line lately, and in several of the largest small tool factories, I have seen this work done in about half the time that was formerly required.

The accompanying illustration shows one of the machines which, I believe, are giving the best results that have thus far been obtained in milling the flutes in large spiral milling cutters, in operation, and incidentally shows how such work is mounted on the No. 3 Universal Cincinnati Miller. This particular machine, it will be seen, is fitted with the geared-feed drive for which these machines are noted, and the work is held between centres of a spiral generating head which was especially designed for this heavy class of work. The material being milled is unannealed tool steel 5½-in. in diameter, with flutes at a 45 degree angle. The space which is milled between the flutes is ½-in. deep, and approximately ¾-in. wide at the top. This machine removes all this metal at a single cut, at a table travel of ¾-in. per minute. A final light finishing cut to smooth the groove is taken at a table travel of more than 1 1-16-in. per minute. This is considered by tool makers to be very fast work. The great difficulty in work of this kind is usually caused by the tendency of the machine to chatter, and it is only fair to state that in the job illustrated this tendency was entirely absent.



No. 3 Cincinnati Miller in operation.

It is reported that the C.P.R. will build new stations at Calgary and Medicine Hat, N.W.T., and at Sudbury and Sturgeon Falls, Ont., this summer.

The I.C.R. will construct car repair shops at Sydney, C.B.

One thousand, nine hundred and seven miles of railway were built during the year ending June 30th last, or 39 miles more than the previous year; and 2,953 miles of siding, or an increase of 124 miles. The gross earnings of Canadian railways were $96,064,527, an increase of $12,398,024. Working expenses, $67,481,524, an increase of $10,137,932. Net earnings, $28,583,003, an increase of $2,260,092. 22,148,742 passengers were carried, being 1,468,768 more than in the previous year; and 47,373,417 tons of freight, an increase of 4,996,890 tons. The electric railway receipts were $7,233,677, an increase of $747,239. Working expenses, $4,472,858, an increase of $670,003. Net earnings, $2,760,819, an increase of $277,436. 17,981,410 more passengers, or a total of 155,662,82, were carried, and the freight amounted to 371,286 tons, or an increase of 105,104 tons.

FIREPROOF GRAIN STORAGE ELEVATOR FOR THE CANADIAN NORTHERN RAILWAY, PORT ARTHUR, ONT.

FROM A PAPER READ BEFORE THE GENERAL SECTION OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS BY R. M. PRATT, C.E.

At the south-end of the town of Port Arthur, Ont., the Canadian head of navigation of Lake Superior and the Lake Superior terminus of the Canadian Northern Railway, and well out into the waters of Thunder Bay, stands a huge building, or rather two buildings about fifty feet apart. One of them is called the Working Elevator, and the other, the first of its kind in Canada or elsewhere, is the 2,130,580-bushel fireproof grain storage elevator built by the Barnett & Record Co., engineers and contractors, of Minneapolis, Minn., for Mackenzie & Mann Co., Limited, of Toronto, Ont. It is the latter building that is the subject of this paper.

The building consists of eighty circular tile grain tanks arranged in a cluster, as shown upon the drawings, and located 50 feet from and directly south of the Working Elevator. The tanks are each twenty-one feet outside diameter and eighty-three feet from the floor to the eaves, and so arranged that the spaces between the tanks are also used for storage of grain. All the walls of the interior tanks are eighty-five feet high. The capacity of the bins is as follows:

48 circular bins, each, 21,825 bushels	1,047,600 bus.
32 circular bins, each, 21,440 bushels	686,080 bus.
Total capacity	2,130,580 bus.

The tile bins rest upon a pile and concrete foundation, the whole surrounded by a revetment wall on three sides of the building and up to the working elevator to protect it from the wash of the waves, and the whole area enclosed within the revetment walls filled with earth to a height of about two feet above the mean level of the surface of the water in Lake Superior.

The piles were of pine, spruce and tamarac, 40 to 50 feet in length, 12 inches in diameter, three feet from the butt and eight inches at top inside of bark. They were driven to a solid bearing or until the penetrations did not exceed 1 inch to a blow of a 2,000-lb. hammer dropping 30 feet, or its equivalent if other weights of hammers were used, and so arranged that the load on the piles should not exceed 350 lbs. per square inch of bearing area under bark at cut off. The weight of hammers used was about 3,600 lbs., and the equivalent drop was made 20 feet after the piles were driven and cut off about 18 inches below water by a circular saw working in a traversing frame secured to the piles themselves to ensure their being cut off true and level; they were then capped with two courses of maple timber each four inches thick and fastened to the piles by ½ by 10-in. boat spikes. Directly upon this grillage, the concrete foundation walls were started. The concrete was composed of one part of Portland cement and three parts of clean, sharp sand and five parts clean gravel, ranging in size from that of a pea to that which would pass through a 2½ ring. The gravel was obtained from Isle Royal by dredging in about 15 feet of water and was a clean, flinty stone and very hard. Tests of the concrete from specimens therefrom showed broken that the stone broke instead of separating from the cement. The forms for the concrete coming below the water were made tight enough to ensure that the action of the waves did not wash out the cement. The concrete floors were constructed of the thickness shown in the drawings and re-inforced with metal rods of sufficient number and weight to carry the full loads imposed upon them without excessive strain, and a steel girder was placed each side spout openings to support the concentrated load. The walls of the tanks were constructed of a special hollow semi-porous tile and of the same quality as those used in the City of Minneapolis in the construction of the St. Anthony and Gt. Eastern elevators. The main wall tiles were 12-in. by 12-in. in size by 5-in. thick, alternately, with courses of channel tile 12-in. long by 3-in. deep and of the same thickness as the main wall tile. The main wall tile was laid with hollows running vertically, and the channel tile was laid horizontally. These tiles were of sound, hard, burnt, unglazed tile.

The exterior surface of the outer row of tanks was recovered with a facing tile 12-in. by 12-in., 2-in. thick, and was hard burnt, semi-glazed tile. The openings in upper end of main wall tile was covered with wire netting three meshes to the inch to permit of a full mortar bed to receive the channel tile. In the channel tile were placed steel bands, not less than two bands in each channel, the weight of these bands decreasing from bottom to the top. The facing tiles were securely anchored to each other and to the main wall tile in every fourth course where the joints come even with the inner tile with a piece of 3-in. by 4-in. galvanized wire netting four meshes to the inch, one anchor to each tile. All the tiles were laid in Portland cement mortar composed of three parts clean, sharp, screened sand well mixed and tempered with lime mortar. All mortar used to imbed the steel bands in the channel tile consisted of one part Portland cement and three parts sharp, screened sand. No lime was used in this mortar, it being made sufficiently thin to run in around the steel bands readily and fill all spaces between them. The tiles in cupola walls were of a thickness of 3-in. hollow tile, the outer courses glazed in the same manner as the facing tile in main walls, and were anchored together with wall chips and wire netting, and laid in Portland cement mortar same as for main building. All the roof surfaces, except the bridges and tunnels, were 12-in. by 18-in. by 3-in. hollow book tile resting upon the irons. These tiles were laid in a bed of Portland cement mortar on the flanges of the tee irons, and the upper surface pointed and smoothed with cement mortar to receive the gravel roof. The tile floors along belt galleries consisted of book tiles laid on tee and angle irons, the same as in the roof, the top surface being finished with a layer of Portland cement 1-in. thick. The floors in the walls between the belt galleries consisted of corrugated iron and concrete finished in the same manner as in the belt galleries.

The standard steel work in cupola of upper story of building consists of a skeleton steel frame work of standard sections arranged, as shown on plans, and put together on the work with suitable bolts, the pitch of bolt holes not exceeding 6-in. or sixteen times the thinnest outside plate or less than three diameters of the bolt.

The bridges for the fire belt conveyor, of which there is one to each conveyor, consisted of two steel trusses, as shown on plans, the floor of book tiles and concrete resting on tees and angles, the same as in upper belt conveyor galleries. The walls of the bridges were wire covered with No. 22, and the roof with No. 20 galvanized corrugated steel, and nailed to strips of wood bolted to the steel trusses. The bridges were provided with telescope joints at each end, so that the change in level of walls in working elevator would not have any injurious effect on either structure. There are two fire cut-off doors to each bridge and tunnel consisting of 2 by 4 studding covered with 1 by 6 D. & M. fencing closely fitted to all sides and around the belts, the sides next the working house being covered with tin, and the doors made to swing with a self-closing device. The cupola window frames were made of 2-in. pine with brick mould and inside casing fitted with 1⅝-in. check rail. All woodwork was covered with crimped galvanized iron. There are no windows inside next to the working elevator. The fifteen galvanized iron frame skylights in the roof were glazed with ¼-in. unpolished glass and the cornices and flashings were of No. 26 plain galvanized iron. The bin ladders were made of iron bars built into tile walls, one ladder to each, and every bin extending from top to bottom. There are also two fire-escape ladders, one on the south wall made of 2½ by ⅜-in. bars for the sides with ring of ⅝-in. round iron placed 16-in. centre to centre.

The entire main roof was covered with four-ply composition felt and gravel roofing, the tarred felt used being the Dominion brand manufactured by Lockerby & McComb, of Montreal. The exposed edges of each part were cemented down with hot pitch, and the entire surface covered with straight rim medium soft domestic coal tar roofing pitch 100 lbs. to the square. The gravel screened through a ¾-in. wire mesh screen one-fifth of a cubic yard to the square. Each and every bin coming over the tunnels or conveyors was provided with a cut-off spout with an extension of the same arranged to load the grain on to the belts, made of No. 14 steel. In the upper part of the building, no spouts are needed, except for the intermediate bins, and for these suitable spouts of No. 14 sheet steel were provided so as to take the grain from the tripper spouts.

There are five belt conveyors running from the working house out over the tanks. The width of the conveyor belts in the upper part is 36-in. supported by disc rolls 5 ft. 3 in. apart. The return belt carried on straight rollers 15 ft. 9 in. centre to centre. The shafts for these rolls were 1 3-16 with standard oscillating bearings attached to the wood supports resting on the steel frame work, and the wood support being covered with No. 26 plain sheet steel. The conveyor belts in the basement are 30-in. wide carried on straight rolls, similarly disposed as in upper belt conveyors. In the upper conveyor belt, there is one 2-pulley tripper for each belt. These trippers being provided with self-propelling devices, platforms, levers, etc., and provided with spouts discharging to either side so that the circular bins can be filled without any other spout than that provided on the tripper. These spouts are provided with cut-off gates and arranged to connect with the spouts from the intermediate bins already mentioned. All the trippers are carried on 16-lb. tee rails attached to the wood support mentioned for the roller bearings.

The shafting in working house required to work the belts is of steel, the couplings of the safety pattern standard flanged forced, bored true and forced on to the shafting under pressure of the collars for shafting, are provided with set screws protected by being counter-sunk and with protecting flange so as to make them flush on their outer circumference. The length of all bearings is three diameters of the shaft on which they are placed the friction clutches and pulleys of cast iron. The friction clutches were supplied by Messrs. Skillin & Richards, of Chicago. The conveyors' head pulleys were covered with four-ply rubber belting. The tension carriages were of approved design, and the rope drives of manilla rope. The conveyor belts are four-ply rubber belting made of 30 oz. cotton duck pliable with hard surface stretched and spliced with Smith's patent No. 1 belt fastener. The conveyor belts are driven by light double leather belting, and the rope used in the various drives was tallow laid transmission ropes (Plymouth, 4 strand E.)

The building is lighted with 100 16 candle power, incandescent lamps, and provided with five extension cords for use in lighting lower part of bins. The building is also provided with signal bells and push buttons where required. The revetment was constructed according to the plans, except that the outside guard piles were 6 ft. centre to centre instead of 3 ft. The guard piles were of tamarac 40 to 45 ft. long, 3 ft. centres capped with 12-in. by 12-in. fir timber bolted to piles with bolts 1-in. diameter and 26-in. long, and two 6-in. by 12-in. fir stringers fastened with ½ by 12-in. boat spikes to outer row of piles, and two 8-in. by 12-in. fenders or wall streaks to outer or harbor side with ¾-in. screw bolts and washers counter sunk lead on outer side. The sheet piling is 8-in. by 12-in. fir timber, 36 feet long, built with tongue and groove of two-inch fir lumber the full width of the 8-in. sheet piles, and secured with 5-in. steel wire nails, 8-in. centre, so as to form a sand-tight bulkhead. A steam jet was used to assist the pile driver in getting these piles in place to avoid heavy pounding. The whole of the piling is being especially pointed. The structural steel work received in the shop one coat of boiled oil mixed with 10 per cent. of lamp black, and after erection one coat of lead and oil. All woodwork around windows received two coats of lead and oil, and all sash two coats red lead and oil.

The work was carried to a successful completion under great difficulties, such as the insufficiency of skilled workmen, the exposed position of the elevators, the long distances the greater part of the structural material had to be brought, retarding the progress of the work and causing a great part of the cement and other work to be done in severe, cold weather which rendered it necessary to heat the water and take the frost out of the sand and mortar before using. The contractors deserve great praise for the energy and courage displayed by them in overcoming all obstacles and giving to the North-West an additional storage for a part of its enormous wheat crop of 1902, and at a time when the lack of just such a storehouse would have been seriously felt by the North-West farmers. It has also had the effect of bringing Port Arthur to the front as one of the most important grain and freight transportation centres of Canada. The following data regarding the work may be of interest: First pile driven in elevator, 11th June, 1902; concrete begun, 20th August, 1902; tile laying, 26th September, 1902; first wheat received into bins, 19th January, 1903. Quantity of material in each eight feet in height of bin: 378 tiles, 12-in. by 12-in. by 5-in.; 378 channel tiles; 216 facing tiles, outside bins only; 336 facing tiles, outside corner bins only; 250 brick; 375 pieces wire netting, 12-in. by 4-in.; 12 pieces wire netting, 4-in. by 8-in.; 126 pieces wire netting, 12-in. by 1-in. for facing tile; 12 clips, 12-in. by 1½-in. by ⅛-in.; 6 crooked steps, 3-ft. 7-in. by ⅝-in. iron; 6 straight steps, 2-ft. 6-in. by ⅝-in iron; 4 tie rods, 11-ft. by ¾-in. Each thousand tiles took ¾ cubic yard grout 3 to 1. Each inside bin has four double channels 75 ft. long. Each outside bin has two double channels 75 ft. long. The hoops or bands in the channel tiles consist of 1½-in. by 3-16-in. and 1½-in by ⅛-in. steel bars, three complete hoops being used in the lower and two in the upper portion of the walls, thus varying the section to suit the pressure. Each bricklayer laid about 364 tiles per day of ten hours in the month of November. The capacity of each of the five top conveyor belts is 15,000 bushels per hour, and of each of the five lower belts 10,000 bushels per hour. The tiles were manufactured at Ottawa, Ill., by the National Fireproof Roofing Company. The steel bars for tank bands were furnished by the Carnegie Steel Company. The structural steel work by the Canadian Bridge Co., Walkerville, Ont. The machinery by Messrs. Skillin & Richards, Manufacturing Co., Chicago, Ill. The belting by the Gutta Percha and Rubber Co., Toronto, Ont. The roofing and sheet metal work was done by Irwin & Son, Hamilton, Ont. Most of the cement was furnished by the Owen Sound Co., some by the Rathbun, and a small quantity was imported from Chicago. The following is a copy of a report by H. E. Smith, consulting engineer, of Minneapolis, Minn., upon a test made to determine the heat resisting properties of a section of hollow tile grain bin, built to correspond with the method used in the present elevator:

In order to make the test as practical as possible, some four weeks ago a section of wall was constructed, the details of which are shown in the accompanying blue print, to correspond to that which would be constructed for a 45-foot diameter grain elevator storage bin. Against this was built an oven or furnace, in which by means of fire the necessary heat could be brought to bear upon the outer wall of the experimental bin.

Time p.m.	Temperature deg. Fahr.
3.30	500
3.37	600
3.38	700
3.38½	800
3.39	900
3.39½	1000
3.40	1100
3.41	1200
3.42	1250
3.44	1270
3.46	1200
3.50	1150
3.51	1200
3.52	1250
3.54	1300
3.55	1330
3.56	1350
3.57	1365
3.59	1390
3.59½	1400
4.01	1440
4.02	1470
4.03	1500
4.04	1540
4.05	1570
4.06	1620
4.07	1700
4.09	1800
4.10	1900
4.10½	1950
4.11	2000

This table shows the time and corresponding temperature during the next 41 minutes of the test.

As the limit of the pyrometer was 2,000 degrees, the instrument had to be removed when this temperature was reached. The actual temperature of the furnace was, no doubt, considerably above 2,000* degrees at the maximum.

*This is the temperature at which cast iron melts.

At the maximum heat a solid body of flame rose to a height of about two feet above the tile chimneys, and flame was always visible during the greater part of the test.

The snow that was packed against the exposed iron band on the inside of the wall began to show signs of melting at 4.09 o'clock, when the temperature of 1,800 degrees had been reached, and, at the end of the test, a small amount of snow still remained at this point. The patches of snow on the interior of the wall showed no signs of melting at the end of the test.

A pyrometer tube was inserted near the top of the furnace and about six inches from the portion of the wall to be tested and directly in the path of the heated flame and gases which impinged on the wall. The pyrometer, when thus located, was believed to show the temperature to which the wall was subjected. On the date of the test the temperature of the outside air was fifteen degrees above zero. On the inside of the wall at the location of the exposed iron band in the wall, some snow was packed against the band and a number of patches of snow placed upon the tile wall itself, in order to observe the effect of the transmitted heat through the wall. A fire was started upon the grate of the furnace at 2.15 o'clock, and the temperature of the furnace rapidly rose to 800 degrees Fahr. After the fire had burned itself out sufficiently, the bin wall of the furnace was carefully examined and no trace of a check or crack could be found. In view of the fact that the fire had been continued for two and one-half hours, the heat to which the wall was subjected correspond, in my opinion, closely to that which would be produced by the burning of a wooden structure built against the side of an actual grain bin of this description. The results of this test seem to indicate that this kind of construction for grain storage would withstand any ordinary external heat due to adjacent fires, and would at the same time also prevent an undue transmission of heat to the grain stored within.

Respectfully submitted,

HARRY E. SMITH,
Consulting Engineer.

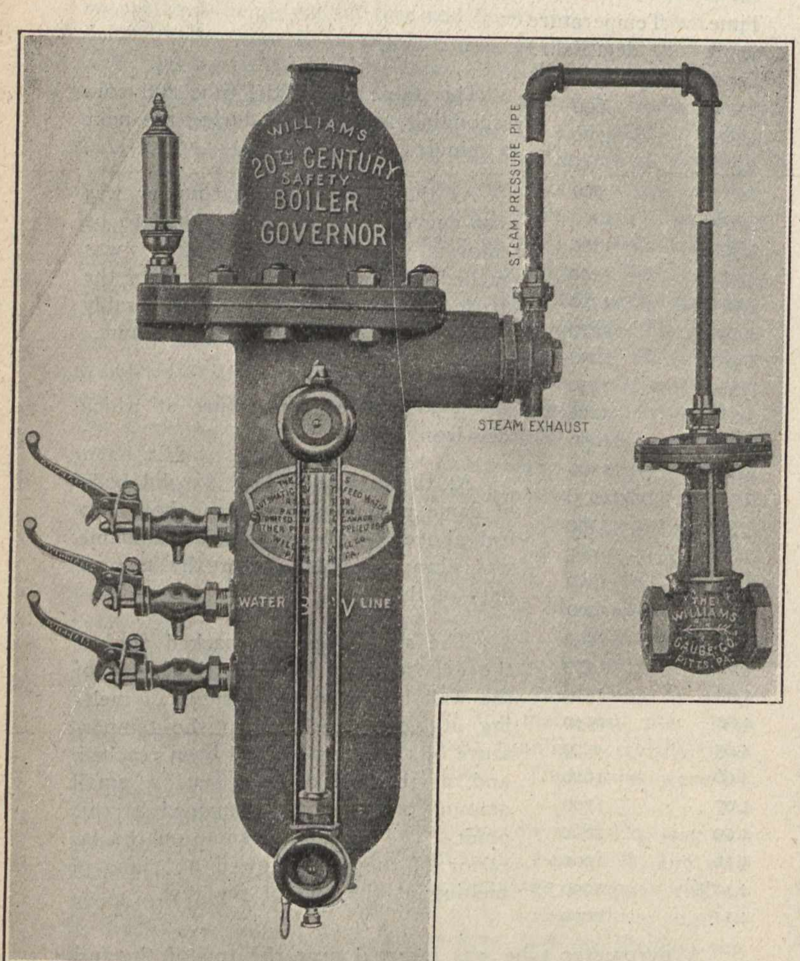
The cost of the building, including revetment, everything complete, except the earth filling around and under foundadations was $397,095.80.

The superintendent of construction for the contractors was F. R. McQueen, and their chief engineer was E. D. Mayo. The writer is indebted to the latter for the photos. of the working drawings used to illustrate this paper.

The superintendent for the company was R, Dickson, and the writer was engineer in charge of the work.

FEED WATER REGULATOR.

The accompanying cut shows the Williams Automatic safety feed water regulator for which Darling Bros., Montreal, have been appointed Canadian agents. This feed water



regulator is applied to steam boilers for the economical production of dry steam. Its aim is to increase the efficiency of steam boilers and engines, by automatically controlling the water at the proper fixed point, preserving the exact amount of water continuously in exact proportion to the heating surface and the capacity of the boiler furnaces, thus constantly producing the limit of the boiler's highest efficiency. It is constructed to give an alarm for high or low water in case of accident, and the makers assure the engineer that his only labor is to start the pumps and blow out the sediment in the regulator once or twice a day. The circulars issued with the regulator contain letters testifying to a saving of 6 to 15 per cent. in fuel, enough in some cases, it is claimed, to save the cost of the machine several times in a year. Particulars as to its mode of action can be had from Darling Bros., Reliance Works, Montreal.

QUEBEC'S MINERAL OUTPUT LAST YEAR.

The following are the quantities in tons of 2,000 lbs. and the values at the shipping point, of the minerals produced in Quebec during 1903, as from returns prepared by J. Obalski, Inspector of Mines, for the province:

	Tons.	Value.
Magnetic and titanic iron	100	$ 300
Bog ore	10,742	34,984
Chrome ore	3,037	45,555
Copper ore	25,000	125,000
Galena (approximate returns not complete; returns not received).		
Asbestos (value approximate)	31,671	900,000
Asbestic	10,581	13,242
Mica (thum trimmed; returns not complete).		
Ochre (calcined)	1,746	20,440
Graphite	....	....
Feldspar	20	37
Sulphate of baryte	440	2,640
Phosphate	1,187	8,214
Gold (ounces)	....	600
Slate quarries	5,510	22,040
Flag stones (square yards)	3,000	2,550
Cement (barrels)	40,000	66,000
Granite (The same as last year).		
Lime (barrel). (The same as last year).		
Bricks. (The same as last year).		
Stones. (The same as last year).		
Pig iron produced	9,635 ¾	$230,639 46

—The Canadian Rubber Co., of Montreal, recently remodelled their power plant and found that the tall brick chimney, 110 feet high, would not give the proper amount of draft necessary in connection with the four new Stirling boilers they were to install. Mechanical draft was necessary and for this purpose a large Sturtevant steel plate fan driven by a Sturtevant horizontal engine was installed, and now the proper amount of draft is easily attained and regulated at will regardless of the weather conditions. This is another illustration of the advantage of mechanical draft in connection with the remodelling of old boiler plants.

The application of the London, Alymer, and North Shore Electric Railway Co. to bond their road at $25,000 per mile has been granted by the Ontario Legislature. The cost of the road is estimated at $1,100,000.

The Kingston Locomotive Works has closed contracts for ten engines for the Canadian Pacific and twenty-five for the Intercolonial Railway.